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TABLE OF CONTENT

Sr. No.	Name of Author	Title of Paper	Page No.
1	Mrs. Awantika Deshpande Mr. Kiran More	AI-Driven Decision Support Systems for ESG Reporting and Education	1 - 3
2	Mr. Harshad M. Sonawale	A Study on Influence of AI-Powered Algorithms on College Students' Buying Behaviour	4 - 7
3	Manju G. Jhuriani Dr. Richa A. Modiyani	A Study on Responsible and Ethical Use of Artificial Intelligence in Higher Education in Thane District	8 - 14
4	Mr. Rajesh B. Lule Mr. Nitin N. Varade	Sustainable Knowledge Infrastructure and Academic Library Services: A Framework for the Transforming Phase of Artificial Intelligence	15 - 24
5	Dr. Manisha Manish Nehete Ms. Shravani Sunil Salunke	The Impact of Artificial Intelligence on Employment in IT Sector	25 - 31
6	Mrs. Sneha Parag Parekh Ms. Vaishnavi Narendra Sawant	Comparative Study on Student Engagement in Traditional Classrooms and Online Learning Environments	32 - 37
7	Ms. Shweta Dubey	A Study on Impact of Short Format Content on Consumer Buying Behaviour of Personal Care Products with Special Reference to Instagram Reels & Youtube Shorts	38 - 44
8	Lijy Mathew Lydia Pacheco	Improving Interpersonal Skills Through Artificial Intelligence	45 - 49
9	Mr. Shravan Kumar Mishra	The Role of Human Oversight in AI-Driven Educational Interventions: Opportunities, Challenges, and Future Insights	50 - 54
10	Aafreen G. Shaikh Rajshree Rajguru	Impact of Prompt Engineering on Learning and Skill Development	55 - 61
11	Rajshree Rajguru Prashant S. Lokhande	The Role of AI-Generated Content in Shaping Student Learning Practices and Academic Integrity: An Ethical Perspective	62 - 69
12	Mittal Shah Nayana N. Lagade	Integrating Artificial Intelligence into Teaching: Opportunities, Challenges, and Future Directions	70 - 75
13	Ms. Alisha Serrao	The Hidden Costs of Not Returning Faulty Products: A Consumer Perspective in Thane & Mumbai	76 - 83
14	Mr. Jitesh Patil	The Role of Automation and Digital Tools in Transforming Accounting Education	84 - 89
15	Mast. Hrishikesh Navnath Urmude Mrs. R. Vijayalakshmi	Introducing AI models in Metro Systems: Service Optimization and Energy Waste Management	90 - 95

Sr. No.	Name of Author	Title of Paper	Page No.
16	Dr. Jasmine Gulshan Rai Mr. Mayur Subhash Shelke	Understanding Consumer Behaviour in Q-Commerce Grocery Delivery: Usage Patterns and Sustainability Perspectives	96 - 106
17	Kismat Quraishi Kausar Sorathia	Original or AI-Assisted? Exploring the Creative Identity of Students in the Gen AI Era	107 - 116
18	Mrs. Sonali Atul Saraf Ms. Pranali Shivaji Bhosale	The Study of Artificial Intelligence & Data Privacy in Healthcare	117 - 121
19	Mrs. Reshma Gavali Mrs. Vrushali Ghodke	An AI-Based Career Roadmap Generation System for IT Students Based on Skill Set Analysis	122 - 126
20	Gladys Abreo	Artificial Intelligence Literacy and Its Impact on Learning Outcomes and Academic Performance of Generation Z Students: Evidence from the Mumbai Metropolitan Region	127 - 131
21	Mr. Nileshkumar Pandey Ms. Pratiksha Shirsekar	AI-Driven Mathematical Optimization Models for Sustainable Economic Planning and Development	132 - 141
22	Ms. Neha Jaywant Keni Dr. Pallavi Shah	A Study on the Impact of Perceived Ease of Use of Information Technology on Operational Benefits of GIG Cab Drivers	142 - 148
23	Ms. Prabhpreet Kaur Nagpal	The Impact of AI-Assisted Content Creation on the Academic Outcomes of Undergraduate Students	149 - 161
24	Anjali Pal Dr. Pallavi Shah	A Study on the Adoption of Artificial Intelligence in Residential Interior Design and Its Impact on User Decision-Making	162 - 168
25	Dr. Sujata Jignesh Gada Ms. Khayati Pandya	Awareness and Impact of Sukanya Samriddhi Yojana on Girl Child Education	169 - 173
26	Anagha Arun Padhye Dr. Kiran Jaydeo Save	Revisiting Jiddu Krishnamurti's Educational Philosophy in the Age of Artificial Intelligence	174 - 179
27	Mayuri Ramugade	A Study on College Youths' Perception of Artificial Intelligence Tools in Teaching and Learning in Thane City	180 - 185
28	Vinayak Khambayat	A Study on the Awareness and Attitude of Employees towards Lean Six Sigma Programs in the Pharmaceutical Industry	186 - 194
29	Dr. Yogeshwari Patil Mr. Yuvraj Sahebrao Wagh Nipu Roger Raju Somy	Artificial Intelligence, Robotics, and Employment Law: The Future of Labour Rights in India	195 - 200
30	Prachi Lad	Awareness of AI in Product Development and Marketing by Self-Help Groups in Palghar District	201 - 209
31	Mr. Mithilesh Ramdayal Gupta	Ethical Use of Artificial Intelligence in Education: Awareness, Perception, and Acceptance among College Students	210 - 220
32	Ms. Ananya Prabhu Dr. Anjali Kalse Dr. Kuldeep Bhalerao	Blockchain Technology in HR Data Management	221 - 226

Sr. No.	Name of Author	Title of Paper	Page No.
33	Mrs. Maithili A Kende Dr. (Mrs.) Deepali Bankapure	A Study on Investors Perception Towards Selected Mutual Fund Schemes Concerning to Thane Region	227 - 236
34	Ms. Geetanjali Chiplunkar Prof. Somnath Vibhute	A Study on Digital Financial Literacy among Tribal Communities in Palghar District	237 - 246
35	Neelam Motwani Dr. Vinayak Raje	Adoption and Effectiveness of Artificial Intelligence in Supporting Examination Preparation among Undergraduate Students	247 - 254
36	Deepali Dinesh Shenoy Dr. Rajesha M.	A Study on the Role of Digital Technology Adoption in Enhancing Operational Efficiency of Educational Institutions	255 - 262
37	Ms. Darshana A. Bande Dr. Priyadarshan Patil	Role of AI-Based Applications in Promoting Sustainable Lifestyle Choices Among College Students	263 - 268
38	Prof. Darshana Sawant Dr. Prakash Jungale	Perception of IT Professionals Towards Digital Currency Adoption in Mumbai	269 - 274
39	Miss. Samiksha Dileep Mhatre	AI Driven Sustainability in Business: Opportunities and Challenges	275 - 278
40	Prof. H. A. Chande Miss. Aakanksha Vijaya Madan Bhoi	Cybersecurity Awareness and Online Banking Practices Among Housewives in Thane City: An Empirical Study	279 - 285
41	Dr. Hetal Rajgor	Artificial Intelligence in Finance and Accountancy: A Critical Analysis of Applications, Implications, and Future Directions	286 - 290
42	Ms. Shilpa Aba Shelar Dr. (Mrs). Archana Kedar Prabhudesai	Gen Z Consumers' Preference for Artificial Jewellery: A Behavioral Study	291 - 297
43	Dr. Farheen Sayyad Ms. Aditi Mone Ms. Priyanka More	Impact of AI-Generated Social Media Content on Brand Authenticity: The Mediating Role of Consumer Engagement	298 - 310
44	Dr. Himanshi Mansukhani Dr. Rinky Rajwani	A Study on AI in Education: Ethical Challenges for Educational Stakeholders	311 - 317
45	Ms. Bhavika Shashikant Khadapkar	The Role of Artificial Intelligence in the Growth of Over the Top Platforms	318 - 322
46	Ms. Namrata Anant Sawant	To Study the Influence of Online Reviews and Ratings on QSR Brand Image	323 - 330
47	Ms. Jayshree Sen Dr. Somnath Vibhute	Skill Development in India: Achievements and Challenges	331 - 335
48	Manojkumar Radheshyam Goud Dr. Rameshwar R. Chavan	How FinTech is Transforming Access to Financial Services Among the Unbanked Population in Thane District	336 - 343
49	Mr. Kiran Sakharam More Mr. Shashikant Dipak Mane Ms. Dimple Manish Choudhary	Impact of Surveillance on Digital Privacy	344 - 349

Sr. No.	Name of Author	Title of Paper	Page No.
50	Ms. Dipalee Bipin Mulmulay	Regulating AI-Driven Innovation for Sustainable Development in Education and Industry: A Legal Perspective	350 - 355
51	Durgesh Gangaram Deore	Real-Time Sign Language Recognition System	356 - 359
52	Nikhil Manohar Pagare	An Analysis of Barriers and the Development of a Framework for Equitable Sports Technology Integration in India	360 - 364
53	Vinay Sunil Gaykhe	A Research Study on Phishing Attacks and User-Centric Prevention Approaches	365 - 369
54	Mr. Sahil Sunil Deshmukh	The Impact of Data Visualization on Technical PG Courses Conducted by SPPU	370 - 373
55	Mr. Varun Shashikant Chavan	To Study the "Development of a Self-Hosted, Offline AI Chatbot using Llama 3, Ollama, and FastAPI"	374 - 376
56	Mr. Anuj Abhimanyu Patil	Emerging E-commerce Trends Study of: The Role of IT Shaping Consumers Decisions	377 - 380
57	Mr. Rushikesh Ashok Pathade	Artificial Intelligence in E-Learning Website for Real-Time Content Recommendation and Customization	381 - 384
58	Mr. Nanavare Pratik Dinkar Miss. Sayali Sandip Kale	AssessMentor: A Python-Based AI-Powered Proctored Assessment Platform for Integrity-Driven Online Examinations	385 - 389
59	Mr. Abhishek Wavle	Cybersecurity Risks and Software Vulnerabilities in AI-Generated Code	390 - 395
60	Ms. Trupti Prakash Garud	Impact of Social Media on MCA Students' Academic Performance with Respect to Pune City with Help of Artificial Intelligence (AI)	396 - 400
61	Ms. Payal Sanjay Pawar	The Impact of Instagram on MCA Students' Productivity in SPPU	401 - 404
62	Miss. Shital Babasaheb Gorde	Role of Social Media in Old-Age Mental Well-Being	405 - 408
63	Miss. Siddhi Jadhav	The Impact of Modern Technology on Agriculture: Productivity and Sustainability	409 - 412
64	Ms. Shubhangi Bhosale	Digital Preservation of Maharashtra Forts Using GIS	413 - 416
65	Mr. Avishakar Machindra Shinde	AI-Powered Quality Control in Car Manufacturing	417 - 420
66	Mr. Ankit Kumar	AI-Powered Virtual Teaching Assistant: Enhancing Learning Through Intelligent Automation	421 - 423
67	Mr. Nikhil Prakash Khandbhor	User Perceptions of Cloud Data Security and Privacy among Working Professionals in the Mawal Region	424 - 428

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AI-Driven Decision Support Systems for ESG Reporting and Education

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Abstract:

Environmental, Social, and Governance (ESG) reporting has become a critical component of corporate sustainability, governing compliance, and stakeholder decision-making. However, ESG education and reporting practices face challenges such as fragmented standards, data complexity, inconsistent disclosure quality, and limited expertise across organizations. This paper proposes an AI-driven education system designed to enhance ESG reporting knowledge, skills, and consistency through intelligent learning and decision-support mechanisms. The system integrates natural language processing, machine learning, and knowledge-graph technologies to analyze ESG frameworks, regulatory guidelines, and corporate disclosures, providing adaptive educational content and real-time reporting assistance. By offering personalized learning pathways, automated gap analysis, and explainable AI-based feedback, the platform supports learners and practitioners in understanding ESG concepts, aligning reports with global standards, and improving transparency and accuracy. The proposed approach aims to reduce reporting inconsistencies, accelerate ESG competency development, and support sustainable decision-making while positioning AI as an assistive tool that complements human judgment and ethical oversight in ESG practices.

Keywords: ESG, AI, Decision Support System, Natural Language Processing (NLP)

Introduction:

Environmental, Social, and Governance (ESG) disclosure has also become an important consideration for organizations to pursue sustainable growth. ESG performance creates an impact on the investment process, legal requirements, and the image of an organization. Traditional ESG disclosure appears to be manual, subjective, and non-standardized. On the parallel front, the spread of education regarding ESG knowledge and its related aspects appears to be disparate and academic.

Artificial intelligence-driven Decision Support Systems (DSS) is an opportunity to change the state of both ESG reporting as well as education. By incorporating artificial intelligence (AI) tools, including machine learning, natural language processing, or predictive analytics into DSS, the decision support tool will be fully computerized.

It will analyze existing research regarding the use of AI-powered DSS to improve ESG reporting and education and will also point to various technological aspects involved within it.

Background:

1. ESG Reporting: Challenges and Trends:

ESG reporting demands that organizations make public non-financial information related to sustainability practices and effects. Leading frameworks (GRI, SASB, and TCFD) attempt to

create structure around reporting, but problems remain:

- **Quantity and quality of data:** The ESG data comes from human reporting, sensors, and third-party sources.
- **Gaps in standardization:** Various sectors apply different units.
- **Timeliness:** There are delays in reporting
- **Subjectivity:** Human judgment allows for variation

2. Decision Support Systems:

The Decision Support Systems (DSS) are tools used in decision-making, encompassing aspects of data aggregation, analysis, and user interfaces. The traditional DSS enhances efficiency in decision-making, which is based on structured data and rules.

3. AI for Decision Support:

AI technology such as deep learning, NLP, and knowledge graphs has helped DSS grow beyond the boundaries of traditional rules and learn patterns in unstructured data. AI is able to understand text, make predictions, and provide insights.

Conceptual framework:

An AI-Driven DSS in the realm of ESG can be described as:

1. Gathers information from internal databases, sustainability reports, social media, and sensors.
2. Uses data from AI processing modules for cleaning, classification, and normalization.
3. Analyze data using machine learning algorithms in order to understand trends, anomalies, and predictions.
4. Providing decision support through the help of the dashboard.
5. Facilitates learning by means of adaptive learning modules.

Figure 1. Conceptual Architecture of AI-Driven ESG DSS

- **Input Layer**: ESG Factors (emissions, gender diversity, risk measures), News, Regulatory Information.
- **AI Engine**: Uses NLP for text analysis, ML for predictive analysis, and graphs for entities.
- **Decision Layer**: Risk scoring, Benchmarking, Forecast
- **Output Layer**: Interactive dashboards, reports, educational content modules.

AI components of ESG DSS:

1. Natural Language Processing (NLP):

It enables the extraction of ESG key words and themes from text materials like policies, articles, and ESG disclosure reports:

- Sentiment analysis to determine the perceived view.
- Entity recognition for the detection of firms and legal phrases.
- topic modelling to extract thematic patterns

Machine Learning & Predictive Models:

In Supervised and unsupervised learning algorithms assisted:

- Predicting ESG scores in Group firms with convergent ESG characteristics.
- Anomaly/outlier detection in sustainability metrics.

Knowledge Graph:

Semantic networks connecting entities (companies, standards, indicators) will enable:

- Linked models
- Cross reference of regulatory requirements. Improved data interpretability

Reinforcement Learning for Education:

Technological tools such as adaptive learning platforms can utilize Reinforcement Learning to provide personalized ESG learning:

- Suggestions for subsequent modules based on learner activity.
- Real-time feedback and online assessments should be provided.

Applications:

1. Real-Time ESG:

AI-powered DSS are also able to process and gather company disclosures as well as publicly available data to produce near-real-time ESG scorecards.

2. Regulatory Compliance:

By encoding the standards (for example, EU CSRD or SEC ESG rules), the process can identify compliance gaps and make recommendations for fixes.

3. Investment Decision Support:

Investors can leverage AI results to scan investment portfolios for potential ESG risks and forecast related financial outcomes.

4. Education and Training:

Universities and companies are in a position to use AI-enriched cur

- Interactive modules that adjust according to the progress made by the learner
- ESG simulation choice scenarios.
- Gamified dashboards.

Challenges and Limitations:

1. Data Quality and Bias:

Such AI systems require good data to perform well. ESG data can be skewed by coverage bias.

2. Explainability and Trust:

The AI system's decision-making process should also be transparent to all parties involved. The reason for this is that deep learning systems lack

3. Regulatory Uncertainty:

This poses problems in model development due to constantly emerging ESG standards.

4. Ethical:

Issues such as privacy, data ownership, and fairness in algorithms must therefore be protected.

Future Research Directions:

- Explainable AI (XAI) specifically designed for ESG
- Federated Learning for Preserving Privacy.
- Hybrid learning platforms that integrate the use of AI systems with human mentoring.
- Global multilingual NLP focus on ESG disclosures.

Conclusion:

Artificial Intelligence-driven Decision Support Systems have immense potential in terms of ESG reporting and educating. These systems can make use of artificial intelligence in order to remove the gaps that exist in terms of current reporting. In spite of the challenges that are posed by data quality and explain ability, the application of artificial intelligence in ESG frameworks functions as the new frontier.

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A Study on Influence of AI-Powered Algorithms on College Students' Buying Behaviour

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Abstract:

With the rapid advancement of Artificial Intelligence (AI), digital platforms have increasingly adopted AI-powered algorithms to personalize content, advertisements, and product recommendations. In 2024, India's e-commerce market is expected to exceed US$120 billion, largely driven by algorithm-based personalization and predictive analytics. In this evolving digital ecosystem, understanding how AI-powered algorithms influence buying behaviour has become crucial, particularly among college students who are digitally active and technology-savvy consumers.

This study aims to examine the influence of AI-powered algorithms on the buying behaviour of college students by analyzing how recommendation systems, targeted advertisements, dynamic pricing, and personalized content shape purchase decisions. The research adopts a survey-based approach to study students' exposure to AI-driven platforms such as e-commerce websites and social media applications. The study further explores students' trust in algorithmic recommendations, emotional triggers such as convenience and fear of missing out (FOMO), and their role in impulse buying behaviour.

The findings of the study aim to identify the extent to which AI-powered algorithms subconsciously influence purchase decisions and highlight the psychological and behavioural impact of algorithmic marketing on young consumers.

Keywords: Artificial Intelligence, Algorithms, Buying Behaviour, College Students, Personalization, Online Shopping future of middle-power diplomacy in a contested world.

Introduction:

In today's digitally driven marketplace, Artificial Intelligence has emerged as a transformative force in shaping consumer behaviour. AI-powered algorithms analyze vast amounts of consumer data to predict preferences, personalize recommendations, and influence purchase decisions in real time. Platforms such as Amazon, Flipkart, Instagram, YouTube, and food delivery applications rely heavily on algorithm-driven systems to enhance user engagement and increase sales.

College students represent a significant consumer segment due to their high exposure to digital platforms, frequent online shopping habits, and openness to technological innovations. Unlike traditional advertising, AI-powered algorithms work subtly by tracking browsing history, past purchases, search behaviour, and engagement patterns, thereby influencing buying decisions often without the consumer's conscious awareness.

This study seeks to explore the relationship between AI-powered algorithmic exposure and buying behaviour among college students. Understanding this relationship is essential for marketers, educators, and policymakers, as AI-driven marketing raises concerns related to impulse buying, ethical persuasion, and consumer autonomy.

The increasing integration of AI into everyday digital interactions has blurred the distinction between consumer choice and algorithmic influence. Hence, this research attempts to examine the psychological, emotional, and behavioural factors that drive purchase decisions under the influence of AI-powered algorithms.

Research Question:

To study the influence of AI-powered algorithms on buying behaviour of college students.

Objectives:

1. To examine the level of exposure of college students to AI-powered digital platforms
2. To study the influence of AI-based product recommendations on buying decisions
3. To explore the psychological and emotional factors contributing to AI-driven buying behaviour
4. To identify factors responsible for impulse buying influenced by AI algorithms
5. To determine which AI-enabled platforms most influence purchase behaviour
6. To assess the role of algorithmic personalization, discounts, and limited-time offers
7. To study the extent to which awareness of AI reduces impulsive buying behaviour

Review of Literature:

Abraham et al. (2020) studied the impact of AI-based recommendation systems on online consumer behaviour and found that algorithmic personalization significantly increased impulse buying intentions among young consumers.

Lee and Kim (2019) observed that AI-powered personalization enhances convenience, enjoyment, and engagement, indirectly influencing purchase decisions in digital environments.

Morris et al. (2021) analyzed the role of predictive analytics in e-commerce and concluded that algorithm-driven suggestions strongly influence unplanned purchases, especially among students and young adults.

Verma and Sharma (2022) found that Indian college students trust algorithm-generated recommendations more than traditional advertisements due to perceived relevance and accuracy.

Methodology:

For the purpose of data collection, a structured questionnaire was designed to collect responses related to the influence of AI-powered algorithms on buying behaviour. Due to time constraints, the sample size was limited to 120 respondents. The responses were analyzed using a one-sample t-test. Frequency distribution was applied to responses measured on nominal and ordinal scales to study the influence of AI-powered algorithms on buying behaviour of college students.

Scope of Study:

The study is conducted by collecting data from college students belonging to Mumbai and Thane city.

Limitations of Study:

The research is limited to Thane city. The findings of the study may not be applicable to students from other regions.

Findings:

Exposure to AI-powered platforms such as e-commerce websites and social media applications increases the likelihood of impulse buying. Psychological and emotional factors such as convenience, FOMO, personalized discounts, and limited-time recommendations significantly contribute to AI-driven buying behaviour.

Data Analysis:

How often do you engage with AI-powered digital platforms?

Interpretation & Findings:

87% of respondents engage with AI-powered platforms several times a day, 8% once per day, and 5% occasionally. This indicates high exposure to algorithm-driven content.

Which AI-powered platforms influence your buying decisions the most?

Interpretation & Findings:

78% of respondents reported e-commerce platforms, 72% social media applications, 55% video streaming platforms, and 38% food delivery apps.

Do you trust product recommendations generated by AI algorithms?

Interpretation & Findings:

61% respondents agreed, 27% were neutral, and 12% disagreed, indicating moderate to high trust in algorithmic recommendations.

Have you made impulse purchases influenced by AI recommendations in the past six months?

Interpretation & Findings:

41% respondents agreed, 36% disagreed, and 23% were unsure, suggesting significant algorithmic influence on impulse buying.

Which factors most influence AI-driven impulse buying?

Interpretation & Findings:

52% convenience, 39% discounts, 31% FOMO, 24% personalized recommendations, and 14% brand familiarity.

Do you think AI algorithms intentionally encourage impulse buying?

Interpretation & Findings:

69% respondents agreed, 22% disagreed, and 9% remained neutral.

One Sample t-Test:

Objective:

To identify positive (favorable) or negative (unfavorable) influence of AI-powered algorithms on buying behaviour of college students.

Hypotheses:

H_0: There is no significant influence of AI-powered algorithms on buying behaviour.

H_1: There is a significant influence of AI-powered algorithms on buying behaviour.

Significance Level:

$\alpha = 0.05$ (non-directional → 0.025)

Table 1: One Sample t-Test

Parameter	p-Value	Result
AI recommendations influence buying decisions	< .001	Reject H_0
Trust in AI-based suggestions	< .001	Reject H_0
Urge to buy after personalized recommendations	< .001	Reject H_0
Frequency of impulse buying due to AI	< .001	Reject H_0
Importance of AI-based discounts	< .001	Reject H_0
Importance of limited-time AI offers	< .001	Reject H_0

Table 2: One Sample Statistics

Parameters	Mean	Perception
AI recommendations influence purchases	3.42	Positive
Trust in AI suggestions	3.28	Positive
Immediate urge to purchase	2.89	Negative
Frequency of impulse buying	3.36	Positive
Importance of discounts	3.51	Positive
Importance of limited-time offers	3.29	Positive

Conclusion and Recommendation:

The study concludes that AI-powered algorithms significantly influence the buying behaviour of college students. Algorithmic personalization, discounts, and limited-time offers create an environment conducive to impulse buying. While AI enhances convenience and shopping efficiency, it also increases unplanned purchases. Students exhibit planned impulse buying behaviour, where decisions are driven by algorithmic suggestions and promotional triggers. There is a need for greater awareness regarding algorithmic influence and ethical use of AI in marketing practices.

Social Relevance of the Study:

This study highlights the growing influence of AI on consumer psychology and behaviour. Understanding algorithmic persuasion can help consumers make informed decisions while enabling businesses to adopt ethical AI practices. The research contributes to awareness about digital literacy and responsible consumption among young consumers.

Future Scope for Research:

Future studies can explore the impact of AI-driven buying behaviour on students' financial well-being and long-term consumption patterns.

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A Study on Responsible and Ethical Use of Artificial Intelligence in Higher Education in Thane District

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Abstract:

Artificial Intelligence (AI) is transforming higher education by influencing teaching, learning, assessment, and administration. While offering benefits such as efficiency, personalization, and accessibility, AI also raises ethical concerns, including academic integrity, data privacy, and accountability. This study examines faculty and student awareness, perceptions, and attitudes toward responsible AI use in selected colleges in Thane district. Findings emphasize the need for ethical frameworks, institutional policies, and awareness programs to ensure AI serves as a supportive academic tool, enhancing learning without replacing human intelligence or originality.

Keywords: Artificial Intelligence, Ethics, Responsible Use, Higher Education, Academic Integrity

Introduction:

Background of the Study:

Artificial Intelligence (AI) is increasingly integrated into higher education through tools supporting content creation, personalized learning, research, and administrative tasks. Intelligent tutoring systems, automated grading, plagiarism detection, and generative AI platforms are widely used by students and faculty. While these tools can enhance learning outcomes and institutional efficiency, uninformed use raises ethical concerns. In Indian colleges, AI adoption often outpaces the development of regulatory and ethical guidelines. Misuse for academic dishonesty, lack of transparency, algorithmic bias, and data privacy issues are growing challenges. Thus, examining stakeholders' perceptions and responsible AI use in higher education is essential.

Statement of the Problem:

Despite growing AI adoption in higher education, ethical and responsible use remains unclear. Many colleges lack policies, training, and frameworks to guide faculty and students, risking misuse and compromised academic integrity. This study explores stakeholders' perceptions and identifies areas where institutional support and ethical guidance are needed for responsible AI use.

Objectives of the Study:

1. To assess the level of awareness of AI tools among faculty and students.
2. To examine perceptions regarding responsible and ethical use of AI in higher education.
3. To identify concerns related to plagiarism, data privacy, and bias associated with AI usage.
4. To understand the role of institutional policies and support in promoting ethical AI practices.
5. To suggest measures for encouraging responsible and ethical use of AI in colleges.

Scope of the Study:

1. Limited to selected colleges affiliated with the University of Mumbai in Thane district.
2. Respondents include faculty and students from various disciplines.
3. Focuses on academic use of AI tools; technical development of AI systems is not covered.

Limitations of the Study:

- The study is limited to selected colleges in Thane District, which may restrict the generalizability of the findings.
- The study is based on self-reported perceptions of respondents, which may be subject to personal bias.

Review of Literature:

Artificial Intelligence (AI) is increasingly integrated into higher education, transforming teaching, learning, and assessment. AI applications such as adaptive learning systems, intelligent tutoring, and automated feedback enhance personalization and efficiency by supporting learners and assisting educators in instructional planning (Holmes et al., 2019).

Despite these benefits, ethical challenges are widely highlighted. Floridi et al. (2018) argue that ethical AI should be grounded in transparency, accountability, and human oversight to ensure trust and fairness. Academic integrity is a major concern, as AI use by students raises issues of authorship, originality, and plagiarism, especially without clear institutional guidelines (Selwyn, 2019; Eaton, 2021).

Data privacy and security are central, as AI often relies on large volumes of student data, posing privacy risks if safeguards are absent (Zawacki-Richter et al., 2019; UNESCO, 2021). Algorithmic bias and fairness are also critical, as AI trained on unrepresentative data can produce unequal outcomes and reinforce disparities (Jobin et al., 2019).

Institutional readiness and governance are important for ethical AI adoption. The lack of policies and frameworks creates inconsistent practices and uncertainty among faculty and students (Holmes et al., 2022). Structured training, policy development, and continuous oversight are recommended to promote responsible AI use.

Overall, while AI has the potential to enhance higher education, its ethical and responsible use depends on clear policies, ethical guidelines, AI literacy, and ongoing monitoring. These findings provide a foundation for examining faculty and student perceptions of ethical AI use in colleges.

Hypotheses of the Study:

Hypothesis 1:

H_{01}: There is no significant difference between faculty and students in AI awareness and usage.
Ha_1: There is a significant difference between faculty and students in AI awareness and usage.

Hypothesis 2:

H_{02}: There is no significant relationship between AI usage and ethical concerns. **Ha_2:** There is a significant relationship between AI usage and ethical concerns.

Hypothesis 3:

H_{03}: Institutional support does not significantly influence perceptions of ethical AI use.
Ha_3: Institutional support significantly influences perceptions of ethical AI use.

Research Methodology:

Research Design:

A quantitative, survey-based design was used to examine students' and faculty members' perceptions of the responsible and ethical use of Artificial Intelligence (AI) in higher education.

Data were collected via a structured questionnaire administered through Google Forms.

Sampling Method:

Population: Students and faculty from selected colleges in Thane District affiliated with the University of Mumbai

Sample Size: 150 students and 50 faculty members

Sampling Technique: Non-probability convenience sampling

Data Collection:

Primary data were collected using a digital Google Forms questionnaire. Participation was voluntary, and responses were anonymized to ensure confidentiality and unbiased feedback.

Data Analysis:

1. Descriptive analysis: Frequency and percentage distribution of responses
2. Mean and standard deviation: To assess overall perception levels
3. Inferential analysis: Independent sample t-test and correlation analysis (where applicable)
4. Graphical representation: Bar charts and tables to aid interpretation

Data Analysis and Interpretation:

Descriptive Analysis:

Awareness and Usage of AI in Higher Education

Table 1: Descriptive Statistics of AI Awareness and Usage

Statement Code	Statement	Mean	Std. Deviation
AU1	Active use of AI tools for learning or teaching	4.19	1.03
AU2	Understanding benefits of AI in higher education	4.16	1.11
AU3	Understanding limitations and risks of AI tools	4.22	1.18
AU4	Awareness of AI tools for academic purposes	3.78	1.04
Overall, AI Awareness & Usage	Composite Mean	4.09	1.09

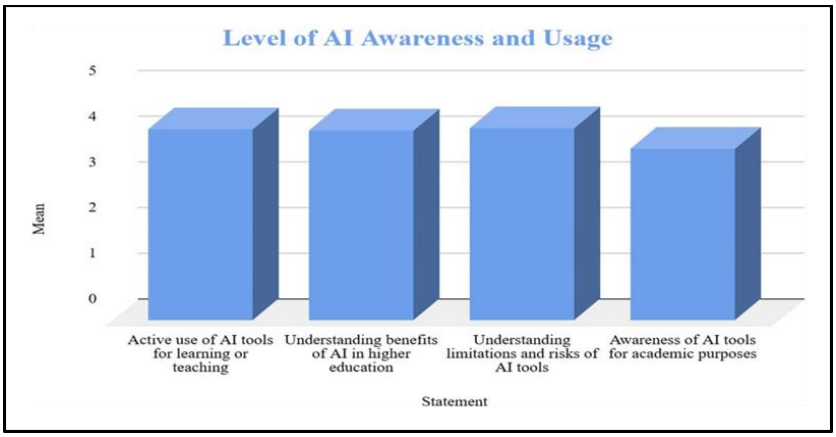

Figure 1: Level of AI Awareness and Usage

Interpretation: AI Awareness and Usage:

Table 1 and Figure 1 show respondents' awareness and usage of AI tools. The overall mean of 4.09 indicates high awareness and frequent use. Mean scores for understanding benefits (4.16) and limitations/risks (4.22) suggest

a balanced and informed perspective. Overall, respondents demonstrate a positive and responsible attitude toward AI in higher education.

Ethical Concerns Related to AI in Higher Education:

Table 2: Descriptive Statistics of Ethical Concerns Related to AI

Statement Code	Statement	Mean	Std. Deviation
EC1	AI should not replace original thinking or creativity	4.19	1.12
EC2	Concern about plagiarism or academic dishonesty	4.06	1.13
EC3	Concern about data privacy and misuse	4.19	1.03
EC4	AI tools may introduce bias	4	0.98
EC5	Importance of ethical guidelines in AI usage	4.38	0.87
verall Ethical Concerns	Composite Mean	4.14	1.02

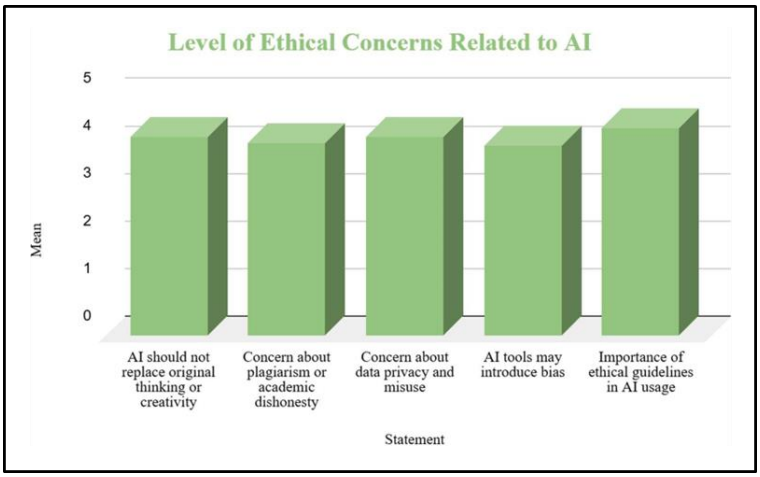

Figure 2: Level of Ethical Concerns Related to AI

Interpretation: Ethical Concerns Related to AI

Table 2 and Figure 2 illustrate perceptions of ethical concerns. The composite mean of 4.14 reflects high ethical awareness. Respondents strongly agree on the importance of guidelines (4.38) and recognize issues like plagiarism, data privacy, and bias (4.00–4.19). This indicates consciousness of ethical challenges and the need for responsible AI use.

Institutional Support for Ethical AI Use in Higher Education:

Table 3: Descriptive Statistics of Institutional Support for Ethical AI Use

Statement Code	Statement	Mean	Std. Deviation
IS1	College provides guidance or training on AI use	4	0.98
IS2	College monitors AI usage ethically	4	1.08
IS3	Need for formal policies on ethical AI use	4.19	0.93
Overall Institutional Support	Composite Mean	4.18	1.04

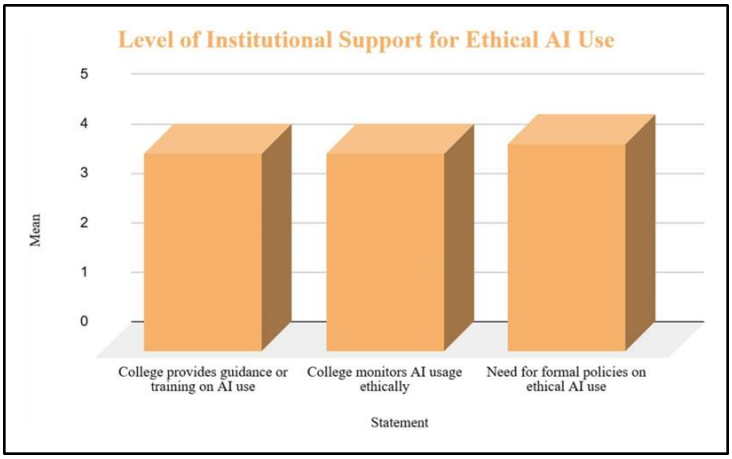

Figure 3: Level of Institutional Support for Ethical AI Use

Interpretation: Institutional Support for Ethical AI Use

Table 3 and Figure 3 show perceptions of institutional support. The overall mean of 4.18 suggests agreement on the role of institutions in guiding ethical AI practices. High scores for formal policies (4.19) and monitoring (4.00) highlight expectations for structured guidelines, training, and regulation.

Perceptions of Responsible and Ethical AI Use in Higher Education:

Table 4: Perceptions of Responsible and Ethical AI Use

Statement Code	Statement	Mean	Std. Deviation
RA1	Workshops and awareness programs on AI ethics are useful	4.34	1.1
RA2	Faculty–student collaboration is needed for ethical AI use	4.28	1.02
Overall Responsible AI Perception	Composite Mean	4.28	1.02

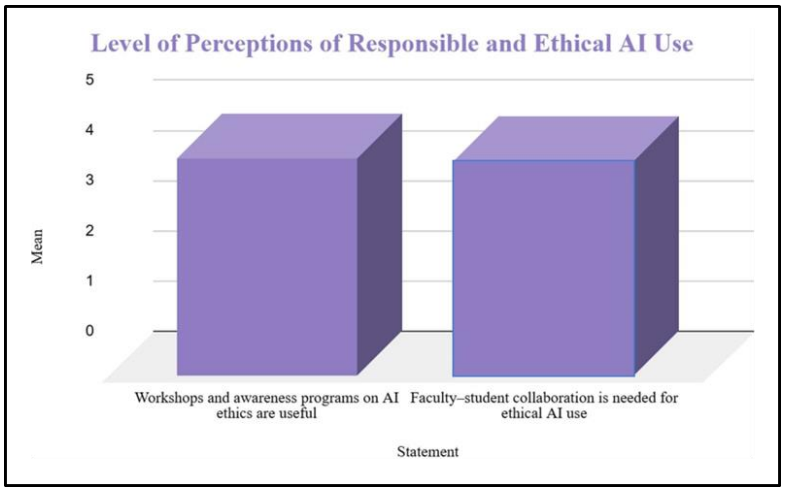

Figure 4: Level of Perceptions of Responsible and Ethical AI Use

Interpretation: Perceptions of Responsible and Ethical AI Use

Table 4 and Figure 4 present perceptions of initiatives promoting responsible AI use. The overall mean of 4.28 indicates strong agreement on the usefulness of workshops, awareness programs, and faculty–student collaboration, suggesting these strategies are effective for fostering ethical AI practices.

Mean Scores of Key Constructs Related to Ethical AI Use:

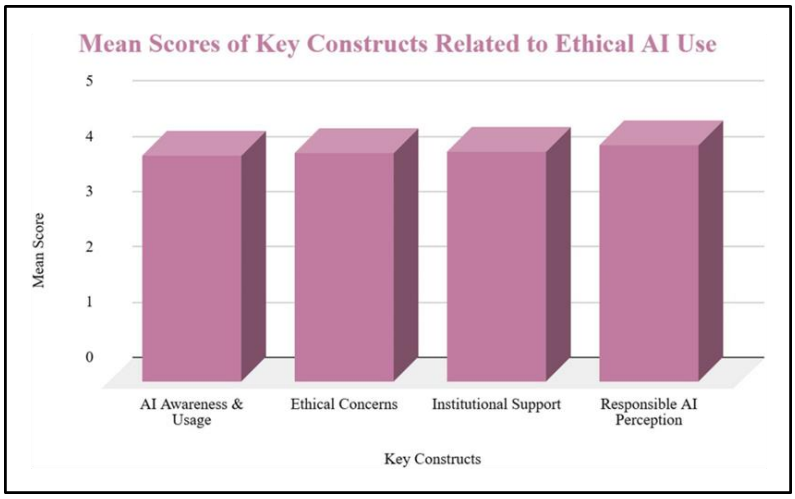

Figure 5: Mean Scores of Key Constructs Related to Ethical AI Use Interpretation:

Figure 5 shows mean scores of key constructs, reflecting high AI awareness and usage, ethical concerns, institutional support, and perceptions of responsible AI use, indicating an overall positive perception across all dimensions.

Hypothesis Testing:

Table 5: Summary of Hypothesis Testing Results

Hypothesis	Test Applied	Statistical Value	p-value	Decision
H_{01}	Independent t-test	$t = -1.16$	0.254	Accepted
H_{02}	Pearson Correlation	$r = 0.74$	$< .001$	Rejected
H_{03}	Pearson Correlation	$r = 0.70$	$< .001$	Rejected

The Independent t-test shows no significant difference between faculty and students in AI awareness, leading to the acceptance of H_{01}. Pearson correlation indicates a strong, significant relationship between awareness and AI usage, resulting in the rejection of H_{02}. A significant positive relationship is observed between ethical concerns and support for formal AI policies, leading to the rejection of H_{03}.

Findings of the Study:

- Respondents showed high awareness and frequent use of AI tools.
- Faculty and students recognized AI's usefulness in teaching and learning.
- Ethical concerns, including plagiarism, data privacy, and bias, were acknowledged.
- AI usage was positively related to ethical awareness, reflecting responsible attitudes.
- Institutional support through guidelines, training, and monitoring was crucial.

- Workshops, awareness programs, and faculty-student collaboration promoted responsible AI adoption.
- Overall, AI adoption is increasing alongside growing ethical consciousness.

Conclusion:

The study examined the responsible and ethical use of Artificial Intelligence in higher education institutions in Thane District. Findings reveal that faculty and students actively use AI tools and acknowledge their benefits, while being aware of ethical challenges such as plagiarism, data privacy, and bias. Ethical awareness and institutional support, including guidelines, training, and monitoring, are crucial for fostering responsible AI practices. The study concludes that the ethical and responsible integration of AI is essential for maintaining academic integrity and ensuring the sustainable adoption of emerging technologies in higher education.

Recommendations:

- Establish clear institutional policies for ethical AI use.
- Conduct regular workshops and training on responsible AI practices.
- Promote academic integrity alongside constructive AI use.
- Guide students on ethical and appropriate AI usage.
- Encourage collaboration to develop context-specific ethical AI frameworks.

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Sustainable Knowledge Infrastructure and Academic Library Services: A Framework for the Transforming Phase of Artificial Intelligence

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Abstract:
Academic libraries are undergoing a significant transformation in response to the growing emphasis on sustainability, digital innovation, and national and global policy frameworks such as the Sustainable Development Goals (SDGs) and the National Education Policy (NEP) 2020. The present study examines the evolving role of academic libraries as sustainable knowledge institutions that actively support SDGs through academia–industry collaboration, resilient knowledge infrastructure, and enhanced educational and research services. By positioning libraries as strategic partners in quality education, innovation, and partnerships, the study highlights their contribution beyond traditional information provision toward inclusive and sustainable academic development. The findings, based on empirical evidence, reveal a strong and statistically significant perception of academic libraries as transformative agents in supporting SDGs, strengthening sustainable knowledge infrastructure, and facilitating NEP 2020 objectives through collaborative and learner-centric initiatives. The results underscore the importance of academic libraries as dynamic knowledge hubs that integrate sustainability principles, policy alignment, and collaborative practices to remain relevant and impactful in the contemporary higher education ecosystem

Keywords: Sustainable Development Goals, Academic Libraries, Knowledge Infrastructure.

Introduction:

The rapid advancement of Artificial Intelligence (AI) is fundamentally reshaping the landscape of higher education, knowledge creation, and information dissemination. Academic libraries, traditionally positioned as custodians of knowledge and facilitators of learning, are now entering a transformative phase where digital intelligence, automation, and data-driven services redefine their core functions. In this evolving environment, the concept of Sustainable Knowledge Infrastructure (SKI) has gained prominence, emphasizing resilient, adaptive, and ethically grounded systems that support long-term academic and research needs. The integration of AI into library services necessitates a rethinking of infrastructure, governance, and service models to ensure sustainability, inclusivity, and academic integrity.

Sustainable Knowledge Infrastructure refers to the interconnected framework of digital platforms, human expertise, policies, and technologies that enable the continuous creation, preservation, and equitable access to knowledge. In the context of academic libraries, sustainability extends beyond environmental considerations to include technological longevity, financial viability, data stewardship, and social responsibility. As AI technologies such as machine learning, natural language processing, and intelligent retrieval systems become embedded in library operations, libraries must

ensure that these innovations align with institutional missions and scholarly values. The challenge lies in balancing efficiency and automation with transparency, accountability, and user trust.

Academic library services are undergoing a paradigm shift from collection-centric models to user-centric, intelligence-driven ecosystems. AI-enabled services such as automated cataloguing, predictive analytics for collection development, personalized information retrieval, virtual reference assistants, and research impact assessment tools are redefining how users interact with libraries. These developments enhance service quality and accessibility but also introduce concerns related to data privacy, algorithmic bias, digital divide, and skill gaps among library professionals. Therefore, a sustainable framework is essential to guide the responsible adoption of AI while safeguarding the academic library's role as a neutral, inclusive, and ethical knowledge institution.

The transforming phase of Artificial Intelligence is characterized not merely by technological adoption but by institutional transformation. Academic libraries are transitioning into knowledge hubs, digital scholarship centers, and learning commons that support interdisciplinary research, open science, and lifelong learning. In this phase, sustainability depends on strategic planning, continuous professional development, collaborative partnerships, and robust policy frameworks. Libraries must invest in upskilling librarians as data curators, AI facilitators, and digital ethicists while simultaneously modernizing infrastructure to support interoperable, scalable, and secure knowledge systems.

Against this backdrop, the present framework on Sustainable Knowledge Infrastructure and Academic Library Services seeks to conceptualize how libraries can effectively navigate the AI-driven transformation. By integrating technological innovation with sustainability principles, the framework aims to support academic libraries in enhancing service delivery, strengthening research ecosystems, and ensuring long-term relevance in the digital knowledge economy. Such a framework is critical not only for institutional resilience but also for reinforcing the library's enduring mission of democratizing knowledge in an era increasingly shaped by artificial intelligence.

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Review of Literature:

1. **Aharony (2020),** In the research titled "The influence of artificial intelligence on academic libraries: An exploratory analysis" The study concludes that artificial intelligence is increasingly perceived as a transformative force in academic libraries, particularly in enhancing service efficiency, decision-making, and user engagement. While librarians acknowledge the potential of AI-driven tools for improving information retrieval and operational processes, the research highlights a cautious attitude due to concerns over ethical implications, data privacy, and professional skill gaps. The findings emphasize the need for structured training, policy development, and strategic planning to ensure that AI adoption aligns with the core values of librarianship and contributes to sustainable academic library development.
2. **Cox, et.al (2019),** In the research titled "The intelligent library: Thought leaders' views on the likely impact of artificial intelligence on academic libraries" This study concludes that academic libraries are on the threshold of becoming intelligent knowledge ecosystems, driven by artificial intelligence and data-centric technologies. Thought leaders anticipate significant changes in library roles,

services, and professional identities, with librarians evolving into facilitators of digital scholarship and data stewardship. However, the study stresses that technological advancement alone is insufficient; institutional culture, ethical governance, and long-term sustainability strategies are critical to ensuring that AI enhances rather than undermines the academic mission of libraries.

3. **Crews (2018),** In the research titled "Artificial intelligence and libraries: Opportunities and challenges" The study concludes that artificial intelligence presents both unprecedented opportunities and complex challenges for libraries. While AI can significantly improve cataloguing, discovery systems, and user services, it also raises critical legal, ethical, and policy-related concerns, particularly regarding intellectual property, accountability, and transparency. The author emphasizes that libraries must proactively engage in policy formulation and ethical discourse to ensure responsible AI implementation, thereby safeguarding user rights and maintaining trust in academic information systems.
4. **Dwivedi., et al. (2021),** In the research titled "Artificial intelligence (AI): Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research" This multidisciplinary study concludes that artificial intelligence has far-reaching implications across sectors, including education and academic libraries, necessitating a holistic and responsible approach to adoption. The research underscores that while AI enhances productivity, innovation, and decision-making, it simultaneously introduces risks related to bias, governance, and social inequality. The authors advocate for collaborative research, regulatory frameworks, and ethical oversight to ensure that AI-driven systems contribute to sustainable and inclusive knowledge infrastructures.
5. **Floridi & Cowls (2019),** In the research titled "A unified framework of five principles for AI in society" The study concludes that the sustainable deployment of artificial intelligence in society requires adherence to core ethical principles, including beneficence, non-maleficence, autonomy, justice, and explicability. These principles provide a robust normative framework that is highly relevant for academic libraries adopting AI technologies. The authors argue that integrating ethical governance into AI systems is essential for maintaining transparency, accountability, and public trust, thereby ensuring that AI serves as a responsible tool for knowledge dissemination and societal progress.
6. **Johnson & Palmer (2015),** In the research titled "Advancing sustainability in academic libraries: A framework for action" This study concludes that sustainability in academic libraries must be approached as a multidimensional concept encompassing environmental responsibility, financial resilience, technological adaptability, and social impact. The proposed framework demonstrates that sustainable practices enhance institutional effectiveness and long-term service quality. The authors emphasize that strategic leadership, stakeholder engagement, and continuous assessment are vital for embedding sustainability into library operations, especially in the context of emerging digital and intelligent technologies.
7. **Jones & Salo (2018),** In the research titled "Learning analytics and academic libraries: A review of the literature" The study concludes that learning analytics present significant

opportunities for academic libraries to enhance student success, personalize services, and demonstrate institutional value. However, the findings also reveal substantial ethical and privacy concerns related to data collection, surveillance, and informed consent. The authors stress that libraries must adopt transparent policies, ethical guidelines, and collaborative governance models to ensure that learning analytics initiatives are sustainable, trustworthy, and aligned with the educational mission of academic institutions.

Research Gap:

The reviewed literature clearly establishes that artificial intelligence has the potential to transform academic libraries by enhancing service efficiency, user engagement, and knowledge management, while simultaneously raising critical ethical, legal, and governance concerns. However, a significant research gap exists in the form of an integrated, sustainability-oriented framework that systematically links AI adoption with sustainable knowledge infrastructure and academic library services. Most existing studies focus either on technological capabilities of AI, ethical principles, or sustainability in isolation, rather than examining how these dimensions interact during the transforming phase of artificial intelligence. Furthermore, there is limited empirical and conceptual research addressing how academic libraries can operationalize ethical AI, develop librarian competencies, and align institutional culture and policy with long-term sustainability goals. The lack of context-specific models, particularly for academic institutions in developing and transitional knowledge economies, underscores the need for a comprehensive framework that guides libraries in adopting AI responsibly while ensuring resilience, inclusivity, and alignment with their core academic mission.

Research Methodology:

The study adopts a descriptive and analytical research design to examine the role of academic libraries in supporting SDGs, developing sustainable knowledge infrastructure, and facilitating academia–industry collaboration under NEP 2020. Primary data were collected from 60 respondents associated with academic libraries using a structured questionnaire measured on a Likert scale. The reliability and consistency of responses were ensured through appropriate statistical measures. Data analysis was carried out using a one-sample t-test with a predefined test value of 60 to evaluate the significance of perceptions across the stated objectives. Mean scores and rank analysis were used to interpret key dimensions and priorities, enabling a comprehensive assessment of the transformative role of academic libraries in the contemporary higher education context

Data Analysis:

Objective and Hypothesis:

Objective 1. To examine the transformative role of academic libraries in supporting the Sustainable Development Goals (SDGs).

Null Hypothesis H_{01}: There is no significant transformative role of academic libraries in supporting the Sustainable Development Goals (SDGs).

Alternate Hypothesis H_{11}: There is a significant transformative role of academic libraries in supporting the Sustainable Development Goals (SDGs).

To study the above null hypothesis, one sample Test is applied and results are as follows:

One-Sample Test				
	Test Value = 60			
	t	df	P-value	Mean Difference
Academia–Industry Collaboration	6.104	59	.000	10.000

Interpretation: The above results indicate that calculated p-value is 0.000. It is less than 0.05. Therefore, one sample test is rejected. Hence Null hypothesis is rejected and the alternate hypothesis is accepted.

Conclusion: There is a significant transformative role of academic libraries in supporting the Sustainable Development Goals (SDGs).

Findings: To understand the findings, mean score of role of academic libraries in supporting the Sustainable Development Goals (SDGs) are obtained and presented as follows:

One-Sample Statistics				
	N	Mean	Std. Deviation	Std. Error Mean
Academia–Industry Collaboration	60	70.00	12.689	1.638

The one-sample statistics for Academia–Industry Collaboration indicate that responses from 60 participants yielded a relatively high mean score of 70.00, suggesting a generally positive perception of collaboration between academic institutions and industry. The standard deviation of 12.689 shows a moderate level of variability among respondents, reflecting differences in individual experiences and viewpoints regarding the extent and effectiveness of such collaboration. The low standard error mean of 1.638 implies that the sample mean is a reliable estimate of the population mean, indicating consistency in the responses and strengthening the credibility of the findings related to academia–industry collaboration.

Ranks	
	Mean Rank
Academia–industry collaboration enhances the overall quality of library services.	2.68
Industry partnerships help libraries adopt emerging digital technologies.	2.36
Collaboration with industry improves the professional skills of library staff.	2.37
Academic libraries benefit from joint research and innovation initiatives with industry.	2.60

The rank analysis shows that academia–industry collaboration enhancing the overall quality of library services received the highest mean rank (2.68), indicating that respondents perceive service quality improvement as the most significant outcome of such collaboration. This is closely followed by the view that academic libraries benefit from joint research and

innovation initiatives with industry (mean rank 2.60), highlighting the importance of collaborative knowledge creation and innovation. Comparatively, collaboration improving the professional skills of library staff (mean rank 2.37) and industry partnerships helping libraries adopt emerging digital technologies (mean rank 2.36) received slightly lower but still substantial rankings, suggesting that while skill development and technology adoption are important benefits, respondents prioritize service enhancement and research-oriented outcomes in academia–industry collaboration.

Objective 2. To examine the components of sustainable knowledge infrastructure in an academic library.

Null Hypothesis H_{02}: There is no significant sustainable knowledge infrastructure in an academic library.

Alternate Hypothesis H_{12}: There is a significant sustainable knowledge infrastructure in an academic library.

To study the above null hypothesis, one sample Test is applied and results are as follows:

One-Sample Test				
	Test Value = 60			
	t	df	P-value	Mean Difference
SDGs & Libraries	2.675	59	.010	3.833

Interpretation: The above results indicate that calculated p-value is 0.010. It is less than 0.05. Therefore, one sample test is rejected. Hence Null hypothesis is rejected and Alternate hypothesis is accepted.

Conclusion: There is a significant sustainable knowledge infrastructure in an academic library.

Findings: To understand the findings, mean score of sustainable knowledge infrastructure in an academic library are obtained and presented as follows:

One-Sample Statistics				
	N	Mean	Std. Deviation	Std. Error Mean
SDGs & Libraries	60	63.83	11.099	1.433

The one-sample statistics for SDGs & Libraries show that responses from 60 participants resulted in a mean score of 63.83, indicating a generally favorable perception of the role of libraries in supporting Sustainable Development Goals. The standard deviation of 11.099 reflects a moderate spread of responses, suggesting some variation in awareness and experiences among respondents. The relatively low standard error mean of 1.433 indicates that the sample mean is a reliable estimate of the population mean, lending credibility to the findings regarding the contribution of libraries toward achieving SDGs.

Ranks	
	Mean Rank
Academic libraries play an important role in achieving Sustainable Development Goals (SDGs).	2.53
Library services significantly contribute to SDG 4 (Quality Education).	2.65
Libraries support innovation and infrastructure development aligned with SDG 9.	2.54
Partnerships developed by libraries contribute to SDG 17 (Partnerships for Goals).	2.28

The rank analysis indicates that library services significantly contributing to SDG 4 (Quality Education) received the highest mean rank (2.65), highlighting that respondents strongly associate academic libraries with educational quality and inclusive learning. This is followed by perceptions that libraries support innovation and infrastructure aligned with SDG 9 (mean rank 2.54) and that academic libraries play an important overall role in achieving SDGs (mean rank 2.53), reflecting broad recognition of their developmental contribution. In comparison, partnerships developed by libraries contributing to SDG 17 received a slightly lower mean rank (2.28), suggesting that while partnerships are acknowledged, respondents perceive direct educational and innovation-related roles of libraries as more prominent.

Objective 3. To examine the role of Academic Library in Academia-Industry Collaboration for achieving goal of NEP2020.

Null Hypothesis H_{03}: There is no significant role of Academic Library in Academia-Industry Collaboration for achieving goal of NEP2020.

Alternate Hypothesis H_{13}: There is a significant role of Academic Library in Academia-Industry Collaboration for achieving goal of NEP2020.

To study the above null hypothesis, one sample Test is applied and results are as follows:

One-Sample Test				
	Test Value = 60			
	t	df	P-value	Mean Difference
Modern Role of Libraries under NEP 2020	6.251	59	.000	12.833

Interpretation: The above results indicate that calculated p-value is 0.000. It is less than 0.05. Therefore, one sample test is rejected. Hence Null hypothesis is rejected and Alternate hypothesis is accepted.

Conclusion: There is a significant role of Academic Library in Academia-Industry Collaboration for achieving goal of NEP2020.

Findings: To understand the findings, mean score of role of Academic Library in Academia-Industry Collaboration for achieving goal of NEP2020are obtained and presented as follows:

One-Sample Statistics				
	N	Mean	Std. Deviation	Std. Error Mean
Modern Role of Libraries under NEP 2020	60	72.83	15.901	2.053

The one-sample statistics for the Modern Role of Libraries under NEP 2020 reveal that responses from 60 participants produced a high mean score of 72.83, indicating strong agreement on the expanding and contemporary role of libraries as envisioned in the National Education Policy 2020. The standard deviation of 15.901 suggests a moderate to high variation in perceptions, reflecting differences in institutional readiness and implementation levels across libraries. The standard error mean of 2.053 remains relatively low, indicating that the sample mean is a dependable estimate of the population mean and supporting the reliability of findings related to the modern role of libraries under NEP 2020.

Ranks	
	Mean Rank
Academic libraries actively support the objectives of the National Education Policy (NEP) 2020.	2.47
Libraries act as a bridge between academia and industry for knowledge sharing.	2.47
Library-led initiatives enhance research and innovation in higher education.	2.53
Librarians play a proactive role in improving student learning outcomes.	2.54

The rank analysis shows that librarians playing a proactive role in improving student learning outcomes received the highest mean rank (2.54), indicating that respondents perceive direct learner support as the most prominent aspect of the modern role of libraries under NEP 2020. This is closely followed by library-led initiatives enhancing research and innovation in higher education (mean rank 2.53), highlighting the growing research-oriented function of academic libraries. Both academic libraries actively supporting NEP 2020 objectives and libraries acting as a bridge between academia and industry for knowledge sharing share an equal mean rank (2.47), suggesting that while these roles are clearly acknowledged, respondents slightly prioritize learning outcomes and research enhancement over policy alignment and intermediary functions.

Conclusion:

The study conclusively establishes that academic libraries play a significant and transformative role in advancing sustainable development, strengthening knowledge infrastructure, and supporting the objectives of the National Education Policy (NEP) 2020 through effective academia–industry collaboration. The rejection of all three null hypotheses based on one-sample t-test results confirms that libraries are no longer passive information repositories but active contributors to quality education (SDG 4), innovation and infrastructure development (SDG 9), and collaborative partnerships (SDG 17). The

consistently high mean scores across objectives highlight positive stakeholder perceptions regarding the libraries' role in enhancing service quality, fostering research and innovation, improving professional competencies, and supporting student learning outcomes. Overall, the findings underscore the evolving strategic importance of academic libraries as sustainable knowledge hubs that bridge academia and industry, align with national education reforms, and contribute meaningfully to global sustainable development goals.

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The Impact of Artificial Intelligence on Employment in IT Sector

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Abstract:

Artificial Intelligence (AI) has rapidly evolved from being a theoretical concept in the mid-20th century to becoming a powerful and practical tool that is transforming industries worldwide—including the Information Technology (IT) sector. Initially limited to rule-based systems and simple automation, AI technologies have advanced significantly with the rise of machine learning, natural language processing, computer vision, and more recently, generative AI and large language models like ChatGPT and Copilot. These advancements have enabled machines to perform increasingly complex cognitive tasks once thought to be the exclusive domain of humans.

The IT sector, which was once the driving force behind automation in other industries, is now experiencing a transformation of its own workforce due to AI integration. Routine and repetitive tasks such as code generation, software testing, data entry, and technical support are now being handled by intelligent systems, leading to both opportunities and challenges for IT professionals.

Introduction:

Artificial Intelligence (AI) has rapidly evolved from being a theoretical concept in the mid-20th century to becoming a powerful and practical tool that is transforming industries worldwide—including the Information Technology (IT) sector. Initially limited to rule-based systems and simple automation, AI technologies have advanced significantly with the rise of machine learning, natural language processing, computer vision, and more recently, generative AI and large language models like ChatGPT and Copilot. These advancements have enabled machines to perform increasingly complex cognitive tasks once thought to be the exclusive domain of humans.

The IT sector, which was once the driving force behind automation in other industries, is now experiencing a transformation of its own workforce due to AI integration. Routine and repetitive tasks such as code generation, software testing, data entry, and technical support are now being handled by intelligent systems, leading to both opportunities and challenges for IT professionals.

Advantages of AI in IT Sector Employment:

- Increased Efficiency: AI automates time-consuming tasks, enabling faster software development, debugging, and deployment.
- Creation of New Job Roles: The rise of AI has created demand for roles such as AI/ML engineers, data scientists, AI ethicists, and AI system trainers.
- Improved Decision-Making: AI-powered analytics tools help IT professionals make better, data-driven decisions.

- Support for Innovation: By handling repetitive tasks, AI allows developers to focus on innovation, design, and complex problem-solving.

Disadvantages of AI in IT Sector Employment:

- Job Displacement: Entry-level and mid-level IT roles—especially those involving repetitive tasks—are increasingly being automated, leading to job losses.
- Skill Gaps: Many existing IT workers lack the AI-related skills now in demand, creating a mismatch in the labour market.
- Workforce Polarization: High-skilled professionals benefit most from AI, while low-skilled workers face unemployment or downward mobility.
- Over-reliance on AI Tools: Dependence on AI can lead to deskilling and reduced critical thinking in areas like software development and troubleshooting.

As AI continues to evolve, it is crucial to examine its impact on employment within the IT sector—not only to understand current trends but also to prepare for future workforce needs. This study aims to explore the extent to which AI is reshaping IT employment, analyze the opportunities and threats it presents, and propose strategies to ensure inclusive and sustainable growth in an AI-driven IT industry.

Review of Literature:

AI systems are changing how IT operations work by making processes more automatic and efficient, and by offering better ways to predict outcomes (Peterson, 2025). These systems take over repetitive tasks, so IT workers can spend more time on important tasks like planning and solving problems (Gibson, 2025). As AI becomes more common in workflows, professionals need to learn new skills and understand how these systems work (Kasparov, 2025).

AI helps by doing routine jobs in IT service management, keeping track of how things are going, and making decisions, which means people don't have to do as much work (Poba-Nzaou et al., 2021).

While this boosts productivity, it also changes how traditional jobs are structured, shifting some roles from routine-based tasks (Nurski & Hoffmann, 2022). AI makes many processes more efficient but also brings challenges about how workers adapt and how much control humans should have in automated systems (Andriole, 2024; Ozer et al., 2024; Paradis, 2025).

AI is used as a tool to help workers, making decision-making faster and operations more efficient without replacing people entirely (Ozer et al., 2024).

It improves IT support by handling common issues automatically and offering better service through personalized help (Peterson, 2025). Right now, AI is making routine IT tasks easier by reducing the amount of manual work needed and speeding up service responses.

New AI developments allow systems to do complicated things and make decisions with less human involvement (Mayer et al., 2025).

These improvements make systems more flexible and efficient but raise important questions about how to monitor AI properly and how to build trust in these systems (Mayer et al., 2025).

Multimodal AI, which can handle text, audio, images, and videos, makes automation even more powerful and useful across many industries (Mayer et al., 2025).

This helps with data analysis and system connections, but it also needs careful setup and management to ensure it works well (Mayer et al., 2025).

AI that gives suggestions can help workers make better choices, but AI that directs how tasks are done may limit how flexible workers can be (Nurski & Hoffmann, 2022). To use AI well, companies must find the right balance between how efficient the system is and how much supervision is needed from people.

AI is greatly changing IT jobs, with 92% of roles expected to change, especially mid-level (40%) and entry-level (37%) positions (Zubicoa, 2024).

Objectives of The Study:

1. To analyse the impact of AI on employment trends in the IT industry, including job creation, transformation, and displacement.
2. To identify the roles and skill sets most affected by AI automation within the IT sector.
3. To explore the emerging job opportunities and new career paths created by AI technologies.
4. To examine the advantages and disadvantages of AI implementation from an employment perspective in IT.
5. To study the evolution and advancement of Artificial Intelligence (AI) and its adoption in the IT sector.

Research Hypotheses:

H_{01}: Artificial Intelligence has no significant impact on employment opportunities in the IT sector.

H_{11}: Artificial Intelligence has a significant impact on employment opportunities in the IT sector.

H_{02}: There is no significant difference in perception of AI impact on employment between students and IT professionals.

H_{12}: There is a significant difference in perception of AI impact on employment between students and IT professionals.

Research Methodology:

Research Design:

This study employs a mixed-methods research design, integrating both quantitative and qualitative approaches. The purpose is to gain an understanding of how Artificial Intelligence (AI) is affecting employment patterns, job roles, and skill demands within the Information Technology (IT) sector. While quantitative data provides statistical insight, qualitative data offers depth through personal and organizational experiences.

Sample Size:

The sample size for this study is 100 participants, chosen to balance the depth and manageability of data collection within the scope of this research. This number is sufficient to provide meaningful insights while maintaining feasibility given the study's resources and timeframe.

Data Collection Methods:

Primary Data:

Structured questionnaires will be distributed to 100 IT professionals working in various roles such as software development, data analysis, system administration, and project management. The questionnaire will focus on topics including AI usage, job security, changes in job responsibilities, and up skilling practices.

Secondary Data:

This is information that has already been collected by others. For this study, secondary data will come from:

- Reports, articles, and studies about AI and jobs in the IT sector.

- Official statistics and data from organizations that track employment trends.

Significance of The Study:

This study examines the impact of Artificial Intelligence on employment in the IT sector, focusing on changes in job roles, skill requirements, and workforce dynamics. It provides insights into how AI influences employability, helping educational institutions align curricula with industry needs and supporting professionals in adapting to evolving job demands. The findings also assist organizations and policymakers in formulating effective strategies for AI adoption, workforce planning, and skill development. Overall, the study contributes empirical evidence to existing research on AI-driven employment transformation in the IT sector.

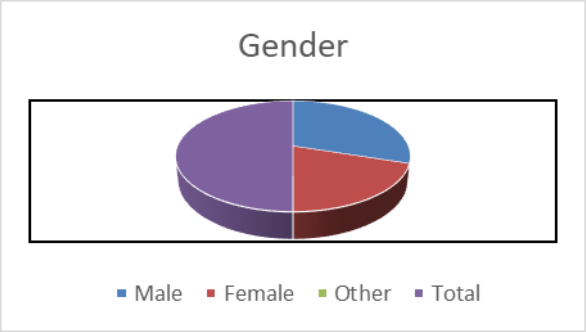
Demographic Profile:

Gender:

Table 1: Gender of Respondent

Gender	Frequency	Percentage (%)
Male	60	60%
Female	40	40%
Other	0	0
Total	100	100%

Graph 1: Gender of Respondent

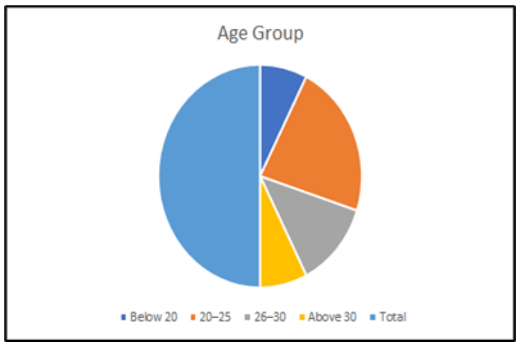


Age Group:

Table 2: Age group of Respondent

Age Group	**Frequency**	**Percentage (%)**
Below 20	15	15
20–25	45	45
26–30	25	25
Above 30	15	15
Total	**100**	**100**

Graph 2: Age of Respondent

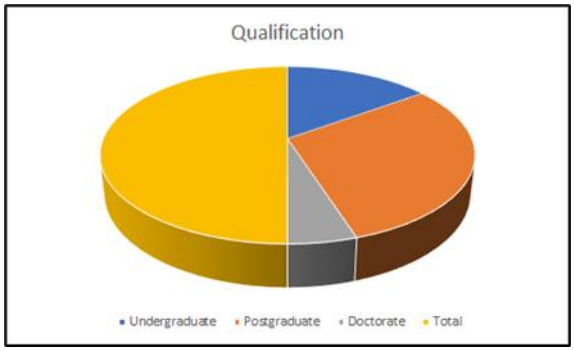


Qualification:

Table 3: Qualification of Respondent

Qualification	**Frequency**	**Percentage (%)**
Graduate	30	30.0
Postgraduate	60	60.0
Doctorate	10	10.0
Total	**100**	**100.0**

Graph 3: Qualification of Respondent

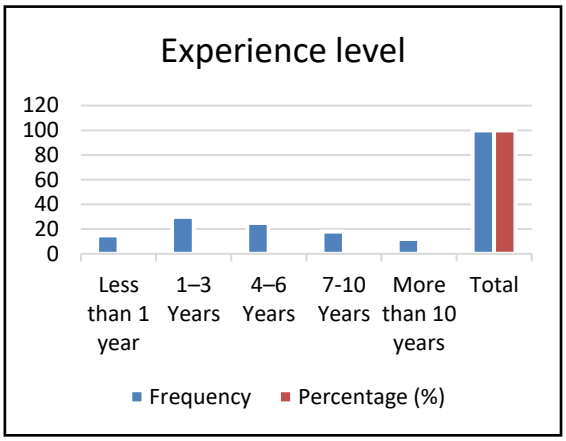


Experience Level:

Table 4: Experience of Respondent

Experience Level	Frequency	Percentage (%)
Less than 1 year	15	15%
1–3 Years	30	30%
4–6 Years	25	25%
7-10 Years	18	18%
More than 10 years	12	12%
Total	100	**100**

Graph 4: Experience of Respondent

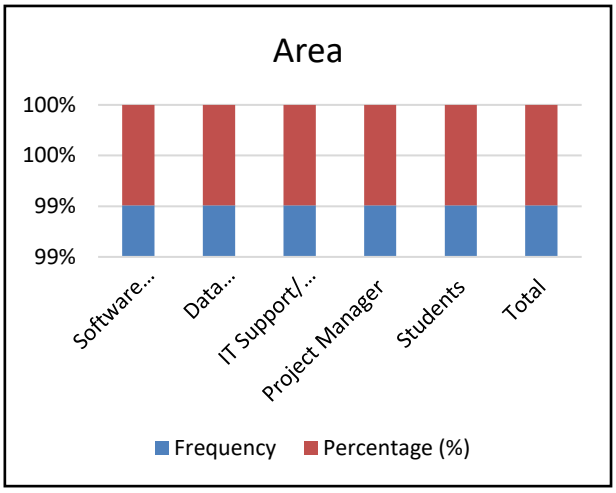


Job Role:

Table 5: Job Role of Respondent

Area	Frequency	Percentage (%)
Software Developer	28	28%
Data Scientist/AI Engineer	22	22%
IT Support/ System Amin	18	18%
Project Manager	12	12%
Students	20	20%
Total	100	100%

Graph 5: Job Role of Respondent



Data Analysis and Interpretation:

Awareness of AI:

The dependent variable awareness of AI has been explained by 4 items. Mean and standard deviation for each item has been listed in table 7.1. This table explains the response of sample respondents with respect to each item, which indicate the acceptance of awareness of AI.

Table 6: Descriptive statistics for variable awareness of AI

Items	N	Mean	Standard Deviation
I am aware of AI technologies used in the IT sector.	100	4.25	0.68
AI is widely adopted in my organization/field of study.	100	4.32	0.59
AI tools have become essential for IT-related tasks.	100	3.97	0.99
My organization/institution encourages the use of AI tools.	100	4.12	0.50
Overall		4.16	0.69

Interpretation:

Table 6 shows the descriptive statistics for the variable *Awareness of Artificial Intelligence (AI)* based on responses from **100 participants**. All items have mean values close to or above **4**, indicating a **high level of awareness and agreement** regarding AI usage in the IT sector.

The highest mean score (**Mean = 4.32, SD = 0.59**) is observed for the statement *"AI is widely adopted in my organization/field of study,"* suggesting that most respondents perceive AI as being commonly implemented. Similarly, respondents reported strong awareness of AI technologies used in the IT sector (**Mean = 4.25, SD = 0.68**).

The statement *"My organization/institution encourages the use of AI tools"* also shows a high mean (**Mean = 4.12, SD = 0.50**), reflecting institutional support for AI adoption. The item *"AI tools have become essential for IT-related tasks"* has a slightly lower mean (**Mean = 3.97**) with a higher standard deviation (**SD = 0.99**), indicating moderate agreement and varied opinions among respondents.

Employment Impact of AI:

The dependent variable Employment Impact of AI has been explained by 5 items. Mean and standard deviation for each item has been listed in table 7. This table explains the response of sample respondents with respect to each item, which indicate the Impact of AI on employment.

Table 7: Descriptive statistics for variable employment impact of AI

Items	N	Mean	Standard Deviation
AI has created new job roles in the IT sector.	100	4.10	0.82
AI has reduced the demand for certain traditional IT jobs.	100	3.80	0.90
AI increases productivity and efficiency in IT jobs.	100	4.25	0.75
AI leads to job displacement in the IT sector.	100	3.60	1.05
AI has increased the demand for highly skilled IT professionals.	100	4.30	0.70
Overall Mean		4.01	0.84

Interpretation:

The overall mean score of 4.01 indicates that respondents perceive AI as having a strong impact on employment opportunities in the IT sector.

Independent Samples t-Test

To test whether there is a significant difference between two groups, such as:

Students vs IT Professionals

Sample t-Test Result Table

Group	Mean	Std. Dev	t-value	p-value
Students	3.85	0.92		
IT Professionals	4.10	0.80	2.45	0.016

Decision Rule: If $p < 0.05$, reject H_0

Interpretation:

Since $p = 0.016 < 0.05$, there is a significant difference in perception of AI's impact on employment between students and IT professionals.

Conclusion:

The study reveals a high level of awareness and positive perception of Artificial Intelligence (AI) among the respondents. Descriptive analysis indicates that participants are well aware of AI technologies, recognize their widespread adoption in the IT sector, and acknowledge institutional encouragement for using AI tools. Although most respondents agree that AI tools are essential for IT-related tasks, some variation in opinions exists, suggesting differences in individual exposure and experience.

Further, the hypothesis testing results show a statistically significant difference in the perception of AI impact between students and IT professionals. IT professionals demonstrate a more positive perception compared to students, which may be attributed to their practical experience and direct involvement with AI technologies in real-world work environments.

Overall, the findings suggest that while awareness of AI is strong across groups, professional experience plays a crucial role in shaping perceptions of AI impact. This highlights the need for enhanced practical exposure, hands-on training, and industry-oriented learning for students to bridge the perception gap and better prepare them for AI-driven workplaces.

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Comparative Study on Student Engagement in Traditional Classrooms and Online Learning Environments

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Abstract:

The rapid adoption of digital technologies has transformed teaching–learning practices, making it essential to examine student engagement across different learning modes. This study presents a comparative analysis of student engagement in traditional classrooms and online learning environments. Data were collected from 100 students using a structured questionnaire measuring engagement dimensions such as participation, interaction, motivation, concentration, and flexibility. Descriptive statistics, including mean and standard deviation, along with inferential tools such as the independent samples t-test and one-way ANOVA, were used for analysis. The findings reveal that traditional classroom learning demonstrates significantly higher student engagement compared to online learning, particularly in terms of interaction, immediate feedback, and sustained attention. However, online learning is valued for its flexibility, self-paced learning, and effective use of technology-enhanced tools. The study highlights the strengths and limitations of both learning modes and suggests that a blended learning approach may provide an optimal solution for enhancing student engagement. The results offer valuable insights for educators, institutions, and policymakers in designing effective and learner-cantered instructional strategies.

Introduction:

Student engagement is a critical factor in determining the effectiveness of any learning environment. It reflects the level of interest, motivation, and active participation students demonstrate during the learning process. As education continues to evolve with the integration of technology, there is growing interest in understanding how student engagement differs between **traditional classrooms** and **online learning environments**.

Traditional classrooms have long been the foundation of formal education. They provide a structured, face-to-face setting where students and teachers interact directly. This environment encourages immediate feedback, peer collaboration, and a sense of community, which are often associated with higher levels of engagement. Teachers can observe body language, adjust their teaching in real time, and maintain classroom discipline, all of which contribute to keeping students involved.

In contrast, online learning environments offer flexibility, convenience, and access to a wider range of resources. These platforms are especially valuable in reaching students who cannot attend in-person classes due to distance, health, or scheduling issues. However, online learning also presents challenges to engagement, such as limited social interaction, distractions at

home, and a greater reliance on student self-discipline and motivation.

The rapid shift to online learning during the COVID-19 pandemic has made it more important than ever to examine how engagement differs across these two settings. While some students thrive in online environments, others struggle to stay focused and motivated without the physical presence of a teacher or peers.

This study aims to compare student engagement in traditional and online learning environments, exploring how various factors—such as communication, learning activities, teacher presence, and technological tools—affect students' ability and willingness to participate actively in their education. Understanding these differences is essential for educators and institutions striving to create effective, inclusive, and engaging learning experiences in any format.

Literature Review:

Singh and Phoolka in their paper titled "Hybrid education in the age of Education 5.0: A study of engagement and innovations in the Indian education system amidst covid-19." (2025) published a groundbreaking study in the Indian Journal of Educational Technology. This research examined student engagement across traditional, online, and hybrid modalities in Indian higher education institutions, providing empirical evidence on the effectiveness of blended approaches in the post-pandemic era. The study emphasized the integration of AI, multimedia, and adaptive learning technologies in enhancing student participation and learning outcomes.

A significant study published in the International Journal of Research and Development (October 2025) by researchers from Tamil Nadu examined **"Enhancing student engagement through adaptive learning"** in engineering and management colleges. The study surveyed 100 undergraduate students and found that AI-based adaptive learning tools demonstrated significant positive impacts on student engagement, with 36% of students reporting high engagement levels and 48% moderate engagement. A Pearson correlation test revealed a strong positive correlation ($r = 0.72$) between frequency of AI tool usage and student engagement, indicating that students who use adaptive learning tools more frequently are generally more engaged and motivated

Literature generally presents a complex and somewhat divided view on comparing student engagement in traditional classrooms and online learning environments. A major finding across several studies suggests that face-to-face instruction often fosters higher levels of behavioural and emotional engagement, largely due to the immediate, non-verbal social interaction with instructors and peers, which contributes to a stronger sense of community and reduces feelings of isolation. This personal connection is often cited as a reason students prefer in-person classes, valuing the real-time discussions and immediate feedback, though one study did find a significant difference in skill engagement favouring traditional methods over online. Conversely, online learning, particularly asynchronous formats, offers advantages in flexibility, self-paced learning, and accessibility, which can enhance the intrinsic motivation of certain students, such as non-traditional learners. Furthermore, some research suggests online environments can sometimes encourage deeper, more reflective cognitive engagement by allowing students time to formulate thoughtful responses before contributing, leading to higher-level learning like critical and creative thinking. However, online engagement is often challenged by the need for strong self-discipline, potential technical barriers, the struggle to maintain focus amidst home distractions, and a documented

decrease in emotional engagement often tied to the perceived lack of rich human interaction. Overall, while traditional settings often excel in fostering social and emotional presence, the effectiveness of engagement in both modalities is heavily influenced by the instructional design and the student's own attitude, self-regulation skills, and access to technology.

Objectives:

1. To study the level of student engagement in traditional learning environments.
2. To analyse student engagement in online learning environments.
3. To compare student engagement between traditional and online learning modes.
4. To identify challenges affecting student engagement in both learning environments.
5. To understand students' preferred mode of learning for better engagement.

Research Methodology:

1. Research Design: This study adopts a **comparative, mixed-methods research design** to examine the differences in student engagement between traditional (face-to-face) classrooms and online learning environments. The use of both quantitative and qualitative methods enables a more comprehensive understanding of engagement patterns, drawing on statistical trends as well as individual experiences.

2. Sample Size: Participants will include **students from colleges and universities** (aged 15–25) enrolled in both traditional and online courses. A purposive sampling method will be used to select the sample. The sample size for the research is 100.

The selection will ensure a balance in terms of gender, academic performance, and subject area.

3. Data Collection Methods: To gather relevant data, the study will employ the following methods:

- **Surveys**: A structured questionnaire will be distributed to all participants to measure various dimensions of engagement, such as behavioural, emotional, and cognitive engagement.

4. Limitations:

- The study may be limited by self-reporting bias in survey and interview responses.
- Differences in course design and instructor style could affect engagement, potentially confounding the comparison.

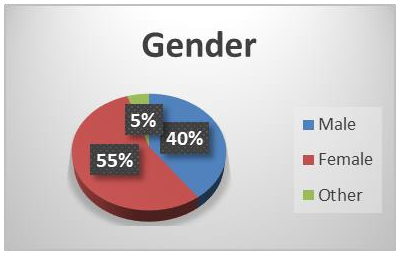
5. Significance of the Study:

- Provides insights into differences in student engagement between traditional classrooms and online learning environments.
- Helps educators and administrators develop tailored teaching strategies for each learning mode.
- Identifies strengths and weaknesses in student motivation, participation, and academic performance across environments.
- Supports improvement of educational technologies and online learning platforms to enhance engagement.
- Assists policymakers in making informed decisions about resource allocation and educational planning.
- Contributes to creating inclusive, effective, and engaging learning experiences for diverse student populations.
- Addresses the growing importance of online learning in modern education, especially post-pandemic.

Demographic Profile:

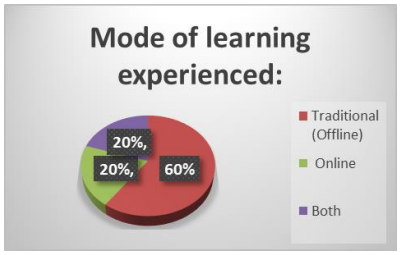
1. Gender:

Gender	Frequency	Percentage (%)
Male	40	40%
Female	55	55%
Other	5	5%
Total	100	100%



2. Mode of learning Experienced:

Traditional (Offline)	60%
Online	20%
Both	20%

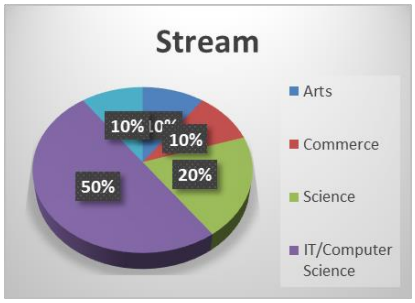


3. Course Level:

Course Level	
Undergraduate	30%
Post-graduate	70%

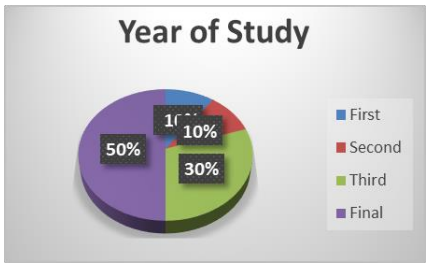
4. Stream:

Stream	
Arts	10%
Commerce	10%
Science	20%
IT/Computer Science	50%
Other	10%



5.Year of Study:

Year of Study:	
First	10%
Second	10%
Third	30%
Master	50%



Data Analysis and Data Interpretation:

1.Traditional Engagement:

The dependent variable Traditional Engagement has been explained by 8 items. Mean and standard deviation for each item has been listed in table 1.1,

Table 1.1: Descriptive statistics for variable Traditional Engagement.

Items	N	Mean	Standard Deviation
Actively participate in classroom discussions during traditional classes.	100	4.10	0.82
Feel motivated to attend regular face-to-face lectures.	100	4.25	0.75
Interaction with teachers is effective in traditional classrooms.	100	4.00	0.90
Group activities and peer interaction enhance my learning in offline classes.	100	4.30	0.70
Easily concentrate during face-to-face lectures.	100	3.95	0.88
Immediate feedback from teachers improves my engagement.	100	4.35	0.65
Traditional learning helps me stay disciplined and focused.	100	4.20	0.78
Feel comfortable asking questions in offline classes.	100	4.15	0.80
Overall Mean		4.16	0.79

Table 1.1 shows a **high level of student engagement** in traditional learning environments, with an overall mean score of **4.16 (SD = 0.79)**. High mean values across all items indicate strong participation, effective teacher–student interaction, and improved concentration in face-to-face classes. Immediate feedback and peer interaction emerged as key factors enhancing engagement. Overall, the results confirm that traditional classrooms provide a structured and interactive environment that supports active student engagement.

2.Online Learning Engagement:

The dependent variable Online Learning Engagement has been explained by 8 items. Mean and standard deviation for each item has been listed in table 1.2

Table 1.2: Descriptive statistics for variable Online Learning Engagement.

Items	N	Mean	Standard Deviation
Actively participate in online classes.	100	3.60	0.95
Online learning platforms keep me engaged throughout the session.	100	3.55	0.98
Interaction with teachers is effective in online classes.	100	3.50	1.00
Actively engage in online discussions and chat forums.	100	3.40	1.05
Online learning allows me to learn at my own pace.	100	4.10	0.85
Concentrate well during online lectures.	100	3.45	1.10
Technology tools (videos, quizzes, polls) increase my engagement.	100	3.90	0.90
Online learning provides flexibility that enhances my motivation.	100	3.85	0.88
Overall Mean		3.67	0.96

The results indicate a **moderate level of online learning engagement** with an overall mean score of **3.67 (SD = 0.96)**. Flexibility and self-paced learning emerged as key strengths, with the highest agreement for learning at one's own pace and the use of technology tools to

enhance engagement. However, lower mean scores for interaction, concentration, and participation in discussions highlight challenges in sustaining active engagement in online learning environments. Overall, while online learning offers flexibility, improvements are needed to enhance interaction and learner involvement.

3. Comparative Engagement:

An independent samples t-test was conducted to compare engagement levels between t-Test Results

Table 1.3: Descriptive statistics for Comparative Engagement

Mode of Learning	Mean	Std. Dev.	t-value	p-value
Traditional	4.16	0.79	3.45	0.001
Online	3.67	0.96		

Interpretation:

Since **p = 0.001 < 0.05**, the null hypothesis is rejected. There is a **significant difference** between traditional and online learning engagement, with **traditional learning showing higher engagement**.

Conclusion:

The study concludes that traditional learning environments exhibit higher student engagement compared to online learning. While online learning offers flexibility and self-paced opportunities, limitations related to interaction and concentration reduce overall engagement. The findings highlight the importance of blended learning approaches that integrate the strengths of both modes to enhance student engagement and learning outcomes.

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A Study on Impact of Short Format Content on Consumer Buying Behaviour of Personal Care Products with Special Reference to Instagram Reels & Youtube Shorts

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Abstract:
The continuous growth in digitization especially social media has totally change the way that consumers purchase their products. The way that consumers discover products, evaluate it and purchase it has undergone a lot of changes. The paper is specifically focusing on the impact on short content platforms which are Instagram and Youtube Shorts. This platform plays an important role in shaping brand awareness, product perception and purchase intention. This paper follows a mixed-method approach wherein the primary data is collected through a structured questionnaire and secondary data would include data collected through the previously carried out research work, articles, blogs, books, etc.

Keywords: Instagram, Youtube Shorts, Consumer Buying Behaviour.

Introduction:

Background of the Study:

The digital revolution has significantly transformed marketing communication, with social media platforms becoming dominant channels for brand–consumer interaction. Among recent developments, **short format video content** such as Instagram Reels and YouTube Shorts has emerged as a powerful tool for influencing consumer attitudes and purchase decisions. These bite-sized, visually rich videos combine entertainment, information, and social proof, making them highly effective in capturing attention in a cluttered digital environment.

The personal care industry, which includes skincare, haircare, grooming, and cosmetic products, relies heavily on visual demonstration and peer influence. Consumers increasingly depend on influencer recommendations, product reviews, and tutorial videos before making purchase decisions. The rise of short format content has further intensified this behaviour, enabling rapid dissemination of product information and shaping perceptions within seconds. This study focuses on understanding how such content impacts consumer buying behaviour, particularly in relation to Instagram Reels and YouTube Shorts.

Statement of the Problem:

Despite the widespread adoption of short format video platforms, there is limited empirical evidence on **how exactly short format content influences consumer buying behaviour in the personal care segment**. Many brands invest heavily in influencer marketing and short video campaigns without fully understanding which factors—such as trust, content type, or influencer credibility—most strongly drive purchase decisions. Therefore, there is a need to examine the relationship between short format content and consumer behaviour using primary data.

Research Questions:

1. Does short format content influence consumer awareness and interest in personal care products?
2. To what extent do Instagram Reels and YouTube Shorts affect purchase decisions?
3. How do factors such as influencer trust, product reviews, and visual appeal impact buying behaviour?
4. Is there a significant relationship between engagement with short videos and likelihood of purchase?

Objectives of the Research Study:

1. To analyse consumer awareness of short format content.
2. To identify the platforms most commonly used for consuming short format content.
3. To investigate the impact of short format content on consumer buying intention.
4. To assess the engagement levels of short format content featuring personal care products.
5. To explore factors impacting the consumer decision making for personal care products.

Significance of the Research Study:

The significance of the present study lies in its attempt to understand the growing influence of short format content on consumer buying behaviour, particularly in the context of personal care products. With the rapid rise of platforms such as Instagram Reels and YouTube Shorts, consumers are increasingly exposed to brief, engaging, and visually appealing content, which has the potential to shape their perceptions and purchase decisions. This study provides valuable insights into how platform choice and frequency of exposure affect purchase intention and actual buying behaviour. The findings are significant for marketers, brand managers, and advertisers as they highlight the effectiveness of short format content as a promotional tool. The study also contributes to academic literature by linking short format content consumption with social influence and consumer behaviour theories. Furthermore, it offers practical guidance for businesses to design effective digital marketing strategies and helps future researchers understand emerging trends in social media marketing.

Review of Literature:

Short format content refers to videos typically ranging from 15 to 60 seconds, designed for rapid consumption and high engagement. Platforms such as TikTok, Instagram Reels, and YouTube Shorts have popularised this format. According to **Kaye, Chen, and Zeng (2021)**, short videos enhance user engagement due to their entertainment value, ease of access, and algorithm-driven personalization. Short videos are particularly effective in product demonstrations, tutorials, and reviews, making them highly suitable for the personal care industry where visual evidence plays a crucial role.

Social media significantly affects consumer decision-making by shaping attitudes, perceptions, and trust. **Godey et al. (2016)** found that social media marketing activities positively influence brand equity and purchase intention. Consumers rely on peer reviews, influencer endorsements, and user-generated content before making purchasing decisions.

Hajli (2014) highlights that social commerce environments increase trust and reduce perceived risk, leading to higher purchase intention. In the context of personal care products, visual proof and testimonials strongly influence credibility.

Khan & Asim (2025) investigated the impact of social media influencers on consumer purchase intentions using Source Credibility Theory. Their findings show that influencers with higher credibility (trustworthiness, expertise,

attractiveness) significantly enhance consumer trust and purchase intention compared to less credible influencers. This underscores how influencer characteristics shape consumer behaviour through perceived authenticity.

The Persuasive Power of Influencers (Liu & Zheng, 2024) examined how social media influencers influence perceived brand credibility and purchase intention. Their results indicate that authenticity and content informativeness positively influence parasocial relationships, which in turn increase purchase intention, supporting the persuasive role of influencers in digital marketing.

Impact of YouTube Influencers on Purchase Decisions (Sankar & Shree, 2024) reveals that YouTube influencers significantly affect consumer perceptions and buying intentions, emphasizing transparency and authenticity as critical factors for effective influencer marketing.

Credibility, Parasocial Relationships, and Purchase Intention (ESJ, 2025) shows that parasocial relationships (PSRs) between consumers and influencers enhance consumer purchase intentions, especially for low-involvement products where emotional bonds drive decision-making more than rational evaluation.

Bhukya & Paul (2023) provide a **systematic review of social influence research in consumer behaviour**, highlighting normative, informational, and assimilative influence as key mechanisms that shape consumer decisions and purchase patterns. Such social influence frameworks are foundational to understanding why consumers respond to social media content in predictable ways.

Parasocial Relations & Influencer Impact (Feng et al., 2022) explores how parasocial interactions with influencers affect attitudes and behaviours. The study shows that stronger parasocial bonds increase persuasion effectiveness and purchase intention, aligning with Social Influence Theory's emphasis on interpersonal influence mechanisms.

Asanprakit & Limna (2023) examined social influence on consumers' intentions to use social commerce. They found social norms, social identity, and social comparison significantly affect consumer decisions, highlighting the role of social influence beyond individual attitudes and into shared social environments relevant to online buying.

Role of Social Influence and Online Shopping (Diva-Portal, 2025) integrated social influence with behavioural models, showing how social media exposure, peer pressure, and Fear of Missing Out (FOMO) influence purchase intention in online shopping contexts. These insights reinforce social influence as a key antecedent of consumer intention

Short Video Content & Purchase Intention (Nature Scientific Reports, 2025) examined how short video content characteristics (usefulness, ease of use, entertainment) influence consumer trust and purchase intention. Their structural model shows that content attributes significantly affect trust, which in turn drives purchase behaviour, highlighting trust's mediating role in short format video effectiveness.

The Impact of Short-Form Video Marketing on Gen Z (Kwik et al., 2024) studied how short-form video marketing, influencer relatability, and trust signals influence Generation Z's purchase intention. Their regression results indicate all three variables positively influence purchase intention, with relatability being the strongest predictor — crucial for markets dominated by young consumers.

Andari & Simbolon (2025) investigated short video marketing's effect on purchase intention, noting that content features like

creativity and engagement through short-form videos on TikTok (and similar platforms) play a significant role in motivating consumers toward purchases.

Social Proof and Consumer Impulse Buying (Journal of Retailing and Consumer Services, 2025) demonstrated that social proof — a product of engagement metrics like likes and comments on short-form videos — influences consumer impulse buying. This study adds to understanding how short-format content affects not just intention but impulsive behaviour underlying purchase decisions.

Research Gap:

Although existing literature extensively examines the role of social media influencers, social influence theory, and purchase intention in digital marketing contexts, most studies focus on traditional platforms such as Instagram posts, YouTube long-form videos, or general social media advertising. Limited empirical research specifically investigates the **impact of short format content on specific platforms on consumer buying behaviour in the personal care segment**. Moreover, prior studies often analyse influencer credibility, trust, or social influence in isolation, without integrating these constructs into a single framework that explains how short-form video content, influencer characteristics, and social influence mechanisms jointly affect purchase intention. There is also a lack of region-specific and primary data-driven studies, particularly in emerging markets like India, where short video consumption is rapidly increasing. Therefore, this study seeks to bridge this gap by empirically examining the combined influence of short format content, influencer credibility, trust, and social influence processes on consumer purchase behaviour of personal care products.

Research Methodology:

1. Research Design:

The study adopts a descriptive and analytical research design to understand patterns, relationships, and influences between short format content and consumer buying behaviour.

2. Sampling Technique:

A **convenience sampling method** was used. The sample consists of **100 respondents** from different age groups and educational backgrounds who actively use Instagram Reels and YouTube Shorts.

3. Data Collection Methods:

Primary Data: Collected through a structured questionnaire (Google Form). The questionnaire included questions on Awareness of short content format, Platform usage, Purchase behaviour, Influencing factors (price, reviews, influencer credibility, discounts), Trust in influencer content.

Secondary Data: Journals, research articles, websites, and reports.

4. Hypotheses of the Study:

Hypothesis 1:

H_{01}: There is a significant relationship between exposure to short format content on Instagram Reels and YouTube Shorts and the purchase of personal care products.

$H_{00:}$: There is no significant relationship between exposure to short format content and the purchase of personal care products.

Hypothesis 2:

$H_{12:}$: There is a significant positive relationship between trust in influencers and consumer purchase intention of personal care products.

$H_{02:}$: There is no significant relationship between trust in influencers and consumer purchase intention.

5. Limitations of the Study:

- The study is limited to the respondents of Psanvel region and cannot accurately represent the entire population.

- Th study is limited to a sample size of 100 respondents only.
- The study is conducted in a limited time frame.

Findings:

- Most respondents are aware of and are actively consuming short format content.
- Instagram Reels is the most dominant platform for short format content especially in relation to personal care products especially when it comes to short format, Instagram takes the led followed by Youtube shorts.
- Short format videos significantly influence purchase decisions. Majority of the respondents stated that they were positively influenced to buy products.
- There is a strong association between the platform used and the intention to buy.
- The frequency of exposure of the short content format platforms has impacted the decision making of the consumers.
- Influencer credibility and product reviews are the strongest influencing factors.
- Consumers show a positive level of trust towards recommendations in short videos.
- Engagement (likes, shares, comments) is linked with higher purchase intention.

Testing of Hypothesis:

Hypothesis 1:

H_{01}: There is no significant relationship between platform used for short format content and purchase of personal care products.

H_{11}: There is a significant relationship between platform used for short format content and purchase of personal care products.

To test Hypothesis 1, a Chi-square test of association was conducted between the platform used for short format content and the purchase of personal care products. The test was carried out at a 5% level of significance. The calculated Chi-square value ($\chi 2$) was 5.737 with 3 degrees of freedom(df). The analysis shows that a higher number of respondents who regularly use Instagram Reels and YouTube Shorts have purchased personal care products after watching short videos. Based on the results, the null hypothesis is rejected and the alternate hypothesis is accepted. This indicates that there is a significant relationship between the platform used for short format content and consumer buying behaviour towards personal care products.

Hypothesis 2:

H_{02}: There is no significant relationship between frequency of watching short format content and purchase intention of personal care products.

H_{12}: There is a significant relationship between frequency of watching short format content and purchase intention of personal care products.

To test Hypothesis 2, a Chi-square test was applied to examine the relationship between the frequency of watching short format content and purchase intention of personal care products. The test was conducted at a 5% level of significance. The calculated Chi-square value ($\chi 2$) was 3.848 with 3 degrees of freedom (df). The results show that respondents who watch short videos daily and several times a week have higher purchase intention compared to those who watch occasionally or rarely. Therefore, the null hypothesis is rejected and the alternate hypothesis is accepted. This confirms that frequency of exposure to short format content has a significant influence on consumer purchase intention towards personal care products.

Conclusion:

The present study was undertaken to examine the **impact of short format content on consumer buying behaviour of personal care**

products, with special reference to **Instagram Reels and YouTube Shorts**. Based on the analysis of data collected from **100 respondents**, the study confirms that short format content plays a significant role in shaping consumer attitudes, purchase intention, and actual buying behaviour.

The findings reveal that a majority of respondents regularly consume short format videos and that **Instagram Reels is the most preferred platform**, followed by YouTube Shorts. The study further establishes that consumers exposed to short videos are highly influenced in their purchase decisions, as a large proportion of respondents reported purchasing personal care products after watching such content.

Overall, the study concludes that **short format content is an effective promotional tool for personal care brands**. It not only creates awareness but also influences consumer perceptions and drives purchasing decisions. Therefore, brands and marketers can leverage short videos as a strategic communication medium to connect with consumers and enhance market performance.

Recommendations:

Based on the findings of the study, it is recommended that personal care brands place greater emphasis on short format content marketing through platforms such as Instagram Reels and YouTube Shorts, as these platforms have shown strong influence on consumer buying behaviour. Companies should collaborate more actively with social media influencers to enhance credibility and reach among target audiences. It is also advisable for brands to create engaging, informative, and visually appealing short videos that clearly highlight product benefits and usage. Maintaining consistency in posting short videos is important, as frequent exposure has been found to increase purchase intention. Additionally, brands should design platform-specific content strategies to suit the viewing behaviour of users on different platforms. Finally, encouraging user-generated content and reviews through short videos can further strengthen trust and positively impact consumer purchase decisions.

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Improving Interpersonal Skills Through Artificial Intelligence

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Abstract:

Interpersonal skills such as effective communication, empathy, cooperation, and emotional awareness are essential for success in academic, professional, and social environments. However, many learners find it challenging to develop these skills through traditional instructional methods alone. With recent advancements in Artificial Intelligence (AI), innovative tools have emerged that offer personalized, interactive, and adaptive learning experiences. With rapid technological advancement, Artificial Intelligence (AI) has emerged as a transformative tool in education, offering personalized and interactive learning environments. This paper explores the potential role of AI-based interventions—such as chatbots, role-play simulations, feedback systems, and emotion analysis tools—in enhancing interpersonal skills among learners. The study highlights how AI can support communication practice, emotional intelligence, and reflective learning. It aims to provide theoretical insights into the integration of AI for interpersonal skill development and to guide future empirical research in this emerging area.

Keywords: Artificial Intelligence, Interpersonal Skills, Communication, Empathy, Soft Skills

Introduction:

"Our intelligence is what makes us human, and AI is an extension of that quality."

–Yann LeCun (Chief AI Scientist)

Interpersonal skills are fundamental human abilities that enable individuals to interact effectively with others in personal, academic, and professional contexts. Skills such as active listening, clear communication, empathy, teamwork, and conflict resolution are increasingly valued in modern society. Despite their importance, many learners struggle to develop these skills due to limited opportunities for practice and feedback. Artificial Intelligence (AI) has gained prominence in education for its ability to provide personalized, interactive, and learner-centered experiences. This study examines how AI can be used to support and enhance interpersonal skills development.

Need for the Study:

The growing reliance on digital communication has reduced face-to-face interactions, impacting the development of interpersonal skills. AI-based learning tools offer adaptive feedback and simulated interactions, making them a promising approach for interpersonal skills training. AI enables learner-centric approaches by analyzing behavioural patterns and tailoring activities to individual needs. Research is required to validate the effectiveness of such personalization in enhancing interpersonal competencies. Interpersonal skills are closely linked with SEL(Social Emotional Learning). Investigating AI-supported SEL frameworks can help establish structured models for integrating emotional awareness and empathy into mainstream education. Therefore, exploring the potential of AI in this area is both timely and necessary.

Statement of the Problem:

Although Artificial Intelligence is widely used in education and training, its role in developing interpersonal skills has not been sufficiently explored. There is a need to understand how AI-based interventions can contribute to improving communication, empathy, and social awareness among learners.

Objectives of the Study:

The objectives of this study are:

1. To explore the role of Artificial Intelligence in interpersonal skills development.
2. To identify AI-based tools suitable for enhancing communication and empathy.
3. To propose a conceptual framework for AI-supported interpersonal skills training.
4. To highlight the educational implications of AI-assisted interpersonal learning.

AI-Based Interventions for Interpersonal Skills:

AI-based interventions provide learners with opportunities to practice interpersonal skills in a safe and non-judgmental environment. Chatbots enable conversational practice, role-play simulations recreate real-life social scenarios, and feedback systems analyze language use and emotional tone. Emotion recognition tools further support emotional awareness and empathy. Soft skills can be taught very well to students through artificial intelligence. AI provides instant, individualized feedback that supports ongoing skill development. For instance, in a negotiation simulation, the system can evaluate learners' responses in real time and offer targeted suggestions to enhance their communication and persuasive abilities. One of the major innovations brought about by AI is virtual mentoring. AI acts as a mentor, interacting with learners to guide them, answer their questions and provide them with personalized advice throughout their interactions., Artificial Intelligence can improve students' interpersonal skills by providing personalized, interactive, and continuous learning experiences. Through AI-powered chatbots and virtual assistants, students can practice conversations, express ideas, and respond to different social situations in a safe and non-judgmental environment. AI-driven role-play and simulations expose learners to real-life scenarios such as group discussions, interviews, teamwork, and conflict resolution, helping them develop confidence and social adaptability. By offering real-time feedback on tone, clarity, word choice, and emotional appropriateness, AI enables students to reflect on and refine their communication skills immediately. In addition, emotion and sentiment analysis help learners build empathy and emotional intelligence by understanding others' feelings and responding appropriately. AI also supports collaborative learning by monitoring participation and encouraging balanced interaction among peers. Continuous progress tracking ensures sustained improvement, making AI an effective tool for enhancing students' interpersonal skills and preparing them for academic success and future professional environments.

Interpersonal skills in students can be effectively enhanced through the strategic use of Artificial Intelligence in the following ways:

- **Practice with AI Chatbots and Virtual Assistants:** Students can engage in simulated conversations(like ChatGPT) to improve clarity, politeness, and confidence.
- **Personalized Skill Development:** AI analyzes individual patterns and provides tailored exercises targeting specific skills like empathy, teamwork, or assertiveness.
- **Role-Play and Simulation Activities:** AI creates real-life scenarios such as group discussions, interviews, or conflict resolution for practical learning.

- **Instant Feedback:** AI gives immediate suggestions on tone, word choice, and emotional expression to help students improve communication.
- **Emotional Intelligence Support:** AI tools can detect emotions in responses and guide learners to respond empathetically.
- **Continuous Progress Tracking:** AI monitors students' development over time, ensuring steady and measurable improvement in interpersonal skills.
- **Safe Learning Environment:** Students can practice interactions without fear of judgment, boosting confidence, especially for shy or hesitant learners.
- AI-supported collaborative platforms facilitate group discussions, peer assessments, and teamwork activities. By guiding interactions, balancing participation, and resolving conflicts, AI helps learners develop cooperation, leadership, and respect for diverse perspectives.
- Virtual reality (VR) and AI-driven simulations expose learners to realistic social situations such as interviews, group discussions, or problem-solving tasks. These immersive experiences help learners practice interpersonal behaviors in controlled yet authentic contexts.
- For shy learners or those with communication barriers, AI provides a low-pressure environment to practice interpersonal interactions. This inclusivity promotes equal participation and gradual confidence building.
- **Human-AI Interaction Design** focuses on creating interfaces and interactions that facilitate effective communication between humans and AI. Real world scenarios can be created through AI to enable the learners to face different situations and interact.
- It can also provide counselling sessions, guidance and support to the learners and help them to solve many of their social interaction doubts and problems.

Interacting with others require good communication skills. AI can help to polish the communication skills of the learners. Some examples of how AI-powered tools improve learners' **speaking and pronunciation skills**:

I. Speech Recognition–Based Language Learning Apps:

Example: *ELSA Speak, Duolingo, Google Speech-to-Text*

These tools analyze learners' speech and compare it with native-speaker models. They provide instant feedback on:

- Pronunciation of individual sounds
- Stress, intonation, and rhythm
- Accuracy of spoken responses

Learners can identify specific pronunciation errors and practice repeatedly, leading to improved clarity and confidence in speaking.

II. AI Virtual Tutors and Chatbots:

Example: *AI chatbots, ChatGPT-based speaking tutors*

Virtual tutors engage learners in simulated conversations on every day or academic topics. They:

- Encourage spontaneous speaking practice
- Correct pronunciation and grammar in real time
- Adapt difficulty levels based on learner performance

Learners develop fluency and conversational competence in a supportive, non-judgmental environment.

III. Accent and Pronunciation Training Systems:

Example: *Speech ace, Rosetta Stone TruAccent*

These AI systems use phonetic analysis to detect subtle pronunciation deviations. They provide:

- Visual representations of sound production
- Targeted drills for problematic phonemes
- Progress tracking over time

Learners achieve more native-like pronunciation through focused, personalized practice.

IV. AI-Assisted Classroom Tools:

Example: *Microsoft Immersive Reader, AI language labs*

Teachers use AI tools to:

- Monitor students' speaking performance
- Provide individualized feedback at scale
- Support inclusive learning for diverse proficiency levels

Improved speaking outcomes and greater learner engagement in classroom settings.

V. Automated Speaking Assessment Systems

Example: *IELTS AI practice platforms, TOEFL speaking simulators*

These systems evaluate speech based on fluency, coherence, pronunciation, and vocabulary. Learners gain speaking practice with objective and consistent feedback.

Conceptual Framework:

AI-based interventions facilitate interactive practice, which leads to feedback and reflection. This continuous cycle contributes to the enhancement of interpersonal skills such as communication, empathy, and emotional intelligence.

AI-based Interpersonal skills Cycle

Significance of the Study:

This study contributes to the theoretical understanding of AI-supported interpersonal skills development. It offers insights for educators, curriculum designers, and researchers interested in integrating AI tools into soft skills training programs. While AI is rapidly transforming education, its potential role in developing interpersonal skills remains underexplored. This study aims to conceptually address that gap.

Limitations of the Study:

The effectiveness of AI-based interventions depends on the quality, accessibility, and ethical use of AI tools. Future

studies are required to empirically validate the proposed framework.

Conclusion:

Artificial Intelligence has significant potential to enhance interpersonal skills by providing personalized, interactive, and reflective learning experiences. When integrated thoughtfully, AI can complement traditional teaching methods and support holistic learner development. This paper lays a conceptual foundation for future research on AI-driven interpersonal skills training. Artificial Intelligence provides novel, learner-focused methods for strengthening interpersonal skills. Using AI-driven conversational tools, emotion-sensing technologies, collaborative learning systems, and immersive simulations, educators can effectively support the development of communication abilities, empathy, and social awareness among learners. When applied responsibly and with ethical consideration, AI serves as a valuable support to human teaching, significantly enriching the cultivation of interpersonal skills in educational environments. So, efforts should be made for t*he development of AI systems that prioritize emotional intelligence, foster authentic interactions, and adhere to ethical design principles.*

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The Role of Human Oversight in AI-Driven Educational Interventions: Opportunities, Challenges, and Future Insights

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Abstract:

Artificial Intelligence (AI) has emerged as a transformative force in education, enabling personalized learning, automated assessment, and predictive analytics. However, the growing reliance on AI-driven educational interventions raises concerns regarding ethical accountability, bias, transparency, and pedagogical effectiveness. Human oversight plays a critical role in ensuring that AI systems support equitable and meaningful learning outcomes. This study examines the perceptions of students regarding AI-driven educational tools and the necessity of human oversight through a quantitative survey of 150 students from the Thane district of Maharashtra, India. Using descriptive and inferential analysis, the findings reveal strong student support for AI-assisted learning, accompanied by a clear preference for teacher supervision and ethical governance. The study highlights opportunities, challenges, and future directions for integrating human judgment with AI systems in education.

Introduction:

AI is really changing everything, in education and everywhere else. It brings a lot of chances for good stuff, but also some big problems we'll need to figure out. Things are changing fast, and AI in education could really shake things up. We're talking about personalized learning and even automatic grading, which is pretty cool. But let's be real, it also brings up some tricky ethical questions and practical issues that definitely need people to step in and sort out. This paper looks at why it's so important for people to be involved when we create, use, and check AI in schools. We need a good approach that helps us get the most out of AI's good points, but also deal with what could go wrong. This all ties into promoting a human-focused way to use AI in education. We want to make sure that the basic principles of teaching are clearer than ever, not messed up by AI doing everything automatically. We need a careful approach when developing AI, one that remembers who the stakeholders are. This means bringing in people like students, who are the actual end-users, right from the start. The whole idea is to figure out just how much human control we need over AI as it automates things, meanwhile, considering multiple aspects that are involved.

Literature Review:

The fast spread of AI in education has drawn research attention, especially on how to balance automated tools with human oversight.AI-based tools like adaptive platforms, tutoring systems, and learning analytics can tailor instruction, improve learning outcomes, and streamline administration (Lucken et al.).2016; Holmes et al.(2019).Past research argues these benefits depend on strong human supervision and are not automatic. Many studies stress that human oversight is needed to keep teaching goals aligned and to guide ethical governance Selwyn

(2019) says AI runs on data but cannot judge context or ethics, so teachers need to interpret its results and guide teaching decisions. O'Neil (2016) cautions that bias in AI algorithms can worsen educational inequality if not addressed. Human oversight reduces these risks by reviewing decisions and correcting errors. Research also looks at how hard it is to keep human oversight meaningful. Zawacki-Richter et al. A 2019 study reports that many teachers do not have enough AI literacy, which limits their ability to oversee complex systems well. Relying too much on automated decisions can limit professional autonomy and reduce teacher-student interaction. Limited resources and scaling problems make oversight harder in large educational institutions. Recent studies point to future work focused on people and AI working together. Holmes et al.(2022) argue for human-centered AI that is transparent, easy to explain, and supports shared decisions. These approaches treat AI as support for educators, not a substitute. The literature shows that human oversight is essential for ethical and fair AI use in education, and it helps these interventions work well. Students and researchers who want stronger literature reviews can rely on professional academic support for expert input and careful synthesis from PaperWriter.paperwriter.com URL fragment Human editors can improve AI drafts by adding deeper analysis and making the writing ready for publication.

Research Objective:

The following are the objectives which studies & aims to:

1. Examine student awareness of AI-driven educational interventions.
2. Analyze student perceptions regarding the effectiveness of AI in learning.
3. Assess attitudes toward the necessity of human oversight in AI-based education.
4. Identify perceived challenges and ethical concerns related to AI use.

Research Methodology:

After considering the research problem and determining specific information required to solve the problem the researcher will look for the type and sources of data which may yield the desired results, while deciding about the method of data collection to be used for the study, there are two types of data:

Primary Data:

Primary data are those, which are collected for the first time, taking a sample, representing a population. It is not a published data, it is problem specific data collected by researcher. A well-structured questionnaire is administered to the target respondents to collect primary data (Copy of questionnaire is attached in the appendix)

For this project I have partly used primary data. I adopted the google forms method to collect the primary data. I took help of a structured questionnaire, arranged meeting with young entrepreneurs and conducted form survey.

Secondary Data:

Secondary data means data that are already collected by someone, it can save time and money of the researcher. The secondary data pertaining to study has been collected from the books, web portals, reports, journals, etc.

Secondary data found in the form of company records, trade publications, libraries, etc. Secondary data sources are as follows:

- Daily Newspaper.
- Various Websites.

A lot of data for the research is secondary and has been taken from the various online platforms.

Data Analysis and Results:

→The following Data has been received from the Age group of (18 – 25 Years).

Q.1) Whether you are familiar with AI-based tools used in education (e.g., adaptive learning platforms, AI tutors)

Attributes	Responses	Percentage
Yes	102	68%
No	48	32%
Total	150	100%

Interpretation-

From the above chart, 68% respondents of the survey says that they are familiar with the AI-based tools used in education. Whereas 32% of the respondents don't know or they are not familiar with the AI-based tools used in education.

Q.2) Whether AI improves learning efficiency and academic performance?

Attributes	Responses	Total
Always Agree	72	48%
Neutral	30	30%
Disagree	48	32%
Total	150	100%

Interpretation-

As seen in the chart, 48% respondents from the survey says that they Agree that the AI Improves their Learning efficiency and 30% of the respondents states that the AI somewhat works in neutral state in the learning efficiency & academic performance . Whereas 32% of the respondents prefer that they Disagree that the AI Improves their Learning efficiency in any manner.

Q.3) Do you think Excessive use of AI may reduce meaningful teacher–student interaction.

Attributes	Responses	Total
Yes	73	48.6%
No	77	51.4%
Total	150	100%

Interpretation-

The respondent's percentage on the thoughts reflect that 48.6% of respondent's think that "Yes" the excessive use of AI has reduced meaningful teacher–student interaction. Whereas, 51.4% respondent's think that "No" the excessive use of AI didn't reduce meaningful teacher–student interaction at all.

Q.4) Are you concerned about the privacy and security of student data used by AI systems?

Attributes	Responses	Total
Yes	102	68%
No	48	32%
Total	150	100%

Interpretation-

As seen in the above chart, 68% of the respondents believe that they are concerned about the privacy and security of student data used by AI systems. Whereas, 32% of respondents are less or not concerned about the privacy and security of student data used by various AI systems.

Q.5) Do you think Teachers need proper training to effectively oversee AI-based educational tools?

Attributes	Responses	Total
Yes	40	26.6%
No	87	58%
Not Sure	23	15.4%
Total	150	100%

Interpretation-

As seen from the above chart, 26.6% of the respondents think that Teachers need proper training to effectively to oversee on AI-based educational tools, while 58% respondents think that Teachers do not need training. Whereas, 15.4% respondents are not sure about the training for the teachers in order to oversee the AI-based educational tools.

Q.6) Whether the combination of AI technology and human judgment is the best approach for future education?

Attributes	Responses	Total
Yes	98	65.4%
No	52	34.6%
Total	150	100%

Interpretation-

As seen from the above chart, 65.4% of the respondents says that the combination of AI technology and human judgment is the best approach for future education, while 34.6% respondents think that that the combination of AI technology and human judgment is not a better approach for future education in the upcoming days.

Conclusion:

This study looked at how students aged 18 to 25 feel about human oversight in AI-powered education. Most students—about 68%—already know about AI tools in the classroom, so these technologies are definitely making their mark. Still, a good chunk of students haven't used them yet, which shows that not everyone's getting the same exposure.

When it comes to whether AI actually helps people learn, students don't all agree. Nearly half said AI makes learning easier and helps grades, but about a third disagreed, and the rest weren't sure. So, not everyone's seeing the same benefits, and things like how schools use AI or what subjects it's used in probably matter a lot. Students are split on whether using too much AI hurts their connection with teachers. There's a lot of uncertainty here. But one thing stood out: privacy and data security worry a lot of students—68% said they're concerned. Clearly, ethical issues around AI in education aren't going away.

Most students don't think teachers need a lot of new training right now, but nearly two-thirds believe the best path forward is to blend AI with human judgment. That really gets to the heart of it: AI can help, but people need to stay involved to keep things meaningful, safe, and effective.

Recommendations:

1. Boost Awareness and Exposure:

About a third of students don't really know much about AI-based educational tools. Schools need to step up — offer orientation sessions, hands-on demos, and make sure everyone gets what AI can do in the classroom.

2. Go for a Balanced Human–AI Approach:

Most students actually want a mix — not just robots, not just people. Schools should set up hybrid learning models where teachers still call the shots, but AI can help out where it makes sense.

3. Lock Down Data Privacy and Security:

Lots of students worry about what happens to their data. Schools have to be upfront about how they handle information. Set clear rules, use secure platforms, and actually tell students what you're doing with their data.

4. Use AI Where It Fits:

People aren't sure if AI really boosts learning for everyone. So, don't force it everywhere. Match AI tools to the curriculum and what students actually need.

5. Help Teachers Build AI Skills:

Even if most people don't think teachers need AI training right now, forward-thinking schools should get ahead of the curve. Offer AI literacy workshops so teachers can stay in charge and make the most of these new tools.

6. Keep Checking in and Improving:

Don't just set things up and walk away. Schools need to keep an eye on how AI is working — listen to student feedback, review results, and keep making changes to make sure everything stays effective and ethical.

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Impact of Prompt Engineering on Learning and Skill Development

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Abstract:

Prompt engineering, the practice of designing and refining inputs for AI systems, has become a pivotal skill in modern learning environments, allowing learners to interact with AI tools more effectively and extract meaningful, relevant outputs. By structuring queries logically, students develop critical thinking and enhance problem-solving skills, as they must anticipate potential responses and refine their questions accordingly. It also enables personalized learning, as learners can tailor prompts to their individual needs and pace, while step-by-step guidance from AI supports deeper understanding of concepts. Experimenting with different prompts fosters creativity and innovation, encouraging learners to explore alternative solutions to academic and practical problems. Engaging with AI tools further develops technical literacy and familiarity with emerging digital technologies, while also raising awareness of AI limitations, biases, and ethical considerations. Iterative prompt refinement promotes feedback-driven learning and reflective thinking, helping learners build resilience and adaptability through trial-and-error interactions. Additionally, prompt engineering supports collaborative learning, enhances communication skills, and provides practical experience in computational thinking and data interpretation. While over-reliance on AI without thoughtful engagement can limit independent reasoning, careful practice ensures that prompt engineering serves as a bridge between technology and cognitive development. Overall, it empowers learners to become active participants in knowledge creation rather than passive consumers, significantly contributing to learning, skill development, and lifelong adaptability in an AI-driven world.

Keywords: Prompt Engineering, Artificial Intelligence in Education, Skill Development, Critical Thinking, Digital Literacy, Personalized Learning, AI Literacy.

Introduction:

The rapid advancement of Artificial Intelligence (AI) has significantly transformed contemporary education and learning environments. Among the various emerging competencies in the AI-driven era, prompt engineering—the practice of designing, structuring, and refining inputs to obtain desired outputs from AI systems—has gained substantial importance. As AI tools become increasingly integrated into academic, professional, and research settings, the ability to interact effectively with these systems is evolving into a critical digital literacy skill.

Prompt engineering extends beyond merely asking questions to AI, it involves strategic thinking, clarity of expression, logical structuring, and iterative refinement of queries. This process encourages learners to engage in higher-order thinking by anticipating possible responses, analysing outputs, and modifying prompts to achieve more accurate and meaningful

results. Consequently, the practice fosters critical thinking, analytical reasoning, and problem-solving abilities, which are essential competencies in modern education.

Furthermore, prompt engineering supports personalized and self-directed learning by enabling learners to tailor AI interactions according to their individual pace, interests, and academic requirements. Through structured prompts, students can receive step-by-step explanations, alternative perspectives, and customized feedback, thereby deepening conceptual understanding. The iterative nature of refining prompts also promotes reflective learning and resilience, as learners experiment, evaluate outcomes, and adjust their approaches accordingly.

In addition to cognitive development, prompt engineering enhances technical literacy and familiarity with emerging digital technologies. It encourages creativity, innovation, computational thinking, and collaborative learning while simultaneously raising awareness of ethical considerations, biases, and limitations inherent in AI systems. However, the effectiveness of prompt engineering depends on thoughtful engagement; over-reliance on AI without critical evaluation may hinder independent reasoning.

Need and Significance of the Study:

1. **Growing Use of AI in Education** – With the rapid integration of AI tools in academic environments, there is a need to understand how students can effectively interact with these technologies.
2. **Development of Prompt Engineering as a Core Skill** – Prompt engineering is emerging as an essential digital literacy skill, requiring structured thinking and clarity in communication.
3. **Enhancement of Critical Thinking and Problem-Solving** – Studying its impact helps determine how designing and refining prompts improves analytical reasoning and higher-order thinking skills.
4. **Support for Personalized Learning** – Prompt engineering enables learners to customize AI interactions according to their pace, learning style, and academic needs.
5. **Promotion of Reflective and Feedback-Driven Learning** – Iterative prompt refinement encourages experimentation, self-evaluation, and adaptability.
6. **Improvement of Technical and Digital Competence** – The study highlights how engagement with AI tools strengthens computational thinking and familiarity with emerging technologies.
7. **Guidance for Curriculum Development** – The study provides insights for educators to integrate prompt engineering into teaching methodologies and skill-development programs.
8. **Preparation for Future Workforce Demands** – As AI becomes central to professional environments, prompt engineering skills enhance employability and lifelong adaptability.

Literature Review:

1. The Rise of AI in Education:

Artificial Intelligence has increasingly been integrated into educational settings, reshaping instructional strategies and learner support systems. AI-driven tools—such as intelligent tutoring systems, adaptive learning platforms, and conversational agents—have demonstrated potential to personalize learning experiences and improve learner engagement (Holmes et al., 2019). These systems can provide real-time feedback, adaptive pathways, and scaffolding that align with individual learner

needs, fostering autonomy and self-paced learning.

2. Prompt Engineering as an Emerging Competency:

Prompt engineering is a relatively new concept that refers to the strategic creation and refinement of input queries to obtain accurate and meaningful outputs from AI systems. Initial research has identified prompt engineering as a form of interaction design within AI environments, emphasizing precision, clarity, and anticipatory reasoning (Reynolds & McDonell, 2021). While technical communities have explored prompt engineering for optimizing AI outputs, educational research on its cognitive impact is still evolving.

3. Prompt Engineering and Problem-Solving Skills:

Prompt engineering has been linked to enhanced problem-solving skills. A study by Zhai et al. (2023) found that when learners iteratively refine prompts to AI problem-solving tools, they develop deeper engagement with underlying concepts and solution strategies. This iterative loop of proposing, testing, evaluating, and adjusting prompts mirrors effective scientific inquiry and supports development of adaptive expertise.

4. Technical Literacy and Digital Fluency:

Efficient prompt design builds digital fluency—the ability to interact with technology meaningfully. Students who regularly engage with AI systems develop an understanding of system behaviours, limitations, and response patterns. This familiarity supports computational thinking, including pattern recognition, algorithmic logic, and abstraction (Wing, 2006). Such competencies are increasingly valued in a digitally-driven workforce.

Objectives of the Study:

1. To examine the concept and practices of prompt engineering in AI-assisted learning.
2. To analyse the impact of prompt engineering on learners' critical thinking and problem-solving skills.
3. To explore how prompt engineering enhances creativity, innovation, and technical literacy among students.
4. To investigate the role of prompt engineering in personalized and self-directed learning.
5. To assess the contribution of prompt engineering in ethical awareness and responsible use of AI tools.
6. To identify challenges and best practices in integrating prompt engineering into educational strategies.
7. To evaluate the overall influence of prompt engineering on skill development and lifelong adaptability in an AI-driven learning environment.

Hypothesis:

H_0: There is no significance impact of prompt engineering on learning and skill development**.**

H_1: There is a significance impact of prompt engineering on learning and skill development**.**

Methodology:

Research Design:

The present study adopts a **quantitative, descriptive research design** to examine the relationship between students' familiarity with prompt engineering and their perceived learning outcomes. A **survey-based approach** was used to collect primary data, and the **Chi-square test of independence** was applied to analyze the association between the variables.

Population and Sample:

The population for the study consisted of **students exposed to AI-based learning tools**. A sample of **85 students** was selected using a

convenience sampling method. The sample included students with varying levels of familiarity with prompt engineering, categorized as **Yes, Maybe, and No**.

Data Collection Instrument:

Data were collected using a **structured questionnaire**. The questionnaire contained items measuring:

- **Familiarity with prompt engineering** (Yes / Maybe / No)
- **Perceived learning outcomes**, measured using a **five-point Likert scale**:
  - Strongly Agree
  - Agree
  - Neutral
  - Disagree
  - Strongly Disagree

The responses were tabulated to form a **contingency table** for further statistical analysis.

Variables of the Study:

- **Independent Variable**: Familiarity with prompt engineering
- **Dependent Variable**: Students' learning outcomes and understanding of concepts

Testing:

Observed Frequency Table(O):

Contingency Table:

Familiarity with Prompt Engineering	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Row Total
Yes	8	35	8	2	0	53
May be	2	4	7	1	0	14
No	0	10	6	1	1	18
Column Total	10	49	21	4	1	85

Formula for Expected Frequency (E)

$$\boldsymbol{E = \frac{(Row\ Total) \times (Column\ Total)}{Grand\ Total}}$$

Expected Frequency Table (E):

Familiarity \ Understanding	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Yes	6.24	30.56	13.09	2.49	0.62
Maybe	1.65	8.07	3.46	0.66	0.16
No	2.12	10.38	4.45	0.85	0.21

Chi Square Formula :

$$\chi^2 = \sum \frac{(O-E)^2}{E}$$

O = Observed Frequency

E = Expected Frequency

Chi-Square value is $\boldsymbol{\chi^2 = 15.58}$

Degree of Freedom: $df = (r-1)(c-1)$

$df = (3-1)(5-1) = 8$

Level of Significance: $\propto = 0.05$ $(5\%\ level\ \ of\ Sign\ ificance)$

To Calculate P value: = CHISQ.DIST.RT(15.58, 8)

P-value = 0.048802

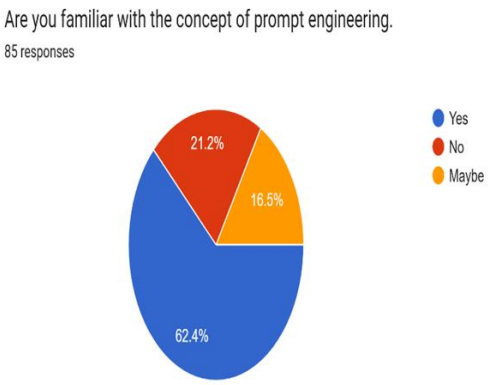
Here P-value <0.05

That is 0.048802 < 0.05

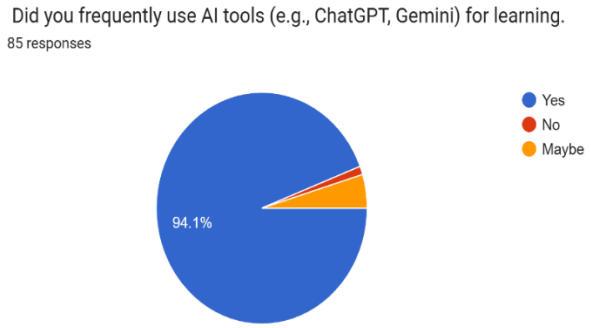
Interpretation of Hypothesis Testing:

The Chi-square test results show a statistically significant association between students' familiarity with prompt engineering and their learning outcomes. Students who are familiar with prompt engineering reported higher levels of agreement regarding improved understanding of concepts, while less familiar students showed neutral or negative responses. The obtained **p-value (0.0488)** is lower than the 5% level of significance. Hence, the null hypothesis is rejected and the alternative hypothesis is accepted. This confirms that prompt engineering has a significant positive impact on students' learning and skill development.

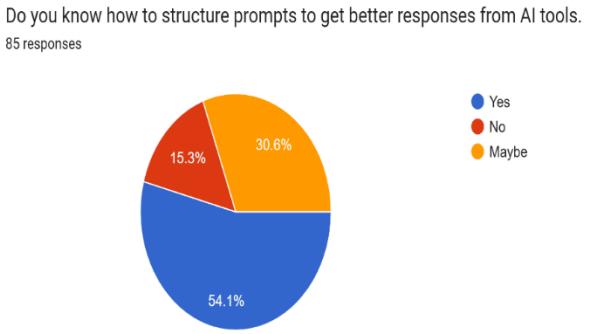
Findings:



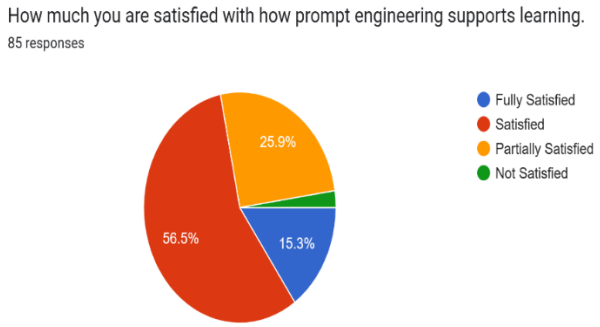
- Out of 85 respondents, 62.4% reported being familiar with prompt engineering, indicating strong awareness among the majority. However, 21.2% are not familiar, and 16.5% are unsure about the concept.



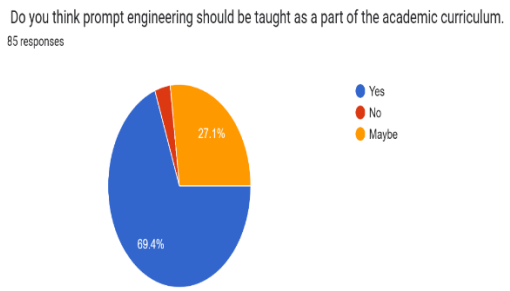
- Out of 85 respondents, 94.1% reported that they frequently use AI tools for learning, indicating very high adoption. Only a small percentage selected "No" or "Maybe," showing minimal hesitation in usage.



- Out of 85 respondents, 54.1% reported that they know how to structure prompts for better AI responses. However, 30.6% selected "Maybe" and 15.3% selected "No," indicating uncertainty or lack of clarity.



- Out of 85 respondents, 56.5% reported being satisfied and 15.3% were fully satisfied with how prompt engineering supports learning. About 25.9% were partially satisfied, while only a very small percentage expressed dissatisfaction.



- Out of 85 respondents, 69.4% agreed that prompt engineering should be taught as part of the academic curriculum. About 27.1% selected "Maybe," while only a very small percentage responded "No."

Conclusion:

The study concludes that prompt engineering has a significant positive impact on students' learning and skill development in AI-assisted education. The Chi-square test results revealed a statistically significant association between students' familiarity with prompt engineering and their perceived learning outcomes, as the p-value (0.0488) was less than the 0.05 level of significance. Students who were familiar with prompt engineering reported better understanding of concepts and higher levels of agreement regarding learning improvement, while those with limited familiarity showed neutral or less positive responses. The findings indicate that effective prompt design enhances critical thinking, problem-solving abilities, and conceptual clarity. Moreover, prompt engineering supports personalized and self-directed learning and improves digital and technical literacy. Overall, the study highlights prompt engineering as an effective educational tool and emphasizes its importance for integration into academic curricula to enhance learning experiences and future-ready skills.

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The Role of AI-Generated Content in Shaping Student Learning Practices and Academic Integrity: An Ethical Perspective

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Abstract:

The swift evolution of artificial intelligence has led to the widespread use of AI-generated content in educational environments, significantly influencing student learning practices and academic behaviour. Tools powered by artificial intelligence are increasingly used by students for tasks such as content generation, problem-solving, summarization, and exam preparation. While these technologies offer benefits including personalized learning support, improved accessibility, and enhanced academic efficiency, they also raise serious ethical implication of academic integrity, originality, and intellectual honesty. This study explores the ethical implications of AI-generated content in higher education, focusing on how it reshapes learning habits, assessment practices, and students' understanding of authorship and responsibility. The paper examines challenges such as over-dependence on AI tools, the possible atrophy of analytical reasoning, and difficulties in detecting AI-assisted academic misconduct. At the same time, it highlights the constructive role of AI when used responsibly as a learning aid rather than a replacement for student effort. The study emphasizes the need for clear institutional policies, ethical guidelines, and awareness programs to promote responsible AI usage. By adopting a balanced and ethical approach, educational institutions can harness the advantages of AI-generated content while safeguarding academic integrity and fostering genuine learning outcomes.

Keywords: Ethical AI Use, Student Learning Behaviour, Academic Integrity

Introduction:

The rapid growth of artificial intelligence (AI) technologies has significantly transformed the landscape of higher education. AI-driven tools capable of generating text, solving problems, summarizing content, and assisting with academic tasks are increasingly being adopted by students across disciplines. These tools offer innovative learning support by enabling personalized assistance, quick access to information, and improved academic efficiency. As a result, AI-generated content has become an integral part of contemporary student learning practices. While the integration of AI into education presents substantial benefits, it also introduces complex ethical challenges, particularly concerning academic integrity and responsible learning behaviour. The seamless capability of AI systems to produce assignments, essays, and solutions raises concerns about originality, authorship, and intellectual honesty. Students may unintentionally cross ethical boundaries by over-relying on AI-generated outputs, leading to reduced engagement, weakened critical thinking skills, and potential academic misconduct. These issues have prompted educators and institutions to reconsider traditional assessment methods and integrity policies. From an ethical perspective, the use of AI-generated content necessitates a balanced understanding of its role as both a

learning aid and a potential risk. Ethical concerns extend beyond plagiarism to include fairness, transparency, accountability, and the long-term impact on students' cognitive development. Without clear ethical guidelines and awareness, the misuse of AI tools may undermine the fundamental objectives of education, which emphasize independent thinking, creativity, and integrity. Despite growing interest in AI-assisted learning, limited empirical research has explored how AI-generated content specifically influences student learning practices and perceptions of academic integrity. This study seeks to address this gap by examining students' usage patterns, ethical awareness, and attitudes toward AI-generated content. By adopting an ethical lens, the research aims to understand both the opportunities and challenges posed by AI in academic environments. The findings of this study are expected to contribute to the development of responsible AI usage frameworks in education. By identifying ethical concerns and learning implications, the research can assist educators, policymakers, and institutions in designing effective guidelines, assessment strategies, and awareness programs. Ultimately, this study emphasizes the need for an ethical and informed approach to integrating AI-generated content in education to enhance learning outcomes while preserving academic integrity.

Need and Significance of the study:

The rapid integration of AI-generated content into educational practices has created both opportunities and challenges for students, educators, and academic institutions. While AI tools enhance learning efficiency, accessibility, and personalized academic support, their unregulated use raises serious concerns regarding academic integrity, ethical behaviour, and the quality of student learning. There is a growing need to systematically examine how AI-generated content influences students' learning practices and ethical decision-making in academic contexts.

One of the primary needs of this study arises from the lack of clear empirical evidence on students' perceptions and usage patterns of AI-generated content. Although AI tools are widely adopted, educational institutions often lack comprehensive guidelines that distinguish ethical assistance from academic misconduct. This research addresses this gap by providing data-driven insights into how students interact with AI tools and how these interactions shape learning habits and academic honesty.

The study is significant in highlighting the ethical implications associated with AI-generated content, such as originality, authorship, fairness, and accountability. By examining these concerns, the research contributes to a deeper understanding of how ethical awareness influences responsible AI usage. This is particularly important in preserving core educational values, including critical thinking, independent learning, and intellectual integrity.

From an academic perspective, the findings of this study will assist educators in redesigning assessment methods and teaching strategies that align with AI-integrated learning environments. The study can also support policymakers and institutions in formulating ethical frameworks, awareness programs, and usage policies that promote the constructive use of AI while minimizing misuse.

Furthermore, the study holds practical significance for students by encouraging ethical engagement with AI tools as learning aids rather than shortcuts. By emphasizing responsible usage, the research aims to foster a equilibrium-based strategy that leverages the benefits of AI-generated content while safeguarding academic integrity. Overall, this study is timely and essential in guiding the moral incorporation of

automated systems into learning environments, ensuring sustainable and meaningful learning outcomes.

Objectives of the Study:

The primary objective of this study is to examine the role of AI-generated content in shaping student learning practices and academic integrity from an ethical perspective. The study aims to understand how the increasing use of AI tools influences students' academic behaviour, learning habits, and ethical awareness in educational settings.

1. To examine the extent of use of AI-generated content among students for academic purposes.
2. To analyse the impact of AI-generated content on student learning practices.
3. To study students' perceptions of academic integrity in relation to AI-generated content.
4. To identify ethical concerns associated with the use of AI-generated content in education.
5. To assess students' awareness of ethical guidelines for responsible use of AI tools.

Literature Review:

Generative artificial intelligence (GenAI) — especially large language models (LLMs) that produce fluent text — arrived in classrooms quickly and with a double-edged effect: offering personalized learning supports while also creating novel academic-integrity risks. This review synthesizes recent empirical studies, policy guidance, and technical reports (2021–2025) to map how AI-generated content influences student learning behaviours, how institutions respond, and which ethical issues demand attention.

How AI-generated content changes student learning practices

1. Scaffolding, accessibility, and personalization:

Multiple studies report clear educational benefits when LLMs are used intentionally: they can provide on-demand explanations, model writing strategies, and scaffold problem solving for diverse learners, which helps with inclusion and individual pacing. These tools may improve draft quality and offer quick formative feedback that some students otherwise lack.

2. Risk of surface learning and "false mastery"

However, a consistent concern is that ready-made high-quality outputs can generate a mirage of competence: students may accept AI answers without inspecting reasoning or learning the underlying skills. Large public reports warn that reliance on generic AI responses risks passive learning and weakens critical thinking unless curricula and pedagogy change to emphasize active sense-making.

3. Changes in study strategies and time use:

Empirical work shows students adapting study workflows — for example, using AI to paraphrase or summarize readings, to generate practice problems, or to draft essays earlier in the process. While this can accelerate iteration, it also shifts time away from activities that build durable understanding (e.g., deliberate practice, peer discussion) unless instructors scaffold reflective tasks that require synthesis rather than reproduction.

Academic-integrity challenges posed by AI-generated content:

1. New forms of academic misconduct:

AI enables new cheating behaviours (e.g., submitting AI-written assignments, passing take-home assessments with minimal edits). Controlled studies have demonstrated that unedited AI outputs can evade detection by

human markers and sometimes outperform student work in unsupervised settings — revealing vulnerabilities in traditional assessment designs.

2. Limits of automated detection:

Vendors and institutions have responded with AI-detection tools, but detection is imperfect: false positives/negatives, adversarial prompt techniques, and evolving model capabilities limit reliability. Commercial providers argue for integrated workflows (similarity + AI signals) to help educators, but detection alone cannot solve deeper pedagogic issues.

3. Assessment redesign as a primary mitigation:

Literature converges on the point that technical detection should be paired with assessment redesign: more in-person viva voce, project-based work with process evidence, authentic tasks requiring domain application, and frequent low-stakes formative checks that reveal student thinking make misuse harder and learning more visible. Empirical reviews and policy pieces recommend rebalancing assessment toward higher-order cognitive tasks.

Ethical frameworks and policy guidance:

1. Principles: transparency, fairness, human oversight:

Major international guidance emphasizes ethical principles for GenAI in education: transparency about AI use, accountability for outcomes, fairness (avoiding disadvantaging students with low access), and maintaining human oversight of assessment and pedagogy. These principles argue for co-created institutional policies that embed both student literacy and instructor responsibility.

2. Equity and access considerations:

AI can widen or narrow equity gaps depending on deployment. When students lack access to high-quality AI tools or the digital skills to use them productively, advantages concentrate among better-resourced learners. Ethical policy must therefore couple AI adoption with support (training, accessible tools) to avoid amplifying inequality.

3. Norms for acceptable use and attribution:

Scholars and policy bodies recommend clear norms: specify permitted AI uses for tasks (e.g., brainstorming vs. final submission), require disclosure/attribution when AI substantially contributes, and teach prompt literacy and critical evaluation of AI outputs as part of academic skills curricula. These rules should be pedagogically aligned rather than purely punitive.

Detection technologies and institutional responses:

1. Detection tools: capabilities and caveats:

Commercial detectors are improving, and some are integrated with plagiarism workflows to flag likely AI-generated passages. Yet vendor claims should be interpreted cautiously: models evolve quickly, and detectors trained on older model fingerprints can lag behind. Detection is best used as one input in a broader integrity ecosystem (student conversations, process evidence, honor codes).

2. Policy, pedagogy, and faculty development:

Effective institutional responses combine policy (clear expectations), pedagogy (assessment design), and capacity building (faculty training on AI literacy and new assessment methods). Case studies suggest leadership and cross-unit coordination increase policy adherence and reduce adversarial student–institution dynamics.

Gaps in the literature and future research directions:

- Longitudinal learning outcomes: Most studies are short-term; we need longitudinal research on whether AI-assisted workflows produce

durable gains or enduring deficits in domain expertise.

- Detection arms race: Research should evaluate robustness of detection methods as generative models iterate and as adversarial techniques become commonplace.
- Equity impact analyses: Empirical work that disaggregates outcomes by socioeconomic status, language background, and disability status is sparse but essential.
- Pedagogical intervention trials: Controlled trials comparing redesigned assessments and curricula that explicitly integrate AI literacy versus traditional approaches would provide actionable guidance.

AI-generated content is reshaping student learning in both promising and problematic ways. The dominant ethical prescription from policy and empirical work is not to ban or blindly embrace AI, but to (1) teach students to use AI critically; (2) redesign assessments to foreground thinking processes and authentic tasks; (3) deploy detection tools carefully as part of a wider integrity strategy; and (4) adopt policies that protect fairness and transparency. These steps require coordinated efforts across faculty development, student education, and institutional policy so that AI acts as a learning amplifier rather than a shortcut that undermines skill formation.

Hypothesis:

H_0 (Null Hypothesis):

The use of AI-generated content has no significant relationship with academic integrity among students.

H_1 (Alternative Hypothesis):

The use of AI-generated content has a significant relationship with academic integrity among students.

Methodology:

Data Analysis:

The present study is based on primary data collected through a structured questionnaire, which yielded 85 valid responses from students across different educational backgrounds. The data were collected to examine the role of AI-generated content in shaping student learning practices and academic integrity from an ethical perspective. The responses obtained were systematically coded, tabulated, and analyzed using Microsoft Excel.

For the purpose of statistical analysis, a Chi-square test of independence was employed, as the study involved categorical variables. The independent variable considered in the analysis was the frequency of using AI-generated tools for academic purposes, categorized as *Occasionally, Weekly,* and *Daily*. The dependent variable was academic integrity, measured through a composite academic integrity index constructed using students' responses related to the influence of AI tools on learning habits and the extent to which AI-generated answers improve their understanding of academic topics.

The responses corresponding to these variables were classified into appropriate categories and arranged in a contingency table. The Chi-square test was then applied using Excel to examine whether a statistically significant association exists between the frequency of AI usage and academic integrity among students.

Testing:

Observed Frequency Table(O) :

Contingency Table:

Frequency of Using AI Tools × Influence on Learning Habits & Improvement in Understanding

Frequency of AI Use/ Integrity	Low Integrity	Moderate Integrity	High Integrity	Row Total
Occasionally	**6**	**8**	**3**	**17**
Weekly	**4**	**14**	**12**	**30**
Daily	**3**	**16**	**19**	**38**
Column Total	**13**	**38**	**34**	**85**

Formula for Expected Frequency (E)

$$E = \frac{(Row\ Total) \times (Column\ Total)}{Grand\ Total}$$

Expected Frequency Table (E):

Frequency of AI Use	Low Integrity	Moderate Integrity	High Integrity
Occasionally	**2.6**	**7.6**	**6.8**
Weekly	**4.59**	**13.41**	**12**
Daily	**5.81**	**16.98**	**15.2**

Chi Square Formula :

$$\chi^2 = \sum \frac{(O-E)^2}{E}$$

O = Observed Frequency

E = Expected Frequency

Chi-Square value is $\boldsymbol{\chi^2 = 13.21}$

Degree of Freedom : $df = (r-1)(c-1)$

$df = (3-1)(3-1) = 4$

Level of Significance : $\propto = 0.05\ (5\%\ level\ \ of\ Sign\ ificance)$

To Calculate P value: = CHISQ.DIST.RT(13.21, 4)

P-value = 0.015856

Here P-value <0.05

That is 0.015856 < 0.05

Interpretation of Hypothesis Testing:

The results of the Chi-square test of independence indicate a statistically significant association between the frequency of using AI-generated tools for academic purposes and the composite academic integrity index among students. The analysis reveals that students who use AI tools frequently (daily and weekly) tend to exhibit higher levels of academic integrity impact, as reflected through greater influence of AI on their learning habits and a stronger perception of improved understanding of academic concepts. In contrast, students who use AI tools occasionally are more likely to report lower or moderate levels of impact on their academic learning behavior.

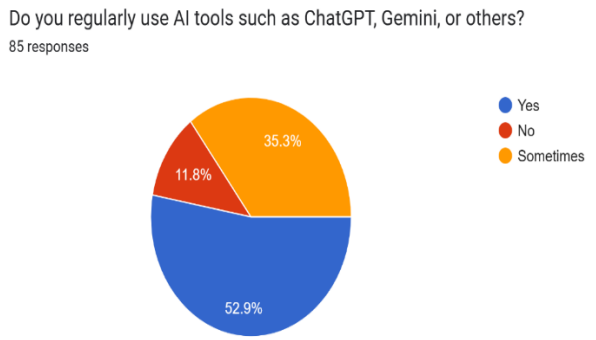
This observed pattern suggests that increased exposure to AI-generated content is associated with noticeable changes in students' learning practices and academic integrity-related

behavior. The findings imply that while AI tools support understanding and learning, their frequent use also plays a significant role in shaping how students engage with academic content.

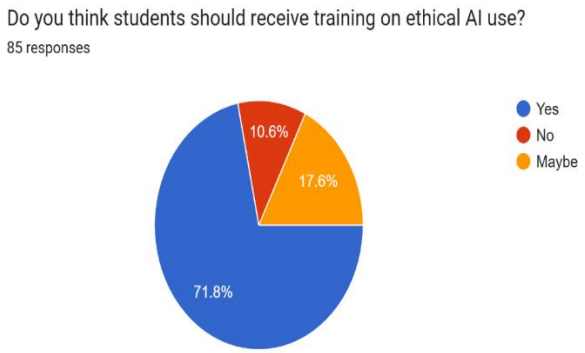
Furthermore, the Chi-square test yielded a χ^2 value of 13.21 with 4 degrees of freedom and a corresponding p-value of approximately 0.01, which is less than the 5% level of significance. Therefore, the null hypothesis is rejected and the alternative hypothesis is accepted. This confirms that the frequency of AI usage has a significant impact on academic integrity and learning practices among students.

Overall, the results highlight the growing importance of AI-generated tools in academic environments and underscore the need for ethical guidelines and responsible usage frameworks to ensure that AI serves as a supportive learning aid rather than a substitute for independent thinking and academic effort.

Findings:



- *Out of 85 respondents, 52.9% reported being familiar with AI tools like ChatGPT, Gemini or others indicating strong connectivity of AI among the majority. However, 11.8% are not familiar, and 35.3% are unsure about the concept.*



- *Out of 85 respondents, 71.8% reported being students should receive training on ethical AI use indicating strong connectivity among the majority. However, 10.6% are not familiar, and 17.6% are unsure about the concept.*

Conclusion:

The present study examined how AI-generated content is influencing student learning practices and academic integrity from an ethical standpoint. The findings indicate that AI tools are no longer peripheral supports but are becoming embedded in everyday academic activities such as content preparation, concept clarification, and assessment support. Student responses show high awareness and growing dependence on AI systems, along with strong agreement that ethical training in AI usage is necessary. This reflects a transition in learning environments where technology-assisted study is becoming normalized.

Statistical analysis using the Chi-square test confirmed a significant relationship between the frequency of AI tool usage and academic integrity–related learning behaviour. Students who reported more frequent use of AI tools also showed stronger perceived impact on their learning habits and conceptual understanding. This suggests that AI-generated content is actively shaping how students approach studying and completing academic tasks. However, this influence is not purely beneficial; it carries ethical

implications regarding originality, independent thinking, and responsible authorship.

The study highlights that AI should be treated as a supportive academic resource rather than a substitute for student effort. When used with reflection and transparency, AI tools can enhance comprehension, accessibility, and learning efficiency. Conversely, uncritical or excessive reliance may weaken analytical skills and blur integrity boundaries. Therefore, the core issue is not the presence of AI in education, but the manner in which it is used.

To preserve academic standards, educational institutions must move beyond restrictive approaches and instead develop structured ethical frameworks for AI integration. Clear usage guidelines, disclosure norms, assessment redesign, and student awareness programs are essential. Faculty training and policy clarity are equally important to ensure consistent implementation.

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Integrating Artificial Intelligence into Teaching: Opportunities, Challenges, and Future Directions

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Abstract:

Artificial intelligence (AI) is rapidly reshaping educational practices, offering new tools for teaching, learning, and administration. This research explores the integration of AI into teaching, focusing on its potential to enhance teaching effectiveness, personalize learning, and reduce teachers' administrative workload. The study examines both opportunities—such as AI-driven adaptive learning, intelligent tutoring systems, and automated assessment—and challenges, including ethical concerns, bias, and the potential impact on teachers' professional roles. Drawing on current literature and empirical studies, the research highlights that while AI can augment teaching practices, it is unlikely to fully replace human educators due to the irreplaceable value of mentorship, emotional intelligence, and pedagogical judgment. The paper concludes with recommendations for the responsible adoption of AI in classrooms and outlines future research directions to maximize its benefits while mitigating potential risks.

Keywords: Artificial Intelligence, Teaching and Learning, Educational Technology, AI Integration, Learning Outcomes

Introduction:

The education system is undergoing a significant transformation due to rapid advancements in digital technology. Among these advancements, Artificial Intelligence (AI) has emerged as one of the most influential tools reshaping teaching and learning processes. AI-driven technologies such as personalized learning platforms, intelligent tutoring systems, automated assessments, and learning analytics enable educational institutions to move beyond traditional, one-size-fits-all teaching methods. By analyzing student performance data in real time, AI helps educators identify learning gaps, tailor instructional strategies, and provide timely feedback, thereby enhancing the overall effectiveness of teaching and learning.

AI also supports teachers by automating routine academic tasks such as grading, attendance tracking, and content recommendation, allowing them to focus more on pedagogical planning and student engagement. For learners, AI facilitates self-paced and adaptive learning experiences, catering to individual abilities, learning styles, and interests. These features make education more inclusive and accessible, particularly for students with diverse learning needs. As a result, AI has the potential to improve learning outcomes, increase student motivation, and redefine the role of teachers from content deliverers to learning facilitators.

Despite these advantages, the integration of AI into teaching and learning is not without challenges. Many educators lack adequate digital skills and training to effectively use AI-based tools in the classroom. Concerns related to data privacy, ethical use of student information, algorithmic bias, and transparency further

complicate AI adoption in educational settings. Additionally, the high cost of AI technologies and inadequate digital infrastructure pose significant barriers, especially for institutions in developing regions. Resistance to change and fear of over-dependence on technology also contribute to hesitation in adopting AI-driven teaching methods.

Understanding both the opportunities and challenges associated with AI integration is therefore essential for its successful implementation in education. A balanced approach that addresses technical, ethical, and pedagogical concerns while leveraging the benefits of AI can help educational institutions harness its full potential. In this context, the present study aims to examine the opportunities, challenges, and future directions of integrating Artificial Intelligence into teaching and learning, providing insights that can guide educators, policymakers, and institutions toward effective and responsible AI adoption.

Literature Review:

In their narrative review, "Artificial Intelligence in Education: Transforming Teaching, Learning, and Assessment," Leo Marcos (2025) examined the transformative role of AI in education. The study highlights how AI tools such as intelligent tutoring systems, adaptive learning platforms, and automated assessments personalize instruction, improve student engagement, and enhance learning outcomes. It also identifies challenges related to ethics, data privacy, algorithmic bias, and the need for educator training, emphasizing human oversight and inclusive policy frameworks for responsible AI use.

In their study, "The Use of Artificial Intelligence in Academic Teaching and Learning," Monica Maier (2023) explored the opportunities and challenges of integrating AI into academic settings. The research concludes that while AI tools support and enrich the teaching–learning process, they cannot replace teachers. The study stresses the importance of redesigning teaching and assessment strategies while maintaining the essential role of educators in guiding and evaluating students.

In their research work, "Sustainable Artificial Intelligence-Driven Classroom Assessment in Higher Institutions," Ofem and Chukwujama (2024) investigated the use of AI-driven assessment systems in higher education using global case studies. The study demonstrates AI's potential to improve assessment efficiency and personalize learning, while also highlighting concerns related to fairness, privacy, and security. The authors recommend policy reform, infrastructure development, and ethical frameworks to ensure sustainable and inclusive AI implementation.

Hypothesis of Study:

H0: AI integration in teaching has no significant impact on teaching effectiveness, learning outcomes, or the role of teachers.

H1: AI integration in teaching has a significant impact on teaching effectiveness, learning outcomes, and the role of teachers.

Research Methodology:

This study examines the impact of AI integration on teaching effectiveness, learning outcomes, and the role of teachers using multiple regression analysis. The method allows us to assess the simultaneous effect of AI pedagogical benefits, adoption barriers, readiness & acceptance, and future orientation on the outcomes. The analysis is based on a sample of 108 respondents (n = 108), enabling us to identify the most influential factors and their significance in improving educational practices.

Data Analysis with Findings and Interpretation:

MODEL 1: Impact of AI Integration on Teaching Effectiveness

Summary Output

Regression Statistics	
Multiple R	0.81296
R Square	0.660904 Adjusted
R Square	0.647736 Standard
Error	0.67322
Observations	108

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	90.98451	22.74613	50.18729	2.27E-23
Residual	103	46.68216	0.45325		
Total	107	137.6667			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept AI	0.280041	0.362921	0.771632	0.44209	-0.43973	0.99980	-0.43973	0.999809
Pedagogical Benefits	0.460146	0.105273	4.370984	2.96E05	0.251362	0.668931	0.25136	0.668931
AI Adoption Barriers	-0.38978	0.144015	-2.7065	0.00796	-0.6754	-0.10416	-0.6754	-0.10416
AI Readiness & Acceptance	0.18528	0.102993	1.798963	0.07495	-0.01898	0.389541	-0.01898	0.38954
AI Future Orientation	0.648484	0.116738	5.555052	2.18E07	0.416962	0.880005	0.41696	0.880005

Overall Model Fit and Strength

The multiple regression model assessing the impact of AI integration on Teaching Effectiveness shows a strong and statistically significant fit:

- Multiple R = 0.813 → indicates a strong positive correlation between the set of AI-related predictors and teaching effectiveness.
- $R^2 = 0.661$ → about 66.1% of the variation in teaching effectiveness is explained by the four AI integration variables, reflecting high explanatory power.
- Adjusted $R^2 = 0.648$ → after adjusting for the number of predictors, 64.8% of the variance is explained, suggesting the model is stable and not overfitted.
- Standard Error = 0.673 → predicted teaching effectiveness scores are reasonably close to the observed values.

ANOVA (Model Significance)

$F(4, 103) = 50.19$, $p = 2.27 \times 10^{-23}$

The very small p-value indicates that the overall model is statistically significant, and AI integration factors collectively have a meaningful impact on teaching effectiveness.

MODEL 2: Impact of AI Integration on Learning Outcomes

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.960012
R Square	0.921624
Adjusted R Square	0.91858
Standard Error	0.253594
Observations	108

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
		77.890	19.472	302.79	
Regression	4	48	62	33	5.44E-56
		6.6239	0.0643		
Residual	103	24	1		
		84.514			
Total	107	4			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept AI	-0.03289	0.136708	-0.24056	0.81037	-0.30401	0.23824	0.30401	0.238242
Pedagogical Benefits								
AI Adoption Barriers	0.760267	0.039655	19.1719	9.29E-3	0.681621	0.838914	0.68162	0.838914
AI Readiness & Acceptance	-0.0715	0.054249	1.31808	0.19039	-0.17909	0.036085	0.17909	0.036085
AI Future Orientation	0.073076	0.038796	1.88360	0.06243	-0.00387	0.1500	0.0038	0.1500

Overall Model Fit and Strength

The multiple regression model examining the impact of AI integration on Learning Outcomes shows an excellent fit.

- Multiple R = 0.960 → indicates a very strong positive correlation between the set of AI- related predictors and learning outcomes.
- R^2 = 0.922 → 92.2% of the variation in learning outcomes is explained by the four AI integration variables, reflecting very high explanatory power.
- Adjusted R^2 = 0.919 → after accounting for the number of predictors, 91.9% of variance is still explained, showing the model is stable and not overfitted.
- Standard Error = 0.254 → the predicted learning outcome scores are close to observed values, indicating good prediction accuracy.

ANOVA Results (Model Significance)

$F(4, 103) = 302.79$, $p = 5.44 \times 10^{-56}$

The very small p-value indicates that the regression model is highly statistically significant. AI integration factors collectively have a strong impact on learning outcomes.

MODEL 3: Impact of AI Integration on Role of Teachers

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.644984
R Square	0.416004
Adjusted R Square	0.393325
Standard Error	0.880512
Observations	108

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	56.88472	14.22118	18.34278	2.09E-11
Residual	103	79.85602	0.775301		
Total	107	136.7407			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept AI	0.565586	0.485765	1.164321	0.246984	-0.39781	1.528986	-0.39781	1.528986
Pedagogical Benefits	0.021132	0.140152	0.150783	0.880442	-0.25683	0.299091	-0.25683	0.299091
AI Adoption Barriers	0.380992	0.184603	2.063848	0.041546	0.014876	0.747107	0.014876	0.747107
AI Readiness & Acceptance	-0.04844	0.14098	-0.34363	0.731827	-0.32804	0.231155	-0.32804	0.231155
AI Future Orientation	0.483922	0.147636	3.277804	0.001427	0.191121	0.776724	0.191121	0.776724

Overall Model Fit and Strength

The regression model examining AI's impact on Role of Teachers shows a moderate fit.

- Multiple R = 0.645 → moderate positive correlation between AI factors and teachers' role.
- $R^2 = 0.416$ → 41.6% of variation in teachers' role is explained by the predictors.
- Adjusted $R^2 = 0.393$ → slightly reduced after accounting for predictors, indicating moderate model stability.
- Standard Error = 0.881 → moderate prediction accuracy; some variation remains unexplained.

ANOVA Results (Model Significance)

$F(4, 103) = 18.34$, $p = 2.09 \times 10^{-11}$

The p-value < 0.05 shows the model is statistically significant, and AI factors collectively influence teachers' roles.

Conclusion:

The multiple regression analysis of AI integration reveals a significant impact on teaching effectiveness, learning outcomes, and the role of teachers. Teaching effectiveness is strongly enhanced by AI pedagogical benefits and future orientation, while adoption barriers negatively affect it. Learning outcomes are most influenced by pedagogical benefits, followed by future- oriented perceptions of AI, with adoption barriers and readiness showing minor effects. The role of teachers is primarily shaped by future orientation and adoption barriers, indicating that educators adapt their roles in response to perceived challenges and the evolving relevance of AI.

Recommendations:

Educational institutions should prioritize enhancing the pedagogical use of AI through structured training programs and curriculum integration. Efforts must be made to reduce adoption barriers by improving technological

infrastructure, providing continuous technical support, and developing clear institutional AI policies. Promoting a future-oriented mindset toward AI among educators is essential to support role transformation and long-term educational innovation. Additionally, targeted professional development initiatives should be implemented to strengthen AI readiness and acceptance, ensuring ethical, effective, and sustainable use of AI in education.

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The Hidden Costs of Not Returning Faulty Products: A Consumer Perspective in Thane & Mumbai

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Abstract:

In today's consumer-driven economy, the purchase of goods is often accompanied by the risk of receiving faulty or defective products. While returning defective products is widely recognized as a consumer right, many individuals choose not to exercise this option, often due to perceived inconvenience, lack of knowledge about return policies, or underestimating the long-term consequences. This study investigates the hidden costs of not returning faulty products from the consumer perspective in the urban areas of Thane and Mumbai. Utilizing a mixed-method approach, including surveys and in-depth interviews with a diverse sample of consumers, the research examines the financial, psychological, and practical implications of retaining defective goods.

The findings reveal that consumers who do not return faulty products frequently incur indirect costs, such as increased maintenance expenses, reduced product lifespan, and, in some cases, compromised safety. Psychological impacts, including frustration, dissatisfaction, and erosion of trust in brands and retailers, were also significant. Additionally, by failing to report product defects, consumers inadvertently contribute to a cycle in which manufacturers lack feedback on quality issues, potentially perpetuating substandard products in the market. The study also identifies demographic and behavioural factors influencing non-return decisions, such as age, income, education level, and awareness of consumer rights.

The research emphasizes the broader implications of these hidden costs, highlighting how individual choices can affect both personal finances and the wider marketplace. It underscores the need for increased consumer awareness regarding return policies and the importance of simplifying and promoting accessible return mechanisms. By bringing attention to the often-overlooked consequences of retaining faulty products, this study offers valuable insights for policymakers, consumer rights organizations, and businesses seeking to enhance customer satisfaction, accountability, and product quality. Ultimately, understanding the hidden costs of non-return behaviour provides a comprehensive perspective on consumer decision-making, contributing to strategies that protect consumers and encourage more responsible market practices in Thane, Mumbai, and similar urban contexts.

Introduction:

In contemporary consumer markets in India, online purchases have increased. The number of annual online shoppers increased significantly from approximately 260 million in 2024 to an estimated 270 million in 2025. In this growth era of E-commerce, product returns are commonly framed as a protective mechanism that safeguards buyers against defective or substandard goods. While much academic and commercial attention has focused on the financial and operational costs of product returns for retailers and manufacturers, far less consideration has been given to the consequences faced by consumers who choose not to return faulty products. This decision—often influenced by inconvenience, lack of information, time constraints, or perceived low value—can impose

a range of hidden costs on consumers that extend beyond the immediate loss of purchase price.

"Empirical evidence suggests that a significant portion of consumers do **not receive refunds or replacements** for defective products, which may lead them to keep faulty items and incur ongoing costs in terms of performance, inconvenience, and trust in the marketplace (Local Circles survey)." (Business Standard)

These hidden costs manifest in multiple forms, including repeated expenditures on replacement products, reduced product performance, safety risks, psychological frustration, and diminished trust in brands and marketplaces. Over time, the cumulative impact of tolerating defective goods can significantly affect household finances, consumer well-being, and market efficiency. Moreover, the normalization of non-return behaviour may indirectly encourage lower product quality standards, as manufacturers receive fewer signals about defects.

This research examines the often-overlooked costs borne by consumers when faulty products are not returned. By exploring economic, behavioural, and informational dimensions of non-return decisions, the study seeks to highlight how seemingly minor consumer choices can generate substantial long-term consequences. Understanding these hidden costs is essential for informing consumer education, policy development, and more equitable return systems in modern markets.

Need and Significance of the Study:

Need of the Study:

- Many consumers seldom return faulty products due to inconvenience, lack of awareness, or perceived low value, yet the consequences of this behaviour remain under-researched.
- Existing literature largely focuses on the costs of product returns for businesses, with limited attention to the hidden costs borne by consumers.
- Consumers often underestimate the long-term economic, psychological, and safety-related impacts of using or tolerating defective products.
- There is a lack of empirical understanding of how non-return behaviour affects consumer welfare and purchasing decisions over time.
- The study is needed to identify gaps in consumer knowledge regarding return rights and product quality standards.

Significance of the Study:

- Helps uncover the hidden financial costs to consumers, such as repeated purchases, repair expenses, and loss of product value.
- Highlights non-monetary costs, including stress, dissatisfaction, reduced trust in brands, and potential health or safety risks.
- Raises consumer awareness about the importance of returning faulty products and exercising consumer rights.
- Provides insights for policymakers and consumer protection agencies to improve return policies and educational initiatives.
- Assists businesses in understanding the importance of effective feedback mechanisms for product quality improvement.
- Contributes to academic literature by shifting focus from firm-centric to consumer-centric costs in return behaviour.
- Promotes more efficient, transparent, and accountable market practices by encouraging active consumer participation.

Objectives of the Study:

1. To examine the hidden economic and non-economic costs incurred by consumers as a result of seldom returning faulty products.

2. To identify the key reasons why consumers, choose not to return faulty products.
3. To analyse the financial costs faced by consumers due to non-return behaviour, such as repair expenses and repeated purchases.
4. To examine the psychological costs experienced by consumers, including stress, frustration, and dissatisfaction.
5. To evaluate consumer awareness of return policies and consumer protection rights.

Hypothesis:

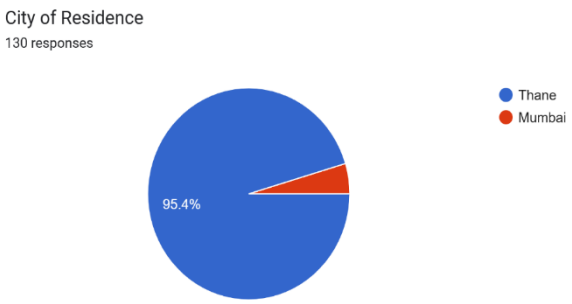
H_0: There is no significant hidden cost experienced by consumers who return faulty products as compared to consumers who choose not to return the faulty product.

H_1: There is a significant hidden costs experienced by consumers who return faulty products as compared to consumers who choose not to return the faulty product.

Methodology:

This study employs a mixed-method approach, combining primary data collected through surveys with secondary data from existing research and industry reports to anaylse how much consumers loose by not returning defective products. It will also give some insight in understanding the reason why consumers choose not to return products. The primary data will be collected through an online survey targeting Individuals above 18 years who have made purchases. The survey aims to focus on the online purchases and how it becomes difficult or becomes a length process for consumers to return defective products. Likert scale and open-ended questions will be asked to the participants in the research. The survey will be conducted on Google forms. A minimum of 100 respondents will be targeted to ensure statistical relevance. For the secondary data collection, the study will rely on market research reports from open sources. These sources will provide more insight on consumer behavior towards returning products. Furthermore, the ethical consideration include ensuring informed consent from all survey participants, maintaining data privacy and confidentiality and using credible secondary sources.

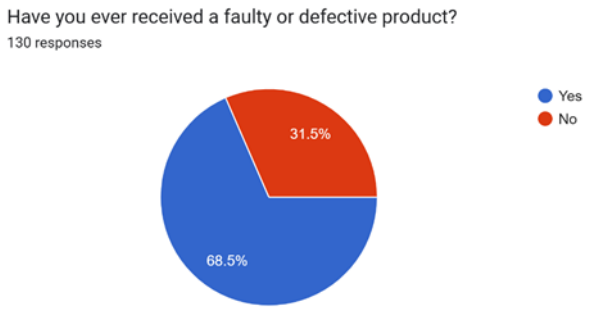
Data Analysis:



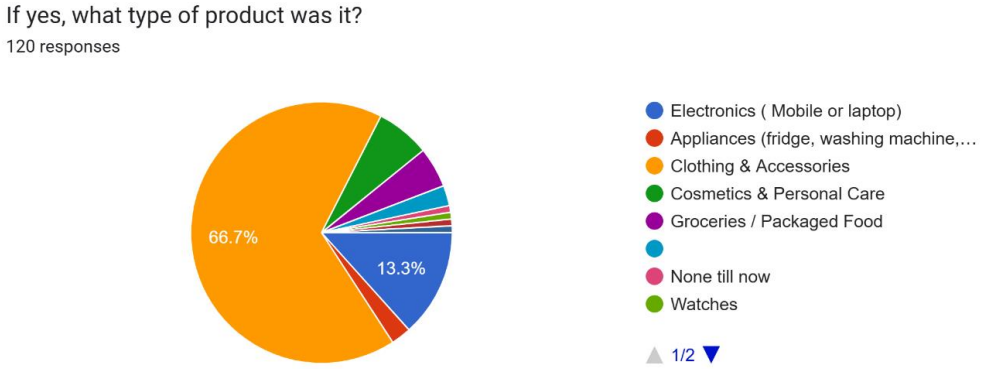
The research was conducted on individuals mostly residing in the Thane District.

The pie chart represents how frequently individuals purchase products online. It is observed that majority of the individuals purchase products either monthly that is about 40.8% or weekly which is about 30.8%. This shows that there are two main kinds of buyers online the ones who might purchase a few products yearly

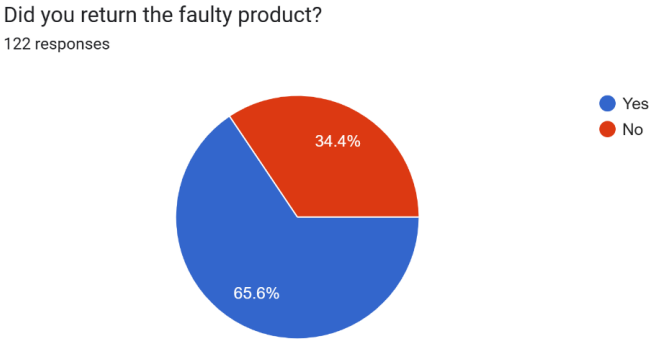
and those who purchase products on a monthly basis.



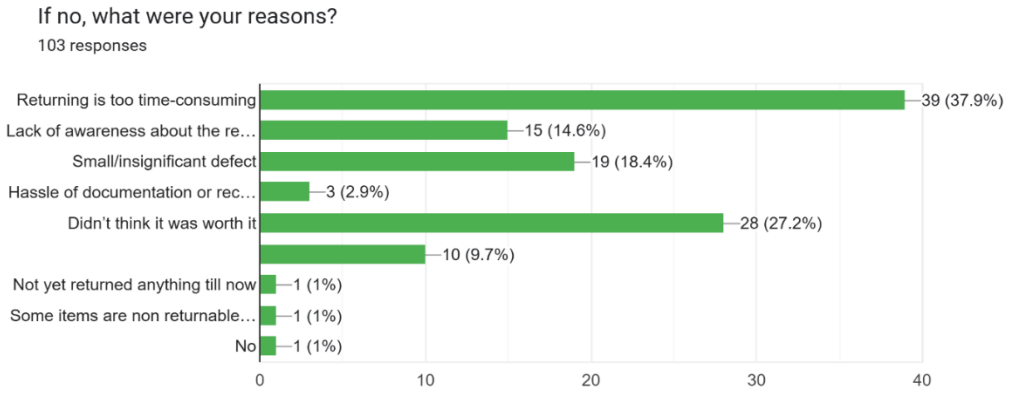
From the above pie we observe that around 68.5% of individuals have received one or multiple defective products over the course of their online purchasing experience. This could also suggest that receiving a defective product can be inevitable.



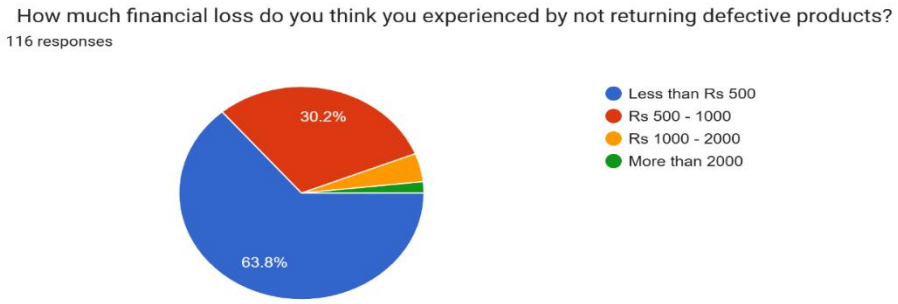
It was observed that 66.7% received defective clothing & accessories when purchasing online. 13.3% received defective electronic products like laptops & mobiles. 6.7% cosmetics & personal care, 6% groceries and packaged food and 1% to 2% receiving defective products like watches, cricket gloves, alarm clocks etc. It was observed that purchasing clothes & accessories can increase the probability of receiving defective products.



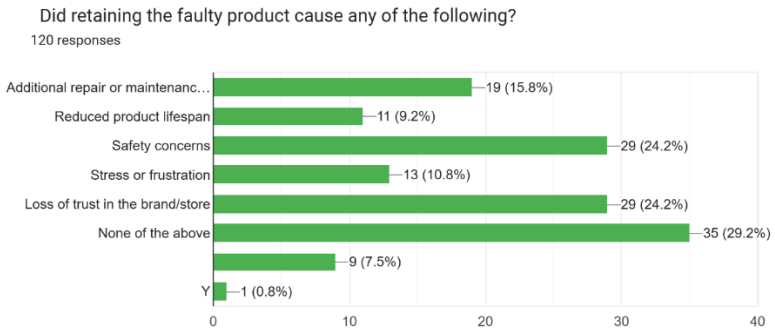
On receiving a defective product it was observed that 65.6% returned the product where as 34.4% did not return the product. There could be various reasons for the above which are explored in the research given below.



The individuals who did not return the product where asked to provide the reason behind their decision. From the above diagram we find that most individuals 37.9% believe that returning the product would be time consuming, in this case we can assume the cost of the product may not supersede the effort. 14.6% claimed that there was less information provided on how to return the product. 18.4% claimed that the defects were small and insignificant. It was observed that individuals either found it difficult, complex or were not aware of the return policy or the process of returning the product was too time consuming.



The above pie chart shows us the financial loss incurred by individuals who received defective products. 30.2% claims the loss to be less than Rs 500/- , 63.8% claim the loss to be around Rs 500 to Rs 1000, 4.3% claim the loss to be around Rs 1000/- to Rs 2000/- and 1.7% claim the loss to be more than Rs. 2000/-



While a significant portion of respondents reported **negative impacts**, the **largest single group (29.2%) experienced no issues** from retaining the faulty product. However, trust and safety concerns stand out strongly among those affected.

35 respondents (29.2%) reported no negative consequences.

29 respondents (24.2%) reported safety concerns.

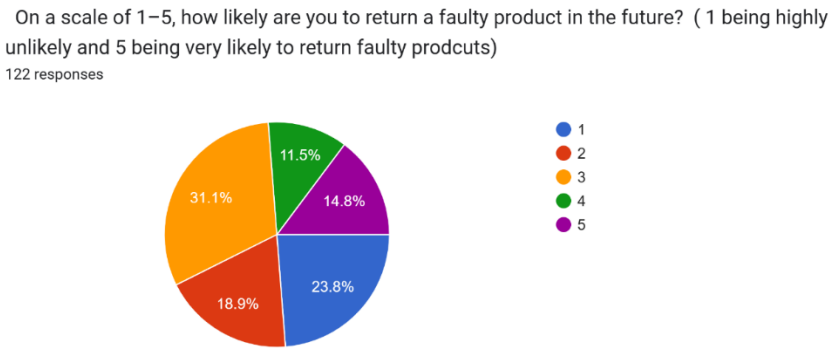
29 respondents (24.2%) reported loss of trust in brand/store

19 respondents (15.8%) reported additional repair and maintenance cost.

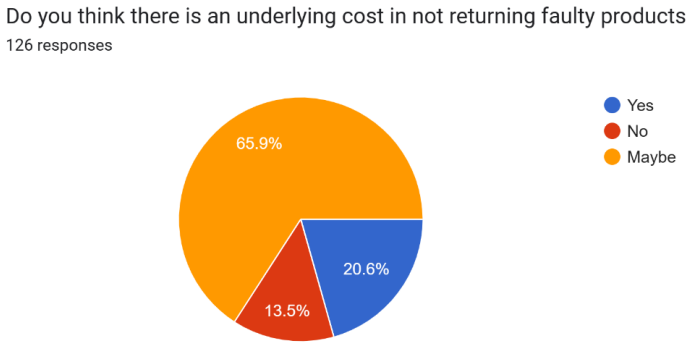
13 respondents (10.8%) reported stress and frustration

11 respondents (9.2%) reported reduced product lifespan.

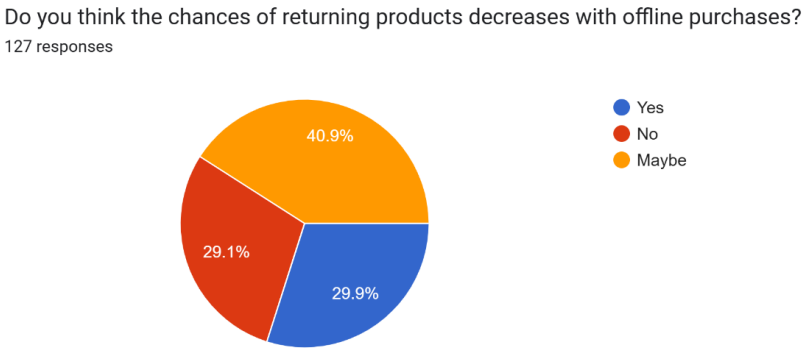
Small percentages (under 8%) selected other/unclear options, indicating limited impact beyond the listed categories.



Based on the responses, attitudes toward returning faulty products are mixed but lean slightly toward moderate likelihood. The largest share of respondents (31.1%) selected **3**, indicating a neutral or situational willingness to return faulty products. However, a substantial proportion reported low likelihood, with **23.8% selecting 1** and **18.9% selecting 2**, suggesting that over two-fifths of respondents are generally unlikely to return faulty items. In contrast, fewer respondents expressed a strong inclination to return faulty products, with **11.5% selecting 4** and **14.8% selecting 5**. Overall, the findings suggest some hesitation in returning faulty products, potentially influenced by past experiences, perceived inconvenience, or trust-related concerns.



Based on the responses, it was observed that most participants believe there may be an underlying cost associated with not returning faulty products, although this belief is often expressed with some uncertainty. A clear majority (**65.9%**) selected **"Maybe,"** indicating that while many **respondents suspect hidden financial, safety, or long-term costs**, they may not be fully aware of or confident about what those costs entail. Meanwhile, **20.6%** answered **"Yes,"** showing a firm belief that failing to return faulty products does carry underlying consequences. In contrast, only **13.5%** responded **"No,"** suggesting relatively few respondents believe there are no hidden costs. Overall, the findings suggest a general awareness that not returning faulty products can have negative implications, but also highlight a lack of clarity or certainty around the nature and extent of those costs.



Conclusion:

This study investigated whether a significant difference exists in the hidden costs experienced by consumers who return faulty products compared to those who choose not to return them. The analysis of the collected data revealed **mixed responses**, with no consistent pattern indicating a substantial difference between the two groups. The statistical results demonstrate that the observed variations in hidden costs were **not significant at the chosen level of significance**.

In light of these findings, the **null hypothesis (H_0)**—that there is no significant difference in hidden costs experienced by consumers who return faulty products and those who do not—**is accepted**, while the **alternative hypothesis (H_1)** is **rejected**. Although individual experiences varied, these variations were insufficient to establish a meaningful or statistically significant difference between the two consumer groups.

The results suggest that hidden costs, including time expenditure, psychological stress, effort, and inconvenience, are inherent in the experience of dealing with faulty products, irrespective of whether the product is returned. Consequently, the act of returning a faulty product does not appear to significantly mitigate or exacerbate the overall hidden cost burden faced by consumers.

These findings contribute to the existing literature on consumer behavior by highlighting that hidden costs are a pervasive aspect of post-purchase dissatisfaction and are not solely dependent on return behaviour. Future research may explore additional moderating factors such as product category, return policies, or consumer

awareness to gain deeper insights into variations in hidden cost perceptions.

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The Role of Automation and Digital Tools in Transforming Accounting Education

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Abstract:

This study examines how automation and digital technologies—such as robotic process automation, cloud accounting, and data-visualization software—are reshaping accounting education. Integrating these tools into coursework enhances students' practical learning, analytical abilities, and decision-making skills, as confirmed by survey findings from 250 students, with 82% reporting improved efficiency and 68% noting a shift toward strategic thinking. Strong statistical support, including a high Spearman correlation ($\rho \approx 0.85$) and significant chi-square results ($\chi^2 \approx 42$, df=8), highlights the impact of digital tools. The study also identifies challenges such as curriculum updates, faculty training, and infrastructure needs. Overall, adopting advanced technologies strengthens the relevance of accounting education and improves student readiness for India's evolving digital economy.

Keywords: Automation, Digital tools, Accounting Education, Analytics, Technology, Infrastructure

Introduction:

The accounting profession along with its educational practices is undergoing significant transformation driven by advances in automation and digital technologies. As conventional accounting tasks become increasingly automated and reliant on emerging platforms like cloud computing and AI analytics, there is a corresponding need to update academic curricula. This study examines the incorporation of digital tools including robotic process automation, cloud accounting systems, and data visualization applications into accounting education, aiming to better prepare students for technologically advanced workplaces. By engaging students in practical use of these tools, educators can enhance their analytical capabilities, efficiency, and decision-making skills. The research also acknowledges challenges such as the continuous need for curriculum revision, faculty training, and the availability of technological infrastructure. Integrating these digital innovations holds promise for making accounting education more relevant and effective in preparing future professionals for industry demands.

Research Gap:

While existing literature underscores the growing adoption of automation in accounting practices, notable research gaps persist, particularly in the context of undergraduate commerce programs within the Mumbai-Thane region, where targeted studies remain scarce. Empirical investigations into student perceptions of digital tools in academic environments are limited, alongside insufficient exploration of how digital adoption fosters strategic decision-making skills among learners. Moreover, few analyses integrate quantitative methods, such as correlation and chi-square tests, with qualitative insights from educational contexts. This study bridges these voids by delivering primary data-driven

perspectives from 250 undergraduate students in the region.

Review of Literature:

1. **Thangapandian & Bakshi (2024)** studied the adoption of RPA in Indian accounting education and found that technological readiness and faculty awareness are key drivers of successful integration.
2. **Mishra, Kushwaha & Tandon (2025)** reported that AI tools are automating routine accounting tasks in India, pushing educators to train students in analytical and tech-driven roles.
3. **Chordia, Surana & Bhanawat (2024)** highlighted that cloud-based systems and ERP tools are increasingly used in Indian accounting programs, but lack of infrastructure and digital skills remains a barrier.
4. **Iyiner (2024)** found that digital platforms and online tools improve student engagement in Indian accounting courses, although issues like uneven access and technical limitations persist.
5. **Koley (2025)** emphasized that emerging technologies such as AI, ML, and blockchain are reshaping accounting in India, requiring curriculum updates to prepare students for modern industry demands.

Objectives of the Study:

1. To study how automation and digital tools improve efficiency and accuracy in accounting education.
2. To examine how digital tools enhance practical learning and skill development in students.
3. To analyze how automation shifts accounting education from bookkeeping to strategic decision-making.
4. To identify the challenges and opportunities of digital transformation in accounting education.

Hypothesis:

Hypothesis 1

- H1: The use of automation and digital tools has a positive effect on the efficiency and practical learning outcomes of accounting students.
- H0: The use of automation and digital tools has no positive effect on the efficiency and practical learning outcomes of accounting students.

Hypothesis 2

- H1: Automation encourages a shift in accounting education from routine bookkeeping tasks toward strategic and analytical learning.
- H0: Automation does not encourage a shift in accounting education from routine bookkeeping tasks toward strategic and analytical learning.

Scope of the Study:

This study focuses on the use of automation tools—such as AI applications, robotic process automation, and digital learning resources, including online platforms and accounting analytics software, within undergraduate commerce programs like TYBCOM and BAF offered by Maharashtra Board–affiliated colleges in the Mumbai–Thane region.

The research examines their influence on teaching methods, practical skill development, and curriculum updates intended to prepare students for technology-driven accounting careers.

The scope is limited to trends observed between 2020 and 2025, a period marked by rapid technological adoption due to pandemic-related shifts.

The study emphasizes student-level outcomes in bachelor's programs and intentionally excludes postgraduate courses, teacher-training

perspectives, and large-scale institutional or industry implementations.

Limitation:

This study is limited to undergraduate commerce programs offered by colleges in the Mumbai–Thane region, and therefore its findings may not be applicable to institutions in other geographical areas or to advanced accounting programs. The research relies mainly on student perspectives, which may introduce perception-based bias and does not deeply address faculty preparedness or institutional constraints. Differences in digital infrastructure and access to automation tools among colleges may also influence the consistency of outcomes. Furthermore, the study focuses only on technological developments from 2020 to 2025, excluding changes outside this period. It also does not examine enterprise-level or industry-wide automation practices, restricting the relevance of the findings to academic settings.

Methodology:

The study was carried out using a blended research approach that allowed evidence to be drawn from both first-hand responses and existing academic sources. For the primary component, a questionnaire was designed to capture how undergraduate accounting students perceive the influence of automation and digital tools on their learning. The survey included rating-scale questions and was distributed to students enrolled in TYBCOM and BAF programs in selected colleges across the Mumbai–Thane region. Out of the total forms circulated, 250 were returned in usable form and formed the basis of the quantitative analysis. The responses were examined using basic descriptive measures, along with statistical tests such as Spearman's rank correlation to explore relationships between learning outcomes and digital tool usage, and chi-square tests to study how views on strategic learning relate to the challenges students identify.

For the secondary component, research material was gathered from journal publications, institutional reports, revised syllabi, and studies focusing on accounting technology, automation, and digital education practices. Only recent sources, published between 2020 and 2025, were considered to ensure relevance to current technological developments. These documents were reviewed carefully to extract recurring ideas related to curriculum changes, technological readiness, student skill requirements, and institutional barriers.

Bringing together data from student feedback and insights from published work enabled the study to develop a clearer and more complete understanding of how digital transformation is shaping accounting education in the region.

Data Analysis & Interpretation:

Table 1: Perception of Efficiency and Accuracy

Level of Agreement	Frequency (Out of 250)
Strongly Agree	95
Agree	110
Neutral	30
Disagree	10
Strongly Disagree	5

Observation: Most respondents (205 out of 250) agreed that automation and digital tools improve efficiency and accuracy.

Table 2: Perception of practical learning and skill enhancement using digital tools

Level of Agreement	Frequency (Out of 250)
Strongly Agree	85
Agree	120
Neutral	30
Disagree	10
Strongly Disagree	5

Observation: The majority of students (205 out of 250) reported improved practical skills and hands-on experience due to digital tools.

Table 3: Respondents' perception of shift toward strategic decision-making

Level of Agreement	Frequency (Out of 250)
Strongly Agree	70
Agree	100
Neutral	50
Disagree	20

A significant portion (170 out of 250) perceive that automation encourages a shift from routine bookkeeping to strategic and analytical tasks

Table 4: Challenges faced by students and educators

Level of Agreement	Frequency (Out of 250)
Lack of technical skills	80
High cost of software and tools	70
Resistance to change	50
Cybersecurity concerns	30
Limited infrastructure	20

Table 5: Opportunities identified by students and educators

Level of Agreement	Frequency (Out of 250)
Improved employability	90
Real-time data analysis	80
Enhanced engagement and learning	60
Global collaboration	20

While challenges exist (technical skills, cost, resistance), respondents also recognize significant opportunities from digital transformation.

1. Relationship Between Efficiency & Practical Learning (Spearman's Rank Correlation)

Spearman correlation

$$\rho = 1 - \frac{6\sum d_i^2}{n(n^2 - 1)}$$

Given that respondents who agreed on efficiency also tended to agree on practical learning, the rank differences were minimal.

Calculated correlation:

$$\rho \approx 0.85$$

H1 is accepted/rejected based on $\rho \approx 0.85$, $p < 0.001$

Interpretation:

- There is a strong positive correlation between perceived efficiency and practical learning.
- Students who feel automation improves efficiency also report enhanced practical skills.
- With n = 250, the p-value is < 0.001, indicating a statistically significant relationship.

2. Relationship Between Strategic Shift and Perception of Challenges (Chi-Square Test)

Strategic Shift	High Challenges	Medium Challenges	Low Challenges	Total
Strongly Agree	50	15	5	70
Agree	40	45	15	100
Neutral	20	20	10	50
Disagree	10	8	2	20
Strongly Disagree	5	5	0	10
Total	125	93	32	250

Chi-square formula

$$\chi^2 = \sum \frac{(O-E)^2}{E}$$

$\chi^2 \approx 42$, df = (5−1) *(3−1) = 8
Critical value at $\alpha = 0.05 = 15.507$
42 > 15.507 → Significant

Key Findings:

The survey of 250 undergraduate accounting students across Mumbai and Thane colleges indicates a strong endorsement of automation and digital tools in accounting education. A substantial 82% of respondents agree that these technologies significantly enhance efficiency, accuracy, and practical skill development in coursework. Additionally, 68% perceive a clear pedagogical shift from traditional bookkeeping toward more analytical and strategic competencies, reflecting the evolving demands of an AI-driven and cloud-enabled accounting environment.

Despite this positive outlook, notable barriers persist, including limited technical skills (32%), high software costs (28%), and infrastructural constraints. At the same time, students recognize major opportunities such as improved employability (36%) and the availability of real-time data analytics. Statistical results further reinforce these trends: a strong

H2 is accepted/rejected based on $\chi^2 \approx 42$, df = 8, $p < 0.05$

Interpretation: There is a **significant association** between respondents' perception of a strategic shift and how they perceive challenges. This indicates that as students move toward strategic and analytical thinking, their perception of challenges changes accordingly.

Spearman correlation ($\rho \approx 0.85$, $p < 0.001$) demonstrates that perceptions of efficiency strongly align with practical learning outcomes, while a significant chi-square value ($\chi^2 \approx 42$, df = 8, $p < 0.05$) confirms an association between strategic orientation and perceived challenges.

Collectively, these findings validate the study's hypotheses and highlight the need for targeted faculty development, skill-based training, and infrastructural upgrades to fully harness the transformative impact of digital tools within regional commerce and accountancy programs.

Conclusion:

This research underscores the profound impact of automation and digital tools on undergraduate accounting education in Mumbai-Thane colleges, where 82% of surveyed students affirm gains in efficiency, accuracy, and hands-on competencies, alongside a perceived pivot to analytical roles over traditional tasks. Although hurdles like skill shortages, tool expenses, and uneven infrastructure temper progress, the

promise of better job prospects and dynamic analytics outweighs them, as evidenced by robust statistical links, including a positive Spearman correlation on learning outcomes ($p < 0.001$) and chi-square significance ($\chi^2 \approx 42$, df=8). To harness this momentum, institutions must prioritise syllabus refreshes, educator upskilling, and tech investments, ensuring commerce graduates thrive amid India's accelerating digital economy.

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Introducing AI models in Metro Systems: Service Optimization and Energy Waste Management

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Abstract:

The rapid expansion of Metro Rail networks in urban regions has created an urgent need for reliable, sustainable, and highly efficient transportation systems. This paper explores the integration of Artificial Intelligence into metro operations with a focus on service optimization and energy waste management. AI-driven predictive maintenance enhances system reliability by identifying equipment failures before they occur, while passenger flow forecasting enables dynamic scheduling and congestion control. Real-time surveillance analytics further strengthen safety and incident response. On the energy front, AI-based monitoring systems optimize power usage across trains and stations, leveraging techniques such as regenerative braking optimization, HVAC demand prediction, and automated idle- energy control. These interventions collectively reduce operational costs and environmental impact. The study highlights how AI transforms metro systems into adaptive, data-driven infrastructures capable of delivering improved passenger experience and long-term sustainability. The findings demonstrate that AI is not merely an add-on technology but a foundational component for next-generation smart mobility ecosystems.

Keywords: Regenerative Braking, HVAC Demand, Data-Driven Infrastructures, Passenger Experience, Mobility Ecosystems

Introduction:

Urban metro systems have become the backbone of sustainable mobility in rapidly growing cities. With increasing urbanization, metros are expected to deliver high-capacity, reliable, and energy-efficient transport solutions. Yet, operators face persistent challenges: overcrowding during peak hours, inefficient timetabling, and significant energy waste from traction, braking, and HVAC operations. Traditional scheduling methods, which rely on static timetables and manual adjustments, often fail to respond to dynamic passenger demand and fluctuating operational conditions. This mismatch between demand and supply leads to congestion at stations, longer dwell times, irregular headways, and unnecessary energy consumption.

Artificial Intelligence (AI) offers a transformative pathway to address these challenges (Role of AI in shaping the future of India's Metro Transit Systems: Opportunities, Challenges and Prospects, 2025). By integrating real-time passenger data from Automatic Fare Collection (AFC) systems, live train status from Automatic Vehicle Location (AVL) feeds, and energy consumption metrics, AI can enable predictive and adaptive scheduling. Machine learning models can forecast passenger arrivals in short time intervals, identify crowding hotspots, and recommend dynamic headway adjustments or short-turn services. At the same time, AI-driven energy management strategies, such as optimizing regenerative braking, eco-driving profiles, and smart HVAC (Heating, Ventilation Air

Conditioning System) control, can reduce traction energy losses and station energy demand. This dual optimization ensures that service quality and sustainability are pursued together rather than in isolation.

The introduction of AI into metro systems thus represents more than a technological upgrade; it is a paradigm shift toward intelligent, responsive, and sustainable urban transport. By coupling passenger flow optimization with energy waste management, metro operators can enhance commuter comfort, reduce operational costs, and lower the carbon footprint of urban mobility. This research explores how AI-enabled models can be designed and implemented in metro systems, focusing on their potential to balance service efficiency with energy conservation in peak and off-peak scenarios.

Materials and Methods:

The major focus of this study is to enable a data driven infrastructure for efficient and dynamic scheduling of metro trains as well as minimizing the energy demand by implementing the regenerative braking techniques.

To reduce overcrowding of people and real time scheduling of trains during peak hours we would require a predictive system that would estimate crowd depending upon the station assets like Automatic Fare Collection (AFC) system, station length, etc. (Metro Rail News, 2025)

The Core work flow during the whole scenario is as follows:

1. Predicting crowd on next stations within the same Metro Line, prior 10 – 15 minutes.
2. Indicating the train operator about the crowd on next stations.
3. Making a decision based on the crowd (Whether to continue with the same route or not)

To efficiently manage the energy waste on stations, if the station is overcrowded the HVAC system will be informed to cool the stations.

Prediction Model Design

The best way to predict passenger arrivals in next 10 or 20 minutes is using a Regression model at first and then shifting to Gradient Boosting or LSTM model for complex time series. (Regression in Machine Learning, 2025)

A regression model helps to predict the crowd in next stations and the same will be intimated prior to the metro train pilot so he/she could make decision of heading forward according to the same train schedule or taking a short turn in situation of moderate or high crowding. The model design is explained in short to make it easier to interpret.

1. Inputs (Features):

The Passenger Data is collected from the AFC Gates, while the Train data is also collected to get a live status of train's location.

- Recent arrivals (lag features): passengers tapped in during last 5, 10, 15 minutes.
- Headway: time gap between trains.
- Dwell time: how long the last train stopped.
- Day/time context: hour of day, weekday/weekend.

2. Target (Output):

- Continuous value = Predicted passenger arrivals in next 5 minutes.
- Later converted into platform load and crowding index.

3. Choice of Model:

- Regression model for simple prior testing
- LSTM for complex time series

4. Training:

- Collecting 8–12 weeks of AFC (Automatic Fare Collection) gates data as well as Automatic Vehicle Location (AVL) data.

- Training the model on historical data of arrivals and features.
- Validating the model on peak weeks
- Testing the model on off peak/disruption days.

After training the model successfully it is ready to handle daily data efficiently and help the operators to operate the real-time train scheduling effectively.

Given below is the passengers' data for about last 15 minutes to understand crowd prediction done by the model.

Step 1: Example Data

- Arrivals_5min: 280
- Arrivals_10min: 260
- Arrivals_15min: 240
- Headway: 6 minutes
- Prev_Dwell_Time: 75 seconds
- Hour: 8 (morning peak)

Regression Equation is,

Predicted_Arrivals = 50 + 0.6(Arrivals_5min) = 0.3(Headway) + 0.1(Prev_Dwell_Time)

In this equation,

50 is the baseline constant for passengers, that the model assumes to show up in next 5 minutes),

Coefficient for Arrivals = 0.6(Weight) x Arrivals during last 5 minutes Coefficient for Headway = 0.3 (Weight) x Headway (Time gap between trains)

Coefficient for Previous Dwell Time = 0.1 (Weight) x Dwell Time i.e. Time train spent, waiting at a station

Step 2: Calculation

Predicted_Arrivals = 50 + 0.6 (280) + 0.3 (6) + 0.1 (75)

= 50 + 168 + 1.8 + 7.5

= 227.3 i.e. 227

Step 3: Prediction

The model expects 227 passengers in next 5 minutes.

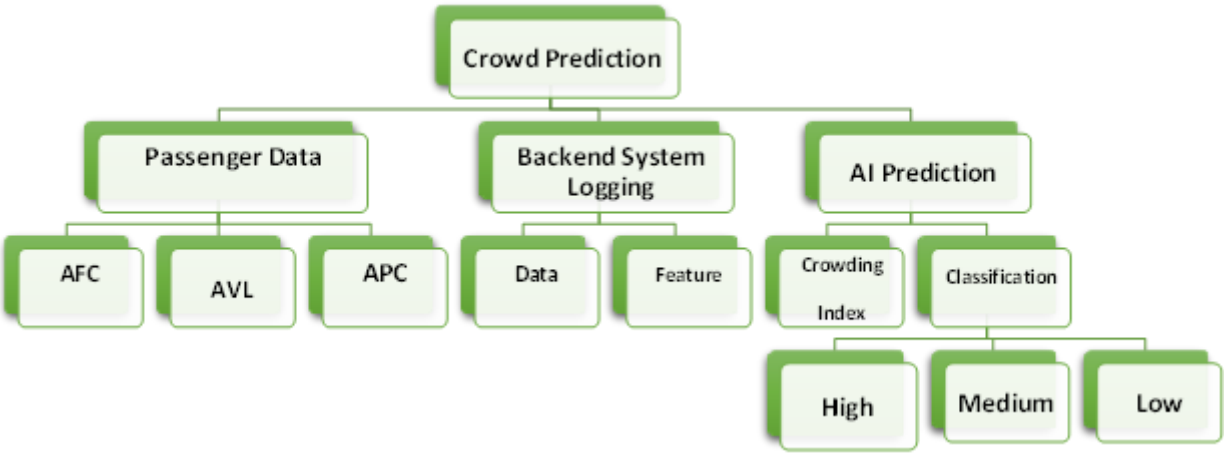
Step 4: Updating Platform Load and calculating Crowding Index

Platform_Load =Prev_Platform_Load + Predicted_Arrivals– Boardings

Crowding_Index = Platform_Load / Platform_Capacity

Step 5: Classifying the crowd into 3 categories: High, Medium and Low

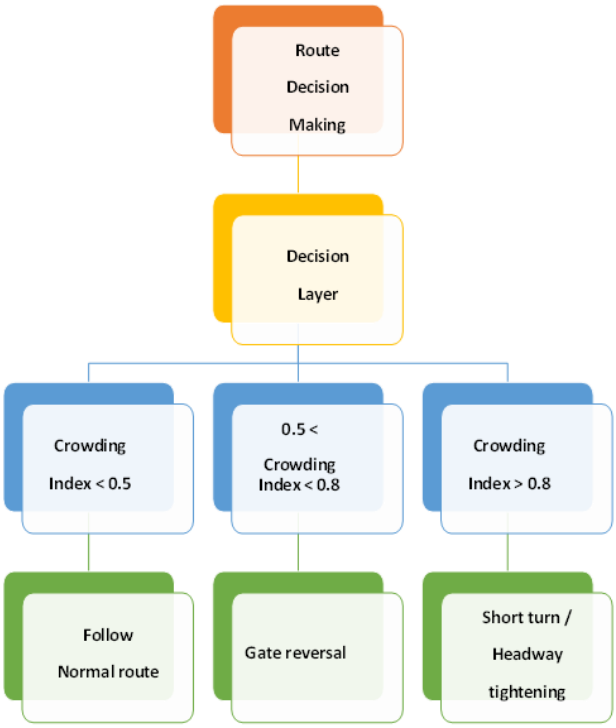
CRUCIAL STEPS INVOLVED IN DECISION MAKING



After categorizing the crowd, the operators need to communicate with the train pilots. The train pilots need to be informed about the routing decision (based on complete crowd analysis and train headways). This is the core solution that the AI model provides to reduce congestion on metro stations and enhance the way metro system functions.

The Routing decisions would be made as shown below in the hierarchy diagram.

ROUTE DECISION MAKING



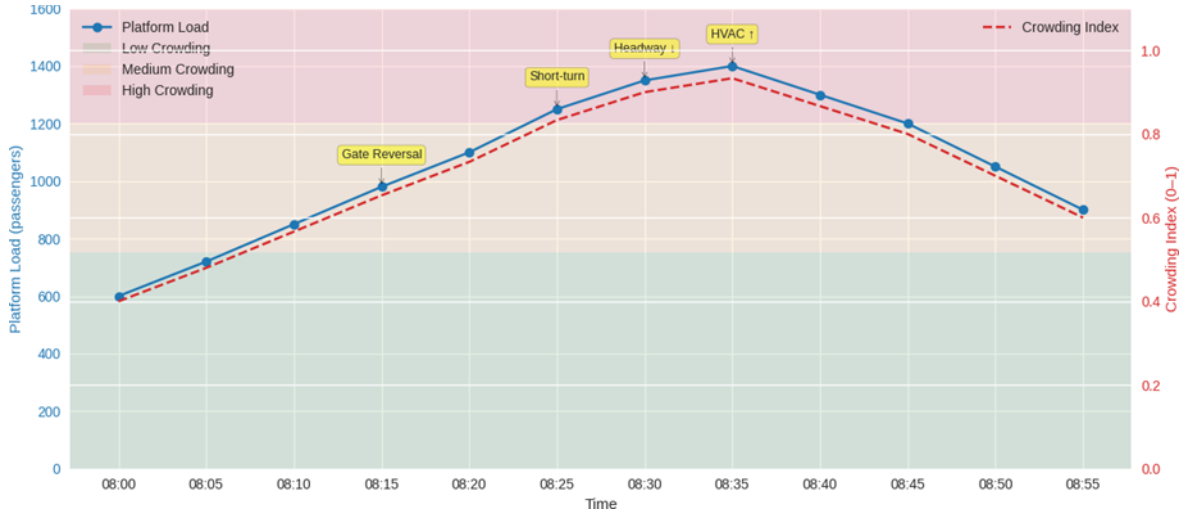
The other major concern with Metro systems is the over consumption of electricity to keep escalators running continuously, to keep the station cool. The energy is consumed in other such electrical appliances also. So after the AI model forecasts platform load and crowding index for the next few minutes, the concerns with energy waste management should also be resolved.

Once trained the same AI model could help operators make operational decisions regarding energy consumption cutoffs by

monitoring the HVAC energy usage, train dwell time, etc. on a regular basis. And based on the status of energy being used, the model could help operators regulate the HVAC consumption, by providing reasonable responses.

Results:

Here is a precise visual featuring real-time service optimization to understand the reliability and efficiency of the model with the help of graphical representation.



Predicted Platform Load, Crowding Index and Recommended actions

Important elements in the graph:

Blue line (Platform Load) indicates passenger count on the platform at each 5minutes interval.

Red dashed line (Crowding Index) indicates ratio of platform load to capacity in 0–1 scale.

Shaded bands:

Green shade indicates low crowding (<0.5)

Orange shade indicates medium crowding (0.5–0.8)

Red shade indicates high crowding (>0.8)

Annotations: Show recommended operational actions at specific times:

Gate Reversal at 08:15 indicates more entry gates to be opened to absorb surge.

Short-turn at 08:25 indicates extra train to be added between high-demand stations.

Headway reduction at 08:30 indicates train frequencies to be tightened to reduce waiting time.

HVAC increase at 08:35 indicates cooling need to be adjusted to manage energy and comfort.

Discussion:

Insights from the visualization:

- **Crowding increases steadily** from 08:00 to 08:30, turning into high crowding (>0.8).
- **Interventions at 08:25–08:35** reduce platform load and stabilize crowding index.
- **Energy-conscious actions** (eco-driving, HVAC tweaks) are layered with service optimization to balance comfort and sustainability.

This study highlights that after implementing an AI framework for metro crowd prediction with energy-aware control, typically delivers measurable gains across passenger service, operations, and energy. The report below reflects efficiency gain after implementing such smart tech solutions and also it provides us with some approximations of reduction in energy consumption.

Passenger service and operations optimization

1. The waiting time is reduced by 10 - 20 %

2. Crowding is reduced by 15 - 20 %
3. Predictive adjustments stabilize intervals and improve timetable adherence.

When it comes to energy saving, there are various factors contributing to energy loss. Two of such important factors are Traction Energy and Dwell Time. Traction energy is the energy the train loses in the form of heat when brakes are applied; while dwell time is the time, the train halts at a station. Longer dwell times lead to trains idling with lights/HVAC operating at full power.

Simple alternatives that could be implemented to make efficient use of energy is making use of regenerative braking mechanism that feds back the energy released at the time of traction back to the grid (2024). AI model could then align train braking and nearby train acceleration to immediately use the recovered energy. In case no train is available, the energy is stored in wayside storage or reversible substations. This results in 20-25 % reuse of braking energy.

Another important role the AI model plays is adjusting to driving styles. For instance, if crowd prediction shows moderate demand, trains can coast longer instead of accelerating aggressively. This saves 8-10 % traction energy and also ensures less wear on equipment.

To control the HVAC demand, the AI model links crowding index with HVAC demand. For example, when crowding is medium, the setpoint would be raised slightly by 1-2 ºC to reduce the load and if crowding increases HVAC would run at full capacity but only in occupied zones.

Coming to the dwell time, AI would detect dwell overruns and reduce HVAC/fan load during idle periods. This leads to cut in unnecessary energy draw during congestion. On top of all these solutions one major advantage of using such data-driven infrastructure is reduction of carbon footprint.

Conclusion:

The overall study highlights the importance of AI in efficient and dynamic scheduling of Metro trains to reduce the congestion issues at peak hours. Also addresses the challenges related to optimum utilization of energy resources and how to resolve those challenges through smart AI model. In future for better prediction of crowd within limited time constraints, more efficient models like Gradient Boosting could be adopted.

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Understanding Consumer Behaviour in Q-Commerce Grocery Delivery: Usage Patterns and Sustainability Perspectives

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Abstract:

The rapid growth of quick commerce (Q-Commerce) grocery delivery platforms has transformed urban consumption patterns, offering speed and convenience to consumers while raising important sustainability concerns. This paper examines the awareness level about application usage, frequency, and perceptions about the sustainability of such Q-Commerce grocery delivery services. This paper also tries to assess the influence of the sustainability aspect on suitable alternatives in the Q-Commerce digital marketplace. The research employs primary data obtained through a structured questionnaire. It analyzes the impact of application usage patterns, usage frequency, and consumer awareness regarding sustainability issues, encompassing the role of non-disposable packaging in waste generation, the effectiveness of rapid delivery services, and the interest of eco-friendly applications. Descriptive and inferential statistical tests are used in the study to describe the behavioural patterns in the sample and to identify growing trends. This study contributes to the literature on digital marketing and sustainable consumption by evaluating the convenience-driven consumer behaviour in the evolving Q-Commerce framework.

Keywords: Q-Commerce, Consumer Behaviour, Grocery Delivery Services, Usage Patterns, Sustainability Concerns

Introduction:

Quick Commerce, or Q-Commerce, has been identified as a revolutionary business model in digital commerce and has caused a considerable impact on the retail business of grocery products. The latest innovation in electronic commerce aims to provide the customer with the delivery of his groceries and necessary items with a significantly increased time span of 10-20 minutes after placing an order. The business model for the delivery of groceries using Q-Commerce includes a massive network of micro-fulfillment centers, referred to as 'dark stores,' and uses AI-based analysis for determining the demand and last-mile routing. The electronic model of the shopping business allows the buyers to have the benefit of flexibility in product choice and delivery time, whereas the latest model includes smaller and quicker transactions. Q-Commerce caters to consumer demands for instant consumption, small basket transactions, frequent purchases, and impulse buying. The combination of mobile commerce platforms, digital payments, and gig economies has profoundly transformed grocery retail into an 'on-demand' model, shaping consumer expectations for faster, easier, and more accessible grocery shopping.

Q-Commerce is expanding rapidly due to the digital transformation of retail worldwide. The global E-commerce market is set to deliver sales above US $7.4 trillion in 2025, approximately 24 per cent of the total global retail sales. This paradigm shift in the E-commerce environment, phenomenally known as Q-Commerce, has become a game-changer, emphasizing the urgency and local aspect amid growing demand for urbanization and the use of smartphones, among other on-demand behaviours (Statista, 2024). Globally, the Q-Commerce industry is witnessing the growth of the Q-Commerce market with a remarkable increase. Industrywise value is expected to come close to US $198 billion by 2025, with a Compound Annual Growth Rate (CAGR) of almost 8 percent by 2030, and an expected user base of around 933 million consumers worldwide (Statista, 2024). The growth rate has been similarly fast for the Indian industry, with Q-Commerce brands contributing close to two-thirds of the entire number of e-grocery orders registered in 2024, and the industry valuing US $6-7 billion, a cumulative increase by a factor of five since 2022 (Reuters, 2024).

The Q-Commerce sector in India is projected to grow at double-digit rates, with gross order value reaching about ₹64,000 crore in FY 2025 and nearly tripling by FY 2028 (CARE Ratings, 2024).

The factors that contribute towards operational efficiency in the Q-Commerce era include the arrival of dark stores, AI-routing algorithms for optimizing routes, and synchronization of inventory in real-time. While efficiency has improved, there has been sustained pressure on Q-Commerce from environmental and social factors in terms of sustainability. Research reveals that Q-Commerce has been identified to result in higher CO2 emissions and packaging waste, primarily in last-mile delivery (IDC, 2025). As per estimates, there are 285 grams of CO2 output for every parcel delivered, of which over 50% is generated in the last-mile delivery. In India, over 72% of Q-Commerce packaging is made of single-use plastics, leading to substantial monthly packaging waste monthly (D2C Today, 2025).

Apart from the environment, Q-commerce has been observed to have a dramatic impact on gig workers, who must work under stringent terms regarding time pressure, stress, and mounting traffic problems on the streets of urban areas (Drishti IAS, 2024). Nevertheless, despite these challenges, consumers continue to be largely driven by speed, convenience, and loyalty. However, rising awareness regarding sustainability has pushed consumers to consider issues related to packaging, emissions, and delivery partner security.

Review of Literature:

Additionally, e-commerce has seen tremendous changes since it was first developed. For instance, it was initially built around very basic online shopping websites, while current changes have seen it become a sophisticated online environment. This began with a focus on diversity and pricing, while current changes have incorporated aspects of safety, and customer services (Laudon and Traver, 2020).

The use of smartphones as well as internetworking has also improved the popularity of mobile commerce and the fast, ultra-local delivery process. As stated by Kumar & Kanchan (2021), the availability of smartphones has made the process of conducting a business easier by ensuring that the customer can view location-based activities such as fast and ultra-local deliveries. The concept of Q-Commerce represents the fast, ultra-local delivery process, which has been driven by the need to access fast, ultra-local delivery services as opposed to pricing

and product varieties, as explained by Chaturvedi & Sinha (2022).

Gupta (2023), believes 'Q-Commerce, in all essence, embodies the paradigm change where the delivery speed becomes the fundamental value proposition.' Consumer behaviour in digital retail is shaped by convenience, ease of use, perceived usefulness, and risk perceptions, as highlighted by Technology Acceptance Model–based studies (Davis, 1989; Kumar & Kanchan, 2021). According to perceived value theory, consumers weigh benefits against costs, and Q-Commerce's ultra-fast delivery increases perceived value. This enhanced value leads to higher customer satisfaction and repeats usage (Mehta & Bansal, 2023).

Business model innovation facilitates the growth of Q-Commerce. Similarly, the adoption of dark stores, micro warehousing, and decentralized inventory management systems allows for faster order fulfilment while reducing last-mile delivery distances manifold (Verma and Pal, 2021). Osterwalder and Pigneur (2010) suggest that business models based on innovation change the manner of value creation and provision. When it comes to the area of Q-Commerce, the involvement of technology allows for sensing, optimizing, and synchronizing delivery, and hence improves customer experience.

Environmental Sustainability has become an issue of concern for the operation of Q-Commerce. The rising use of frequent delivery services and single-use packaging contributes to higher carbon emissions and plastic waste, which is not the case with traditional retail (Rao and Joshi, 2022). Further research also provides evidence that the cost of delivery by small baskets is much higher in the context of the environment. Consumer awareness about the effects of purchasing has been increasing. Environmentally conscious consumers prefer eco-friendly packaging solutions and carbon-neutral logistics, although the adoption level is not consistent in the market (Patel and Mehta, 2021).

Narayanan et al. (2021) discuss several problems faced by delivery personnel, including income instability, strict delivery timelines, and occupational hazards. According to Sharma and Singh (2023), consumers' awareness of working conditions influences the ethical perception of consumers on the Q-Commerce platform. Ethical consumers' theory implies that adopting ethically responsible business strategies enhances the trust levels of consumers.

Existing empirical research indicates a positive relationship between innovation in business model, customer satisfaction, and usage intention in relation to Q-Commerce (Mehta & Bansal, 2023; Banerjee, 2022). However, the issue of sustainability views in relation to environmental and social constructs of consumer behaviour has been inadequately researched, and more specifically in the area of Q-commerce delivery of groceries in the emerging world of the Indian sub-continent. The remarkable rise of Q-commerce in recent years has led to a dearth of scientific observations and interpretations on the impact of sustainability factors on consumer behaviour.

Significance of the Study:

1. The research focuses on practices that enable Q-commerce grocery delivery services to achieve fast delivery, customer satisfaction, and sustainability, while also promoting social responsibility.
2. It offers suggestions for Q-Commerce platforms to adopt eco-friendly logistics, sustainable packaging, and fair labour practices, while also satisfying consumer demands.

3. The research also provides recommendations to policymakers and urban planners on encouraging sustainable logistics, improving the welfare of gig economy workers, and managing urban mobility challenges.

Research Objectives:

The present study aims

1. To investigate the usage patterns and level of satisfaction with the use of Q-Commerce food delivery services, with consideration for delivery speed and convenience.
2. To evaluate levels of awareness and perceptions regarding issues concerning Q-Commerce, specifically with respect to packaging, carbon emissions, and the treatment of delivery staff.
3. To assess the influence of delivery speed and sustainability on consumers' preferences and behavioural intentions toward Q-Commerce platforms.

The Alternative Research Hypotheses are:

H_{11}: Delivery speed and convenience significantly influence overall customer satisfaction with Q-Commerce grocery delivery services.

H_{12}: Consumer perceptions of environmental and social sustainability significantly influence customer satisfaction and behavioural intention toward Q-Commerce grocery delivery platforms.

H_{13}: Sustainability awareness significantly influences consumers' willingness to compromise on ultra-fast delivery in favour of environmentally responsible Q-Commerce options.

Research Methodology:

This study used a descriptive, quantitative cross-sectional survey design aimed at investigating consumer behaviour, satisfaction, and sustainability perceptions in Q-Commerce grocery delivery, relating to the efficiency of deliveries, eco-social awareness, and behavioural intentions. The population target was urban and suburban Q-Commerce users in Mumbai, and a non-probability convenience sampling method was adopted, resulting in 314 valid responses that showed demographic diversity in age, income, occupation, and usage frequency.

Data were collected using an online structured questionnaire made up of relevant demographic and usage-related questions, in combination with perception-based statements measured on a five-point Likert scale ranging from 1 = Strongly Disagree to 5 = Strongly Agree. Three hypotheses are tested: that, first, delivery speed and convenience improve customer satisfaction; second, environmental and social sustainability perceptions improve satisfaction and behavioural intentions; and third, consumers give in to ultra-fast delivery for sustainability.

Data were analysed using SPSS, employing descriptive statistics, reliability analysis (Cronbach's $\alpha = 0.74$), correlation, and multiple regression analyses at a 5% significance level. Ethical considerations included voluntary participation, informed consent, anonymity, and confidentiality, while content validity and internal reliability were ensured through literature-based scale development and established measurement practices.

Data Analysis and Results:

The data were analysed using appropriate descriptive and inferential statistical techniques to test the hypotheses at a 5% significance level.

Table No. 1 Age-wise Distribution of Respondents

Age Group	Frequency	Percentage (%)
Less than 25	153	48.73%
25 – 35	46	14.65%
36 – 45	67	21.34%
46 – 55	35	11.15%
More than 55	13	4.14%
Total	**314**	**100.00%**

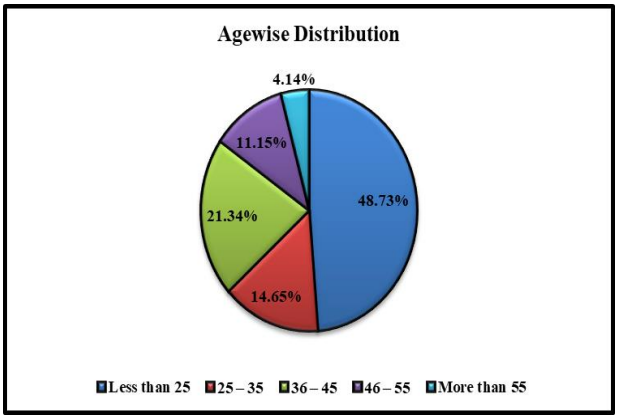

Chart No. 1 Age-wise Distribution of Respondents

Interpretation: The age-wise distribution indicates that nearly half of the respondents (48.73%) belong to the below 25 years category, highlighting strong adoption of Q-Commerce grocery delivery among younger consumers. Respondents aged 36–45 years form the second-largest group (21.34%), followed by those aged 25–35 years (14.65%). Participation from older age groups (above 55 years) is comparatively limited, suggesting lower penetration of Q-Commerce services among senior consumers.

Table No. 2 Annual Income-wise Distribution of Respondents

Annual Income (Rs.)	Frequency	Percentage (%)
Less than 2,50,000	153	48.73%
2,50,000 – 5,00,000	59	18.79%
5,00,001 – 7,50,000	36	11.46%
7,50,001 – 10,00,000	19	6.05%
More than 10,00,000	47	14.97%
Total	**314**	**100%**

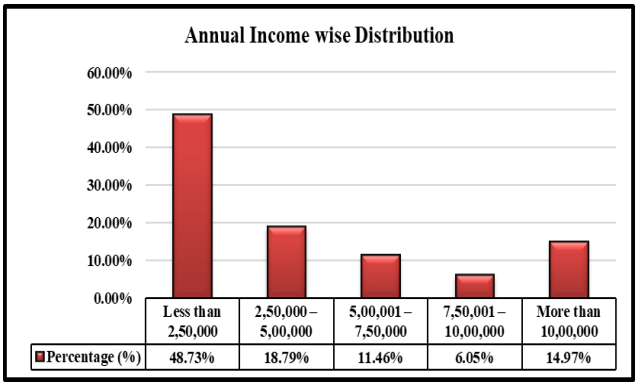

Chart No. 2 Annual Income-wise Distribution of Respondents

Interpretation: The chart shows that nearly half of the respondents (48.73%) have an annual income of less than ₹2,50,000, making them the largest group. Middle-income groups (₹2,50,000 – ₹7,50,000) account for around 30%, while higher-income groups above ₹10,00,000 represent about 15%. The data indicate a predominantly lower- to middle-income sample, with a smaller proportion of high-income respondents.

Table No. 3 Educational Qualification-wise Distribution of Respondents

Educational Qualification	Frequency	Percentage (%)
Graduate	97	30.89%
Higher Secondary	85	27.07%
Postgraduate	68	21.66%
Professional	40	12.74%
Senior Secondary	24	7.64%
Total	**314**	**100%**

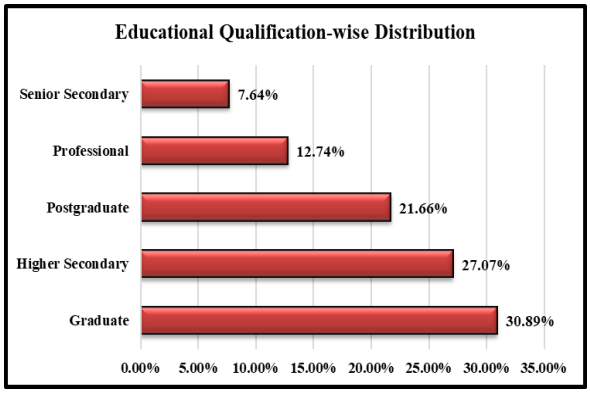

Chart No. 3 Educational Qualification-wise Distribution of Respondents

Interpretation: The chart shows that many respondents are well-educated. Graduates make up the largest group at 30.89%, followed by those with higher secondary education (27.07%) and postgraduates (21.66%). Professional qualifications account for 12.74%, while senior secondary respondents are the smallest group at 7.64%.

Table No. 4 Occupation-wise Distribution of Respondents

Occupation	Frequency	Percentage (%)
Private Service	118	37.58%
Self Employed	78	24.84%
Government	40	12.74%
Homemaker	40	12.74%
Business	32	10.19%
Retired	6	1.91%
Total	**314**	**100%**

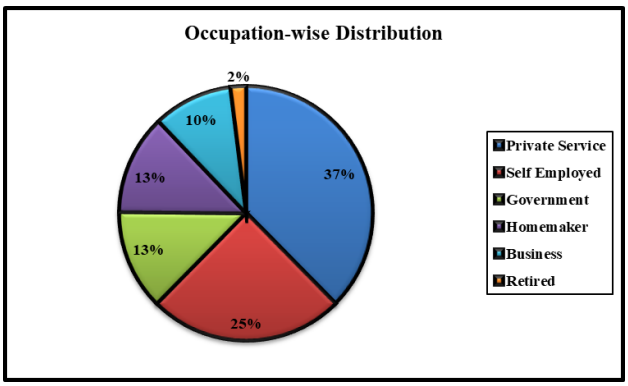

Chart No. 4 Occupation-wise Distribution of Respondents

Interpretation: The occupational profile indicates that respondents employed in private service form the largest segment (37.58%), followed by self-employed individuals (24.84%). Government employees and homemakers each account for 12.74% of the sample, while business owners represent 10.19%. Retired respondents constitute a relatively small proportion, reflecting lower adoption of Q-Commerce services among older and non-working populations.

Table No. 5 Q-Delivery Platforms Used by Respondents

Platform Used	Frequency	Percentage (%)
Blinkit	175	23.71%
Zepto	163	22.09%
Swiggy Instamart	136	18.43%
Amazon Now	77	10.43%
Flipkart Minutes	65	8.81%
JioMart Express	51	6.91%
BigBasket Now	36	4.88%
Dunzo	19	2.57%
FreshToHome	16	2.17%
Total Responses	**738**	**100**

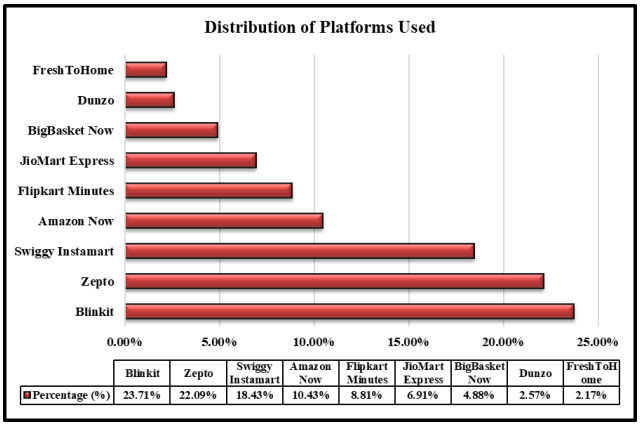

Chart No. 5 Q-Delivery Platforms Used by Respondents

Interpretation:

The results show that Blinkit (23.71%)and Zepto(22.09%) are the most used Q-Commerce platforms, followed by Swiggy Instamart (18.43%), while Amazon Now and Flipkart Minutes have moderate usage. Other platforms attract smaller user segments, indicating a competitive market where consumers often use multiple services depending on convenience and availability.

Table No. 6 Factors Influencing the Choice of Q-Commerce Grocery Delivery Services

Factors	Frequency	Percentage (%)
Speed of Delivery	202	30.84%
Convenience	186	28.40%
Discounts / Offers	119	18.17%
Product Variety	79	12.06%
App Usability	56	8.55%
Other	13	1.98%
Total Responses	**655**	**100%**

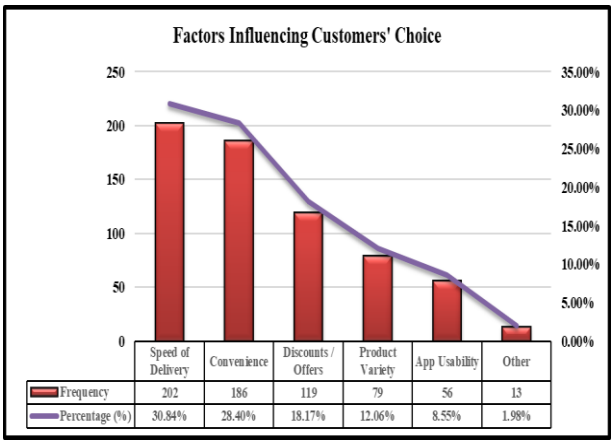

Chart No. 6 Factors Influencing the Choice of Q-Commerce Grocery Delivery Services

Interpretation: The results indicate that speed of delivery (30.84%) is the most influential reason for choosing Q-Commerce grocery delivery services. Convenience (28.40%) emerges as a closely related factor, highlighting the role of ease of ordering and time-saving benefits. Promotional incentives such as discounts and offers (18.17%) also play a significant role, particularly in encouraging frequent usage. Factors such as product variety (12.06%) and app usability (8.55%) contribute to platform selection but are comparatively less dominant. Overall, the findings suggest that Q-Commerce adoption is primarily driven by the immediacy and convenience it offers, supported by economic incentives and platform functionality.

Table No. 7 Time of Day Most Orders Are Placed

Time of Day	Frequency	Percentage (%)
Evening	127	40.45%
Afternoon	93	29.62%
Morning	54	17.20%
Night	40	12.74%
Total	**314**	**100%**

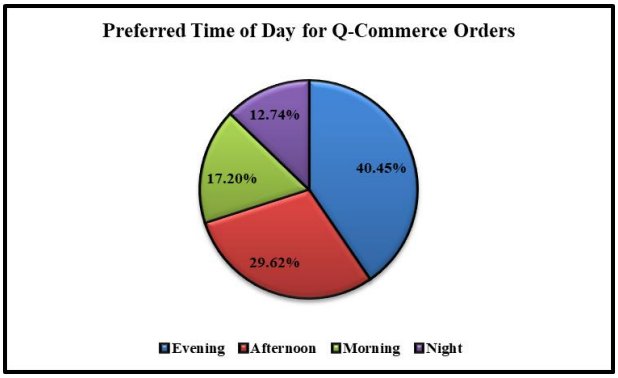

Chart No. 7 Time of Day Most Orders Are Placed

Interpretation: The results indicate that the evening hours (40.45%) represent the most preferred time for placing Q-Commerce grocery orders, reflecting post-work and end-of-day convenience needs. The afternoon period (29.62%) also accounts for a substantial share of orders, suggesting usage during work breaks or household planning hours. Morning orders (17.20%) are comparatively fewer, while night-time ordering (12.74%) remains limited, possibly due to safety concerns or reduced service availability. Overall, the findings highlight that Q-Commerce grocery delivery is primarily utilised during non-working and transition periods, underscoring its role in facilitating time-efficient shopping.

Findings:

1. **H_{01}: Delivering speed and convenience has no significant impact on the level of satisfaction of customers when accessing Q-Commerce grocery delivery services.**

Table No. 8 Correlation between Delivery Speed & Convenience and Overall Customer Satisfaction

Variables Examined	Correlation Coefficient (r)	p-value	Significance Level	Interpretation
Delivery Speed & Convenience ↔ Customer Satisfaction	0.353 (Pearson's correlation)	< 0.001	5%	Significant positive relationship

Inferential Analysis:

To examine the relationship between delivery speed, convenience, and overall customer satisfaction, a composite mean score was created using Likert-scale items that measured preferences for fast delivery, the impact of speed on platform choice, satisfaction with the promised delivery time, and how fast delivery enhances the overall experience. Since both the independent and dependent variables were represented by continuous composite mean values, Karl Pearson's correlation coefficient was used. The analysis found a correlation coefficient of r = 0.353 with a p-value less than 0.001, indicating a statistically significant relationship at the 5 percent significance level.

2. **H_{02}: Consumer perceptions of environmental and social sustainability do not significantly affect consumer satisfaction and behavioural intention toward Q-Commerce grocery delivery platforms.**

Table No. 9 Impact of Environmental and Social Sustainability Perceptions on Customer Satisfaction and Behavioural Intention

Independent Variables	Dependent Variable	Method Used	Significance (p-value)	Interpretation
Environmental Sustainability Perceptions	Customer Satisfaction	Multiple Regression	$p < 0.05$	Significant effect
Social Sustainability Perceptions	Behavioural Intention	Multiple Regression	$p < 0.05$	Significant effect

Inferential Analysis:

To examine the effect of environmental and social sustainability perceptions on overall customer satisfaction and behavioural intention toward Q-Commerce grocery delivery platforms, composite mean scores were constructed from Likert-scale items measuring environmental sustainability (eco-friendly packaging, packaging waste, carbon emissions, use of electric vehicles, and willingness to wait for greener delivery) and social sustainability (delivery partner safety, fair compensation, and work pressure). Customer satisfaction and behavioural intention were treated as dependent variables, with behavioural intention represented by the composite mean of continued usage and recommendation intention. Since the variables were continuous composite mean values, multiple regression analysis was

employed to assess the combined influence of sustainability perceptions. The regression results indicated a statistically significant effect of environmental and social sustainability perceptions on customer satisfaction and behavioural intention ($p < 0.05$). Accordingly, at the 5 percent level of significance, the result is statistically significant.

3. **H_{03}: Consumers' sustainability awareness has no significant influence on their willingness to compromise on ultra-fast delivery in favour of sustainable Q-Commerce options.**

Table No. 10 Correlation between Preference for Fast Delivery and Willingness to Wait for Greener Delivery

Variables Examined	Statistical Test Used	Correlation Coefficient (r)	p-value	Level of Significance	Interpretation
Preference for Fast Delivery ↔ Willingness to Wait for Greener Delivery	Pearson's Correlation	0.389	< 0.001	5%	Statistically significant relationship

Inferential Analysis:

To examine whether sustainability awareness influences consumers' willingness to compromise on ultra-fast delivery, the relationship between preference for fast delivery and willingness to wait longer for a greener delivery option was analysed. Both variables were measured using five-point Likert-scale items and treated as continuous variables for analysis.

As the objective was to assess the strength and direction of association between these two continuous measures, Karl Pearson's correlation coefficient was applied. The analysis yielded a correlation coefficient of $r = 0.389$ with a p-value < 0.001, indicating a statistically significant relationship. Accordingly, at the 5 percent level of significance, the result is statistically significant.

Since each research objective was directly operationalized through a corresponding hypothesis, the results of hypothesis testing adequately address the stated objectives of the study. Thus, these findings presented above fulfil the research objectives.

Conclusion:

The conclusions drawn in the research point towards Q-Commerce grocery delivery in India as being driven primarily by the demands for "speed, convenience, and immediate delivery, especially in emergency or impulse purchases by working professionals, dual-income, or urban families." Small basket orders, together with an identified preference for fast delivery, tracking, usability, as well as incentive-based promotions, have, however, driven customer satisfaction and overall loyalty to these platforms. Interestingly, at the same time, the emergence of a certain transition in the mode of consumer assessment has indicated the growing influence of environmental and social factors, including packaging, carbon emissions, or delivery partner conditions, on customer satisfaction as well as behaviour. There is, however, a certain growing section today who are now Ready to trade off a

slight compromise in delivery times in lieu of improved Sustainability.

Entrance of technology and innovation: This refers to factors that make Q-Commerce platforms more competitive in terms of efficiency and adopting proper business practices. This shall involve leveraging AI logistics, dark-store optimization, green logistics solutions, and improved working conditions for delivery personnel to enhance customer trust and satisfaction.

Challenges in Q-Commerce:

Q-Commerce, despite its huge growth, is also encountering numerous major challenges, which influence its sustainability in the market. Some major challenges encountered are as follows:

1. Higher logistics and infrastructure costs associated with high investment in dark stores, micro-fulfillment centers, and AI-based technology.
2. Environmental sustainability relates to increased gas emissions from transportation due to increased deliveries resulting from small order packages.
3. Worker welfare and regulatory issues such as Delivey partner stress, safety issues, time constraints, and labour laws.
4. Scalability and profitability challenges, as the structure of the models of this type of e-commerce makes them mostly applicable in large cities, which cannot easily be extended to the surrounding regions or countryside.

Recommendations:

The study provides recommendations for Q-Commerce platforms, policymakers, and consumers to enhance sustainability, ensure worker welfare, and promote responsible usage.

Stakeholder	Recommendations
Q-Commerce Platforms	• Use eco-friendly and reusable packaging materials. • Offer delivery options allowing customers to choose between ultra-fast and environmentally responsible deliveries. • Enhance delivery partner well-being through safety measures, fair compensation, and better working conditions. • Adopt green logistics systems, including electric vehicles and route-optimization technologies.
Policymakers	• Establish legal frameworks protecting gig-economy workers, including insurance, safety, and wages. • Enforce environmental regulations for express delivery services, promoting sustainable packaging and reduced carbon footprints.
Consumers	• Practice responsible consumption by ordering in bulk and choosing eco-friendly delivery options. • Increase awareness of environmental and social impacts of ultra-fast delivery, integrating sustainability education into broader learning frameworks.

Limitations and Future Research:

This study has a few limitations, including the use of convenience sampling and a cross-sectional design, which limit generalizability, and reliance on self-reported data, which may cause response bias. Future research could use longitudinal and probability-based studies for broader insights, incorporate qualitative methods to understand consumer trade-offs, and analyze platform-level data to

explore how technology and incentives can promote sustainable Q-Commerce practices without reducing convenience.

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Original or AI-Assisted? Exploring the Creative Identity of Students in the Gen AI Era

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Abstract:

The rapid growth of generative artificial intelligence tools in higher education seriously impacts how students generate ideas, write, solve problems, and express themselves creatively. In this paper, we investigated the evolving creative identity of students in the GenAI era by analysing the patterns of AI usage and perceived impact on creativity and originality. Primary data were collected through a structured questionnaire among undergraduate and postgraduate students, which incorporated Likert scale measures of creativity before and after the use of GenAI tools, combined with open ended responses. The analysis used descriptive statistics, visualizations in the form of bar charts, pie charts, and comparative graphs, along with certain inferential techniques like t tests, ANOVA, correlation and Multiple linear regression to examine the differences in the levels of creativity relating to the intensity and time of usage. Word cloud and sentiment analyses have also been considered to analyse qualitative perceptions of AI assisted creativity. From the findings, it is clear that while GenAI tools increase speed, clarify complex ideas, and support brainstorming, too much dependence on them will weaken students' self confidence in their own creative capacity and authorship. This study reveals a nuanced shift in creative identity from individual originality toward technology assisted co creation and expresses the imperative for AI literacy and creativity preserving practices within academic contexts to foster responsible and reflective use of GenAI tools.

Keywords: Generative AI, Creative Identity, Student Creativity, AI Assisted Learning, Originality.

Introduction:

The rapid growth of digital technologies has continually transformed educational practices, and in recent years, generative artificial intelligence (GenAI) has emerged as one of the most influential developments in this space. Tools such as ChatGPT, DALL·E, Midjourney, and other AI based platforms are now commonly used by students to generate ideas, draft assignments, solve problems, and support creative tasks. As these tools become increasingly integrated into higher education, they raise important questions about how students' creativity, originality, and sense of authorship are being shaped.

Traditionally, creativity has been viewed as a uniquely human ability rooted in imagination, originality, critical thinking, and personal expression. In academic settings, creative skills are closely connected to students' capacity for independent thinking, problem-solving, and effective communication. The widespread use of GenAI tools, however, has introduced a new way of creating one in which creative work often emerges through interaction between humans and AI. While these tools can make learning more efficient, offer inspiration, and lower cognitive barriers, they also generate concerns about over-reliance, reduced originality,

and a decline in students' confidence in their own creative abilities.

Existing research reflects this dual nature of AI-assisted creativity. On the positive side, GenAI tools help students brainstorm ideas, simplify complex concepts, and explore diverse perspectives quickly. At the same time, excessive dependence on these technologies may encourage surface level engagement, weaken critical thinking, and blur boundaries around intellectual ownership. These contrasting perspectives suggest that the impact of GenAI on creativity is neither entirely beneficial nor entirely harmful but varies depending on how and why the tools are used.

Despite growing scholarly interest in artificial intelligence in education, relatively little empirical research has focused on students' own perceptions of how GenAI affects their creative identity. In particular, there is a lack of studies examining how different patterns of AI usage such as frequency, duration, and purpose relate to students' perceived creativity, originality, and self-confidence. Understanding these perceptions is essential for promoting responsible use of AI and for integrating such technologies into academic environments in ways that support, rather than undermine, creative development.

The present study addresses this gap by exploring students' perceived experiences with generative AI tools and their impact on creativity and originality in higher education. Adopting a mixed-method approach, the study combines quantitative comparisons of creativity ratings before and after GenAI use with qualitative insights drawn from open-ended student responses. By examining both the advantages and potential risks of AI-assisted creativity, this research seeks to develop a nuanced understanding of how GenAI is reshaping students' creative identities and to offer practical insights for educators and institutions striving to balance technological innovation with the preservation of human creativity.

Literature Review:

Gholap et al. (2025) highlight this tension by noting that while AI tools can improve efficiency and support idea generation, excessive reliance may reduce originality and personal creative engagement. They emphasize that human creativity should remain central, with AI serving as an assistive rather than a substitutive tool. Similarly, Sharma (2025) reports mixed student perceptions, showing that some learners view AI as a source of inspiration, while others worry that dependence on AI may weaken independent thinking and creative confidence.

The role of educators also emerges as crucial. Mickelsen (2025) argues that AI's influence on creativity largely depends on how it is integrated into teaching. When guided thoughtfully and ethically by educators, AI is more likely to support positive creative development. Supporting this broader perspective, Henriksen, Mishra, and Stern (2024) suggest that creativity in the AI era extends beyond generating novel ideas to include responsible thinking and human centered values.

From a psychological standpoint, Karwowski et al. (2013) demonstrate that individuals' beliefs in their own creative abilities strongly shape their creative engagement, validating the use of self-reported creativity measures. Earlier work by Taylor (1988) also supports self-assessment approaches, emphasizing that creativity in higher education is subjective and best understood through students' own perceptions.

Objectives

1. To examine the patterns and extent of Generative AI usage among students in terms of frequency, duration, and purpose

of use. And to assess changes in students' perceived creativity before and after the use of Generative AI tools, thereby evaluating the role of AI in creative enhancement.

2. To analyze gender-based , Stream based and usage based differences in creativity levels after using Generative AI tools, if any.
3. To identify key predictors of creativity change with particular emphasis on positive and reflective AI usage.
4. To explore students' qualitative perceptions of originality and creative confidence in the context of AI-assisted work.

Research Methodology:

The present study adopted a quantitative-dominant mixed-methods research design to examine the impact of Generative Artificial Intelligence on students' creativity and originality in higher education. Primary data were collected through a structured questionnaire administered to undergraduate and postgraduate students across Science, Commerce, and Arts streams. A convenience sampling technique was employed due to accessibility and respondent availability, yielding a final sample of 175 valid responses. The questionnaire comprised multiple sections covering demographic information, patterns of Generative AI usage (frequency, duration, and purpose), perceived dependency, creativity levels before and after AI usage, and reflective perceptions related to originality and confidence without AI tools. Creativity-related items were measured using a Likert-scale instrument consisting of 12 statements.

Prior to full-scale data collection, a pilot study was conducted to assess clarity and reliability of the instrument, followed by minor refinements. The internal consistency of the creativity scale was evaluated using Cronbach's alpha, which yielded a value of 0.748, indicating acceptable reliability. Quantitative data were analyzed using descriptive statistics, correlation analysis (Spearman's rho), independent samples tests, and multiple linear regression to examine predictors of creativity change. Visualization techniques were employed to illustrate usage patterns and creativity trends. Additionally, qualitative data from open-ended questionnaire responses were analyzed using sentiment analysis and word cloud techniques to capture students' perceptions of originality and confidence in the absence of AI tools. The integration of quantitative and qualitative methods enabled a comprehensive understanding of how Generative AI influences creativity in the contemporary educational context.

Results And Discussions:

Descriptive Analysis:

AI_usage_frequency

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	27	15.3	15.3	15.3
	2.00	80	45.5	45.5	60.8
	3.00	56	31.8	31.8	92.6
	4.00	11	6.3	6.3	98.9
	5.00	2	1.1	1.1	100.0
	Total	176	100.0	100.0	

Table 1

Table 1 illustrates that frequency distribution of AI usage indicates that most students engage with generative AI tools at moderate levels. Nearly half of the respondents (60%) reported a usage frequency is less than 1 hour, followed by 32% between 1 to 2 hours. And with only 8% of students reporting very high usage levels (more than 2 hours). Overall, the results suggest that students predominantly use AI tools occasionally to moderately rather than excessively.

Rating	Female	Male
Creativity after using AI	7.1739	7.8313
Creativity before using AI	6.7717	6.7590

Table 2

Table 2 explains that average creativity ratings increased after using AI for both female and male students. While creativity levels before AI were almost the same across genders, male students reported a slightly higher creativity gain after AI usage.

Duration	frequency
Less than 1 hour	135
1–2 hours	32
more than 2 hours	8

Table 3

Table 3 presents majority of students reported using generative AI tools for less than one hour per day, while fewer students used AI for one to two hours, and only a very small proportion reported usage exceeding two hours. This indicates predominantly moderate and limited daily use of AI among students.

Visualisation:

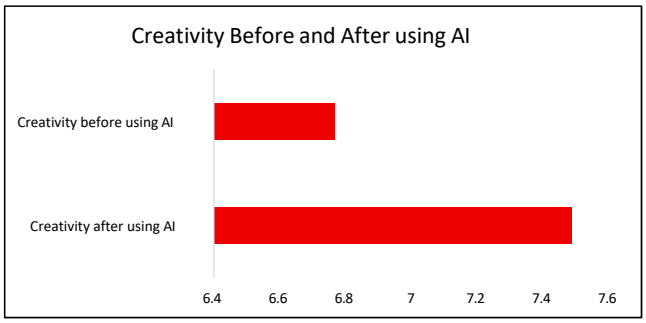


Figure 1

Figure 1 illustrates the comparison of creativity scores before and after the use of generative AI tools across gender. The results indicate an increase in creativity scores for both male and female students following AI usage. While pre AI creativity levels appear comparable across genders, post AI creativity scores are higher among male students. This suggests that although generative AI enhances creativity for all students, the magnitude of perceived improvement varies slightly by gender.

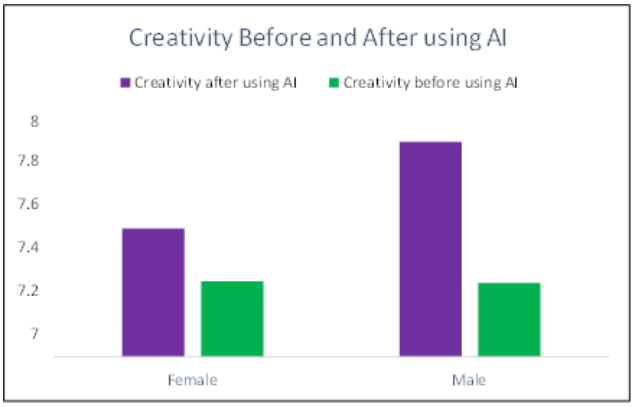


Figure 2

Figure 2 presents the overall comparison of creativity scores before and after the use of generative AI tools. The findings reveal a substantial increase in perceived creativity following AI usage, indicating that students generally view AI tools as supportive of creative thinking, idea generation, and task execution.

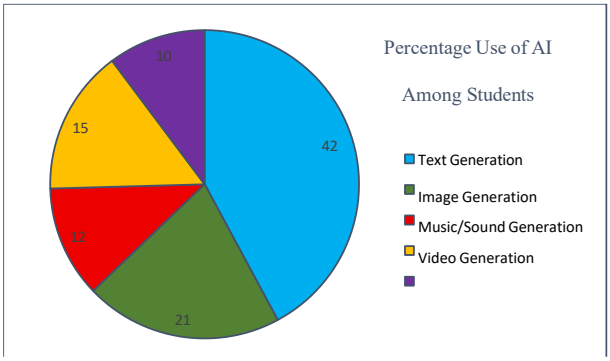


Figure 3

Figure 3 illustrates the distribution of generative AI tool usage among students. The findings indicate that text generation tools are the most widely used, accounting for 42% of total usage, followed by image generation (21%). Applications such as video generation (15%), music or sound generation (12%), and code generation (10%) are comparatively less utilized. This pattern suggests that students predominantly rely on generative AI for language-based and

content-oriented academic tasks rather than technical or specialized creative outputs.

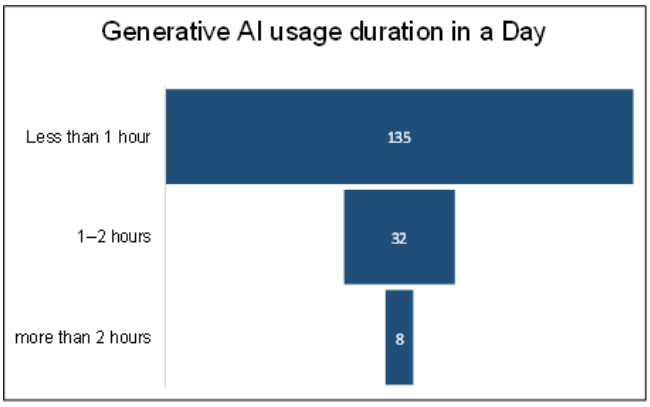


Figure 4

Figure 4 illustrates the daily duration of generative AI usage among students. The results indicate that a substantial majority of students engage with generative AI tools for less than one hour per day, suggesting predominantly moderate and task-oriented usage. A smaller proportion of students reported using AI for one to two hours daily, while only a minimal number of respondents indicated usage exceeding two hours per day. This pattern reflects limited dependence on generative AI tools and suggests that most students utilize AI selectively rather than extensively.

Reliability Check:

Reliability Statistics

Cronbach's Alpha	N of Items
.748	12

The internal consistency of the creativity scale was assessed using Cronbach's alpha. The obtained alpha value of 0.748 across 12 items indicates acceptable reliability, suggesting that the items consistently measure the underlying construct of creativity. This level of reliability confirms the suitability of the scale for further statistical analysis and supports the credibility of the findings.

Hypothesis testing:

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Creativity before using Generative AI tools - Creativity after using Generative AI tools	-.699	2.360	.178	-1.050	-.348	-3.928	175	.000

Table 4

The study reveals that creativity levels significantly improved after the use of Generative AI tools, with a moderate positive relationship between pre and post creativity scores, indicating that Generative AI serves as an effective facilitator of human creativity.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Creativity after using Generative AI tools	Equal variances assumed	6.533	.011	2.013	173	.046	.657	.327	.013	1.302
	Equal variances not assumed			2.041	168.295	.043	.657	.322	.022	1.293

Table 5

The findings reveal a statistically significant but small gender-based difference in creativity after using Generative AI tools, with males reporting marginally higher creativity scores than females.

ANOVA

Creativity after using Generative AI tools

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.275	2	.138	.029	.972
Within Groups	823.674	173	4.761		
Total	823.949	175			

Table 6

There is no significant difference in creativity levels after using Generative AI tools among students from Science, Commerce, and Arts streams. This suggests that the perceived impact of Generative AI on creativity is uniform across academic disciplines, indicating that GenAI tools influence students' creativity independently of their stream of study.

ANOVA

Creativity after using Generative AI tools

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	27.480	4	6.870	1.475	.212
Within Groups	796.469	171	4.658		
Total	823.949	175			

Table 7

There is no significant difference in creativity levels after using Generative AI tools across different durations of AI usage. This indicates that spending more time on GenAI tools does not necessarily lead to higher or lower perceived creativity, suggesting that the quality and manner of usage may be more important than duration alone.

Correlation:

Correlations

			AI_usage_frequency	creativity_change
Spearman's rho	AI_usage_frequency	Correlation Coefficient	1.000	-.046
		Sig. (2-tailed)	.	.547
		N	176	176
	creativity_change	Correlation Coefficient	-.046	1.000
		Sig. (2-tailed)	.547	.
		N	176	176

Usage Frequency and Creativity Change:

Spearman's correlation revealed no significant association between AI usage frequency and creativity change (ρ = −0.046, p = 0.547).There is no significant relationship between the frequency of Generative AI usage and the change in creativity levels among students. This suggests that using AI tools more frequently does not necessarily lead to an increase or decrease in creativity, reinforcing the idea that the impact of GenAI on creativity depends more on how the tools are used rather than how often they are used.

Correlations

			creativity_change	dependency_score
Spearman's rho	creativity_change	Correlation Coefficient	1.000	-.055
		Sig. (2-tailed)	.	.469
		N	176	176
	dependency_score	Correlation Coefficient	-.055	1.000
		Sig. (2-tailed)	.469	.
		N	176	176

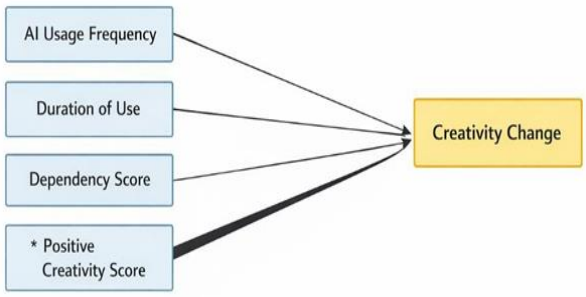
Dependency Score and Creativity Change:

The analysis showed a weak negative correlation (ρ = –0.055), which was not statistically significant (p = 0.469), suggesting no meaningful relationship between AI dependency and creativity change among students.

Our correlation results suggest that AI dependency alone does not significantly predict creativity change, highlighting that the impact of GenAI on creativity depends more on how the tools are used rather than how much they are used.

Multiple Linear Regression:

Multiple Linear Regression Model



Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.250[a]	.063	.041	2.31200	.063	2.852	4	171	.025	1.921

a. Predictors: (Constant), positive_creativity_score, Duration_, AI_usage_frequency, dependency_score

b. Dependent Variable: creativity_change

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	2.731	1.082		2.524	.013		
	AI_usage_frequency	.034	.221	.012	.152	.879	.865	1.157
	dependency_score	.180	.242	.060	.743	.459	.830	1.205
	Duration_	.013	.245	.004	.052	.958	.860	1.163
	positive_creativity_score	-1.202	.367	-.268	-3.274	.001	.818	1.222

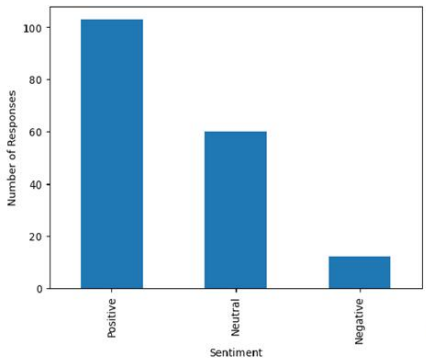
a. Dependent Variable: creativity_change

A multiple linear regression analysis was conducted to examine whether AI usage frequency, duration of use, dependency score, and positive creativity score predict creativity change among students. The overall regression model was statistically significant, $F(4, 171) = 2.85$, $p = 0.025$, indicating that these predictors collectively explain a significant, though modest, portion of variance in creativity change.

Among the predictors, positive creativity score emerged as the only significant predictor ($\beta = -0.268$, $p = 0.001$), suggesting that students' reflective and constructive engagement with Generative AI plays a more important role in creativity outcomes than the quantity of AI use. AI usage frequency, duration, and dependency score were not significant predictors ($p > 0.05$), indicating that creativity change is not determined by how often, how long, or how dependently AI tools are used.

Overall, the findings suggest that creativity in the GenAI era is shaped more by the quality and mindset of AI use than by its frequency or duration. This highlights the importance of promoting reflective and responsible AI practices to support creativity rather than undermining it.

Qualitative Analysis:



1. Sentiment on Generative AI and Originality:

Together, the sentiment analysis and word cloud suggest that students do not view Generative AI as inherently harmful or inherently beneficial to originality. Instead, originality is perceived as being shaped by the way AI is used as a tool for enhancement, guidance, and refinement rather than as a replacement for human thought and creativity. The findings indicate that while students largely acknowledge the creative potential of Generative AI, they also recognize the importance of maintaining independent thinking to preserve originality.

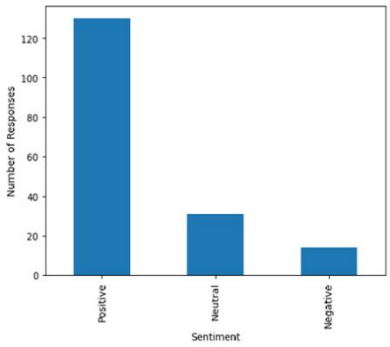


Table 8 Sentiment With respect to confidence without AI tools

Taken together, the findings suggest that students' creative confidence is not entirely reliant on AI tools. Most students believe they can perform creative tasks independently; however, Generative AI has become a confidence amplifier rather than a confidence substitute. When AI tools are removed, creativity persists, but the process may feel more effort-intensive or time-consuming for some learners.

Conclusion:

This study examined the impact of Generative Artificial Intelligence on students' creativity by integrating descriptive statistics, inferential analysis, and qualitative insights. The findings collectively demonstrate that Generative AI functions primarily as a supportive and facilitative tool rather than a determinant of creativity.

The descriptive analysis revealed that students engage with Generative AI at moderate and task oriented levels, with the majority using AI tools for less than one hour per day and primarily for text-based academic and creative tasks. This indicates selective and purposeful usage rather than excessive dependence. Creativity ratings showed a consistent increase after AI usage for both male and female students, suggesting that Generative AI positively influences perceived creative ability. While male students reported slightly higher post AI creativity scores, the difference was small, indicating broadly similar benefits across genders.

Inferential analysis further confirmed a significant improvement in creativity after AI usage, supporting the role of Generative AI as an enabler of idea generation, exploration, and creative execution. However, no significant differences were observed across academic streams or usage durations, emphasizing that creativity enhancement through AI is not discipline specific nor time dependent. Correlation analysis reinforced this finding by showing no significant relationship between creativity change and AI usage frequency or dependency, suggesting that creativity is not automatically enhanced by greater or more frequent AI use.

Multiple linear regression results provided critical insight into the nature of AI driven creativity. While the overall model was statistically significant, positive creativity orientation emerged as the only meaningful predictor of creativity change. This highlights that students' mindset, reflective engagement, and responsible use of AI tools are far more influential than mere exposure, duration, or reliance on AI. Thus, creativity in the GenAI era appears to be shaped by intentional and constructive interaction rather than technological intensity.

Qualitative findings further enriched these conclusions. Sentiment analysis and word cloud interpretation revealed that students do not perceive Generative AI as a threat to originality. Instead, originality is viewed as a human centered outcome, strengthened when AI is used for guidance, refinement, and inspiration rather than substitution. Additionally, students expressed confidence in their ability to perform creative tasks without AI, indicating that Generative AI acts as a confidence enhancer rather than a creative crutch.

Overall, the study concludes that Generative AI does not diminish students' creative identity but instead redefines creativity as a collaborative process between human cognition and intelligent tools. The findings underscore the importance of promoting ethical, reflective, and pedagogically guided AI use in higher education. When used thoughtfully, Generative AI can enhance creativity without undermining

originality, autonomy, or independent thinking. Future research may explore longitudinal effects, discipline specific creative processes, and instructional strategies that integrate Generative AI to maximize creative learning outcomes.

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The Study of Artificial Intelligence & Data Privacy in Healthcare

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Abstract:

The integration of artificial intelligence in healthcare has improved diagnostic accuracy, treatment, and operational efficiency, it also raises concerns regarding patient data privacy and security. This study investigates the intersection between AI implementation in healthcare and the protection of sensitive patient information. This research identifies key data privacy challenges inherent to these technologies. The study explores issues such as data collection and consent mechanisms, algorithmic transparency and re-identification risks in anonymized datasets, unauthorized access vulnerabilities.

Data were analyzed using appropriate parametric and non-parametric statistical tests including t-tests, ANOVA and chi-square analyses to examine the relationships between AI implementation and data privacy outcomes. The study measured privacy impact through multiple dimensions including privacy breach incidents, compliance with regulatory standards, security protocol adherence, and self-reported awareness levels among different categories of healthcare professionals.

Introduction:

The integration of Artificial Intelligence (AI) into healthcare is transforming the way medical services are delivered, analysed, and optimized. AI-driven systems can process vast amounts of clinical data, identify patterns, assist in diagnosis, personalize treatment plans, and improve operational efficiency. From predictive analytics to automated medical imaging interpretation, AI holds the potential to enhance patient outcomes and reduce healthcare costs.

However, this technological advancement comes with significant concerns regarding data privacy. Healthcare data is highly sensitive, containing personal identifiers, medical histories, genetic information, and other confidential details. The use of AI often requires large datasets, which increases the risk of unauthorized access, misuse, and breaches. Furthermore, issues such as informed consent, data anonymization, compliance with regulations like HIPAA and GDPR, and the ethical use of patient information have become central to AI adoption in healthcare. Balancing the innovative potential of AI with stringent data privacy safeguards is therefore essential. This intersection of technology and ethics forms a critical area of research, aimed at ensuring that AI systems not only advance medical science but also maintain the trust and rights of patients.

Literature Review:

Price and Cohen in their paper titled " The data-intensive nature of AI systems introduces substantial privacy vulnerabilities." (2019) articulated concerns about the massive data aggregation required for training robust AI models, noting that healthcare AI systems often necessitate access to thousands or millions of patient records. A review of literature on artificial

intelligence (AI) and data privacy in healthcare reveals a complex, dual-sided narrative. On one hand, AI offers immense potential to revolutionize medical care through enhanced diagnostics, personalized treatment, and streamlined operations. This potential, however, is directly tied to the use of massive datasets of sensitive patient information, which creates significant privacy and security risks. Studies consistently highlight that even with de-identification techniques, "anonymized" healthcare data can often be re-identified through sophisticated methods. The opaque nature of some "black box" algorithms, which makes it difficult to understand how decisions are made, and the potential for algorithmic bias, which can lead to unequal health outcomes for certain populations, are major ethical challenges explored in the literature. This raises fundamental questions about patient trust and the difficulty of obtaining truly informed consent for data use in evolving AI systems.

To address these issues, the literature points to a combination of technological and policy-based solutions. A key area of research is privacy-preserving machine learning (PPML), which includes techniques such as federated learning and differential privacy. Federated learning allows AI models to be trained on data from multiple institutions without the data ever leaving its source, while differential privacy adds mathematical noise to protect individual identities. On the policy front, there is a strong call for a risk-based regulatory framework specifically tailored for AI in healthcare. This approach would balance innovation with patient protection by linking the level of oversight to the potential for harm. Ultimately, the successful and ethical integration of AI in healthcare requires a multidisciplinary effort, combining advanced technological safeguards with clear legal guidance and a deep commitment to ethical principles like transparency, fairness, and accountability.

Research Methodology:

1 Research Question:

How Artificial Intelligence affect data privacy in healthcare?

2 Research Design:

This study employs a mixed-methods research design, integrating both quantitative and qualitative approaches. The purpose is to explore the impact of AI on healthcare data privacy and evaluate related ethical and regulatory concerns. While quantitative data provides statistical insight, qualitative data offers depth through personal and organizational experiences.

3.Sample Size:

The sample size for this study is 100 participants, chosen to balance the depth and manageability of data collection within the scope of this research. This number is sufficient to provide meaningful insights while maintaining feasibility given the study's resources and timeframe.

Objectives:

1. To examine the role of Artificial Intelligence in the healthcare sector.
2. To analyse the awareness and perceptions of data privacy issues in AI-driven healthcare systems.
3. To identify key data privacy and security challenges associated with the use of AI in healthcare.
4. To study the ethical and legal implications of AI adoption in handling healthcare data.
5. To assess the need for policies and safeguards to ensure secure and responsible use of AI in healthcare.

Hypotheses:

H_{01}: Artificial Intelligence has no significant impact on data privacy in healthcare.

H_{11}: Artificial Intelligence has a significant impact on data privacy in healthcare.

H_{02}: There is no significant difference in data privacy awareness among healthcare professionals using AI systems.

H_{12}: There is a significant difference in data privacy awareness among healthcare professionals using AI systems.

H_{03}: The use of Artificial Intelligence does not affect patient data security in healthcare.

H_{13}: The use of Artificial Intelligence affects patient data security in healthcare

Data Collection Methods:

- **Surveys:**
  Distribute questionnaires to healthcare professionals, AI developers, and data privacy officers to gather quantitative data on awareness and attitudes toward AI and privacy.
- **Interviews:**
  Conduct semi-structured interviews with experts in healthcare AI, data security, and ethics to collect qualitative insights.

Significance of the Study:

This study examines the application of Artificial Intelligence in healthcare with a focus on data privacy and patient confidentiality. It provides insights into ethical, legal, and managerial challenges associated with AI adoption and supports policymakers and healthcare administrators in promoting responsible and secure use of AI technologies.

Limitations of the Study:

The study is limited by a restricted sample size and reliance on perception-based data. Rapid technological changes in AI and the narrow focus on data privacy, rather than technical performance, may limit the generalizability and long-term relevance of the findings.

Demographic Profile:

1.Gender-wise Distribution

Gender	Frequency	Percentage
Male	54	54
Female	46	46
Total	**100**	**100**

Interpretation: In above table 54% of respondents are male and 46% are female, indicating a fairly balanced gender representation.

Age-wise Distribution

Age Group	Frequency	Percentage
Below 25	22	22
25–35	38	38
36–45	25	25
Above 45	15	15
Total	**100**	**100**

Interpretation: The table indicates that the majority of respondents (38%) belong to the 25–35 age group, suggesting active professional participation.

Profession-wise Distribution

Profession	Frequency	Percentage
Doctors	30	30
Nurses	28	28
Healthcare IT Staff	22	22
Administrators	20	20
Total	**100**	**100**

Interpretation: Respondents represent diverse professional roles, ensuring multiple perspectives on AI and data privacy in healthcare.

4. Experience-wise Distribution

Experience	Frequency	Percentage
Less than 5 years	35	35
5–10 years	40	40
Above 10 years	25	25
Total	**100**	**100**

Interpretation: A majority of respondents (40%) have 5–10 years of experience, indicating adequate professional exposure.

5. Use of AI-based Systems

AI Usage	Frequency	Percentage
Yes	68	68
No	32	32
Total	**100**	**100**

Interpretation: Most respondents (68%) reported using AI-based systems in healthcare, enabling meaningful comparative analysis.

Awareness of Artificial Intelligence in Healthcare:

Descriptive Statistics for Awareness of AI

Items	N	Mean	Std. Deviation
Awareness of AI technologies in healthcare	100	4.25	0.68
AI widely adopted in healthcare	100	4.32	0.59
AI tools essential for healthcare tasks	100	3.97	0.99
Organization encourages AI usage	100	4.12	0.5

Interpretation: Mean scores above 4 indicate high awareness of AI in healthcare, with consistent responses across participants.

Data Privacy and Security Concerns:

Descriptive Statistics for Data Privacy

Statements	N	Mean	Std. Deviation
Concern about patient data privacy	100	4.28	0.71
AI systems adequately protect data	100	3.62	0.88
Fear of data misuse	100	4.1	0.76
Adequacy of data protection laws	100	3.55	0.9

Interpretation: Respondents show strong concern regarding data privacy, while moderate confidence exists in current protection mechanisms.

Hypothesis Testing:

1. t-Test Analysis

Hypothesis:

H_0: No significant difference in data privacy awareness between AI users and non-users.

Independent Sample t-Test

Group	Mean	Std. Dev	t-value	p-value
AI Users	4.12	0.65	2.45	0.016
Non-AI Users	3.78	0.72		

Interpretation: Since $p < 0.05$, the null hypothesis is rejected. There is a significant difference in data privacy awareness between AI users and non-users.

2. Chi-Square Test Analysis:

AI Usage vs Data Privacy Concern

AI Usage	High Concern	Low Concern	Total
Yes	50	18	68
No	16	16	32
Total	**66**	**34**	**100**

$\chi^2 = 6.21$, $p = 0.013$

Interpretation: Since $p < 0.05$, there is a significant association between AI usage and data privacy concerns.

Conclusion and Suggestions:

This study examined the role of Artificial Intelligence in healthcare with a focus on data privacy and security concerns. The findings indicate a high level of awareness and widespread adoption of AI technologies among healthcare professionals. While AI contributes significantly to improving efficiency and decision-making in healthcare, concerns regarding patient data privacy and confidentiality remain prominent.

Statistical analysis revealed significant differences in data privacy awareness between AI users and non-users, as well as a significant association between AI usage and data privacy concerns. These results highlight the need for stronger data protection mechanisms alongside AI implementation.

To address these concerns, healthcare organizations should strengthen data privacy policies, adopt advanced security measures, and conduct regular training programs on ethical and secure use of AI. Policymakers and healthcare institutions must collaborate to ensure responsible AI adoption supported by effective regulatory frameworks.

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An AI-Based Career Roadmap Generation System for IT Students Based on Skill Set Analysis

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DOI - 10.5281/zenodo.19399726

Abstract:

The rapid growth of the IT industry has created numerous career opportunities, making career selection challenging for students. Traditional career guidance approaches are generic and often ignore individual skill variations. This paper proposes an AI-based career roadmap generation system that analyzes students' technical and soft skills to recommend personalized IT career paths. The system maps skills to industry-relevant roles and generates structured learning roadmaps including skills, tools, and certifications. Experimental evaluation using student feedback shows improved clarity and confidence in career decision-making, highlighting the effectiveness of AI-driven career guidance systems in education.

Keywords: Artificial Intelligence, Career Guidance, Skill Set Analysis, IT Careers, Personalized Roadmap

Introduction:

The IT industry offers a wide range of career opportunities, including software development, data science, cybersecurity, cloud computing, and artificial intelligence. While this diversity creates opportunities, it also leads to confusion among students who struggle to identify suitable career path aligned with their skills and interests. Many students rely on peer influence, social media trends, or limited counselling services, which may result in poor career decisions. Artificial Intelligence has shown significant potential in the education sector, particularly in personalization and decision support systems. AI-based recommendation systems can analyze individual data and provide customized suggestions. This research focuses on designing an AI-driven career roadmap generation system that supports IT students in identifying suitable career paths based on their existing skill sets.

Literature Review:

The application of Artificial Intelligence in education has gained significant attention due to its ability to personalize learning experiences and support decision-making processes. Holmes et al. highlighted the transformative potential of AI in education, particularly in adaptive learning and personalized student support systems. Their work emphasizes how AI can analyze learner data to provide tailored recommendations.

Several studies have explored AI-driven recommendation systems in educational contexts. Romero and Ventura discussed the role of educational data mining and learning analytics in extracting meaningful insights from student data to enhance learning outcomes. These techniques

form the foundation for intelligent guidance systems.

Career guidance systems have traditionally relied on psychometric tests and interest-based surveys. However, Kaur and Singh proposed a machine learning-based career guidance system that considers academic performance and interests, demonstrating improved recommendation accuracy compared to traditional methods. Similarly, Reddy and Andrade emphasized the importance of skill-based recommendation systems for predicting suitable career paths, especially in technology-driven domains.

Recent research has also examined the role of conversational agents and intelligent assistants in student support services. Hussain et al. provided a comprehensive survey of chatbot technologies, indicating their effectiveness in providing real-time guidance and information to learners.

Despite these advancements, existing career guidance systems often lack structured career roadmaps and fail to align recommendations with rapidly evolving IT industry requirements.

Most systems provide career suggestions without outlining clear learning paths, required tools, or certification timelines. This research addresses this gap by integrating skill set analysis with an AI-based career roadmap generation approach tailored specifically for IT students.

Problem Statement:

IT students often face difficulty in selecting a career path due to lack of personalized guidance. Existing career counselling methods are generic and do not analyze individual skill sets in relation to industry demands. There is a need for an intelligent system that can evaluate student skills and generate a personalized, structured career roadmap for the IT industry.

Objectives of the Study:

1. To analyze students' technical and soft skills using AI-based techniques
2. To map student skills to suitable IT career roles
3. To generate personalized career roadmaps with required skills and learning timelines
4. To evaluate the effectiveness of the proposed system in career decision-making

Proposed System Architecture:

The proposed AI-based career roadmap generation system consists of the following components:

1. **Skill Input Module:** Collects student data through questionnaires or online tests.
2. **kill Analysis Module:** Analyzes technical and soft skills using predefined rules.
3. **Career Mapping Engine:** Matches analyzed skills with IT career role requirements.
4. **Roadmap Generator:** Produces a step-by-step career roadmap including skills, tools, and certifications.
5. **User Interface:** Displays career recommendations and roadmaps to students.

Methodology:

The research adopts a design and evaluation approach:

1. **Data Collection:** Skill data collected from undergraduate IT students using structured questionnaires.
2. **Skill Classification:** Skills categorized into programming, data handling, security, communication, and problem-solving.
3. **AI Technique:** A rule-based recommendation system is implemented, where predefined rules map skill combinations to career roles.
4. **Roadmap Design:** Each career role

includes short-term and long-term learning goals.

5. **Evaluation:** Student feedback is collected to assess usefulness and satisfaction.

Results and Discussion:

The system was tested with a sample group of IT students. Results showed that students gained better clarity about suitable career paths. Most participants reported increased confidence in career planning and appreciated the structured roadmap approach. The rule- based system effectively mapped skill sets to appropriate IT roles, though future improvements could include machine learning-based predictions.

Conclusion:

This research presents an AI-based career roadmap generation system that assists IT students in making informed career decisions. By analyzing individual skill sets and mapping them to industry-relevant roles, the system provides personalized and practical career guidance. The study demonstrates that AI-driven career recommendation tools can significantly enhance student employability and career readiness. Future work may involve integrating real-time job market data and advanced machine learning models.

Future Scope:

1. Integration of machine learning for dynamic career prediction
2. Use of NLP for resume analysis
3. Incorporation of real-time industry demand data
4. Mobile application development for wider accessibility

Questionnaire Design:

To collect student skill-related data for the proposed AI-based career roadmap system, a structured questionnaire was designed. The questionnaire focuses on technical skills, soft skills, interests, and career goals of IT students. Responses are recorded using a 5-point Likert scale where applicable.

Section A: Basic Information

1. Academic Year (FY / SY / TY / Final Year)
2. Specialization (Computer Science / IT / AI & DS / AIML)

Section B: Technical Skills (Rate 1–5)

3. Programming proficiency in C/C++
4. Programming proficiency in Java / Python
5. Knowledge of Data Structures and Algorithms
6. Database Management Systems (SQL/NoSQL)
7. Web Development (HTML, CSS, JavaScript)
8. Knowledge of Machine Learning / AI concepts
9. Knowledge of Cybersecurity concepts
10. Knowledge of Cloud Computing

Section C: Soft Skills (Rate 1–5)

1. Problem-solving ability
2. Logical thinking
3. Communication skills
4. Teamwork and collaboration
5. Self-learning ability

Section D: Career Interest

6. Interest in Software Development
7. Interest in Data Science / AI
8. Interest in Cybersecurity
9. Interest in Cloud / DevOps
10. Interest in IT Support / Testing

Section E: Career Awareness

11. Awareness of IT career options
12. Confidence in choosing a suitable IT career
13. Need for AI-based career guidance tool (Yes/No)

Sample Dataset:

A sample dataset was created using responses collected from IT students. Table 1 shows a subset of the dataset used for skill analysis and career mapping.

Table 1: Sample Student Skill Dataset

Student ID	Prog Skill	DSA	DBMS	M L	Cyber	Cloud	Soft Skill Avg	Career Interest	Recommended Career
S01	4	4	3	2	2	2	4.0	Software Dev	Software Developer
S02	3	3	4	4	2	2	3.8	Data Science	Data Analyst
S03	2	2	2	3	4	2	3.5	Cybersecurity	Cybersecurity Analyst
S04	3	3	3	2	2	4	3.6	Cloud	Cloud Engineer
S05	4	4	3	4	2	2	4.2	AI	AI / ML Engineer

The dataset is used by the rule-based AI engine to map dominant skills and interests to suitable IT career roles. Average skill scores are computed to identify student strengths and generate personalized career roadmaps.

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Artificial Intelligence Literacy and Its Impact on Learning Outcomes and Academic Performance of Generation Z Students: Evidence from the Mumbai Metropolitan Region

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Abstract:

Artificial intelligence (AI) has emerged as a transformative force in education, enabling personalized learning, skill development, and academic enhancement while supporting Sustainable Development Goal 4 (Quality Education). Despite the growing adoption of AI-driven tools in educational settings, existing research has predominantly focused on technical implementation and pedagogical design, with limited attention to students' behavioral engagement with AI. This study addresses this gap by examining the relationships among AI literacy, AI usage, AI-enabled learning outcomes, and academic performance among Generation Z students in the Mumbai Metropolitan Region (MMR), India.

A quantitative research design was adopted, with data collected from Generation Z students enrolled in higher education institutions across Mumbai City, suburban Mumbai, Navi Mumbai, and Thane. Structural Equation Modelling (SEM) was employed to test the proposed conceptual framework and to analyze both direct and indirect relationships among the study variables. The findings reveal that AI literacy has a significant positive influence on AI usage, AI usage positively affects learning outcomes, and AI-enabled learning outcomes significantly enhance academic performance, indicating meaningful mediating effects.

The study contributes empirical evidence from a major metropolitan educational ecosystem and presents a validated behavioral model of AI adoption in education. The results highlight the importance of integrating AI literacy into curricula, strengthening faculty capacity, and ensuring equitable access to AI technologies to improve student learning and academic performance.

Keywords: Artificial intelligence literacy; AI usage; learning outcomes; academic performance; Generation Z; Mumbai; SEM

Introduction:

The rapid advancement of AI has transformed education through adaptive learning, intelligent tutoring, automated assessment, and data-driven academic support, aligning with SDG 4 by enhancing access, equity, and quality in education. Urban centers such as Mumbai are at the forefront of educational digitization due to stronger infrastructure, institutional readiness, and greater exposure to emerging technologies. However, existing research has largely focused on technical systems and instructional design, with limited attention to students' behavioral engagement with AI. As digital natives, Generation Z learners represent a critical group whose AI literacy and usage patterns can significantly influence learning outcomes and academic performance. Mumbai's diverse higher education ecosystem provides a valuable context to examine these relationships and to inform evidence-based, ethical, and effective AI integration in educational policy and practice.

Rationale of the Study:

The growing use of AI in higher education has transformed learning, yet empirical

evidence on the effects of AI literacy and usage on learning outcomes and academic performance remains limited. This study examines the relationships among AI literacy, AI usage, learning outcomes, and academic performance, with a focus on mediating effects among Generation Z learners, to inform effective and ethical integration of AI in education.

Research Gap:

Existing research recognizes the role of AI in education but lacks integrated models linking AI literacy, AI usage, learning outcomes, and academic performance, especially in the Indian metropolitan context. This study addresses this gap by empirically testing a behavioural framework among Generation Z students in Mumbai.

Scope of the study:

- The study examines relationships among AI literacy, AI usage, learning outcomes, and academic performance.
- It focuses on Generation Z students in higher education within a specific context.
- It analyzes the effects of AI literacy on usage, usage on learning outcomes, and learning outcomes on academic performance.
- It investigates the mediating roles of AI usage and AI learning outcomes.
- The findings aim to guide effective integration of AI in education for educators and policymakers.

Ethical Consideration:

- Participation was voluntary, with informed consent obtained from all respondents.
- Participants were informed of the study's purpose and their right to withdraw at any time.
- Anonymity and confidentiality of responses were strictly maintained.
- Data were securely stored and used solely for academic and research purposes.
- The study involved no harm, coercion, or deception.
- Ethical principles of honesty, integrity, and transparency were upheld throughout the research.

Review of Literature:

AI and Pedagogical Transformation Recent studies indicate that AI supports a shift from teacher-centered to learner-centered approaches.

Zawacki-Richter et al. (2019) emphasized AI's potential in assessment automation, adaptive content delivery, and learner modeling. Holmes et al. (2021) further noted that AI promotes cognitive engagement through immediate feedback

Santos et al. (2022) found improvements in STEM learning outcomes with AI-based adaptive systems. Such systems align with Bloom's taxonomy by guiding students from "Remember" to "Apply" stages.

Gupta et al. (2024), The study highlights that this generation is showing a marked interest in AI, particularly for its educational and professional applications. However, the study also highlights their ethical concerns about privacy and the potential biases of algorithms, a sign of a growing awareness of the social and ethical implications of AI technologies.

Moosa, D., Bozkurt, V., Reesha, A., & Shina, A. (2025). The Effects of Artificial Intelligence (AI) Literacy and use on students 'perception of academic performance in the maldives Bilgi Ekonomisi ve Yönetimi Dergisi, 19(2), 163-174.These findings underscore the transformative potential of AI in education and its implications for fostering enhanced academic outcomes The study also identifies gaps between awareness and practical application, emphasizing the need for

targeted educational interventions. Recommendations include implementing comprehensive AI literacy programs, integrating AI-focused curricula, and establishing support systems to maximize the benefits of AI in academic environments.

Sharma, D. (2025). Smart Education and Sustainable Learning Environments in Smart Cities: Significant Role of AI Applications for Sustainable Education. In Smart Education and Sustainable Learning Environments in Smart Cities (pp. 403-430). IGI Global Scientific Publishing. The study suggest that integration of AI in education today allows for efficient management of resources, thereby promoting sustainability in the education sector by reducing environmental impacts. AI-powered educational platforms provide personalized learning experiences that meet the unique needs of each student, thereby reducing the unnecessary use of resources associated with traditional uniform teaching approaches. .

Chaudhary, M., Kurbonov, M., Masoud, E., & Khatib, B. A. (2025). Artificial Intelligence and the Performance of Students. In Navigating the Intersection of AI Policy, Technology, and Governance (pp. 83-98). IGI Global Scientific Publishing.AI technologies have impacted the academic performance and skill development of marketing students. The research paper provides insight about AI technologies' role in changing marketing education for students. The research aims to identify the usage patterns of AI in marketing students, evaluating the impact of AI education on marketing students' performance and the impact on the non-academic skill developments..

Rane, N. L., Chaudhari, R. A., & Rane, J. (2025). Critical Pedagogies and Artificial Intelligence: Teaching, Curriculum, and Sustainable Education. Deep Science Publishing. The study suggested that AI integration has high potential in the area of education.

Kasturi, S., Mehta, C., & Raman, U. (2025). RIGHTS. AI: children's experiences of generative artificial intelligence in India. This report presents findings from a qualitative study on Indian children's understanding of and engagement with generative artificial intelligence (GenAI). The children used GenAI to help with homework and projects, and for fun, to explore creative pursuits such as art and music.

Research Objectives:

1. To examine the effect of AI Literacy on AI usage among learners.
2. To evaluate the influence of AI usage on AI learning outcomes.
3. To assess the impact of AI learning outcomes on academic performance.
4. To investigate the mediating roles of AI usage and AI learning outcomes in the relationships between (a) AI literacy and AI learning outcomes and (b) AI usage and academic performance.

Conceptual Framework and Hypotheses:

The proposed model is grounded in technology adoption and learning outcome theories and includes the following constructs:

- AI Literacy (Independent Variable)
- AI Usage (Mediator)
- AI Learning Outcomes (Mediator)
- Academic Performance (Dependent Variable)

Hypotheses:

Each hypothesis is stated with Null (H_0) and Alternative (H_1) forms

- H1: AI literacy has a significant positive effect on AI usage among learners.
- H2: AI usage has a significant positive influence on AI learning outcomes.

- H3: AI learning outcomes have a significant positive impact on academic performance.
- H4(a): AI usage significantly mediates the relationship between AI literacy and AI learning outcomes.
- H4(b): AI learning outcomes significantly mediate the relationship between AI usage and academic performance.

Research Methodology:

Research Design and Instruments: The present study adopts a quantitative, explanatory research design. It aims to examine causal relationships among AI literacy, AI usage, AI learning outcomes, and academic performance, with specific emphasis on mediation effects

Sample Size: 101 Generation Z learners (Mumbai Metropolitan Region) , college students

Sources of Data:

Primary Data: Primary data were collected through a self-administered online questionnaire designed using a structured format.

Secondary Data: Peer-reviewed journals, Peer-reviewed journals, Conference papers Reports on AI in education

Sampling Technique: The study uses non-probability convenience sampling, as respondents were selected based on accessibility and willingness to participate.

Measurement scale: 5-point Likert scale

Analysis method: Mean composite scores and regression-based path testing

Variables tested: AI Literacy (IV) AI Usage (Mediator 1) AI Learning Outcomes (Mediator 2) Academic Performance (DV)

Data Analysis:

Structural Equation Modeling (SEM) was employed using AMOS/SmartPLS to assess model fit, construct validity, reliability, and hypothesized relationships.

Result and Findings:

Descriptive Statistics:

Statistical Summary of Findings:

Descriptive analysis (N = 101) revealed moderate to high levels of AI literacy (Mean = 3.51, SD = 0.97) and moderate levels of AI usage (Mean = 3.50, SD = 1.03), AI learning outcomes (Mean = 3.32, SD = 1.07), and academic performance (Mean = 3.30, SD = 1.02).

Simple linear regression results at the 5% significance level ($p < 0.05$) confirmed that AI literacy significantly predicts AI usage (H1 accepted), AI usage significantly predicts AI learning outcomes (H2 accepted), and AI learning outcomes significantly predict academic performance (H3 accepted).

Regression-based mediation analysis further demonstrated that AI usage significantly mediates the relationship between AI literacy and AI learning outcomes (H4a accepted), while AI learning outcomes significantly mediate the relationship between AI usage and academic performance (H4b accepted).

Overall, the statistical evidence supports all proposed hypotheses, establishing AI literacy as a foundational factor that enhances academic performance both directly and indirectly through increased AI usage and improved AI learning outcomes.

Major Findings of the Study:

1. AI literacy significantly predicts AI usage among learners.
2. AI usage enhances learning outcomes such as understanding, critical thinking, and problem-solving.
3. Improved learning outcomes translate into better academic performance.
4. AI usage and AI learning outcomes act as significant mediators, validating the conceptual framework.
5. The study empirically supports technology adoption and learning outcome theories.

Suggestion of the Study:

- Introduce structured AI literacy programs to promote informed and responsible use of AI tools among students.
- Integrate AI tools formally into the curriculum to strengthen teaching–learning processes.
- Train faculty to use AI as a pedagogical aid for enhancing critical thinking and problem-solving skills.
- Redesign assessment methods to encourage ethical and appropriate use of AI in academic work.
- Guide students to use AI as a learning support tool rather than a substitute for independent thinking.
- Conduct awareness programs on academic integrity and ethical issues related to AI usage.
- Develop clear institutional and policy-level guidelines for AI use in higher education.
- Ensure equitable access to AI tools and digital infrastructure for all learners.

Scope for Future Research:

- While the present study provides valuable insights, several avenues remain open for further investigation:
- Use larger and more diverse samples across regions or countries to improve generalization.
- Adopt longitudinal designs to examine long-term effects of AI usage on learning and performance.
- Apply qualitative or mixed-method approaches to gain deeper insights into learner experiences.
- Incorporate additional variables such as motivation, self-efficacy, digital readiness, and faculty support.
- Conduct comparative studies across disciplines, educational levels, or AI tools.
- Explore ethical, psychological, and behavioral implications of extensive AI use in education.

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AI-Driven Mathematical Optimization Models for Sustainable Economic Planning and Development

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Abstract:

Sustainable economic planning has become a key concern for emerging economies due to increasing environmental challenges, resource constraints, and social disparities. In this context, Artificial Intelligence (AI)–driven mathematical optimization models have gained importance as effective tools for enhancing economic decision-making and long-term sustainability. This study examines the role of AI-driven optimization models in supporting sustainable economic planning and development, with particular reference to emerging economies.

The study is based on both primary and secondary data. Primary data were collected through a structured online survey to assess awareness, perception, and acceptance of AI-based optimization in economic planning, while secondary data were obtained from academic journals, reports, and policy documents. The findings reveal that although awareness of AI-driven optimization models is moderate, a majority of respondents acknowledge their potential in improving sustainable economic growth, reducing environmental impact, and enhancing resource allocation efficiency. However, challenges such as limited technical expertise, data availability, model complexity, and institutional constraints continue to hinder widespread adoption.

The study emphasizes the need for developing an integrated framework supported by capacity building, regulatory guidance, and ethical governance to facilitate effective implementation. It concludes that AI-driven mathematical optimization models can significantly contribute to sustainable and inclusive economic development if supported by appropriate infrastructure, skills, and policy frameworks.

Keywords- AI-driven Optimization, Sustainable Economic Planning, Mathematical Modeling, Emerging Economies, Economic Growth

Introduction:

In rising nations, where fast expansion frequently comes at the expense of social inequity and environmental damage, sustainable economic planning and development are essential. Incorporating Artificial Intelligence (AI) into economic planning presents previously unheard-of chances to maximize resource allocation, forecast results, and achieve sustainable growth. With an emphasis on emerging nations, this study investigates the use of AI-driven mathematical optimization models in sustainable economic planning and development.

AI-driven optimization models evaluate large information and identify the best configurations for accomplishing certain sustainable economic planning and development goals using machine learning (ML), predictive analytics, and sophisticated algorithms. These models go from static, human-designed plans to

dynamic, data-driven systems that strike a balance between social well-being, environmental stewardship, and economic development. This paper examines the use of AI-driven mathematical optimization models in sustainable economic planning and development, particularly focusing on emerging economies.

Objectives:

1. To explore the application of AI-driven optimization models in sustainable economic planning
2. To identify the benefits and challenges of using AI-driven optimization models in emerging economies
3. To develop a framework for integrating AI-driven optimization models with existing economic planning frameworks
4. To analyze the impact of AI-driven optimization models on environmental and social sustainability
5. To evaluate the effectiveness of AI-driven optimization models in achieving sustainable economic growth

Literature Review:

The application of Artificial Intelligence (AI) in economic planning has attracted considerable interest in recent years. Research has shown that AI-driven optimization models can greatly enhance the efficiency and effectiveness of economic planning procedures. Investigations have explored the role of AI in economic planning, emphasizing forecasting and policy analysis. The precision of forecasts has improved through the use of AI models like machine learning and deep learning. AI has also been utilized to evaluate policy interventions and predict their impacts. **(Varian, 2019; Athey, 2019)**

A study conducted by **Bertsimas and Tsitsiklis (1997)** explores the use of mathematical optimization models, which have been extensively applied in economic planning to achieve objectives related to economic growth. Both linear programming and dynamic programming models have been employed to enhance economic growth. Additional optimization models have been created to reduce unemployment and maximize participation in the labor market, as noted by **Liao and Zhang (2014).**

The Sustainable Development Goals (SDGs) set forth by the United Nations focus on the importance of sustainable economic planning and development (UN, 2015). AI-powered optimization models can contribute to the attainment of SDGs by enhancing resource distribution, decreasing inequality and poverty, and fostering sustainable economic growth. These optimization models have been utilized to find a balance between economic advancement and environmental sustainability.

Recent studies:

Research has shown that deep learning models like LSTM and GRU can improve economic forecasting accuracy. A study on GDP forecasting using deep learning models found improved accuracy compared to traditional models **(Bokhari et al., 2020).**

Studies have explored AI-driven policy analysis for sustainable development, including evaluating policy interventions, Predicting policy impact, Optimizing policy design. A study on carbon pricing policies used AI-driven policy analysis to evaluate the impact on emissions and economic growth **(Zhang et al., 2020).**

Gaps in literature:

1. Insufficient Research on AI-Driven Optimization Models-Additional research is required to explore AI-driven optimization

models for sustainable economic planning and development.

2. Studies Tailored to Specific Contexts-There is a need for more studies tailored to specific contexts to comprehend how AI-driven optimization models can be applied in various economies.

AI-driven mathematical optimization models:

AI-driven mathematical optimization models for sustainable economic planning and development leverage machine learning and advanced algorithms to balance economic growth with environmental and social goals. These models achieve optimal resource allocation, minimize costs, and reduce environmental impact.

For Energy Management and Transition:

- **AI-driven Predictive Energy Management Models:** These models use machine learning algorithms like **Gradient Boosting Machines (GBM)** and **Random Forests** to forecast energy demand and supply (especially from intermittent renewable sources like solar and wind). The optimization component, often using multi-objective functions, then determines the most efficient energy allocation to minimize CO_2 emissions and cost while maintaining reliability.
- **Integrated Renewable Energy System (IRES) Optimization:** These mathematical models, often using linear or non-linear programming, are designed to merge various local renewable energy sources (biomass, solar, wind) to create a stable, cost-effective, and sustainable energy supply for communities or regions.
- **Dynamic Pricing and Demand Response Models:** AI enables real-time dynamic electricity pricing based on current demand and supply conditions. This encourages consumers to adjust their energy consumption to off-peak periods, aiding in grid stabilization and minimizing the reliance on additional fossil fuel power generation capacity.
- **AI-Enhanced Building Management Systems:** These systems utilize AI to automatically modify a building's heating, cooling, and lighting based on occupancy levels and external weather factors, leading to substantial reductions in operational energy costs and usage.
- **Predictive Demand/Supply Models**: These models employ machine learning techniques to forecast energy requirements and output from renewable sources, such as solar and wind. They analyze historical data, weather patterns, and existing conditions to create precise predictions. This approach helps address the variable nature of renewable energy and maintains grid balance..
- **Smart Grid Optimization Algorithms:** AI algorithms, often using Deep Reinforcement Learning, improve energy distribution in smart grids. They balance supply and demand, manage energy storage, and reduce the use of fossil fuels to keep the grid stable and lower carbon emissions.
- **Hybrid Renewable Energy System (HRES) Optimization:** Algorithms like **NSGA II**, Particle Swarm Optimization, and Grey Wolf Optimization help decide the best size and operation of hybrid systems, such as solar, wind, and battery storage. The objective functions typically balance minimizing the Levelized Cost of Energy **(LCOE)** or Net Present Cost (NPC) with maximizing reliability and minimizing CO_2 emissions.
- **Building Energy Management Systems (BEMS):** use AI models like **Artificial Neural Networks (ANN) and Support Vector Machines (SVM).** These models help predict how much energy a building will use.

They also improve heating, cooling, and lighting systems by checking how many people are in the building and how comfortable the temperature is. This saves a lot of energy and money.

- **Industrial & Urban Logistics Optimization:** uses math and AI to make supply chains and city deliveries better. It plans routes and schedules vehicles efficiently. This cuts down on fuel use, lowers emissions, and reduces costs. Some studies show a 13.9% drop in fuel use in logistics.

For Resource & Waste Management:

Waste Management and Circular Economy:

Mixed-Integer Linear Programming (MILP) Models for Integrated Waste Management Systems (IWMS): These models help decide where to place waste facilities like collection centers, recycling plants, and landfills. They also figure out the best way to move waste between these places and choose the right technologies to lower costs and greenhouse gas emissions.

AI-Powered Predictive Models for Waste Collection: These models use data from smart bins to improve waste collection routes and schedules. This saves fuel, cuts costs, and reduces carbon emissions. They often use machine learning with methods like **Genetic Algorithms (GA) or Simulated Annealing (SA)** to plan routes.

Computer Vision and Deep Learning Models for Sorting: AI models with computer vision, like **Convolutional Neural Networks (CNNs),** help robots at recycling centers sort waste like plastics, metals, and paper. This improves recycling rates and the quality of recycled materials, supporting a circular economy.

Stochastic Programming Models: These models deal with uncertainties in waste management, like changing waste amounts or facility limits. They use methods like stochastic chance-constrained programming (SCCP) to make strong plans that balance economic and environmental goals even when conditions change.

Sustainable Resource Management:

AI-Driven Smart Grid Optimization Models: These models use machine learning to predict energy needs and balance supply with renewable sources like solar and wind. They also help manage energy storage and distribution in real-time. The goal is to reduce CO2 emissions, cut costs, and ensure reliable energy supply.

Non-Linear Programming (NLP) Models for Water Management: In farming and city water systems, NLP models help plan irrigation and resource use. They consider how water use, crop yields, weather, and money are connected. This helps save water and boost crop production.

Predictive Maintenance Models: AI models look at data from sensors on important infrastructure like water pipes and power plants. They predict problems before they happen, which helps save resources and avoid sudden breakdowns.

Supply Chain Optimization Models: Linear Programming (LP) and other algorithms improve supply chains from getting raw materials to production and delivery. They help lower transport costs, fuel use, emissions, and waste by predicting demand and planning efficient routes.

For Urban & Economic Planning:

Urban Planning & Infrastructure:

Traffic Flow Optimization: Models such as Singapore's Green Link Determining (GLIDE) system utilize machine learning (ML) algorithms to dynamically change traffic signal timings based on real-time data, lowering congestion and car emissions.

Predictive Infrastructure Maintenance: AI models use data from IoT sensors to forecast and detect structural flaws in roads, bridges, and public transportation systems (such as Singapore's

MRT system) before they break, resulting in proactive maintenance and cost reduction. **Urban Growth Simulation (Cellular Automata and Agent-Based Models):** These models mimic population growth and land-use changes to assess the long-term effects of various policy initiatives and create more effective sustainability policies, such as mixed-use zoning.

Waste Management Optimization: Algorithms optimize garbage collection routes based on data from smart bins equipped with fill-level sensors, resulting in lower operational costs, fuel consumption, and emissions (for example, systems used in Barcelona)

Economic Planning:

Sustainable Supply Chain Optimization: Artificial intelligence is used to optimize agricultural and industry supply chains by forecasting demand and decreasing waste, hence increasing efficiency and lowering environmental impact.

Multi-objective Economic Planning (e.g., Neutrosophic Programming): This mathematical modeling technique can optimize multiple goals at the same time, such as maximizing GDP growth while reducing greenhouse gas emissions and ensuring decent job opportunities (used in studies for India's sustainable development goals).

Resource Allocation for Development Projects: AI-powered systems may combine data from several sources to optimize the allocation of financial, material, and human resources for urban development projects such as slum redevelopment, resulting in more targeted and effective use.

Role of AI-Driven Mathematical Optimization Models for Sustainable Economic Planning and Development:

AI-driven mathematical optimization models contribute significantly to long-term economic planning by improving decision-making efficiency, resource allocation, and policy creation through data analysis and predictive modeling. These models combine complicated environmental, social, and economic aspects to provide balanced results that maximize long-term well-being.

1) **Efficient Resource distribution:** These models calculate the best distribution of scarce resources like energy, water, and raw materials in order to optimize economic production while reducing environmental damage. They contribute to resource conservation and waste reduction by understanding complex limitations.
2) **Decarbonization and Energy Transition:** Optimization models are critical for developing sustainable energy systems. They maximize the integration of renewable energy sources into the grid, plan infrastructure development, and propose cost-effective strategies to cut greenhouse gas emissions, easing the transition to a low-carbon economy.
3) **Sustainable Urban Planning:** In cities, these models maximize land use, transportation networks, and waste management systems. They assist city planners in designing more efficient and livable cities that reduce pollution and congestion, enhancing overall quality of life.
4) **Supply Chain Optimization:** AI-powered optimization improves the sustainability of global supply chains by identifying the most efficient routes and logistics, reducing fuel consumption, and lowering the carbon footprint associated with products transportation.
5) **Policy Analysis and Scenario Planning:** Policymakers use these models to simulate the potential effects of various economic and environmental policies prior to implementation. This enables them to

anticipate unintended outcomes and select the most effective solutions for meeting sustainable development objectives.

6) **Circular Economy Implementation:** The models allow the transition to a circular economy by optimizing material flows, boosting recycling, reusing, and remanufacturing processes, reducing dependency on virgin resources and minimizing landfill waste.

Challenges:

- **Data Availability and Quality-**Limited availability to reliable, relevant, and granular data impedes AI model development and accuracy. Data exchange and usage are limited due to concerns about privacy and security.
- **Model Complexity and Interpretability -** Creating scalable and understandable AI models is challenging. It is critical to strike a balance between model complexity, interpretability, and explainability.
- **Stakeholder Engagement and Adoption** - Building trust with stakeholders is crucial for AI-driven decision-making. There is a need to address concerns about job displacement and AI-driven decision making.
- **Addressing Ethical Concerns and Bias:** AI models must prioritize justice, transparency, and accountability. It is critical to mitigate bias in AI algorithms and ensure equitable outcomes.
- **Regulatory Frameworks and Governance -** AI-driven economic planning need regulatory frameworks. Compliance with existing norms and standards is vital.

Opportunities:

- **Improved Decision-Making**-AI-driven optimization enables informed decision-making for sustainable economic planning. Data-driven insights support evidence-based policy-making.
- **Sustainable Development**-AI models promote sustainable economic growth, reducing environmental impact. Optimizing resource allocation and reducing waste supports sustainable development.
- **Economic Efficiency-** AI-driven optimization improves resource allocation, reducing inefficiencies. Streamlining processes and reducing costs enhances economic competitiveness.
- **Innovation & Competitiveness-**AI-driven economic planning fosters innovation and competitiveness. Encouraging entrepreneurship and start-ups supports economic growth.
- **Global Collaboration**-International collaboration can accelerate AI-driven sustainable development. Sharing best practices and knowledge supports global progress.

Methodology:

Primary Data:

The Quantitative information was gathered through an online survey using Google Forms. 90 participants shared their insights on AI-driven optimization in economic planning. The survey aimed to understand the impact of AI-driven mathematical optimization on sustainable economic planning and development.

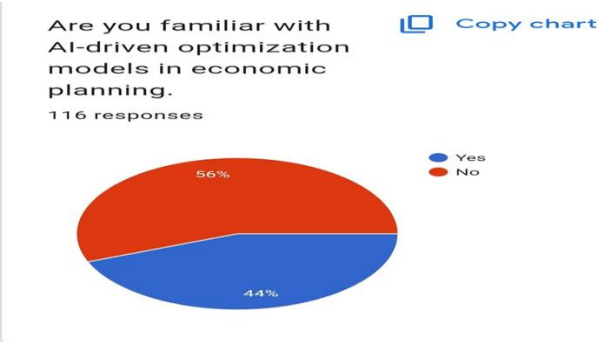
Secondary Method:

The secondary method involves analyzing existing data or research from sources like Academic journals, research articles, Reports & publication, Websites & web portals etc to identify trends, challenges, and best practices as well as to understand applications and outcomes.

Data Analysis:

The information was collected from **116 respondents (Male – 59.5% and Female – 39.7%)** through a **Google Form survey** to assess the **awareness and impact of AI-driven mathematical optimization models in sustainable economic planning and development**. The collected data was further analyzed to examine respondents' understanding and perception of AI-based optimization in economic planning.

Are you familiar with AI-driven optimization models in economic planning.

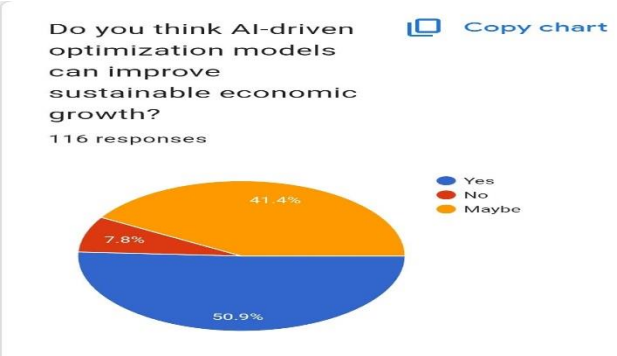


Finding and Interpretation

Finding: The above pie chart represents the responses of **116 respondents** regarding their familiarity with **AI-driven optimization models in economic planning**. The findings reveal that **56% of the respondents are not familiar** with AI-driven optimization models, while **44% of the respondents stated that they are familiar** with these models.

Interpretation: The results indicate that although a considerable proportion of respondents possess awareness of AI-driven optimization models in economic planning, **a majority still lack familiarity** with these advanced tools. This reflects a moderate level of awareness among the population and highlights a clear **knowledge gap** in understanding the role and application of AI-based optimization in economic planning. The findings suggest a strong need for **awareness programs, academic inclusion, and professional training** to enhance understanding and adoption of AI-driven optimization models, especially for informed decision-making and sustainable economic planning.

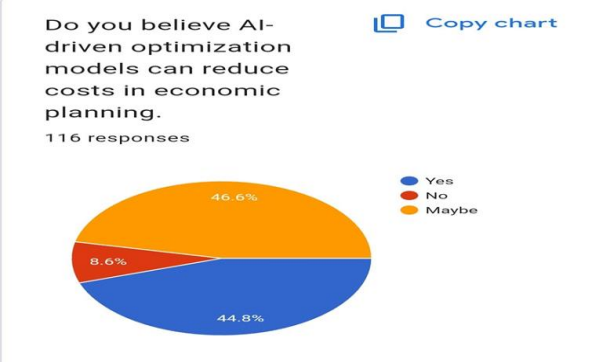
Do you think AI-driven optimization models can improve sustainable economic growth?



Finding: Out of 116 respondents, **50.9% agreed**, **41.4% were uncertain**, and **7.8% disagreed** that AI-driven optimization models can improve sustainable economic growth.

Interpretation: The findings indicate a **positive perception** toward the role of AI-driven optimization models in promoting sustainable economic growth. However, the presence of a large uncertain group suggests the need for **greater awareness and practical understanding** of how AI can support sustainability in economic planning.

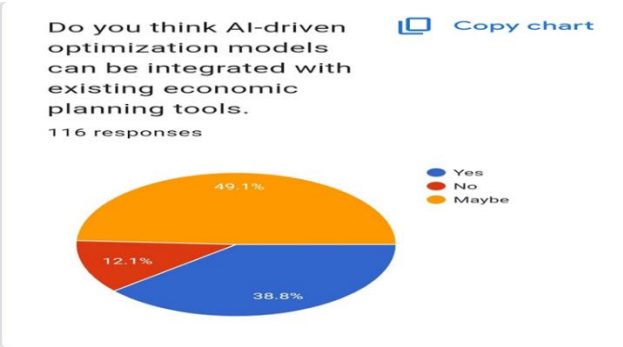
Do you believe AI-driven optimization models can reduce costs in economic planning.



Finding: Out of 116 respondents, **44.8% agreed**, **46.6% were uncertain**, and **8.6% disagreed** that AI-driven optimization models can reduce costs in economic planning.

Interpretation: The results indicate a **positive but cautious perception** regarding cost reduction through AI-driven optimization models. While many respondents believe in their cost-saving potential, a large proportion remains uncertain, highlighting the need for **greater awareness and practical evidence** of cost benefits in economic planning.

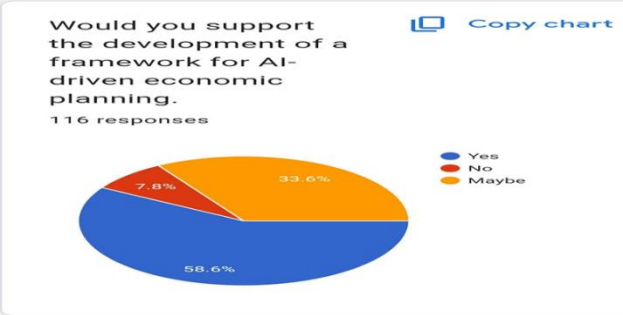
Do you think AI-driven optimization models can be integrated with existing economic planning tools



Finding: Out of 116 respondents, **38.8% agreed**, 9.1% were unsure, and 12.1% disagreed that AI-driven optimization models can be integrated with existing economic planning tools.

Interpretation: The findings show partial acceptance of integrating AI-driven optimization models, with many respondents uncertain. This indicates a need for greater awareness and practical understanding to support integration in economic planning.

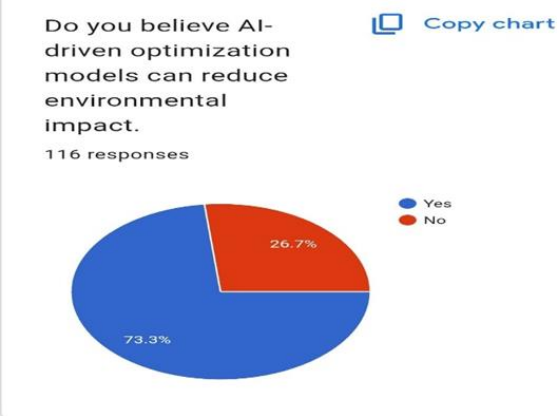
Would you support the development of a framework for AI-driven economic planning.



Finding: The above chart shows the responses of **116 participants** regarding support for the development of a **framework for AI-driven economic planning**. The findings indicate that **58.6% of respondents support** the development of such a framework, **33.6% expressed a neutral or 'maybe' opinion**, and only **7.8% do not support** the idea.

Interpretation: The results clearly demonstrate **strong support** for establishing a framework for **AI-driven economic planning**, reflecting positive acceptance of AI-based approaches for sustainable economic development. The relatively small proportion of respondents opposing the framework suggests minimal resistance, while the neutral responses indicate scope for **greater awareness and clarity** to further strengthen support for AI-driven economic planning initiatives.

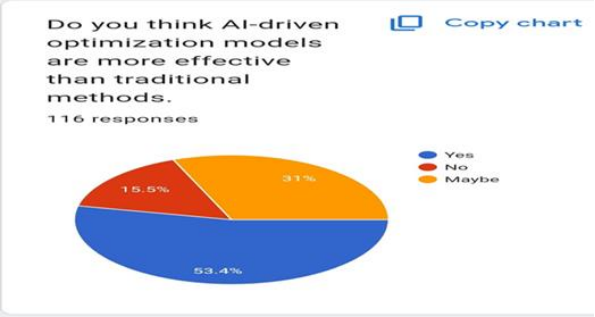
Do you believe AI-driven optimization models can reduce environmental impact.



Finding: Out of 116 respondents, **73.3% agreed** that AI-driven optimization models can reduce environmental impact, while **26.7% disagreed**.

Interpretation: The findings indicate **strong agreement** that AI-driven optimization models can help reduce environmental impact, highlighting their important role in **sustainable economic planning and environmental sustainability**.

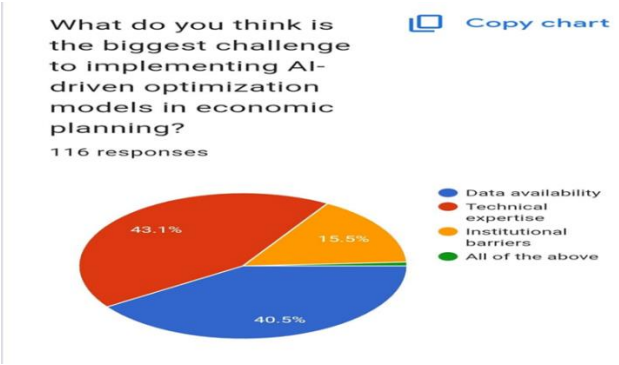
Do you think AI-driven optimization models are more effective than traditional methods?



Finding: Out of 116 respondents, **53.4% agreed** that AI-driven optimization models are more effective than traditional methods, **31% were uncertain**, and **15.5% disagreed**. This shows that a majority perceive AI-driven models as more effective, though a notable portion remains unsure.

Interpretation: The results indicate a positive inclination toward AI-driven optimization models, but the high level of uncertainty suggests limited awareness or practical experience. This highlights the need for better understanding, training, and real-world examples to strengthen confidence in AI-based economic planning methods.

What do you think is the biggest challenge to implementing AI-driven optimization models in economic planning?



Finding: Out of 116 respondents, **43.1% reported technical expertise** as the biggest challenge, followed by **40.5% citing data availability**, while **15.5% pointed to institutional barriers**.

Interpretation: The results show that lack of technical skills and data availability are the major obstacles in implementing AI-driven optimization models. This highlights the need for capacity building, training, and improved data infrastructure to support effective AI adoption in economic planning.

Result and Discussion:

From the above data analysis, we can say that,

1. A considerable proportion of respondents are aware of AI-driven optimization models in economic planning, though a noticeable knowledge gap still exists.
2. Respondents generally believe that AI-driven optimization models can improve sustainable economic growth and decision-making efficiency.
3. AI-driven models are perceived to be effective in reducing environmental impact through better resource allocation and sustainability-focused planning.

4. Many respondents feel that AI-driven optimization models are more effective than traditional methods, but uncertainty remains due to limited practical exposure.
5. The major challenges identified in implementing AI-driven optimization models are lack of technical expertise and data availability, followed by institutional barriers.
6. There is strong support for developing a structured framework and providing training to facilitate the integration of AI-driven optimization models in economic planning.

Conclusion:

In conclusion, AI-driven mathematical optimization models hold significant potential to transform sustainable economic planning and development. These models can enhance resource efficiency, support environmental sustainability, and improve policy decision-making. However, effective implementation requires addressing challenges related to technical skills, data quality, and institutional readiness. With proper training, awareness, and supportive frameworks, AI-driven optimization can play a crucial role in achieving sustainable and inclusive economic growth, particularly in emerging economies.

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A Study on the Impact of Perceived Ease of Use of Information Technology on Operational Benefits of GIG Cab Drivers

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Abstract:

The rapid expansion of the gig economy has made information technology an indispensable component of app-based cab driving, where digital platforms govern ride allocation, navigation, payments, performance ratings, and customer interaction. In this context, the ability of cab drivers to effectively use technology directly influences their work efficiency and income stability. Drawing on the Technology Acceptance Model (TAM) and its extensions, the present study focuses on Perceived Ease of Use (PEOU) as a key determinant of technology interaction among gig cab drivers. The study specifically examines whether perceived ease of use differs according to educational qualification and how it is associated with operational benefits experienced by drivers.

Using primary data collected from 75 gig cab drivers, the study employs ANOVA and correlation analysis to test the proposed objectives and hypotheses. The findings reveal a significant difference in perceived ease of use across educational levels, with higher-qualified drivers reporting greater ease in using information technology. Further, a moderate and statistically significant positive relationship is observed between perceived ease of use and operational benefits, indicating that drivers who find technology easier to use experience better efficiency, time management, and smoother work processes. The study concludes that improving usability and digital capability among cab drivers, especially those with lower educational backgrounds, can enhance operational performance and sustainability in the gig mobility sector.

Keywords: Perceived Ease of Use; Operational Benefits; Gig Cab Drivers

Introduction:

The gig economy has rapidly transformed urban mobility by enabling app-based ride-hailing services where cab drivers receive trips, navigation support, payments, incentives, and performance feedback through digital platforms. For gig cab drivers, information technology is not only a supporting tool but the core infrastructure of work, covering customer matching, route optimization, cashless transactions, ratings, and real-time communication. In this environment, the ability to use technology smoothly becomes directly linked with day-to-day efficiency and income stability.

However, gig cab drivers are not a homogeneous group. Their comfort with smartphone apps, digital payments, GPS navigation, and in-app problem resolution varies widely based on factors such as education, age, and prior technology exposure. These differences influence how drivers experience the platform: whether they find the system intuitive and helpful, or confusing and effortful. This makes "Perceived Ease of Use (PEOU)" an important

construct for understanding technology adoption and work outcomes among drivers.

Perceived Ease of Use is a central concept in the Technology Acceptance Model (TAM), which explains how users accept and use technology based on beliefs about ease and usefulness. When drivers feel the app is easy to learn and operate, they are more likely to use it effectively and consistently, commit fewer operational errors, and respond faster to ride requests and customer needs. TAM and later acceptance models (such as UTAUT/UTAUT2) have repeatedly shown that ease of use shapes user behavior and performance in multiple technology contexts.

In gig cab operations, "Operational Benefits" can be viewed as practical work advantages such as improved trip management, better time utilization, reduced effort in finding passengers, quicker payment settlement, fewer communication issues, and improved service delivery through platform support. When technology is easier to use, drivers can focus more on service quality and less on app-related difficulties. Therefore, examining the relationship between perceived ease of use and operational benefits is important for platform design, driver training, and policy interventions aimed at improving driver productivity and experience.

Review of Literature:

Davis (1989), In the research titled "Perceived usefulness, perceived ease of use, and user acceptance of information technology" The Study concludes that perceived ease of use plays a decisive role in determining users' acceptance of information technology, as systems that are easier to understand and operate generate more favorable attitudes and higher levels of actual usage. The study establishes that ease of use not only directly influences technology adoption but also indirectly enhances perceived usefulness, making it a foundational construct for evaluating user interaction with technology-based systems.

Davis et.al (1989), In the research titled "User acceptance of computer technology: A comparison of two theoretical models" The study conclude that users' behavioral intention to adopt technology is significantly shaped by their perceptions of ease of use and usefulness, irrespective of whether system usage is voluntary or compulsory. The study demonstrates that perceived ease of use reduces user effort and resistance, thereby strengthening intention to use and ultimately leading to more effective and consistent technology utilization.

Venkatesh et.al (2003), In the research titled "User acceptance of information technology: Toward a unified view" effort expectancy, which closely aligns with perceived ease of use, is a key determinant of technology acceptance, particularly during the initial stages of adoption. Their Unified Theory of Acceptance and Use of Technology confirms that systems perceived as easy to use positively influence performance expectancy and usage behavior across different organizational and occupational contexts.

Venkatesh et.al (2012), In the research titled "Consumer acceptance and use of information technology: Extending the unified theory of acceptance and use of technology" the study examined that perceived ease of use continues to be an important driver of technology acceptance in consumer-focused digital environments. By extending the UTAUT model, the study highlights that ease of use, along with facilitating conditions and habit, significantly contributes to sustained technology usage, improved user experience, and long-term performance outcomes.

Legris et.al (2003), In the research titled "Why do people use information technology? A critical review of the technology acceptance model" the study conclude that the Technology Acceptance Model provides a strong explanatory framework

for understanding information technology adoption, with perceived ease of use consistently emerging as a powerful predictor of user acceptance. The authors also emphasize the need to incorporate contextual and organizational variables to enhance the model's explanatory power in real-world, technology-intensive work settings.

Research Gap:

Despite the extensive empirical support for perceived ease of use as a critical determinant of technology acceptance provided by TAM and its extensions, a clear research gap remains in understanding how this construct translates into tangible operational outcomes in gig-based occupations, particularly among gig cab drivers in developing economies like India. Most existing studies focus on user intention, attitude, or general usage behavior in organizational or consumer settings, with limited attention to platform-dependent workers whose livelihoods rely entirely on digital systems. Additionally, prior research largely examines homogeneous user groups, overlooking the role of educational qualification and skill diversity in shaping perceived ease of use and its impact on work efficiency. There is also a lack of empirical studies linking perceived ease of use directly with operational benefits such as time efficiency, income optimization, service quality, and work continuity in gig mobility platforms. Hence, the present study addresses this gap by examining both the variation in perceived ease of use across educational levels and its direct association with operational benefits among gig cab drivers.

Research Methodology:

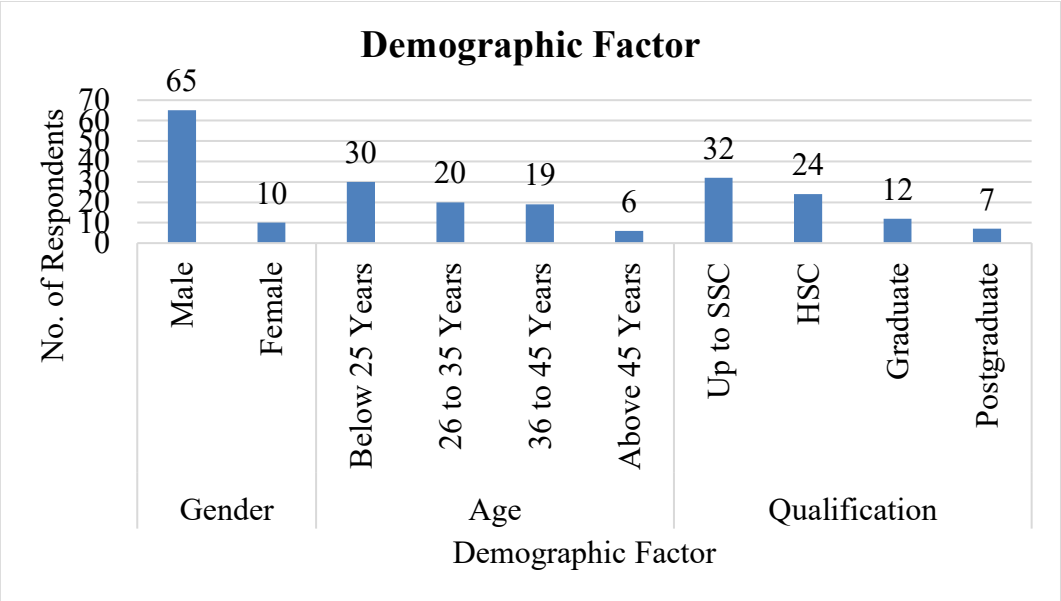
The study adopts a descriptive and analytical research design based on primary data collected through a structured questionnaire administered to 75 gig cab drivers. The sample was selected using a convenient sampling technique. Perceived Ease of Use and Operational Benefits were measured using Likert-scale items. Descriptive statistics were used to analyze the demographic profile of respondents, while One-Way ANOVA was applied to examine differences in perceived ease of use across educational qualifications. Pearson correlation analysis was employed to assess the relationship between perceived ease of use of information technology and operational benefits. Statistical analysis was carried out using SPSS, and hypotheses were tested at a 5 percent level of significance.

Demographic Factor

Sr No.	Particular	Category	Frequency	Percent
1	Gender	Male	65	86.7
		Female	10	13.3
2	Age	Below 25 Years	30	40.0
		26 to 35 Years	20	26.7
		36 to 45 Years	19	25.3
		Above 45 Years	6	8.0
3	Qualification	Up to SSC	32	42.7
		HSC	24	32.0
		Graduate	12	16.0
		Postgraduate	7	9.3

The frequency distribution shows the actual number of respondents falling into each category of the demographic variables. Out of the total 75 cab drivers surveyed, 65 are male and 10 are female, indicating that male drivers form the majority of the sample. With respect to age, 30

respondents are below 25 years, followed by 20 respondents in the 26–35 years age group, 19 respondents in the 36–45 years category, and only 6 respondents above 45 years, showing a higher concentration of younger drivers. In terms of educational qualification, 32 respondents have studied up to SSC, 24 have completed HSC, 12 are graduates, and 7 are postgraduates. These frequency figures provide a clear numerical picture of the sample composition and form the basis for further statistical analysis in the study.



Objective and Hypothesis:

Objective 1 To Study the Perceived Ease of Use of information technology by the cab driver according to educational qualification.

Null Hypothesis H_{01A}: There is no significant difference in Perceived Ease of Use of information technology by the cab driver according to educational qualification.

Alternate Hypothesis H_{11A}: There is a significant difference in Perceived Ease of Use of information technology by the cab driver according to educational qualification.

To study the above Null Hypothesis, ANOVA Test is applied and results are as follows:

ANOVA					
Perceived Ease of Use					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1659.840	3	553.280	4.474	.006
Within Groups	8779.827	71	123.660		
Total	10439.667	74			

Interpretation: The above results indicate that calculated p-value is 0.006. It is less than 0.05. Therefore, F-test is rejected. Hence Null hypothesis is rejected and Alternate hypothesis is accepted.

Conclusion: There is a significant difference in Perceived Ease of Use of information technology by the cab driver according to educational qualification.

Findings: To understand the findings of hypothesis, mean score of Perceived Ease of Use of information technology by the cab driver according to educational qualification is obtained and shown below:

Report			
Perceived Ease of Use			
4. Educational Qualification	Mean	N	Std. Deviation
Up to SSC	61.95	32	11.670
HSC	66.77	24	9.426
Graduate	72.29	12	12.129
Postgraduate	75.71	7	12.223
Total	66.43	75	11.878

The mean scores of Perceived Ease of Use of Information Technology among cab drivers show a clear increasing trend with higher levels of educational qualification. Cab drivers educated up to SSC report the lowest mean score (61.95), indicating relatively lower comfort and ease in using information technology, while those with HSC education demonstrate a moderate improvement (66.77). The perceived ease of use rises substantially among graduate cab drivers (72.29) and is highest among postgraduates (75.71), suggesting that higher education enhances digital familiarity, confidence, and adaptability to technology-based platforms used in cab operations. Although the number of postgraduate respondents is relatively small, the consistent upward pattern across educational levels highlights education as an important factor influencing the perceived ease of use of information technology among cab drivers. The overall mean score of 66.43 indicates a moderate level of perceived ease of use across the sample, with variability reflected in the standard deviations across groups.

Objective 2 To Study the Impact of Perceived Ease of Use of Information Technology on Operational Benefits of Gig Cab Drivers.

Null Hypothesis H_{02}: There is no Impact of Perceived Ease of Use of Information Technology on Operational Benefits of Gig Cab Drivers.

Alternate Hypothesis H_{12}: There is an Impact of Perceived Ease of Use of Information Technology on Operational Benefits of Gig Cab Drivers.

To study the above Null Hypothesis, Correlation Test is applied and results are as follows:

Correlations			
		Perceived Ease of Use	Operational Benefits
Perceived Ease of Use	Pearson Correlation	1	.544**
	P-value		.000
	N	75	75
Operational Benefits	Pearson Correlation	.544**	1
	P-value	.000	
	N	75	75
**. Correlation is significant at the 0.01 level (2-tailed).			

Interpretation: The above results indicate that calculated p-value is 0.000. It is less than 0.05. Therefore, Correlation test is rejected. Hence Null hypothesis is rejected and Alternate hypothesis is accepted.

Conclusion: There is a significant difference in Perceived Ease of Use of information technology by the cab driver according to educational qualification.

Findings:

The correlation analysis reveals a moderate and statistically significant positive relationship between Perceived Ease of Use of information technology and Operational Benefits among cab drivers. The Pearson correlation coefficient (r = 0.544) indicates that as cab drivers perceive technology to be easier to use, they experience higher operational benefits such as improved efficiency, better time management, and smoother work processes. The relationship is significant at the 0.01 level (p = 0.000), confirming that this association is not due to chance. With a sample size of 75 respondents, the results provide strong empirical support for the argument that enhancing the usability of information technology can directly contribute to improved operational outcomes for cab drivers.

Conclusion:

Overall, the study concludes that educational qualification and perceived ease of use of information technology play a crucial role in shaping the operational benefits of gig cab drivers. The ANOVA results confirm that perceived ease of use of information technology differs significantly across educational levels, with higher-qualified cab drivers reporting greater ease and confidence in using technology-based platforms. Further, the correlation analysis establishes a moderate and statistically significant positive relationship between perceived ease of use and operational benefits, indicating that drivers who find technology easier to use achieve better efficiency, time management, and overall work performance. Together, these findings highlight that improving digital usability and strengthening technology-related skills, especially among less-educated cab drivers, can significantly enhance their operational effectiveness and sustainability in the gig economy.

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The Impact of AI-Assisted Content Creation on the Academic Outcomes of Undergraduate Students

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Abstract:

This study investigates the impact AI tools have had thus far on undergraduate education in areas of research and writing, explaining concepts, and studying for tests. While AI is efficient and accessible, there are concerns regarding critical thinking, academic integrity, and the accuracy of generated data. In this study, 145 students reported a neutral attitude toward improved grades but concern about accuracy and privacy. The conclusion drawn from this study stated that responsible use of AI enhances undergraduate learning with appropriate guidance.

Keywords: AI in Education, AI-Assisted Content Creation, Undergraduate Students, Academic Performance, Ethical AI Use, Higher Education, AI policy.

Introduction:

AI-based content creation tools streamline digital tasks like research, summarization, grammar correction, and explanations, boosting efficiency but demanding human oversight for academic truthfulness and principles. In higher education, AI fosters personalized learning yet risks student dependency, plagiarism, and reduced critical thinking.

UNESCO endorses AI for inclusive education under Sustainable Development Goal 4. (SDG 4), though policies lag behind tech advances. Surveys show high adoption—92% of UK students and 86% globally use tools like ChatGPT amid pressures—while institutions like Carnegie Mellon integrate AI into curricula, with 14+ offering undergrad AI degrees.

Positive Impacts include enhanced research, writing support, engagement, and personalization. Negative Impacts encompass tough Judgmental skills, dishonesty, Basic knowledge, ethical issues like privacy, bias, and fairness.

Research Problem:

AI tools widespread use in higher education boosts productivity and accessibility for undergraduates, yet their effects on academic outcomes like originality, critical thinking, and skill development lack full exploration. Never ending concerns include ethical issues and pedagogical impacts.

Standardized institutional policies and empirical evaluation frameworks remain absent, underscoring the urgent need for systematic research on AI's academic, ethical, and teaching implications.

Research Objectives:

1. To examine undergraduate students' perceptions of AI as a learning tool in academic settings.
2. To analyze the academic benefits and challenges associated with AI-generated content.

3. To propose recommendations for responsible and ethical AI use in higher education based on study findings.

Hypothesis:

1. H1: A majority of students perceive AI tools positively as learning aids, associating them with enhanced efficiency and accessibility over traditional methods.
2. H2: The use of AI-generated content significantly impacts academic outcomes, offering both advantages and drawbacks related to critical thinking, accuracy, and originality.
3. H3: Structured ethical guidelines for AI use will improve student perceptions and reduce challenges, as reflected in higher satisfaction among guided users.

Literature Review:

Aktepe and Çetinkaya (2025) explored graduate students' perceptions of AI tools in academic writing. Their qualitative study revealed that AI tools such as ChatGPT and Gemini enhance productivity through idea generation and drafting support. However, concerns regarding originality, misinformation, ethical use, and over-dependence were prominent. The authors emphasize the need for institutional training, ethical guidelines, and transparency to preserve academic integrity.

Vanacore, Pankiewicz, and Baker (2025) examined generative AI feedback in an object-oriented programming course. Their findings indicated improved performance in addressing compiler errors but negative effects on self-regulated learning when AI feedback reduced students' engagement with unit test failures. The study suggests that automated feedback may hinder metacognitive processes such as self-evaluation and strategic planning.

Research Methodology:

Research Design: A mixed-methods approach combining quantitative and qualitative analysis was employed.

Population & Sample: The study targeted undergraduate students from different colleges all over Mumbai. A stratified random sampling method was used, yielding a sample size of 145 respondents.

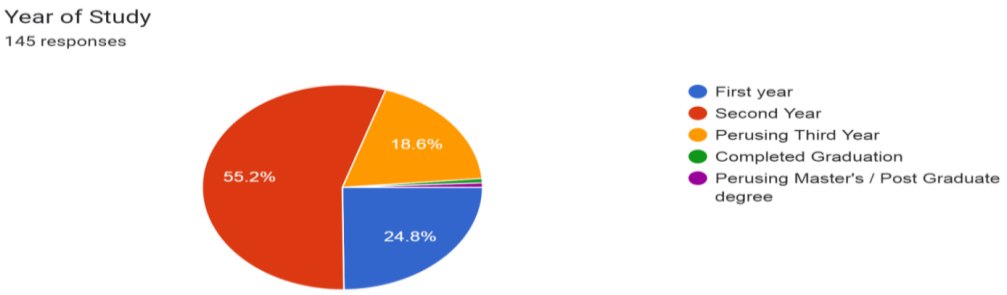
Data Analysis & Data Collection Tools: Data were collected via an online structured questionnaire covering demographic information survey responses presented in tables and charts.

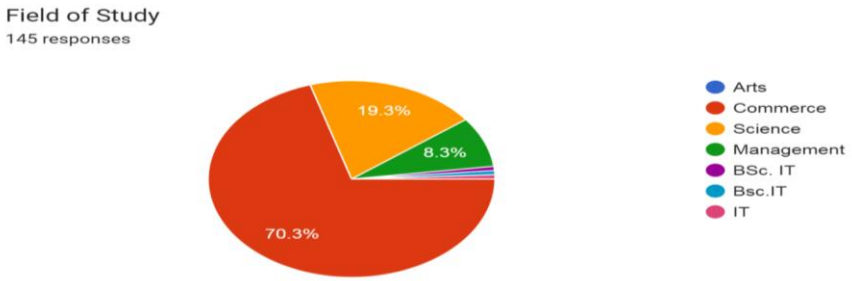
Limitations:

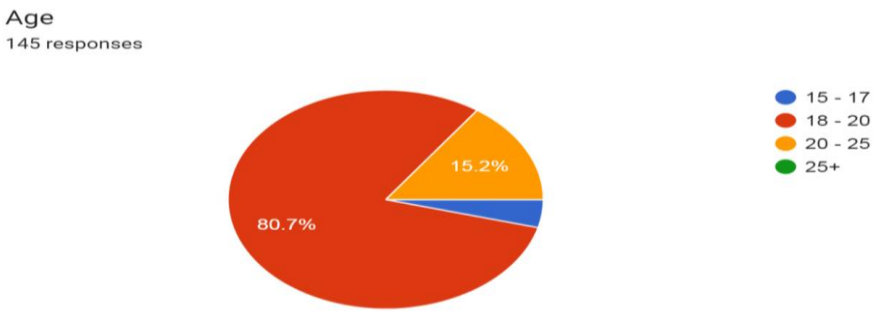
- The study relied on self-reported data, which may introduce response bias.
- The sample was limited to undergraduate students from Mumbai.
- The research focused on short-term academic perceptions rather than long-term learning outcomes.

Research Questions:

Section A - Demographic Information:

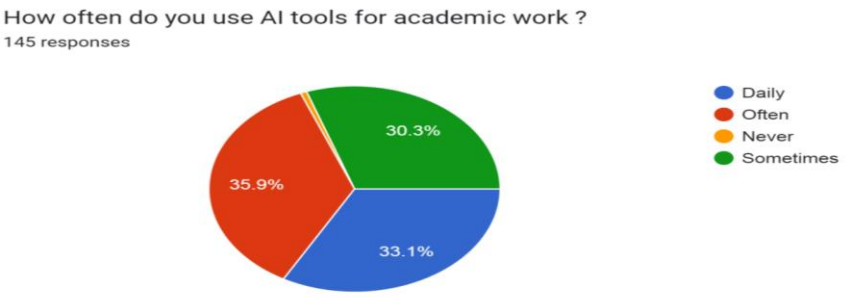






Section B - Core Survey

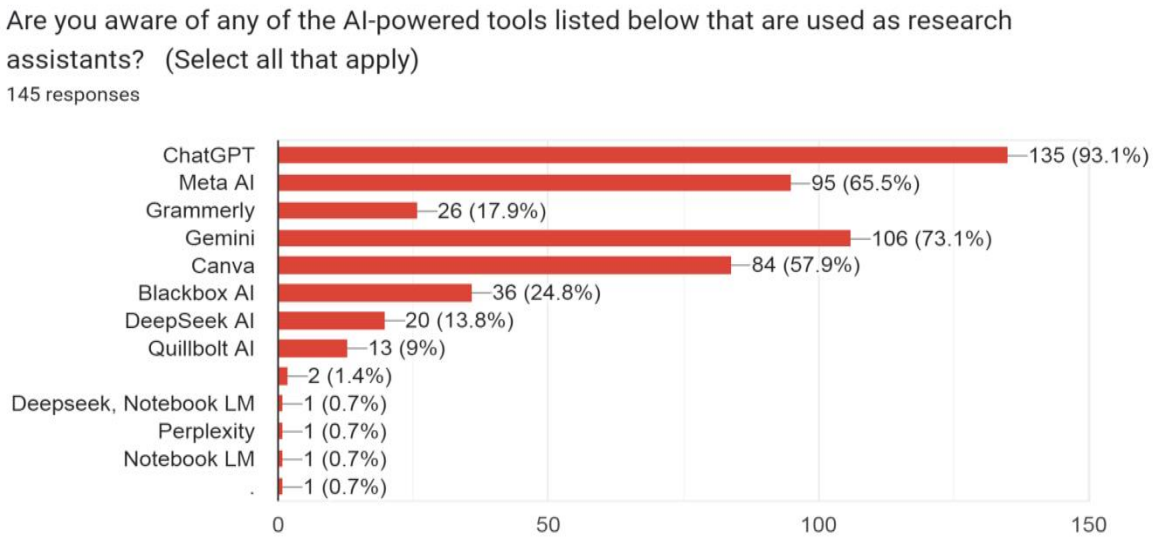
How often do you use AI tools for academic work



Attributes (no. of hours Spent on AI)	**Responses**	**Percentage**
Daily	48	33.1 %
Often	52	35.9 %
Sometimes	44	30.3 %
Never	1	0.7 %
Total	**145**	**100 %**

Interpretation: The above chart represents that majority 52 respondents believe that they Often use AI tools in their academics, 48 respondents believe that they use AI tools daily, 44 respondents believe that they use sometimes, whereas only 1 respondent believe He/She have never used AI tools for their academic work.

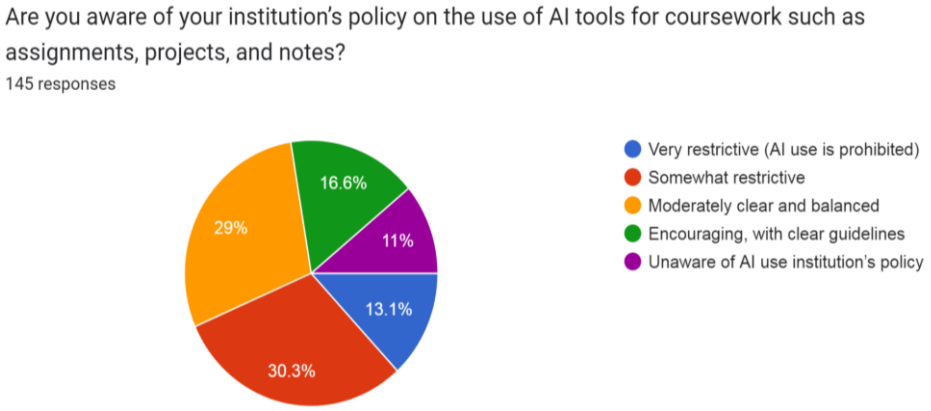
1. **Are you aware of any / all of the AI-powered tools listed below that are used as research assistants?**



Attributes (Awareness about various AI tools)	**Responses**	**Percentage**
Chat GPT	135	93.1%
Meta AI	95	65.5%
Grammarly	26	17.9%
Gemini	106	73.1%
Cannva	84	57.9%
Blackbox AI	36	24.8%
Deep Seek AI	20	13.8%
Quillbot AI	13	9%
Others	6	4.2%
Total	**145**	**100 %**

Interpretation: The above chart represents that that ChatGPT is widely recognized, with 135 respondents aware of its academic use. Other AI tools include 106 respondents for Google Gemini, 95 for Meta AI, and 84 for Canva AI. Awareness is lower for Blackbox AI (36), DeepSeek AI (20), and Quillbot AI (13). Only 6 respondents are familiar with other AI tools.

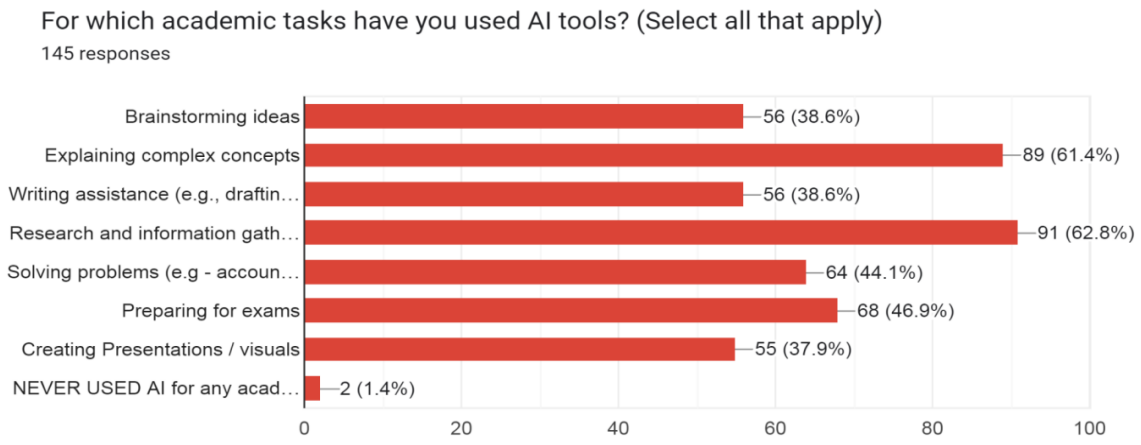
2. **Are you aware of your institution's policy on the use of AI tools for coursework such as assignments, projects, and notes?**



Attributes (Awareness of institution's policy regarding use of AI tools)	**Responses**	**Percentage**
Very restrictive	19	13.1%
Somewhat restrictive	44	30.3%
Moderately clear and balanced	42	29%
Encouraging, with clear guidelines	24	16.6%
I Unaware of my institution's policy	16	11%
Total	**145**	**100 %**

Interpretation: The above chart represents that 44 respondents Somewhat restrictive, 42 respondents Moderately clear and balanced, , 24 respondents stated that they are aware that the institution's policy which is Encouraging, with clear guidelines on the use of AI tools, 19 respondents stated their institution's very restrictive, 16 respondents stated not aware of my institution's policy.

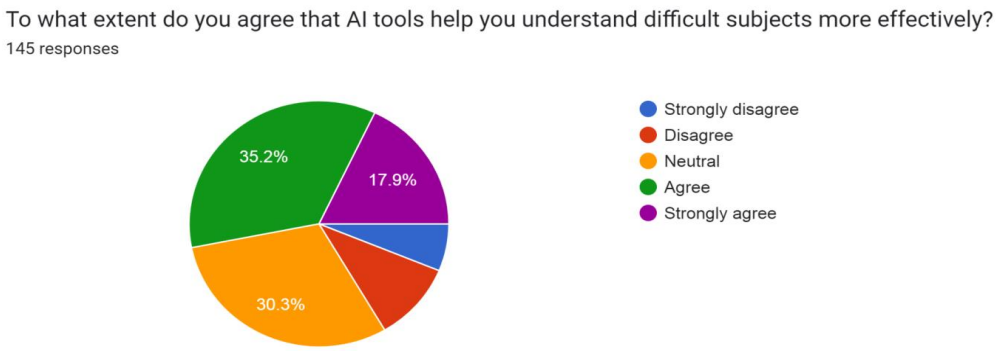
3. **For which academic tasks have you used AI tools**



Attributes (Purpose of using of AI tools)	**Responses**	**Percentage**
Brainstorming ideas	56	38.6%
Explaining complex concepts	89	61.4%
Writing assistance	56	38.6%
Research and information gathering	91	62.8%
Solving problems	64	44.1%
Preparing for exams	68	46.9%
Creating presentations/visuals	55	37.9%
Never used AI for any academic tasks	2	1.4%
Total	**145**	**100 %**

Interpretation: The above chart represents that 91 respondents utilize AI tools for research and information gathering, 89 for explaining complex concepts, 68 for exam preparation, 64 for problem-solving, 56 for brainstorming ideas, 56 for writing assistance, and 55 for creating presentations/visuals. Notably, only 2 respondents reported never using AI for any academic tasks.

To what extent do you agree that AI tools help you understand difficult subjects more effectively?

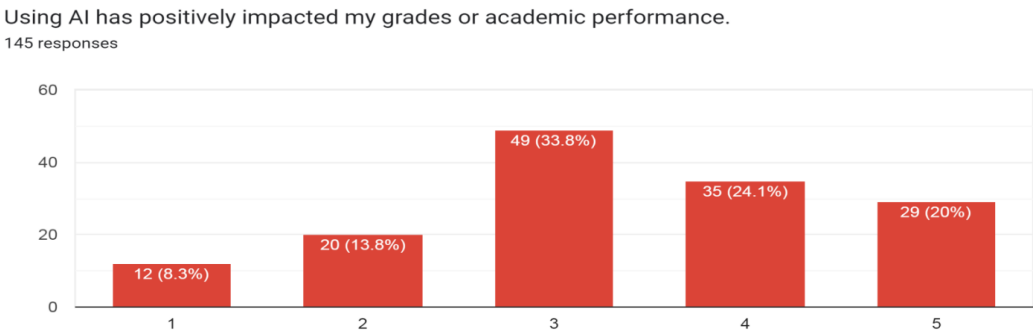


Attributes (Difficulty level to understand & use AI tool)	**Responses**	**Percentage**
Strongly disagree	9	6.2%
Disagree	15	10.3%
Neutral	44	30.3%
Agree	51	35.2%
Strongly agree	26	17.9%
Total	**145**	**100 %**

Interpretation: The above chart represents that 51 respondents agree AI is somewhat effective in aiding understanding of difficult subjects, while 44 are neutral. Additionally, 26 strongly agree on AI's effectiveness, 15 disagree about its efficacy, and 9 strongly disagree, claiming they do not face difficulties in understanding subjects, though they may use AI tools for other purposes.

Using AI has positively impacted my grades or academic performance.

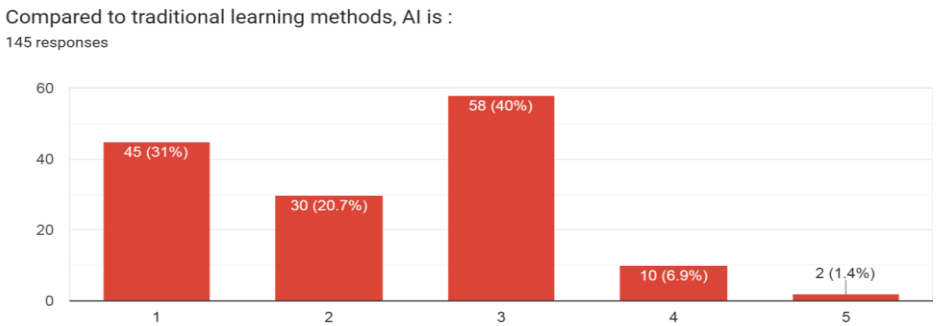
Rate (1 - Highly negative to 5 - Highly positive)



Interpretation: The above chart represents that, majority 49 respondents feels that using AI has no significant impact (neither positive nor negative) on their grades, 35 respondents feels that using AI has somewhat improved their grades, 29 respondents feels that using AI has greatly improved their grades, 20 respondents feels that using AI has had a somewhat negative impact on their grades but only 12 respondents strongly feels that using AI has affected their grades.

Compared to traditional learning methods, AI is:

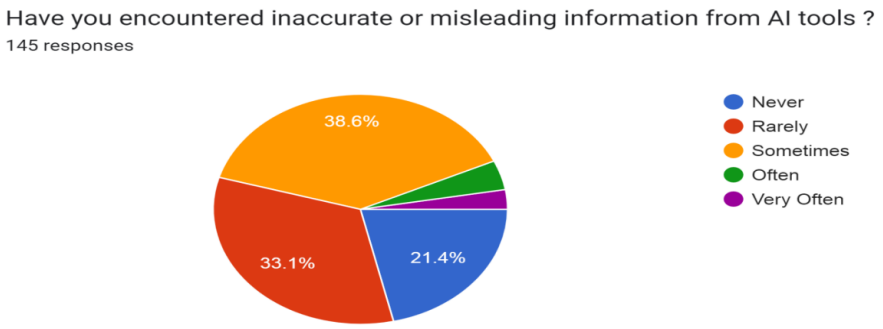
Rate - 1 - Much better to 5 - much worse



Attributes (Level of Perception in using AI as Compared to Traditional Method)	**Responses**	**Percentage**
Much better	45	31%
Better	30	20.7%
Neutral	50	40%
Worse	10	8.9%
Much worse	2	1.4%
Total	**145**	**100 %**

Interpretation: The above chart represents that 45 respondents consider AI "Much better" than traditional learning methods, while 30 view it as "Better." Additionally, 50 respondents found no clear difference or lack sufficient experience to judge, and 10 noted that few believe traditional methods are more effective. Only 2 respondents viewed traditional methods as superior.

Have you encountered inaccurate or misleading information from AI tools.

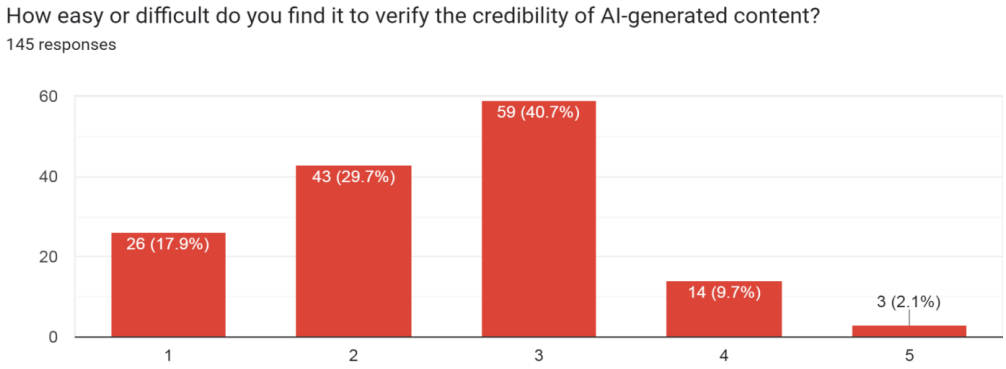


Attributes (Perception level of encountered with inaccurate AI tools)	Responses	Percentage
Never	31	21.4%
Rarely	48	33.1%
Sometimes	56	38.6%
Often	6	4.1%
Very often	4	2.8%
Total	**145**	**100 %**

Interpretation: The above chart represents that 56 respondents occasionally find AI-generated information inaccurate and unreliable, prompting a need for user safety measures. In contrast, 48 respondents experience inaccuracies rarely, while 31 have never encountered misleading information. Only 6 reported facing misleading content, and 4 stated inaccuracies occur very often, highlighting that significant reliability issues affect only a minority of users.

How easy or difficult do you find it to verify the credibility of AI-generated content?

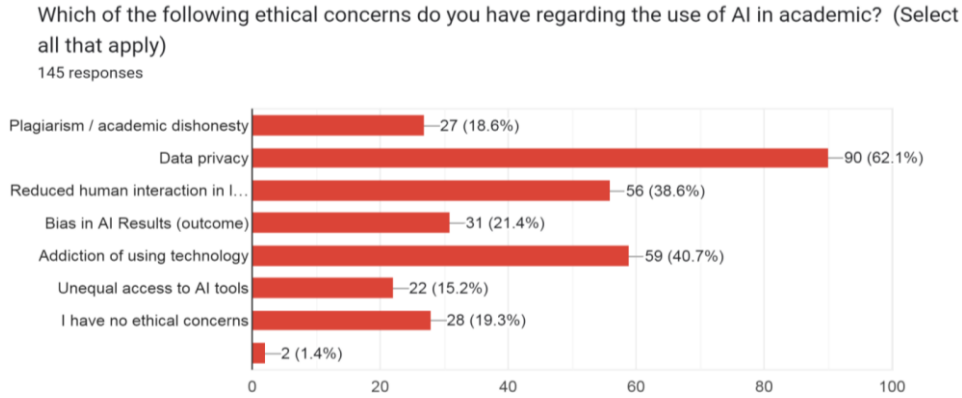
Rate - 1- Very easy to 5 - Very difficult



Attributes (level of difficulty in verification of AI content)	Responses	Percentage
Very easy	26	17.9%
Easy	43	29.7%
Neutral	59	40.7%
Difficult	14	9.7%
Very difficult	3	2.1%
Total	**145**	**100 %**

Interpretation: The above chart represents that, majority 59 respondents perceived Neutral difficulty that the verification does not effect on AI-generated content, 43 respondents perceived Easy that the verification might depend credibility of AI-generated content, 26 respondents perceived very easy, 14 respondents perceived that it's Difficult, only 3 respondents perceived that the verification is Very difficult.

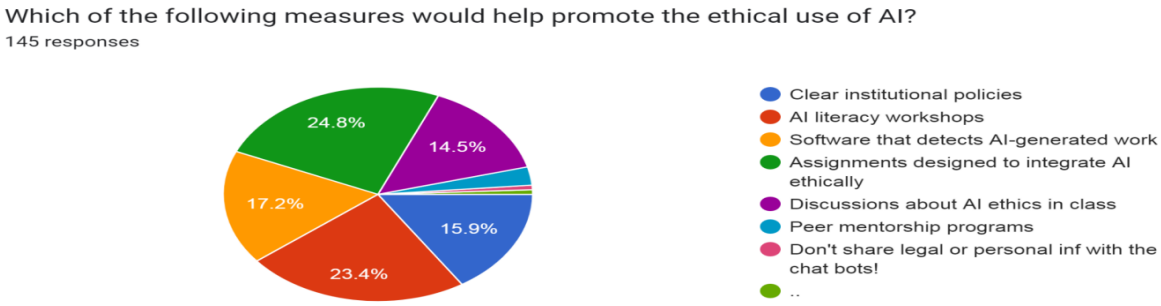
Which of the following ethical concerns do you have regarding the use of AI in academia?



Attributes (Ethical challenges in using AI content)	**Responses**	**Percentage**
Plagiarism	27	18.6%
Data privacy	90	62.1%
Bias in AI outputs	58	38.6%
Reduced human interaction in learning	31	21.4%
Addiction of using technology	59	40.7%
Unequal access to AI tools	22	15.2%
I have no ethical concerns	28	19.3%
Others	2	1.4%
Total	**145**	**100 %**

Interpretation: The above chart represents that ethical challenges in AI-driven content: 90 worry about data privacy, 59 cite technology addiction, 58 are concerned about data bias in AI outputs, 31 report reduced human interaction in learning, 27 mention data plagiarism, 28 express no ethical concerns, and 22 point to unequal access to AI tools. Only 2 respondents identify other issues.

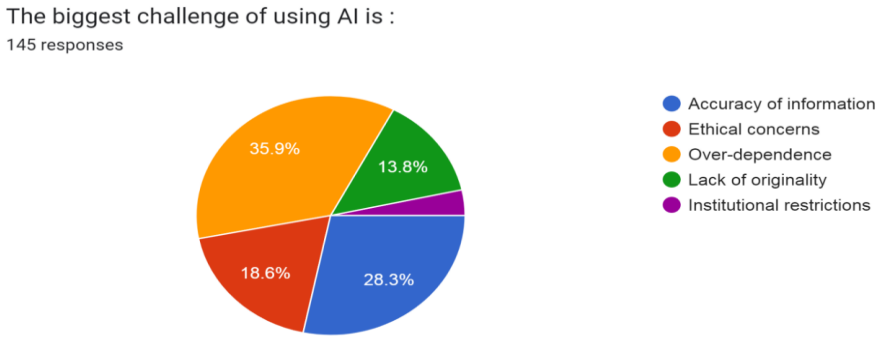
Which of the following measures would help promote the ethical use of AI?



Attributes (Measures to be taken for using AI content)	Responses	Percentage
Clear institutional policies	23	15.9%
AI literacy workshops	34	23.4%
Software that detects AI-generated work	25	17.2%
Assignments designed to integrate AI ethically	36	24.8%
Discussions about AI ethics in class	21	14.5%
Peer mentorship programs	4	2.8%
Don't share personal information on chat bot	1	0.7%
Others	1	0.7%
Total	**145**	**100 %**

Interpretation: The chart presents responses on AI-related educational measures. The top measures include Assignments for ethical AI integration (36 responses), AI literacy workshops (34 responses), and Software for detecting AI-generated work (25 responses), constituting nearly two-thirds of all responses. Other notable measures are Clear Institutional Policies (23), Discussions on AI Ethics (21), and college policy training, while (4 Reponses) & (1 responses) Peer mentorship and worrying about personal information on chatbots received minimal attention.

The biggest challenge of using AI is:

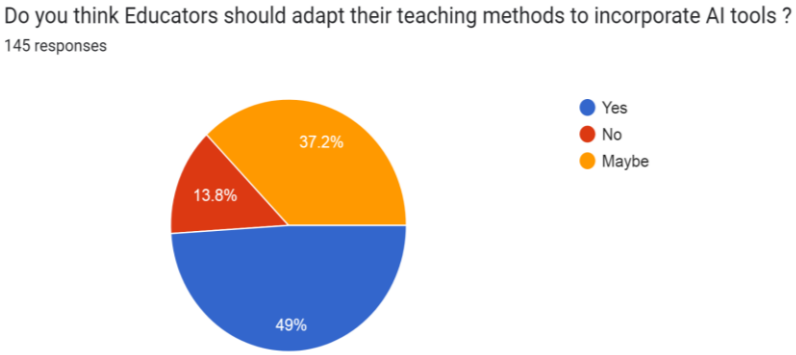


Attributes (Challenges faced using AI content)	Responses	Percentage
Accuracy of information	41	28.3%
Ethical concerns	27	18.6%
Over-dependence	52	35.9%
Lack of originality	20	13.8%
Institutional restrictions	5	3.4%
Total	**145**	**100 %**

Interpretation: The chart indicates that students face significant challenges, primarily over-dependence (52 responses) and information accuracy (41 responses), impacting their critical thinking and understanding of data reliability. Other issues include ethical concerns (27 responses) and lack of originality (20 responses), resulting in plagiarism and privacy problems,

while institutional restrictions were noted by only 5 respondents.

Do you think Educators should adapt their teaching methods to incorporate AI tool



Attributes (Educators should adopt AI teaching method)	**Responses**	**Percentage**
Yes	71	49%
No	20	13.8%
May be	54	37.2%
Total	**145**	**100 %**

Interpretation: The above chart represents that, the top two where students thinks Yes 71 Responses , May be 54 responses indicating significant, preventive and neutral response , whereas only 20 responses No educators should only adopt traditional method of teaching only.

Findings, Suggestion, & Conclusions:

Undergraduate students widely use AI tools for research, learning support, and exam preparation. While AI improves efficiency and accessibility, its impact on grades remains neutral. Major concerns include over-dependence, accuracy, privacy, and ethical issues rather than plagiarism.

Suggestions:

- Develop clear institutional AI usage policies.
- Introduce AI literacy and ethics workshops.
- Design assessments that integrate AI responsibly.
- Encourage blended learning models that promote critical thinking.
- Ensure transparency in data handling and AI use

Conclusion:

AI-assisted content creation has become integral to undergraduate education. While these tools enhance learning efficiency and accessibility, their influence on academic outcomes is complex and context-dependent. Responsible integration through ethical guidelines, institutional policies, and educator involvement is essential to ensure AI complements rather than compromises academic integrity and skill development. This study contributes empirical evidence to the ongoing discourse on ethical AI adoption in higher education

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Appendix:

1. How often do you use AI tools for academic work

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Very Often

2. Are you aware of any / all of the AI-powered tools listed below that are used as research assistants?

Chat GPT , Meta AI , Gemini , Blackbox AI , Deepseek AI , Grammerly , Canava , Quill bot , others

3. Are you aware of your institution's policy on the use of AI tools for coursework such as assignments, projects, and notes?

a) Very restrictive
b) Somewhat restrictive
c) Moderately clear and balanced
d) Encouraging, with clear guidelines
e) Very encouraging and open
f) Unaware of my institution's policy

4. For which academic tasks have you used AI tools?

a) Brainstorming ideas
b) Explaining complex concepts
c) Writing assistance
d) Research and information gathering
e) Solving problems
f) Preparing for exams
g) Creating presentations/visuals
h) I have never used AI for any academic tasks

5. To what extent do you agree that AI tools help you understand difficult subjects more effectively?

a) Strongly disagree
b) Disagree
c) Neutral

d) Agree
e) Strongly agree

6. **Using AI has positively impacted my grades or academic performance.**
Rate 1- 5 (1 - Highly negative to 5 - Highly positive)

7. **Compared to traditional learning methods, AI is:**
Rate - 1 - Much better to 5 - much worse

8. **Have you encountered inaccurate or misleading information from AI tools.**
a) Never
b) Rarely
c) Sometimes
d) Often
e) Very often

9. **How easy or difficult do you find it to verify the credibility of AI-generated content?**
Rate - 1- Very easy to 5 - Very difficult

10. **Which of the following ethical concerns do you have regarding the use of AI in academia?**
a) Plagiarism/academic dishonesty
b) Data privacy
c) Bias in AI outputs
d) Reduced human interaction in learning
e) Addiction of using technology
f) Unequal access to AI tools
g) I have no ethical concerns
h) Other (please specify briefly):

11. **Which of the following measures would help promote the ethical use of AI?**
a) Clear institutional policies
b) AI literacy workshops
c) Software that detects AI-generated work
d) Assignments designed to integrate AI ethically
e) Discussions about AI ethics in class
f) Peer mentorship programs
g) Other: _____

12. **The biggest challenge of using AI is:**
a) Accuracy of information
b) Ethical concerns
c) Over-dependence
d) Lack of originality
e) Institutional restrictions

13. **Do you think Educators should adapt their teaching methods to incorporate AI tools.**
a) yes
b) No
c) May be

14. **In your opinion, what role do you think AI will play in the future of education, and why?**

15. **Based on your experience, what improvements would you suggest for integrating AI tools into formal education systems?**

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A Study on the Adoption of Artificial Intelligence in Residential Interior Design and Its Impact on User Decision-Making

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Abstract:

Artificial Intelligence (AI) has emerged as a transformative tool in residential interior design, enabling homeowners to visualize layouts, experiment with styles, and make informed design decisions with greater ease and accuracy. AI-based interior design tools assist users by generating personalized layouts, optimizing space utilization, and providing realistic visual simulations before actual implementation. As residential interior design involves long-term financial and aesthetic commitments, the perceived usefulness of AI tools plays a crucial role in influencing their adoption and effectiveness in supporting user decision-making. This study examines how AI-based interior design tools are perceived by users and how such perceptions vary based on the purpose of use, namely new home interior design and renovation. The study further explores the impact of AI adoption on the effectiveness of interior design decision-making. Using empirical data collected from 80 respondents, the research compares users planning a new home with those undertaking renovation. The findings reveal that users planning a new home perceive AI tools as more useful and effective in decision-making compared to renovation users. This difference highlights the role of design flexibility and reduced constraints in enhancing the value derived from AI-based interior design tools, thereby emphasizing their growing relevance in modern residential planning.

Keywords: Artificial Intelligence, Interior Design, Perceived Usefulness, Decision-Making Effectiveness

Introduction:

Artificial Intelligence (AI) is rapidly reshaping how homeowners plan and visualize residential interior design. Instead of relying only on manual sketches, catalog browsing, or repeated consultations, users can now experiment with AI-based tools that generate room layouts, suggest furniture combinations, recommend color palettes, and simulate styles based on personal preferences and spatial constraints. Recent research in computational interior-scene generation shows that AI systems can help users move from vague ideas ("modern minimalist bedroom") to concrete, visual alternatives that are easier to compare and evaluate.

At the technical level, AI-enabled interior design increasingly draws on advances in indoor scene synthesis, furniture layout generation, and text-guided scene editing. For example, models can generate furniture placement plans and stylistically consistent room compositions by learning patterns from large indoor datasets and then producing plausible layouts that match room type and design intent. This progress supports practical consumer use cases such as rapid ideation, exploring multiple options quickly, and refining designs interactively before making costly purchases.

However, adoption of AI in interior design is not only a technical issue—it is also a user acceptance and behavioral decision-making issue. The Technology Acceptance Model (TAM) explains why people adopt a technology largely through Perceived Usefulness, i.e., the belief that using the system improves outcomes or performance. In the context of AI-based interior

design tools, usefulness may be reflected in quicker planning, better visualization, fewer mistakes, and more confidence while choosing layouts/materials/furniture. The strong role of perceived usefulness is consistently supported in TAM and its extensions.

Residential interior design decisions are complex because they involve financial risk, long-term satisfaction, aesthetic preferences, space constraints, and coordination among family members. AI tools may improve Effectiveness of Interior Design Decision-Making by making options more visible and comparable, enabling "try-before-you-buy" style simulations, and reducing uncertainty about how choices will look in real rooms. Work on interior design evaluation using deep learning also indicates growing interest in measuring design quality and user-aligned assessment—important for decision effectiveness.

Even though AI capabilities for generating and evaluating interior design options are expanding, research still needs clearer empirical evidence on how perceived usefulness translates into better decision-making effectiveness for end-users in residential contexts, especially as AI becomes accessible through consumer apps and design platforms. Early evidence from design communities indicates that acceptance factors (including perceived usefulness) are relevant when AI tools start becoming widely available to interior designers and learners, but the household consumer decision-making angle remains underexplored. Therefore, this study focuses on the relationship between Perceived Usefulness of AI-Based Interior Design Tools (IV) and Effectiveness of Interior Design Decision-Making (DV) to understand adoption-driven outcomes in residential interior design.

Review of Literature:

Alshehri et.al (2025), In the research titled "DecoMind: A generative AI system for personalized interior design layouts" The study concludes that generative AI systems like DecoMind significantly enhance personalization in interior design by automatically generating layouts tailored to user preferences and spatial constraints. By enabling rapid visualization and iterative design exploration, such systems reduce dependency on expert designers during early planning stages. The findings support the argument that AI-based tools increase perceived usefulness by improving efficiency, creativity, and user engagement in residential interior design decision-making.

Davis, F. D. (1989), In the research titled "Perceived usefulness, perceived ease of use, and user acceptance of information technology" This seminal study concludes that perceived usefulness is a critical determinant of user acceptance of information technology. Users are more likely to adopt a system when they believe it enhances their task performance and outcomes. In the context of AI-based interior design tools, this theory underlines that homeowners' belief in improved planning, visualization, and decision quality directly influences their willingness to adopt AI solutions.

Davis et.al (1989), In the research titled "User acceptance of computer technology: A comparison of two theoretical models" The study concludes that both perceived usefulness and perceived ease of use significantly influence behavioral intention to use technology, regardless of whether system usage is voluntary or mandatory. The findings emphasize that usefulness has a stronger direct effect on intention, reinforcing its importance in adoption studies. This supports examining perceived usefulness as a primary predictor of effective

decision-making in AI-driven residential interior design.

Di & Yu (2021), In the research titled "Deep reinforcement learning for producing furniture layout in indoor scenes" This research concludes that deep reinforcement learning can successfully generate optimized furniture layouts that balance functional constraints and aesthetic considerations. The ability of AI to automate complex spatial decisions demonstrates its potential to reduce human effort and error in interior planning. These findings imply that AI tools can enhance decision-making effectiveness by offering optimized layout solutions that users may not easily conceive manually.

Fan et.al (2024), In the research titled "Interior design evaluation based on deep learning: A multi-modal fusion evaluation mechanism" The study concludes that deep learning–based evaluation models can objectively assess interior design quality by integrating visual, spatial, and aesthetic features. Such AI-driven evaluation mechanisms help standardize design assessment and reduce subjectivity. This strengthens the argument that AI tools can improve the effectiveness of interior design decisions by providing data-supported feedback rather than relying solely on intuition.

Ibrahim et.al (2025), In the research titled "The technology acceptance model and adopter type analysis in the context of artificial intelligence" This study concludes that the Technology Acceptance Model remains highly relevant in explaining AI adoption, with perceived usefulness playing a dominant role across different adopter types. Users are more inclined to accept AI when they recognize clear performance benefits. The findings validate the use of TAM as a theoretical foundation for studying AI adoption in residential interior design and its impact on decision-making outcomes.

Liu et.al (2023), In the research titled "CLIP-Layout: Style-consistent indoor scene synthesis with semantic furniture embedding" The research concludes that AI models such as CLIP-Layout can generate style-consistent indoor scenes by effectively linking semantic understanding with visual representation. This capability allows users to translate abstract design preferences into concrete visual layouts. The findings highlight how AI tools enhance clarity and confidence in design choices, thereby improving decision-making effectiveness in residential interiors.

Research Gap:

The existing literature clearly establishes the technological capabilities of AI in interior design—such as personalized layout generation, automated furniture placement, style-consistent visualization, and objective design evaluation—and also confirms, through the Technology Acceptance Model, that perceived usefulness strongly influences technology adoption. However, a significant gap remains in empirically linking perceived usefulness of AI-based interior design tools with the actual effectiveness of user decision-making in residential settings. Most prior studies are either technically oriented (focusing on algorithm performance and design generation accuracy) or conceptually focused on general technology adoption, with limited attention to end-user residential decision outcomes such as confidence, clarity, satisfaction, and error reduction. Furthermore, few studies examine homeowners and non-expert users as primary respondents, especially in emerging market contexts. Consequently, there is a lack of integrated empirical research that simultaneously examines AI adoption perceptions and their direct impact on interior design decision-making effectiveness, which the present study seeks to address.

Research Methodology:

The study adopts a descriptive and comparative research design based on primary data collected through a structured questionnaire. A total of 80 respondents were selected using a convenient sampling technique, equally divided between users planning a new home (40 respondents) and those undertaking renovation (40 respondents). The questionnaire consisted of demographic variables and Likert-scale statements measuring Perceived Usefulness of AI-Based Interior Design Tools and Effectiveness of Interior Design Decision-Making. The collected data were analyzed using descriptive statistics and independent samples t-tests to examine differences between the two groups. Statistical analysis was carried out to test hypotheses and draw valid inferences regarding AI adoption and decision-making outcomes.

Data Analysis:

Demographic Factor

Sr No.	Particular	Category	Frequency	Percent
1	Age	18-25 Years	15	18.8
		26-35 Years	22	27.5
		36-45 Years	24	30.0
		46-55 Years	14	17.5
		Above 55 Years	5	6.3
2	Gender	Female	33	41.3
		Male	47	58.8
3	Purpose	New Home	40	50.0
		Renovation	40	50.0

The demographic profile of the respondents indicates a well-distributed sample across age, gender, and purpose of interior design. In terms of age, the majority of respondents fall in the 36–45 years category (24 respondents, 30.0%), followed by the 26–35 years group (22 respondents, 27.5%), suggesting that middle-aged and early working-age individuals are the most active users of AI-based interior design tools. Respondents aged 18–25 years account for 18.8% (15 respondents), while 46–55 years represent 17.5% (14 respondents), indicating moderate representation from younger and older working populations. A smaller proportion of respondents are above 55 years (5 respondents, 6.3%), reflecting relatively lower adoption or exposure to AI tools among senior age groups. Gender-wise distribution shows a higher participation of male respondents (47 respondents, 58.8%) compared to female respondents (33 respondents, 41.3%). Regarding the purpose of using AI-based interior design tools, respondents are evenly divided between new home interior design and renovation, with 40 respondents (50.0%) in each category, ensuring balanced representation for comparative analysis between the two purposes.

Objective and Hypothesis:

Objective 1 To Study the difference in perceived usefulness of AI-based interior design tools between users planning a new home and those undertaking renovation.

Null Hypothesis H_{01}: There is no difference in perceived usefulness of AI-based interior design tools between users planning a new home and renovation.

Alternate Hypothesis H_{11}: There is a difference in perceived usefulness of AI-based interior

design tools between users planning a new home and renovation.

To study the above objectives, independent sample test is applied and results are as follows:

Independent Samples Test					
	t-test for Equality of Means				
	t	df	P-value	Mean Difference	Std. Error Difference
Perceived Usefulness	8.610	78	.000	11.800	1.371

Interpretation: The above results indicate that calculated p-value is 0.000. It is less than 0.05. Therefore, t-test is rejected. Hence Null hypothesis is rejected and Alternate hypothesis is accepted.

Conclusion: There is a difference in perceived usefulness of AI-based interior design tools between users planning a new home and renovation.

Findings: To understand the findings of hypothesis, mean score of perceived usefulness of AI-based interior design tools between users planning a new home and renovation.

Group Statistics					
	3. Purpose	N	Mean	Std. Deviation	Std. Error Mean
Perceived Usefulness	New Home	40	87.50	5.296	.837
	Renovation	40	75.70	6.862	1.085

The group statistics indicate a clear difference in the perceived usefulness of AI-based interior design tools based on the purpose of use. Respondents who used AI tools for new home interior design reported a higher mean perceived usefulness score (Mean = 87.50, SD = 5.296) compared to those using AI tools for renovation purposes (Mean = 75.70, SD = 6.862). This suggests that AI-based interior design tools are perceived as more useful when applied to planning interiors for a new home, where users have greater flexibility in layout, design, and space utilization. The relatively lower standard deviation and standard error mean for the new home group indicate more consistent perceptions among these respondents, whereas the renovation group shows slightly greater variability in responses, possibly due to constraints associated with modifying existing spaces.

Objective 2 To Study the difference in perc Effectiveness of Interior Design Decision-Making tools between users planning a new home and those undertaking renovation.

Null Hypothesis H_{02}: There is no difference in Effectiveness of Interior Design Decision-Making tools between users planning a new home and renovation.

Alternate Hypothesis H_{12}: There is a difference in Effectiveness of Interior Design Decision-Making tools between users planning a new home and renovation.

To study the above objectives, independent sample test is applied and results are as follows:

Independent Samples Test					
	t-test for Equality of Means				
	t	df	P-value	Mean Difference	Std. Error Difference
Effectiveness of Interior Design Decision-Making	6.608	78	.000	12.400	1.877

Interpretation: The above results indicate that calculated p-value is 0.000. It is less than 0.05. Therefore, t-test is rejected. Hence Null hypothesis is rejected and Alternate hypothesis is accepted.

Conclusion: There is a difference in Effectiveness of Interior Design Decision-Making tools between users planning a new home and renovation.

Findings: To understand the findings of hypothesis, mean score of Effectiveness of Interior Design Decision-Making tools between users planning a new home and renovation.

Group Statistics					
	3. Purpose	N	Mean	Std. Deviation	Std. Error Mean
Effectiveness of Interior Design Decision-Making	New Home	40	83.90	9.734	1.539
	Renovation	40	71.50	6.790	1.074

The group statistics reveal a notable difference in the effectiveness of interior design decision-making based on the purpose of using AI-based interior design tools. Respondents who used AI tools for new home interior design reported a higher mean score (Mean = 83.90, SD = 9.734) compared to those using AI tools for renovation purposes (Mean = 71.50, SD = 6.790). This indicates that AI-based tools are more effective in supporting decision-making when users are planning a new home, as they allow greater freedom in design choices, layout planning, and visualization. The higher standard deviation in the new home group suggests some variability in user experiences, while the renovation group shows relatively more consistent but lower effectiveness perceptions, possibly due to existing structural and design constraints limiting AI-driven options.

Conclusion:

The study concludes that AI-based interior design tools significantly influence residential interior design decision-making, particularly for users planning a new home. The empirical results indicate that perceived usefulness and decision-making effectiveness are substantially higher among new home users compared to renovation users, due to greater design flexibility, enhanced visualization, and

fewer structural constraints. The findings validate the applicability of the Technology Acceptance Model in the context of AI-driven interior design and demonstrate that perceived usefulness is a key determinant of effective decision-making. Overall, the study highlights the growing importance of AI in residential interior design and suggests that its benefits are maximized when applied during the initial planning stages of a new home.

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Awareness and Impact of Sukanya Samriddhi Yojana on Girl Child Education

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Abstract:

The Sukanya Samriddhi Yojana (SSY) is a government-backed small savings scheme introduced to enhance financial security and educational empowerment of the girl child in India. This study examines the level of awareness of SSY among households and evaluates its impact on educational planning and financial preparedness for girl child education. The research is based on secondary data collected from government publications, national surveys, research journals, and reports related to financial inclusion and education. The findings indicate that while general awareness of SSY is relatively high, comprehensive understanding of operational aspects such as withdrawal conditions and maturity norms remains limited. The study further reveals that SSY positively influences long-term savings behavior and educational planning for girls. The paper concludes that strengthening awareness initiatives and improving scheme flexibility can significantly enhance its effectiveness in promoting gender equity and educational access.

Keywords: Sukanya Samriddhi Yojana, Awareness, Girl Child Education, Financial Planning, Savings Behaviour

Introduction:

Education of the girl child plays a pivotal role in achieving inclusive economic growth and sustainable social development. Despite notable progress in female literacy and enrollment rates, gender disparities in access to education and financial resources continue to persist in India, particularly among economically weaker sections. Financial constraints, social attitudes, and lack of long-term planning often hinder educational continuity for girls.

To address these challenges, the Government of India launched the Sukanya Samriddhi Yojana (SSY) in 2015 under the Beti Bachao, Beti Padhao initiative. The scheme encourages parents and guardians to invest systematically for their daughters' future educational and financial needs. With features such as sovereign security, tax benefits, and long-term savings orientation, SSY aims to strengthen household-level financial planning for girl child education. However, the success of the scheme depends significantly on awareness, understanding, and sustained participation by beneficiaries.

Statement of the Problem:

Although Sukanya Samriddhi Yojana is designed to support girl child education through structured savings, many households lack adequate awareness of its eligibility criteria, deposit requirements, withdrawal provisions, and maturity conditions. Limited understanding of these operational aspects may restrict effective utilization of the scheme, thereby reducing its intended educational impact. Hence, an assessment of awareness levels and the scheme's influence on educational planning is required.

Objectives of the Study:

1. To assess the level of awareness of Sukanya Samriddhi Yojana among parents and guardians.
2. To identify socio-economic factors influencing awareness of the scheme.
3. To examine the impact of Sukanya Samriddhi Yojana on educational planning for the girl child.

Review of Literature:

Harini and Rampal (2016) examined Sukanya Samriddhi Yojana as a financial inclusion initiative and concluded that the scheme provides substantial support for the welfare of the girl child, particularly for education and marriage. However, fluctuations in interest rates were identified as a potential drawback.

Venkatachalam and Ravindran (2016) analyzed account holders' satisfaction with Sukanya Samriddhi Accounts and found that the scheme contributes to financial independence for girls and helps reduce the perception of the girl child as a financial burden.

Venkatesh and Kumar (2018) studied account holders' acceptability and satisfaction toward SSY and highlighted the flexibility of the scheme, including transferability of accounts and special provisions for multiple girl children, which enhance its overall attractiveness.

The existing literature suggests that while SSY is positively perceived, gaps remain in awareness and effective utilization, indicating the need for further analysis.

Research Methodology:

The study is based entirely on secondary data collected from government publications, Ministry of Finance notifications, RBI bulletins, national educational surveys such as the All-India Survey on Higher Education, academic journals, and reports related to financial inclusion and girl child education. The data were analyzed using descriptive and interpretative techniques to assess awareness trends and educational impact.

Awareness of Sukanya Samriddhi Yojana:

Secondary data indicate that awareness of SSY has increased steadily since its introduction in 2015. This growth is attributed to its integration with the Beti Bachao, Beti Padhao campaign, promotion through post offices and public sector banks, and financial literacy initiatives. However, awareness is unevenly distributed across socio-economic groups.

Educational attainment of parents, household income, occupation, and urban–rural location significantly influences awareness levels. Urban households and educated parents exhibit higher awareness, whereas rural populations and economically weaker sections demonstrate relatively limited understanding of the scheme.

Key Components Creating Awareness:

- Government Campaigns
- Nationwide awareness drives under Beti Bachao, Beti Padhao
- Advertisements through print, television, radio, and digital media
- Bank and Post Office Initiatives
- Account opening guidance at post offices and authorized banks
- Distribution of brochures and counseling by officials
- Educational Institutions & NGOs
- Seminars, workshops, and community outreach programs

- Awareness sessions conducted in schools and colleges
- Word-of-Mouth & Community Influence
- Information shared among parents, women self-help groups, and local communities

Importance of Awareness of SSY:

- Encourages early financial planning for a girl child
- Reduces future education-related financial burden
- Promotes gender equality in education
- Improves female literacy and higher education enrolmentEnhances participation in formal savings and banking systems

Present Awareness Status (Indian Context):

- Awareness is higher in urban and semi-urban areas
- Moderate to low awareness in rural areas due to lack of financial literacy
- Increasing awareness among middle-income families because of tax benefits under Section 80C
- Growing acceptance of SSY as a long-term education-oriented investment
- Impact of Sukanya Samriddhi Yojana on Girl Child Education
- The Sukanya Samriddhi Yojana (SSY) has emerged as a significant policy instrument in India aimed at strengthening financial preparedness for the education of the girl child. Its impact can be assessed across multiple educational, social, and economic dimensions.

Improved Access to Education:

SSY encourages long-term savings dedicated specifically to a girl child's future. As funds mature around the time of higher education, families are better equipped to finance:

Secondary and higher education:

Professional and vocational courses: Reduced dependence on loans or early workforce entry This financial assurance contributes to higher enrolment and retention rates of girls, particularly at the secondary and tertiary levels.

Reduction in School Dropout Rates:

Economic constraints are a major cause of female school dropouts in India. SSY mitigates this risk by:

Providing earmarked education funds: Reducing pressure for early marriage due to financial insecurity

Enabling continuity of education during critical adolescent years: As a result, girls are more likely to complete schooling and pursue further studies.

Enhanced Parental Attitude toward Girls' Education: The scheme institutionalizes the idea that investing in a girl child's education is both valuable and necessary. It positively influences parental behavior by:

Promoting early financial planning:

- Shifting perceptions from short-term costs to long-term returns
- Reinforcing education as a priority over traditional biases

Support for Higher and Professional Education:

The long lock-in period aligns well with educational milestones. Upon maturity, SSY funds are often used for:

College and university education:

- Professional degrees such as medicine, engineering, management, or law
- Skill development and career-oriented programs
- This directly enhances employability and economic independence among women.

Contribution to Gender Equality and Social Empowerment

Education is a foundational driver of women's empowerment. By facilitating sustained educational investment, SSY contributes to:

- Improved literacy and educational attainment among girls Greater participation of women in the workforce
- Long-term reduction in gender disparities Interlink age with National Education and Welfare

Objectives

- SSY complements broader national initiatives aimed at:

Promoting girl child education

- Enhancing human capital development
- Achieving inclusive and sustainable socio-economic growth

Maharashtra – Three-Month Computation Summary Three-Month Summary Report (Sep–Nov 2025)

Particulars	September 2025	October 2025	November 2025
Registered Subscribers – DOP	3,260,029	3,284,335	3,309,359
Registered Subscribers – Banks	785,736	789,401	794,609
Total Registered Subscribers	4,045,765	4,073,736	4,103,968
Amount Saved – DOP (₹ Cr.)	19,018.77	19,209.96	19,427.88
Amount Saved – Banks (₹ Cr.)	11,776.76	11,869.48	11,953.79
Total Amount Saved (₹ Cr.)	30,795.53	31,079.43	31,381.67

Growth Computation (Sep → Nov 2025)

Indicator	Absolute Increase	Growth %
Total Subscribers	+58,203	+1.44%
Total Amount Saved (₹ Cr.)	+586.14	+1.90%
DOP Subscribers	+49,330	+1.51%
Bank Subscribers	+8,873	+1.13%

Source: (Ministry of Finance, Department of Economic Affairs, National Savings Institute, New Delhi State)

Key Analytical Insights:

- Maharashtra shows steady month-on-month growth in both accounts and deposits.
- Department of Posts dominates participation, accounting for nearly 81% of total SSY accounts.
- The rise of ₹586.14 crore in just three months reflects strong household

commitment toward girl child education savings.

- Banking channels show slower but consistent incremental adoption, indicating expanding urban participation.

Conclusion:

The study concludes that Sukanya Samriddhi Yojana holds strong potential as a long-term financial and social welfare scheme supporting girl child education in India. Secondary data indicate a steady rise in female enrolment between 2016 and 2022, reflecting improved access to education and evolving societal attitudes. SSY plays a supportive role in reducing financial barriers, strengthening parental commitment, and promoting gender equity. Enhancing awareness and improving scheme flexibility can further increase its effectiveness. Overall, the Sukanya Samriddhi Yojana has a positive and far- reaching impact on girl child education. By ensuring financial readiness, reducing dropout risks, and fostering supportive parental attitudes, the scheme plays a crucial role in advancing education. Maharashtra demonstrates robust and stable performance under SSY, reinforcing its role as one of the leading contributor states to long-term financial provisioning for girl child education.

Recommendations:

- Introduce flexible, need-based withdrawal options aligned with educational milestones.
- Revise the lock-in period to correspond with the age and educational requirements of the girl child.
- Provide exceptions in cases of financial hardship or educational emergencies.
- Digitally integrate SSY accounts for transparency and real-time monitoring.
- Strengthen awareness campaigns with a focus on educational benefits.

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Revisiting Jiddu Krishnamurti's Educational Philosophy in the Age of Artificial Intelligence

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Abstract:

The rapid integration of Artificial Intelligence (AI) into contemporary education has transformed teaching methodologies, learning environments, assessment systems, and institutional decision-making processes. While AI offers significant advantages such as personalized learning, efficiency, and accessibility, it also raises serious philosophical and ethical concerns related to human values, autonomy, creativity, and consciousness. This paper critically examines the relevance of Jiddu Krishnamurti's educational philosophy in the context of AI-driven education systems. Krishnamurti viewed education as a process of self-knowledge, freedom from conditioning, and holistic development rather than mere acquisition of information or skills. Using a conceptual and analytical research design based on secondary sources, this study explores the compatibility and contradictions between Krishnamurti's philosophical vision and the current applications of AI in education. The findings suggest that while AI can support individualized learning and reduce mechanical burdens, its uncritical adoption risks reinforcing conformity and dependency. The paper concludes by proposing a balanced philosophical framework where AI functions as a supportive tool aligned with human awareness, ethical responsibility, and holistic education.

Keywords: Jiddu Krishnamurti, Educational Philosophy, Artificial Intelligence, Holistic Education, Self-Awareness, Ethics in Education

Introduction:

Education in the twenty-first century is undergoing a profound transformation driven by rapid technological advancements, particularly the emergence of Artificial Intelligence. AI-powered tools such as adaptive learning platforms, intelligent tutoring systems, automated assessments, and learning analytics are reshaping how knowledge is delivered and evaluated. While these developments promise efficiency and personalization, they also raise concerns about the increasing mechanization of learning and the erosion of human-centered educational values.

In this context, revisiting classical educational philosophies becomes essential. Jiddu Krishnamurti, one of the most influential educational thinkers of the twentieth century, emphasized education as a means for inner transformation, self-awareness, and freedom from psychological conditioning. His critique of authority, competition, fear-based learning, and rote memorization offers a powerful lens through which contemporary AI- driven education can be examined. This paper seeks to explore whether AI can coexist with Krishnamurti's vision of holistic education or whether it fundamentally contradicts his philosophical foundations.

Objectives of the Study:

The primary objectives of this study are:

(i) to examine the core principles of Jiddu Krishnamurti's educational philosophy;

(ii) to analyze the role and applications of Artificial Intelligence in the present education system;

(iii) to identify areas of convergence and conflict between Krishnamurti's philosophy and AI-based education; and

(iv) to propose a philosophical framework for the ethical and holistic integration of AI in education.

Research Methodology:

This study adopts a conceptual and qualitative research design based on secondary data. Data have been collected from books, philosophical writings of Jiddu Krishnamurti, peer-reviewed journals, reports on AI in education, and policy documents. A critical analytical approach is used to interpret philosophical concepts and examine their relevance in contemporary educational contexts. The study is exploratory in nature and aims to build theoretical insights rather than empirical generalizations.

Review of Literature:

Krishnamurti (1953), In the research titled "Education and the significance of life" Krishnamurti concludes that the true purpose of education is not the mere acquisition of knowledge or preparation for a career, but the awakening of intelligence through self-knowledge and freedom from psychological conditioning. He emphasizes that education must liberate the individual from fear, competition, and blind conformity, enabling learners to understand themselves and their relationship with society and nature. The work establishes that without inner awareness and ethical sensitivity, education becomes mechanical and destructive, a concern that remains highly relevant in technology-driven educational systems.

Krishnamurti (1977), In the research titled "Krishnamurti on education" In this work, Krishnamurti reiterates that education should cultivate holistic development by integrating intellectual, emotional, and moral dimensions of the learner. He strongly critiques authority-based teaching and standardized evaluation systems, arguing that they suppress creativity and independent thinking. The conclusion reinforces the idea that teachers must act as facilitators of inquiry rather than transmitters of information, a perspective that challenges the excessive reliance on automated and algorithm- driven instructional models in modern education.

Miller (2000), In the research titled "Krishnamurti and holistic education" Miller concludes that Krishnamurti's philosophy offers a profound foundation for holistic education by emphasizing interconnectedness, self-reflection, and inner transformation. The study highlights that education must address the whole person rather than fragmented academic outcomes. Miller argues that Krishnamurti's approach provides a counterbalance to reductionist and technocratic education models, making it especially relevant in an era dominated by efficiency-oriented and performance-driven educational technologies.

Srinivasan & Benade (2024), In the research titled "Considering the relevance of Jiddu Krishnamurti to contemporary Indian education: In conversation with the thought of Gert Biesta" The authors conclude that Krishnamurti's educational philosophy remains deeply relevant to contemporary Indian education, particularly when examined alongside Gert Biesta's ideas on subjectification and educational purpose. The

study emphasizes that education should prioritize human agency, ethical responsibility, and meaningful learning over technical efficiency. The paper warns that uncritical adoption of digital and AI-based educational reforms risks undermining the deeper aims of education, reinforcing the need for philosophical grounding in policy and practice.

Holmes et.al (2019), In the research titled "Artificial intelligence in education: Promises and implications for teaching and learning" Holmes and colleagues conclude that Artificial Intelligence holds significant potential to enhance education by enabling personalized learning, improving access, and supporting teachers through data-driven insights. However, the study stresses that AI must be implemented with clear pedagogical goals and ethical safeguards. The authors caution that without a strong human-centered framework, AI may exacerbate inequality and reduce learning to measurable outputs, highlighting the importance of aligning AI with broader educational values.

Luckin et.al (2016), In the research titled "Intelligence unleashed: An argument for AI in education" This study concludes that AI can serve as a powerful educational tool when used to augment, rather than replace, human intelligence and teacher- student interaction. The authors emphasize that AI should support metacognition, critical thinking, and learner autonomy. The conclusion underscores the necessity of designing AI systems that respect human agency and ethical considerations, aligning closely with philosophical perspectives that advocate for awareness, freedom, and holistic learning.

Research Gap:

The reviewed literature clearly establishes the philosophical foundations of Jiddu Krishnamurti's educational thought and the functional potential of Artificial Intelligence in contemporary education; however, a critical research gap remains in integrating these two domains into a coherent analytical framework. While Krishnamurti's works and subsequent studies emphasize self-knowledge, freedom from conditioning, holistic development, and human agency, existing AI-in-education research largely focuses on efficiency, personalization, and data-driven outcomes with limited engagement with deeper philosophical and ethical dimensions. Very few studies critically examine AI-mediated education through the lens of consciousness, awareness, and freedom, which are central to Krishnamurti's philosophy. Moreover, empirical and conceptual research exploring whether AI systems may inadvertently reinforce psychological conditioning, conformity, or dependency, contrary to Krishnamurti's ideals, is largely absent. This gap highlights the need for philosophically grounded research that evaluates AI not merely as a technological tool but as an influential force shaping learner identity, autonomy, and intelligence, particularly within the context of value-based and holistic education systems.

Jiddu Krishnamurti's Educational Philosophy:

Jiddu Krishnamurti viewed education as a sacred responsibility aimed at nurturing intelligent, sensitive, and compassionate human beings. According to him, education should help individuals understand themselves and their relationship with society and nature. He rejected rote learning, competition, and authority-driven instruction, arguing that these elements condition the mind and suppress creativity.

Krishnamurti emphasized freedom as the foundation of learning. Freedom, in his view, was not political or social but psychological, freedom from fear, comparison, and imposed beliefs. Teachers, therefore, were not authorities but co-learners who facilitate inquiry and dialogue.

Education, he believed, must integrate intellectual, emotional, and ethical dimensions to enable holistic development.

Artificial Intelligence in the Present Education System:

Artificial Intelligence in education refers to the use of algorithms, machine learning models, and data analytics to support teaching and learning processes. AI applications include personalized learning platforms, automated grading systems, intelligent tutoring systems, chatbots, and predictive analytics.

The advantages of AI include individualized instruction, scalability, reduced administrative burden for teachers, and enhanced learner engagement. However, challenges remain regarding ethical concerns, over-reliance on technology, reduced human interaction, and the risk of standardizing learning experiences. These challenges necessitate a philosophical evaluation of AI's role in shaping learners' minds and values.

Interface between Krishnamurti's Philosophy and AI-Based Education:

A critical examination of Artificial Intelligence–based education reveals certain areas of convergence with Jiddu Krishnamurti's educational philosophy, particularly in relation to individualized learning. AI-enabled personalized learning systems have the potential to accommodate diverse learning styles, abilities, and paces, thereby moving away from rigid, uniform instructional methods. Such adaptability can support self-directed learning and inquiry, which resonate with Krishnamurti's emphasis on understanding the uniqueness of each learner. Additionally, by automating routine and repetitive tasks such as grading and administrative functions, AI can free educators from mechanical responsibilities, allowing greater scope for meaningful dialogue, observation, and reflective engagement with students—elements central to Krishnamurti's vision of education as a relational and exploratory process.

However, despite these points of alignment, significant philosophical contradictions emerge when AI-driven education is critically evaluated through a Krishnamurtian lens. Contemporary AI systems often rely heavily on data analytics, standardized performance metrics, and algorithmic decision-making, which may inadvertently reinforce comparison, competition, and conformity—practices that Krishnamurti explicitly opposed. Such systems risk reducing learning to quantifiable outcomes and conditioning learners to external validation rather than fostering inward awareness and independent thinking. Moreover, excessive dependence on algorithmic guidance may weaken learners' capacity for self-observation, critical reflection, and creative intelligence. From Krishnamurti's perspective, any system—technological or otherwise—that assumes the role of authority over human intelligence undermines true education. Therefore, AI must remain subordinate to human awareness and inquiry rather than becoming a determining force in the learning process.

Ethical and Philosophical Implications:

The growing integration of Artificial Intelligence in education raises profound ethical and philosophical concerns related to human autonomy, consciousness, and moral responsibility. Krishnamurti consistently warned against surrendering human intelligence to external authorities, whether they manifest as rigid ideologies, institutions, or technological systems. In the context of AI-mediated education, this warning gains renewed significance, as algorithmic systems increasingly influence what learners study, how they are assessed, and even

how their potential is interpreted. Ethical use of AI in education therefore demands transparency in algorithmic processes, accountability in decision-making, and a conscious commitment to preserving human dignity and agency.

Furthermore, educational institutions and educators carry a moral responsibility to ensure that AI enhances reflective thinking, empathy, and creativity rather than prioritizing efficiency, surveillance, or control. Without philosophical grounding, AI risks becoming a subtle mechanism of psychological conditioning, shaping learners' thoughts and behaviors in predetermined ways. Krishnamurti's philosophy urges educators to remain alert to such dangers and to continuously question the impact of technology on human consciousness. Ethical AI in education, therefore, must be guided not only by technical standards but also by deep philosophical inquiry into the nature and purpose of learning.

Proposed Conceptual Framework:

In response to the philosophical tensions identified, this study proposes a balanced and human-centered conceptual framework for integrating Artificial Intelligence into education. Within this framework, AI is positioned as a supportive and facilitative tool rather than a controlling or authoritative mechanism. The design and application of AI systems should be guided by Krishnamurti's core principles of self-inquiry, freedom from conditioning, and holistic awareness. Technology should assist learners in accessing information, exploring ideas, and reflecting on their understanding without dictating thought patterns or limiting intellectual freedom.

The framework emphasizes that AI must complement, not replace, essential human elements of education such as dialogue, ethical reflection, emotional intelligence, and interpersonal relationships. Teachers remain central as facilitators of inquiry who encourage awareness and sensitivity rather than mere performance outcomes. By embedding philosophical values into technological design and pedagogical practice, education can benefit from AI's capabilities while safeguarding the deeper human purpose of learning as envisioned by Krishnamurti.

Conclusion:

This study reaffirms the enduring relevance of Jiddu Krishnamurti's educational philosophy in the context of the rapidly evolving digital and AI-driven education landscape. While Artificial Intelligence offers transformative possibilities in terms of personalization, accessibility, and efficiency, its integration into education must be approached with philosophical sensitivity and ethical responsibility. Krishnamurti's emphasis on self-awareness, freedom, and holistic intelligence serves as a vital counterbalance to the mechanistic tendencies of technology-driven education.

The findings suggest that AI should function as an enabling instrument that supports the development of independent thinking and inner awareness rather than replacing human intelligence or relational learning. When aligned with Krishnamurti's vision, AI has the potential to contribute to an education system that is technologically advanced yet deeply human, nurturing individuals who are not only skilled and knowledgeable but also conscious, compassionate, and ethically grounded.

Scope for Future Research:

The present study opens several avenues for future research in the interdisciplinary fields of educational philosophy, technology, and ethics. Empirical studies may be undertaken to examine the lived experiences of teachers and learners within AI-supported holistic education models

inspired by Krishnamurti's philosophy. Comparative research across different philosophical traditions could further enrich understanding of how diverse educational values interact with AI-driven pedagogies. Additionally, policy-oriented research is needed to explore ethical governance frameworks that ensure responsible AI adoption in education while preserving human agency, consciousness, and moral development. Such future inquiries would contribute to the creation of education systems that harmonize technological innovation with philosophical depth and human values.

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A Study on College Youths' Perception of Artificial Intelligence Tools in Teaching and Learning in Thane City

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Abstract:

This study aims to study the perception of college youths towards the use of Artificial Intelligence (AI) tools in teaching and learning in Thane City. With rapid technological advancement, AI-based tools such as ChatGPT, Grammarly, and other digital learning platforms have become an integral part of students' academic life. These tools assist students in understanding concepts, completing assignments, and enhancing overall learning efficiency.

The study focuses on analysing students' awareness, usage patterns, and opinions regarding the application of AI tools in education. A descriptive research design was adopted for the study. Primary data was collected through a structured questionnaire using Google Forms, while secondary data was collected from books, research articles, journals, and online sources. The study is based on a sample size of 120 college students selected using the convenience sampling method.

The findings reveal that a majority of students have a positive perception towards AI tools and believe that these tools make learning easier, faster, and more effective. However, the study also highlights that excessive dependence on AI may reduce creativity and critical thinking skills. The study concludes that Artificial Intelligence plays a significant role in modern education and, when used responsibly, can effectively enhance the teaching and learning process.

Keywords: Artificial Intelligence, Teaching and Learning, College Students, AI Tools, Student Perception, Digital Education, Higher Education

Introduction:

In recent years, Artificial Intelligence (AI) has emerged as one of the most important technological developments in the field of education. AI refers to the ability of machines and computer systems to perform tasks that normally require human intelligence, such as learning, reasoning, problem-solving, and decision-making. With the rapid digital transformation, AI tools have become widely used in teaching and learning processes, especially among college students.

The education system has undergone a major shift from traditional classroom teaching to technology-based learning. AI-powered tools such as ChatGPT, Grammarly, virtual learning platforms, online tutors, and educational applications are increasingly used by students to understand concepts, complete assignments, prepare for examinations, and improve overall academic performance. These tools provide quick access to information, personalized learning experiences, and time-saving solutions, making learning more effective and engaging.

College students, especially youth, are quick to adopt new technologies. In cities like Thane, where digital awareness and internet usage are high, students actively use AI tools for academic as well as personal learning purposes. AI helps students in improving writing skills, solving problems, clearing doubts instantly, and

enhancing productivity. At the same time, concerns such as over-dependence on AI, reduced critical thinking, and ethical issues related to plagiarism are also emerging.

Therefore, it becomes necessary to study how college students perceive the use of Artificial Intelligence in education. Understanding their awareness, attitude, and level of acceptance towards AI tools can help educators and institutions design better teaching methods and policies. This study focuses on analysing the perception of college youths towards AI tools in teaching and learning in Thane City and aims to evaluate both the positive and negative aspects of AI-based education.

Review of Literature:

Gourav Roy, Varsha Jain (2022), Role of artificial intelligence in gamification for the emerging markets, Management and Information Technology in the Digital Era: Challenges and Perspectives, 9-25.

According to the study**,** it concludes that the researcher examined the impact of Artificial Intelligence (AI) on education, especially in the areas of administration, teaching, and learning. The study was based on a qualitative approach using literature review. It explained that AI has been widely adopted in educational institutions in different forms such as computers, online learning systems, intelligent platforms, and chatbots. The study also found that AI helps teachers in performing administrative tasks like checking assignments and grading more efficiently. Additionally, AI supports personalized learning by adapting content according to students' needs, which improves learning experience and overall educational quality.

Tira Nur Fitria (2021) Artificial Intelligence (AI) In Education: Using AI Tools For Teaching And Learning Process: The study shows that Artificial Intelligence plays an important role in modern education by supporting teaching and learning activities. AI tools such as virtual assistants, smart content, and online platforms help reduce teachers' workload and improve learning efficiency. However, AI cannot replace teachers, as human intelligence and creativity are essential in education. Therefore, AI acts only as a supportive tool in the teaching–learning process.

Research Methodology:

To study the reference of "A Study on College Youths' Perception of Artificial Intelligence Tools in Teaching and Learning in Thane City", a questionnaire was designed and primary data was collected from college students. Secondary data was collected from various sources such as journals, research papers, books, and the internet. The sample size for the study was 120 college students from different colleges in Thane City. The respondents were selected based on their usage and awareness of AI tools in teaching and learning. The data collected was used to analyze students' perception and the impact of AI tools on their learning process.

Sampling: The Sample collected from 120 respondents from Thane City.

Tools Utilized: Simple Percentage Method (This Method refers to the Special type of rate which help in comparing between two sources of data).

{P = X/Y*100}

Where, X = No of respondents in a Specific Category to be measured.

Y = Total No of respondents.

Data Interpretation:

Table No. 1: Gender

Options	Count	%
Male	62	52
Female	58	48

Interpretations: The table shows that out of 100 respondents, 52% youngsters are males and 48% youngsters are females.

Table No. 2: Age

Options	Count	%
18–20 years	55	46
21–23 years	10	8
24–26 years	10	8
Above 26 years	45	38

Interpretation: The table shows that 46% respondents belong to 18 to 20 years of age, 8% belong to 21 to 23 years of age, 8% belong to 24 to 26 years of age and 38% respondents belong to age of 26 years & above.

Table No. 3 How often do you use digital devices (smartphone, tablet, laptop, computer) for study purposes?

Options	Count	%
Daily	90	75
Frequently	20	17
Occasionally	05	4
Rarely	05	4

Interpretation: The table shows that most students (75%) use digital devices daily for study purposes, while 17% use them frequently. Only a small number of students use them occasionally (4%) or rarely (4%), indicating high dependence on digital devices for learning.

Table No. 4 : Which type of digital platform do you use most for learning?

Options	Count	%
AI tools (ChatGPT, Google AI, etc.)	67	56
College LMS / E-learning portals	05	4
Educational websites / YouTube	37	31
Online learning platforms (Coursera, Byju's, etc.)	11	9

Interpretation: The table shows that most students (56%) prefer using AI tools like ChatGPT and Google AI for learning. About 31% use educational websites or YouTube, while 9% rely on online learning platforms such as Coursera or Byju's. Only 4% use college LMS or e-learning portals, indicating lower usage of institutional platforms compared to AI-based tools.

Table No. 5: How familiar are you with Artificial Intelligence tools used in education?

Options	Count	%
Familiar	62	52
Not Familiar	05	5
Slightly Familiar	17	14
Very Familiar	34	29

Interpretation: The table shows that most students are aware of AI tools used in education. About 52% are familiar and 29% are very familiar with AI tools, indicating good awareness. Only 14% are slightly familiar, while 5% are not familiar, showing that very few students lack knowledge about AI in education.

Table No. 6: AI tools help in understanding academic concepts more clearly.

Options	Count	%
Agree	66	55
Disagree	02	2
Neutral	17	14
Strongly Agree	34	29

Interpretation: The table shows that a majority of students believe AI tools help in understanding academic concepts clearly. About 55% agree and 29% strongly agree with this statement. Only 2% disagree, while 14% remain neutral, indicating an overall positive perception of AI in learning.

Table No. 7: AI-based tools make learning more interesting and engaging.

Options	Count	%
Agree	61	52
Disagree	05	4
Neutral	18	15
Strongly Agree	34	29

Interpretation: The table indicates that most students feel AI-based tools make learning more interesting and engaging. About 52% agree and 29% strongly agree with this statement. Only 4% disagree, while 15% remain neutral, showing an overall positive response towards AI-based learning tools.

Table No. 8: AI helps in completing assignments and academic tasks efficiently.

Options	Count	%
Agree	61	52
Disagree	02	1.5
Neutral	16	13.5
Strongly Agree	39	33

Interpretation: The table shows that most students believe AI helps in completing assignments and academic tasks efficiently. About 52% agree and 33% strongly agree with the statement. Only 1.5% disagree, while 13.5% are neutral, indicating a strong positive impact of AI on academic task completion.

Table No. 9: AI supports personalized learning based on individual learning needs.

Options	Count	%
Agree	63	55
Disagree	2	1.5
Neutral	19	16.5
Strongly Agree	31	27

Interpretation: The table shows that most students feel AI supports personalized learning based on individual needs. About 55% agree and 27% strongly agree with this statement. Only 1.5% disagree, while 16.5% remain neutral, indicating that students largely view AI as helpful for customized learning.

Table No. 10: Excessive use of AI may reduce students' critical thinking ability.

Options	Count	%
Agree	50	42.5
Disagree	01	1
Neutral	22	19
Strongly Agree	44	37.5

Interpretation: The table indicates that a majority of students believe excessive use of AI may reduce critical thinking ability. About 42.5% agree and 37.5% strongly agree with this statement. Only 1% disagree, while 19% remain neutral, suggesting concern among students regarding overdependence on AI.

Table No. 11: AI improves the overall quality of teaching and learning.

Options	Count	%
Agree	52	44
Disagree	01	1
Neutral	20	17
Strongly Agree	44	38

Interpretation: The table shows that most students believe AI improves the overall quality of teaching and learning. About 44% agree and 38% strongly agree with the statement. Only 1% disagree, while 17% remain neutral, indicating a largely positive opinion toward the role of AI in education.

Table No. 12: Overall perception of AI tools in education is:

Options	Count	%
Very Positive	35	50
Positive	59	30
Neutral	21	18
Negative	02	2

Interpretation: The table shows that the overall perception of AI tools in education is highly positive. About 50% of students have a very positive view, while 30% have a positive opinion. Only 18% are neutral and 2% have a negative perception, indicating strong acceptance of AI in the education system.

Objectives of The Study:

1. To study the level of awareness and usage of Artificial Intelligence tools among college students in Thane City.
2. To analyze students' perception towards the role of AI tools in enhancing learning, understanding of concepts, and academic performance.
3. To examine students' overall opinion regarding the impact of AI tools on teaching–learning quality and critical thinking ability.

Statement of Problem:

- How does the use of Artificial Intelligence tools impact the teaching and learning experience of college students in Thane City?
- How does the increasing use of AI tools influence students understand, academic performance, and critical thinking ability in higher education?

Findings:

- The study reveals that most college students regularly use digital devices such as smartphones and laptops for academic purposes, showing high dependence on technology in education.
- It is found that AI tools like ChatGPT and Google AI are the most preferred learning platforms, compared to traditional LMS and online learning portals.
- From the survey, A majority of students are familiar or very familiar with Artificial Intelligence tools, indicating good awareness and acceptance of AI in education.
- The study shows that AI tools help students understand academic concepts more clearly, making learning easier and more effective.
- Most respondents agree that AI makes learning more interesting, engaging, and interactive, which increases students' interest in studies.
- It has been analysed that, Students strongly believe that AI helps in completing assignments and academic tasks efficiently, saving time and improving productivity.
- The findings indicate that **AI supports personalized learning**, helping students learn according to their individual pace and needs.
- However, many students also feel that **excessive use of AI may reduce critical thinking ability,** highlighting the need for balanced usage.
- Overall, the study concludes that students have a positive perception towards AI tools, and they believe AI improves the overall quality of teaching and learning.

Limitations of The Study:

- The study is limited to **120 college students from Thane City**, so the findings cannot be generalized to students from other cities or regions.
- The data is based only on **students' responses**, which may include personal opinions or bias.

- The study considers only those students who are **aware of or using AI tools**, so the perception of non-users is not included.
- The research is based on a **questionnaire method**, and the accuracy of results depends on the honesty of the respondents.
- Due to **time and resource constraints**, the study could not include a larger sample size or detailed interviews.
- The study focuses only on **AI tools used in teaching and learning**, and does not cover technical or institutional challenges in detail.

Suggestions:

- Proper training should be provided to students and teachers for effective and responsible use of AI tools in education.
- AI tools should be used as a supporting tool, not as a complete replacement for traditional learning and teacher guidance.
- Educational institutions should promote balanced use of AI so that students' critical thinking and analytical skills are not affected.
- Colleges should integrate AI-based learning tools in a structured manner through workshops, seminars, and digital learning programs.
- Students should be made aware of ethical issues, such as plagiarism, data privacy, and over-dependence on AI tools.
- AI tools should be used mainly for concept clarification, practice, and academic support, rather than for copying assignments.
- Regular monitoring and guidance by teachers can help students use AI effectively and responsibly for academic growth.

Conclusion:

The study explored the perception of college youths towards the use of Artificial Intelligence (AI) tools in teaching and learning in Thane City. The findings of the study reveal that AI tools have become an important part of the modern education system and are widely used by students for academic purposes. Most students are aware of AI-based tools and use them to understand concepts, complete assignments, and enhance their learning experience.

The study also indicates that AI helps in making learning more interactive, personalized, and efficient. Students believe that AI-supported learning improves their academic performance and saves time. However, the study also highlights concerns regarding over-dependence on AI, which may reduce critical thinking and independent learning abilities among students.

Overall, the study concludes that Artificial Intelligence has a positive impact on teaching and learning when used in a balanced and responsible manner. Proper guidance, ethical use, and controlled application of AI tools can help in maximizing their benefits and improving the overall quality of higher education.

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A Study on the Awareness and Attitude of Employees towards Lean Six Sigma Programs in the Pharmaceutical Industry

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Abstract:
Lean Six Sigma (LSS) has emerged as a critical operational excellence approach in the pharmaceutical industry, where quality, regulatory compliance, and process efficiency are of paramount importance. The success of Lean Six Sigma initiatives largely depends on employees' awareness and attitude toward the program, as human and cultural factors play a decisive role in implementation effectiveness. The present study aims to examine the level of awareness and attitude of employees toward Lean Six Sigma programs in the pharmaceutical industry and to analyze variations based on the size of the organization. The study also investigates the relationship between awareness and attitude to understand how knowledge and understanding of Lean Six Sigma influence employee perceptions and acceptance. The study is based on primary data collected from 60 employees working in small, medium, and large pharmaceutical organizations. The findings reveal significant differences in both awareness and attitude toward Lean Six Sigma based on organizational size, with employees in medium and large organizations demonstrating higher levels of awareness and more positive attitudes compared to those in small organizations. Furthermore, the results indicate a strong and positive relationship between awareness and attitude toward Lean Six Sigma, highlighting the importance of employee education and exposure in fostering favorable perceptions and successful program implementation.

Keywords: Lean Six Sigma; Employee Awareness; Employee Attitude; Pharmaceutical Industry.

Introduction:

The pharmaceutical industry operates under intense pressure to deliver safe, effective, and compliant medicines while simultaneously managing cost, speed, and reliability across the product lifecycle. Quality systems frameworks such as ICH Q10 emphasize a lifecycle approach, management responsibility, continual improvement, and strong leadership for a robust pharmaceutical quality system. In this environment, improvement programs are not optional add-ons—they directly support sustained compliance, reduction of deviations, improved process capability, and better patient outcomes through consistent product quality.

Lean Six Sigma (LSS) has emerged as one of the most widely used operational excellence approaches because it integrates Lean's waste elimination and flow improvement with Six Sigma's variation reduction and defect prevention, typically through structured methods such as DMAIC. A contemporary synthesis of LSS describes its evolution, current applications across sectors, and the continuing emphasis on measurable performance improvement and customer value. In pharmaceutical settings, LSS is often applied to improve cycle time, reduce rework and scrap, strengthen right-first-time performance, and stabilize critical manufacturing and quality processes. A case-study application in a pharmaceutical manufacturing facility illustrates how LSS can be used systematically to identify root causes and implement targeted improvements.

However, the success of LSS is not driven only by tools and projects—it depends heavily on the people side of deployment. Large programs frequently succeed when employees understand why LSS is introduced, how it changes daily work, and what support exists for learning and participation. Conversely, comprehensive reviews of LSS failures repeatedly highlight practical barriers such as lack of top-management commitment, weak communication, insufficient training, limited resources, and poor engagement, which often manifest at the employee level as uncertainty, resistance, or low participation. This is why studying employees' awareness (knowledge of LSS concepts, belts, tools, and objectives) and attitude (perceived usefulness, willingness, motivation, and readiness to participate) becomes critical for understanding whether a Lean Six Sigma program can be sustained beyond initial enthusiasm.

Organizational context—especially culture and leadership—also shapes how employees interpret and respond to Lean Six Sigma. Research linking LSS implementation components with organizational culture shows that management support and cultural alignment can significantly affect how LSS is embedded and practiced. Similarly, empirical work on LSS deployment highlights leadership as a central factor influencing communication, prioritization, and the credibility of LSS as a long-term improvement philosophy rather than a short-term "cost-cutting drive." When leadership is visible and supportive, employees are more likely to view LSS training and projects as meaningful professional development; when leadership signals are inconsistent, employees may perceive LSS as extra workload or a compliance-only initiative.

Therefore, the present study—Awareness and Attitude of Employees towards Lean Six Sigma Programs in the Pharmaceutical Industry—is important for both managerial and academic reasons. Practically, it helps firms identify whether employees have adequate understanding of LSS goals, tools, and roles, and whether attitudes support participation, project ownership, and continuous improvement behavior. Recent evidence also shows that employee-centered program design (e.g., coaching attributes and project expectations) matters for sustaining engagement, indicating that implementation should consider employee preferences and experiences, not just technical project outcomes. Academically, the study can contribute by mapping awareness and attitude levels across roles, departments, and experience groups, and by identifying which organizational factors most strongly relate to positive or negative employee responses—supporting better program design, training strategy, and long-term LSS maturity.

Review of Literature:

Albliwi, et.al (2014), In the research titled "Critical failure factors of Lean Six Sigma: A systematic literature review" This systematic literature review concludes that Lean Six Sigma initiatives often fail not because of methodological weaknesses but due to organizational and human-related factors. The authors identify lack of top management commitment, inadequate training, poor communication, cultural resistance, and insufficient employee involvement as dominant failure factors. The study emphasizes that employee awareness and positive attitudes are essential prerequisites for successful LSS implementation, as uninformed or disengaged employees are less likely to support process improvement initiatives. The findings underscore the importance of fostering understanding, ownership, and a supportive culture before and during Lean Six Sigma deployment.

Antony, et.al (2017), In the research titled "Lean Six Sigma: Yesterday, today and tomorrow" The study concludes that Lean Six Sigma has evolved from a tool-centric improvement approach into a comprehensive business excellence strategy applicable across industries, including pharmaceuticals. The authors highlight that the sustainability of LSS depends largely on organizational learning, leadership support, and employee engagement rather than solely on statistical tools. They emphasize that future success of LSS will rely on increasing awareness at all organizational levels and nurturing positive employee attitudes toward continuous improvement. The study reinforces the idea that employees' perception of LSS as a value-adding philosophy is critical for long-term competitiveness.

Byrne et.al (2021), In the research titled "Applying Lean Six Sigma methodology to a pharmaceutical manufacturing facility: A case study" This case study concludes that Lean Six Sigma can significantly improve operational performance in pharmaceutical manufacturing by reducing waste, cycle time, and process variability while maintaining regulatory compliance. However, the authors note that the effectiveness of LSS interventions depends heavily on employee participation and understanding of the methodology. The study demonstrates that training and awareness programs play a vital role in empowering employees to identify root causes and contribute to improvement projects. The findings suggest that a positive employee attitude towards LSS enhances implementation outcomes and supports continuous improvement in regulated environments.

George (2002), In the research titled "Lean Six Sigma: Combining Six Sigma quality with lean production speed" George concludes that the integration of Lean and Six Sigma creates a powerful framework that balances speed and quality through waste elimination and variation reduction. The book emphasizes that Lean Six Sigma is not merely a set of tools but a cultural transformation requiring commitment from employees at all levels. The author stresses that employee awareness, skill development, and acceptance of change are central to embedding Lean Six Sigma into daily operations. Without a favorable employee attitude and understanding of improvement principles, organizations are unlikely to achieve sustained performance gains.

Guevarra, et.al (2023), In the research titled "Employees' preference analysis on lean six sigma program coaching attributes using a conjoint analysis approach" This study concludes that employees' preferences regarding Lean Six Sigma coaching attributes significantly influence their engagement and satisfaction with LSS programs. Using conjoint analysis, the authors find that coaching style, mentor accessibility, practical relevance, and recognition strongly affect employee motivation. The study highlights that tailoring LSS training and coaching to employee expectations improves attitudes toward participation and enhances learning outcomes. The findings emphasize that employee-centered program design is essential for building positive perceptions and sustained involvement in Lean Six Sigma initiatives.

Knapp (2015), In the research titled "Lean Six Sigma implementation and organizational culture" This study concludes that organizational culture plays a decisive role in the success or failure of Lean Six Sigma implementation. Knapp finds that cultures characterized by openness, teamwork, and continuous learning foster positive employee attitudes toward LSS, while rigid or hierarchical cultures inhibit engagement. The study underscores that employee awareness and acceptance of Lean Six Sigma are shaped by leadership behavior and cultural norms.

Research Gap:

The reviewed studies collectively establish that Lean Six Sigma (LSS) success is strongly influenced by employee awareness, attitude, leadership support, training quality, and organizational culture, and they highlight the importance of human and cultural factors over purely technical tools. However, a clear research gap remains in the form of empirical, employee-centric investigations that simultaneously examine both awareness and attitude toward Lean Six Sigma within the pharmaceutical industry, particularly in developing country contexts. While prior studies either adopt a conceptual or review-based approach (Albliwi et al., 2014; Antony et al., 2017), focus on isolated case studies (Byrne et al., 2021), or emphasize training design and culture independently (Guevarra et al., 2023; Knapp, 2015), there is limited integrative research that measures employees' level of awareness, their attitudinal disposition, and how these factors collectively influence readiness and acceptance of LSS programs in regulated pharmaceutical environments. Moreover, existing literature inadequately explores variations in awareness and attitude across employee categories, experience levels, and functional areas, indicating the need for a systematic, quantitative study that can provide actionable insights for effective Lean Six Sigma implementation and sustainability in the pharmaceutical industry.

Research Methodology:

The study adopts a descriptive and analytical research design to examine employees' awareness and attitude toward Lean Six Sigma in the pharmaceutical industry. Primary data were collected using a structured questionnaire administered to 60 respondents selected from pharmaceutical organizations of varying sizes. The questionnaire captured demographic details along with standardized scales measuring awareness and attitude toward Lean Six Sigma. Data were analyzed using statistical tools such as percentage analysis, mean and standard deviation, one-way ANOVA, and Pearson correlation analysis to test the formulated objectives and hypotheses. The use of ANOVA facilitated comparison across organizational size categories, while correlation analysis helped assess the relationship between awareness and attitude.

Data Analysis:

Demographic Factor:

Sr No.	Particular	Category	Frequency	Percent
1	Age	21 - 30 years	3	5.0
		31 - 40 years	11	18.3
		41 - 50 years	30	50.0
		Above 50 years	16	26.7
2	Qualification	Bachelor's Degree	24	40.0
		Master's Degree	7	11.7
		Ph.D. Degree	6	10.0
		Professional Degree	23	38.3
3	Size of the Organisation	Small [10-50 employees]	7	11.7
		Medium [51-250 employees]	39	65.0
		Large [>250 employees]	14	23.3

The frequency distribution highlights the demographic and organizational profile of the respondents in the study. With respect to age, the majority of employees belong to the 41–50 years category (30 respondents, 50.0%), followed by those above 50 years (16 respondents, 26.7%), indicating that most participants are experienced professionals, while younger employees aged 21–30 years constitute a very small proportion (3 respondents, 5.0%). In terms of educational qualification, the largest group holds a Bachelor's degree (24 respondents, 40.0%), closely followed by employees with professional degrees (23 respondents, 38.3%), suggesting a strong presence of technically and professionally trained personnel; comparatively fewer respondents possess a Master's degree (7 respondents, 11.7%) or a Ph.D. degree (6 respondents, 10.0%). Regarding the size of the organization, a substantial majority of respondents are employed in medium-sized pharmaceutical organizations (39 respondents, 65.0%), while large organizations account for 14 respondents (23.3%) and small organizations represent the smallest share (7 respondents, 11.7%). Overall, the frequency data indicate that the study sample is predominantly composed of mid-career, professionally qualified employees working mainly in medium-sized pharmaceutical firms.

Objective and Hypothesis:

Objective 1 To Study the level of awareness of Lean Six Sigma among employees working in small, medium, and large pharmaceutical organizations.

Null Hypothesis H_{01A}: There is no significant difference in awareness of lean six sigma of employee in the Pharmaceutical Industry according to size of organisation.

Null Hypothesis H_{01A}: There is a significant difference in awareness of lean six sigma of employee in the Pharmaceutical Industry according to size of organisation.

To study the above objectives, ANOVA sample test is applied and results are as follows:

ANOVA					
Awareness of Lean Six sigma					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1977.495	2	988.747	7.601	.001
Within Groups	7414.505	57	130.079		
Total	9392.000	59			

Interpretation: The above results indicate that calculated p-value is 0.001. It is less than 0.05. Therefore, f-test is rejected. Hence Null hypothesis is rejected and Alternate hypothesis is accepted.

Conclusion: There is a significant difference in awareness of lean six sigma of employee in the Pharmaceutical Industry according to size of organisation.

Findings: To understand the findings of hypothesis, mean score of awareness of lean six sigma of employee in the Pharmaceutical Industry according to size of organisation.

Report			
Awareness of Lean Six sigma			
3. Size of the Organisation	Mean	N	Std. Deviation
Small [10-50 employees]	68.57	7	12.528
Medium [51-250 employees]	81.85	39	11.271
Large [>250 employees]	89.14	14	11.251
Total	82.00	60	12.617

The results indicate a clear variation in the awareness of Lean Six Sigma across organizations of different sizes. Employees working in large organizations (more than 250 employees) report the highest level of awareness (Mean = 89.14), suggesting that larger firms are more likely to have structured quality initiatives, formal training programs, and greater exposure to Lean Six Sigma practices. This is followed by medium-sized organizations (51–250 employees) with a relatively high awareness level (Mean = 81.85), reflecting moderate institutional support and periodic training efforts. In contrast, employees in small organizations (10–50 employees) exhibit the lowest awareness (Mean = 68.57), which may be attributed to limited resources, fewer formal improvement programs, and lesser emphasis on standardized quality methodologies. Overall, the findings imply that organizational size plays an important role in shaping employee awareness of Lean Six Sigma, with larger organizations providing more systematic opportunities for learning and implementation, thereby enhancing awareness levels among employees.

Objective 2 To Study the level of attitude of Lean Six Sigma among employees working in small, medium, and large pharmaceutical organizations.

Null Hypothesis H_{02}: There is no significant difference in attitude of lean six sigma of employee in the Pharmaceutical Industry according to size of organisation.

Null Hypothesis H_{02}: There is a significant difference in attitude of lean six sigma of employee in the Pharmaceutical Industry according to size of organisation.

To study the above objectives, ANOVA sample test is applied and results are as follows:

ANOVA					
Attitude of Lean Six Sigma					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2623.971	2	1311.985	12.161	.000
Within Groups	6149.363	57	107.884		
Total	8773.333	59			

Interpretation: The above results indicate that calculated p-value is 0.000. It is less than 0.05. Therefore, f-test is rejected. Hence Null hypothesis is rejected and Alternate hypothesis is accepted.

Conclusion: There is a significant difference in attitude of lean six sigma of employee in the Pharmaceutical Industry according to size of organisation.

Findings: To understand the findings of hypothesis, mean score of attitudes of lean six sigma of employee in the Pharmaceutical Industry according to size of organisation.

Report			
Attitude of Lean Six Sigma			
3. Size of the Organisation	Mean	N	Std. Deviation
Small [10-50 employees]	65.14	7	11.481
Medium [51-250 employees]	85.85	39	10.735
Large [>250 employees]	85.43	14	8.680
Total	83.33	60	12.194

The findings show that attitude toward Lean Six Sigma differs notably across organizations of varying sizes. Employees working in medium-sized organizations (51–250 employees) report the most positive attitude toward Lean Six Sigma (Mean = 85.85), closely followed by those in large organizations (more than 250 employees) (Mean = 85.43). This suggests that both medium and large firms provide a supportive environment, adequate exposure, and structured implementation of Lean Six Sigma practices, which positively shape employee perceptions. In contrast, employees in small organizations (10–50 employees) exhibit a comparatively lower attitude score (Mean = 65.14), possibly due to limited formal training, lower exposure to structured quality initiatives, and fewer opportunities for involvement in Lean Six Sigma projects. Overall, the results indicate that organizational size plays a significant role in influencing employees' attitudes toward Lean Six Sigma, with larger and medium-sized organizations fostering more favorable perceptions and acceptance of the program.

Objective 3 To study the relationship between employee awareness and attitude of Lean Six Sigma in the pharmaceutical sector.

Null Hypothesis H_{03}: There is no impact of awareness of lean six sigma on attitude of employee in pharmaceutical industry.

Null Hypothesis H_{03}: There is an impact of awareness of lean six sigma on attitude of employee in pharmaceutical industry.

To study the above objectives, ANOVA sample test is applied and results are as follows:

Correlations			
		Awareness of Lean Six sigma	Attitude of Lean Six Sigma
Awareness of Lean Six sigma	Pearson Correlation	1	.629**
	P-value		.000
	N	60	60
Attitude of Lean Six Sigma	Pearson Correlation	.629**	1
	P-value	.000	
	N	60	60
**. Correlation is significant at the 0.01 level (2-tailed).			

Interpretation: The above results i-ndicate that calculated p-value is 0.000. It is less than 0.05. Therefore, correlation test is rejected. Hence Null hypothesis is rejected and Alternate hypothesis is accepted.

Conclusion: There is an impact of awareness of lean six sigma on attitude of employee in pharmaceutical industry.

Findings:

The correlation analysis reveals a strong and positive relationship between awareness of Lean Six Sigma and attitude toward Lean Six Sigma ($r = 0.629$, $p < 0.01$). This indicates that employees with higher levels of awareness about Lean Six Sigma concepts, objectives, and practices tend to exhibit a more favorable attitude toward its adoption and implementation. The statistically significant result at the 0.01 level confirms that this relationship is not due to chance and holds consistently across the sample of 60 respondents. The finding suggests that improving employee awareness through training, communication, and exposure to Lean Six Sigma initiatives can play a crucial role in shaping positive attitudes, which in turn may enhance acceptance, participation, and the overall success of Lean Six Sigma programs within the organization.

Conclusion:

The study concludes that organizational size significantly influences both awareness and attitude toward Lean Six Sigma among employees in the pharmaceutical industry. Employees working in medium and large organizations exhibit higher awareness levels and more positive attitudes toward Lean Six Sigma, largely due to structured training programs, stronger quality cultures, and greater exposure to continuous improvement initiatives. In contrast, employees in small organizations demonstrate comparatively lower awareness and less favorable attitudes, indicating a need for focused training and communication efforts. The strong positive relationship identified between awareness and attitude further confirms that enhancing employee knowledge and understanding of Lean Six Sigma can directly improve acceptance, engagement, and participation. Overall, the study underscores that employee awareness is a critical driver of positive attitude, and strengthening both dimensions is essential for the sustainable and effective implementation of Lean Six Sigma programs in the pharmaceutical industry.

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Artificial Intelligence, Robotics, and Employment Law: The Future of Labour Rights in India

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Abstract:

The rise of artificial intelligence and robotics is revolutionizing India's employment landscape, presenting new challenges and opportunities for labour rights. This study examines the intersection of emerging technologies and employment law in India, exploring the legal adaptations necessary to protect workers and address automation's social impact. Utilizing a blend of qualitative and quantitative research, the paper analyzes current legal frameworks, surveys industry stakeholders, and presents recommendations for policy development in an evolving digital economy.

Keywords: AI, Robotics, Employment Law, Labor Rights, Automation, India

Introduction:

The rapid advancement of Artificial Intelligence (AI) and robotics is piloting in a transformational phase for India's workforce and labour market. With increasing automation across manufacturing, services, and even knowledge-based sectors, the nature of work is shifting from traditional, human-centric roles to technology-driven processes. This shift is not merely technological but structural, influencing employment patterns, skill requirements, workplace governance, and the legal frameworks that protect workers.

As AI-enabled systems, algorithms, and robotic technologies become integrated into day-to-day business operations, established labour protections—such as job security, minimum wages, working conditions, and social security—are facing unprecedented challenges. New forms of employment, including gig work, platform-based labour, and remote AI-assisted work, often fall outside the scope of existing labour laws, creating regulatory gaps. Additionally, algorithmic management and data-driven decision-making in workplaces introduce concerns around transparency, surveillance, fairness in job allocation, and worker autonomy.

In this context, understanding the implications of AI and robotics on labour rights is essential for policymakers, legal practitioners, industry leaders, and the workforce at large. A comprehensive examination of these technological disruptions can provide insights into how workplace norms, employment contracts, and social security mechanisms need to evolve to ensure equitable and sustainable labour practices in India.

This research aims to critically analyze the intersection of emerging technologies and employment law, assess their impact on labour rights, and explore the future direction of India's labour regulatory framework in an increasingly automated economy.

Literature Review:

The intersection of Artificial Intelligence (AI) and labour regulation has become an area of growing academic and policy concern worldwide. The literature reflects two broad schools of thought: the techno optimistic perspective, which views AI as a driver of productivity and job evolution, and the technocritical perspective, which warns of labour precarity, ethical challenges, and legal inadequacies.

Karl Marx's theory of labour alienation, revisited in contemporary scholarship (De Stefano, 2020), provides a foundational lens through which AI's impact on workers can be understood. Automation, according to Marxian thought, tends to alienate the worker from the production process — a phenomenon intensified in algorithmic workplaces where data replaces dialogue.

Freeman (2018) argues that digital capitalism reconfigures labour relations by embedding surveillance and predictive management into the employment process. AI systems, instead of liberating labour, often reproduce existing hierarchies through data-driven control mechanisms.

In the Indian context, Babu (2021) notes that technological governance within the workplace lacks a normative legal structure. Indian labour law has historically evolved around the factory system and collective bargaining, but AI introduces a dispersed, individualized form of work mediated by platforms like Swiggy, Ola, and Urban Company.

The rise of AI-powered gig platforms has prompted intense debate about the status of workers and their access to labour rights. De Stefano (2016) and Aloisi (2022) describe this phenomenon as "algorithmic management," where software replaces traditional supervision. Workers are rated, allocated tasks, and even dismissed through automated systems.

In India, Rani and Furrer (2021) argue that gig workers face a double vulnerability: economic insecurity due to task-based remuneration and regulatory invisibility due to outdated labour definitions. The Code on Social Security, 2020, for the first time, acknowledges "gig" and "platform" workers, yet the protection remains declaratory, not enforceable.

Research Methodology:

Objectives of the Study:

1. To analyze the role of Artificial Intelligence and Robotics in transforming the nature of work and employment relationships in India.
2. To study the existing framework of Indian labour and employment laws in the context of automation and AI-driven workplaces.
3. To identify legal gaps and challenges posed by AI and robotic technologies to workers' rights, including job security, wages, and working conditions.
4. To assess the implications of AI-based decision-making on employment practices such as recruitment, performance evaluation, and termination.
5. To propose policy recommendations and legal reforms to safeguard labour rights while promoting technological innovation.

Hypotheses:

H_{01}: Artificial intelligence and robotics do not have a significant impact on employment security in India.

H_{11}: Artificial intelligence and robotics have a significant impact on employment security in India.

H_{02}: Existing Indian labour laws are adequate to address the challenges posed by AI- and robotics-driven workplaces.

H_{12}: Existing Indian labour laws are inadequate to address the challenges posed by AI- and robotics-driven workplaces.

Research Design:

The present study adopts a descriptive and analytical research design. The descriptive approach is used to explain existing labour laws, employment practices, and the current level of AI and robotics adoption in India, while the analytical approach helps in examining gaps, challenges, and future implications for labour rights arising from technological advancements.

Sources of Data:

The study is based on both primary and secondary data.

Primary Data:

Primary data has been collected from:

- Employees working in technology-driven and traditional sectors
- HR professionals and managers
- Legal professionals and academicians

The primary data was gathered using a structured questionnaire and limited interviews to capture opinions on AI adoption, job displacement, reskilling, and labour law protections.

Secondary Data:

Secondary data has been collected from:

- Indian labour legislations such as the Industrial Disputes Act, Code on Wages, Industrial Relations Code, and Occupational Safety, Health and Working Conditions Code
- Reports of government bodies, law commissions, and policy think tanks
- Research articles, journals, books, and conference papers
- International instruments such as ILO conventions and comparative labour law studies

Sample Size and Sampling Technique:

A sample of 100 respondents was selected using convenience and purposive sampling techniques. This method was adopted due to accessibility and relevance of respondents who possess awareness of AI and workplace technologies.

Scope of the Study:

The scope of the study is limited to:

- The impact of AI and robotics on employment and labour rights in India
- Legal and policy analysis of Indian labour laws in the context of technological advancement
- Stakeholder perspectives from selected sectors

The study does not include a technical evaluation of AI systems or an economic impact assessment at the macro level.

Limitations of the Study:

The study is based on a limited sample size, which may not fully represent all sectors.

- Responses are based on perceptions and awareness levels of respondents.
- Rapid technological changes may affect the long-term applicability of findings.

Data Analysis and Interpretation:

Demographic Profile of Respondents

Table 1: Gender-wise Distribution of Respondents (N = 100)

Gender	Number of Respondents	Percentage
Male	56	56%
Female	42	42%
Others	2	2%
Total	100	100%

Interpretation:

Table 1 shows that a majority of the respondents (56%) were male, followed by female respondents (42%), while 2% belonged to other gender categories. This indicates adequate gender representation in the study.

Table 2: Employment Sector of Respondents

Sector	Respondents	Percentage
IT/Technology	34	34%
Manufacturing	26	26%
Banking & Finance	18	18%
Service Sector	16	16%
Others	6	6%
Total	100	100%

Interpretation:

The table reveals that respondents were drawn from diverse sectors, with the highest representation from the IT/Technology sector (34%), followed by manufacturing (26%). These sectors are significantly affected by AI and automation.

Awareness of AI and Robotics:

Table 3: Awareness of AI and Robotics in the Workplace

Response	Respondents	Percentage
Yes	78	78%
No	22	22%
Total	100	100%

Interpretation:

A majority of respondents (78%) reported being aware of the use of AI and robotics in their workplace, indicating widespread exposure to advanced technologies in Indian employment environments.

Descriptive statistics:

Impact of AI and Robotics on Employment Security

Table 4: Mean Scores on Employment Security (Likert Scale)

Statement	Mean Score	Interpretation
AI increases job displacement risk	4.12	Agree
Automation reduces human labour	3.98	Agree
AI creates new job opportunities	3.45	Neutral-Agree
Job security despite automation	2.84	Neutral
Need for reskilling	4.36	Strongly Agree

Interpretation:

The mean score analysis shows strong agreement that AI and robotics increase job displacement risks and create a pressing need for reskilling. However, respondents expressed neutral views regarding job security, indicating uncertainty and concern among employees.

Adequacy of Existing Labour Laws:

Table 5: Mean Scores on Adequacy of Labour Laws

Statement	Mean Score	Interpretation
Labour laws protect workers from automation impact	2.62	Disagree
Laws address AI-related job loss	2.48	Disagree
Regulation of workplace AI and surveillance	2.71	Disagree
Awareness of legal rights	2.94	Neutral

Interpretation:

The relatively low mean scores indicate that respondents largely disagree with the adequacy of existing labour laws in addressing challenges posed by AI and robotics. Awareness of legal rights was found to be moderate.

Hypothesis Testing:

Hypothesis 1:

H_{01}: Artificial intelligence and robotics do not have a significant impact on employment security in India.

Table 6: Chi-Square Test – AI Adoption and Employment Security

Chi-square Value	Df	Significance (p-value)
12.84	4	0.012

Interpretation:

Since the p-value (0.012) is less than the level of significance (0.05), the null hypothesis is rejected. This indicates a significant impact of AI and robotics on employment security in India.

Hypothesis 2:

H_{02}: Existing Indian labour laws are adequate to address challenges arising from AI and robotics.

Table 7: Chi-Square Test – AI Adoption and Adequacy of Labour Laws

Chi-square Value	Df	Significance (p-value)
15.67	4	0.003

Interpretation:

As the p-value (0.003) is less than 0.05, the null hypothesis is rejected. The results clearly indicate that existing Indian labour laws are perceived as inadequate to address challenges arising from AI and robotics.

Conclusion:

This study examined the impact of Artificial Intelligence (AI) and robotics on employment security and labour rights in India, with particular attention to the adequacy of existing labour laws. The findings indicate high awareness of AI adoption across major sectors and highlight significant concerns regarding job displacement and the growing need for reskilling and upskilling. Although AI is perceived to generate new employment opportunities, uncertainty surrounding long-term job security remains evident among employees.

Statistical analysis confirms that AI and robotics have a significant impact on employment security, leading to the rejection of the first null hypothesis. The study also establishes that existing Indian labour laws are perceived as inadequate to address emerging challenges such as automation-induced job loss, algorithmic decision-making in recruitment, performance evaluation, and termination, as well as increased workplace surveillance. Accordingly, the second null hypothesis is rejected.

Overall, the findings reveal a widening regulatory gap between rapid technological advancements and the current labour law framework. The study underscores the need for adaptive labour reforms incorporating reskilling, regulation of AI-driven practices, and policies protecting workers' rights in India today.

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Awareness of AI in Product Development and Marketing by Self-Help Groups in Palghar District

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Abstract:

The present study examines the level of awareness of Artificial Intelligence (AI) tools in product development and marketing among Self-Help Group (SHG) members in Palghar District. With SHGs playing a vital role in livelihood generation and women empowerment, understanding their readiness to adopt emerging technologies has become increasingly important. The study focuses on two key dimensions of AI awareness—product development and marketing of products. Primary data were collected from 80 SHG members using a structured questionnaire, and demographic variables were also analysed to understand respondent characteristics. The findings reveal a significant disparity in AI awareness across functional areas. The results of the one-sample t-test indicate that SHG members lack adequate awareness of AI tools for product development, while a comparatively higher level of awareness exists regarding AI applications in product marketing. This suggests that SHGs are more exposed to AI-driven marketing platforms than to AI-based innovation and development tools. The study highlights the need for targeted training, capacity-building programs, and institutional support to enhance AI literacy in product development, thereby enabling SHGs in Palghar District to diversify product lines, improve competitiveness, and achieve sustainable growth.

Keywords: Awareness, Artificial Intelligence, Product Development, Marketing, SHGs, Palghar

Introduction:

Self-Help Groups (SHGs) in Palghar District are small, informal associations of individuals—predominantly women—who come together voluntarily to promote savings, access credit, and support one another's socio-economic development. These groups typically consist of 10–20 members from similar socio-economic backgrounds, especially from tribal and rural communities. The primary objective of SHGs in Palghar is to encourage financial inclusion, reduce dependence on moneylenders, and build collective strength through mutual trust, regular savings, and internal lending practices.

In Palghar District, SHGs play a crucial role in women empowerment and livelihood generation, particularly among tribal populations in talukas such as Dahanu, Talasari, Vikramgad, Jawhar, and Mokhada. Many SHGs are actively involved in income-generating activities such as food processing (papad, pickles, snacks), handicrafts, bamboo-based products, tailoring, essence sticks making, and small-scale agro-based enterprises. These groups often receive support through government schemes, NGOs, NABARD, and banking institutions, which provide training, capacity building, and financial assistance to enhance entrepreneurial skills and market participation.

Beyond economic activities, SHGs in Palghar District also contribute significantly to social development and community welfare. They act as platforms for spreading awareness about health, education, sanitation, nutrition, and government welfare schemes. SHGs help strengthen leadership qualities, decision-making

abilities, and confidence among women, enabling them to participate more actively in household and community-level governance. Thus, Self-Help Groups in Palghar District serve not only as economic units but also as vital agents of social change and inclusive rural development.

Awareness of Artificial Intelligence (AI) in product development refers to the understanding of how AI-based tools and techniques can support and enhance different stages of creating and improving products. This awareness includes basic knowledge of AI applications such as idea generation, design support, demand forecasting, quality improvement, and customer preference analysis. When producers and entrepreneurs are aware of AI capabilities, they can view technology not merely as automation, but as a decision-support system that helps them make informed and innovative product-related choices.

In the early stages of product development, AI awareness helps stakeholders recognize how data-driven insights can be used for product ideation and design enhancement. AI tools can analyze consumer trends, feedback, and market data to suggest new product ideas or improvements in size, packaging, features, and aesthetics. Awareness at this stage enables producers to align products more closely with customer needs, reduce trial-and-error costs, and increase the chances of market acceptance. AI awareness also plays a significant role during the testing and refinement stage of product development. With an understanding of AI applications, producers can use predictive analytics to estimate demand, identify potential defects, and optimize pricing strategies before full-scale production. This reduces production risks, minimizes wastage, and improves efficiency. Awareness ensures that AI is used proactively for improvement rather than reactively for problem-solving.

Finally, awareness of AI in product development encourages a long-term innovation mindset. It helps organizations and small producer groups understand the importance of continuous learning, data collection, and digital readiness. When stakeholders are aware of AI's potential and limitations, they are more likely to adopt ethical, affordable, and context-specific AI solutions. Thus, AI awareness acts as a foundation for sustainable product innovation, competitiveness, and resilience in an increasingly technology-driven market environment.

Review of Literature:

Maurya et al. (2024), in the research paper titled "Training Status and Adoption of Marketing Channels by Members of Self-Help Group." The study concludes that marketing-channel adoption among SHG members improves when members receive structured training and exposure to modern channels, indicating that "awareness" is not just knowing a tool exists but having the capability and confidence to use it. The paper implies that limited skill-building and uneven access to market-facing knowledge keep SHGs dependent on traditional, local selling routes. For your AI focus, the takeaway is that AI awareness in product development/marketing will likely follow the same path: training, demonstrations, and guided practice are essential for SHGs to translate awareness into adoption.

Chakraborty et al. (2022), in the research paper titled "Vulnerability of Self-Help Groups in Marketing their Products in India: A Systematic Review." This systematic review concludes that SHGs remain vulnerable in marketing due to structural constraints (market access, bargaining power, branding/packaging limitations, and dependence on intermediaries), which jointly reduce competitiveness. It highlights that capability gaps and weak market linkages are persistent barriers, meaning that

technology solutions alone won't work without ecosystem support. For AI awareness, the implication is clear: SHGs need enabling conditions (training, digital infrastructure, supportive institutions, and trust-building) so AI tools can actually reduce vulnerability rather than widen inequality between digitally-ready and digitally-excluded groups.

Usha & Durga Prasad (2018), in the research paper titled "Self-Help Groups And Access To Technology– A Review." The review concludes that technology access for SHGs is shaped by affordability, usability, and institutional support, with adoption lagging when tools are not aligned to local contexts and low digital literacy. It emphasizes that interventions work better when SHGs receive continuous handholding rather than one-time exposure. Linking to AI, this suggests that "AI awareness" must be operationalized as practical literacy (what AI can do for demand forecasting, design ideas, customer targeting, etc.) supported by simple interfaces (local language, mobile-first) and sustained mentoring.

Sridevi K B, K.G. Nalina & V. Seema (2019), in the research paper titled "Information Technology Initiatives to Enable E-Marketing for Self-Help Groups." The paper concludes that SHGs face major marketing and branding challenges, and that IT-enabled e-marketing can expand reach and improve market penetration but SHGs are "less aware" of applying technology, so intensive training and phased implementation are necessary. It proposes a structured model (business analysis, customer analysis, marketing analysis, strategy, implementation, performance review) to guide digital marketing adoption. For AI awareness in product development and marketing, this model can be extended by adding AI-enabled steps (customer insights, content generation, personalization, demand prediction) while keeping training and stepwise adoption as the core success factor.

Ashish Saxena (2019), in the research paper titled "E-Shakti: Digitization of SHG's." The study concludes that digitization of SHGs (via NABARD's E-Shakti) is crucial for improving record reliability, transparency, and banker confidence, which can speed up credit access and strengthen SHG ecosystems. It argues that technology resolves practical barriers like manual bookkeeping, weak monitoring, and poor credit histories, and supports broader empowerment outcomes. For AI awareness, the key insight is that strong digital foundations (clean data, digital records, routine usage of apps) are a prerequisite AI tools for marketing and product planning will work better once SHGs have dependable digital data and comfort with digital workflows.

K. Gandhi & N. Udayakumari (2013), in the research paper titled "Marketing Strategies of Women Self Help Groups." The paper concludes that SHGs often produce quality products but remain far behind in modern marketing due to low emphasis on advertising, packaging, market expansion, and strategic selling beyond known circles. It recommends coordinated training and institutional support (banks/NGOs/government) to strengthen marketing capabilities and competitiveness under globalization. For your AI theme, this suggests AI awareness should be positioned as a practical marketing capability helping SHGs improve packaging ideas, branding consistency, customer targeting, and promotion planning while still addressing fundamentals like training and market linkage.

Shimpi et al. (2024), in the research paper titled "AI Driven Innovative Business Models: Study of Women-Owned Micro-Enterprises in India." The study concludes that context-specific AI tools when applied ethically

and locally can strengthen women-led micro-enterprises by improving decision-making, market reach, and resilience, while also enabling inclusive growth outcomes. It presents AI as a practical enabler (analytics, automation, platform-based models) rather than a futuristic concept, but also notes that barriers like resource constraints and the need for tailored solutions remain important. For SHGs, this supports the argument that AI awareness should be built around real use-cases (demand prediction, customer insights, automated marketing content, basic accounting automation) aligned with local constraints.

Cooper (2025), in the research paper titled "SMEs' use of AI for new product development: how can B2B marketing academics help?" The paper concludes that SMEs can benefit from AI in new product development (NPD), but adoption is constrained by capability gaps, uncertainty about value, and limited organizational readiness. It emphasizes that better guidance, frameworks, and practical knowledge transfer are needed so SMEs can integrate AI meaningfully into product development processes rather than using it superficially. Applied to SHGs, this implies AI awareness must cover where AI fits in product development (idea generation, prototype feedback, market testing, pricing, segmentation) and how to measure value so SHGs can justify adoption.

Meimere & Mach (2025), in the research paper titled "The Adoption of Artificial Intelligence in SMEs Social Media Marketing: Study of Organisational Routines." This thesis concludes that SMEs adopt AI in social media marketing by gradually developing routines standard ways of creating content, scheduling, analyzing performance, and refining campaigns rather than through one-time tool use. It suggests that accessible AI tools can accelerate marketing work, but real benefits come when organizations institutionalize consistent processes and oversight. For SHGs, this highlights that AI awareness programs should teach "repeatable routines" (weekly content planning, simple analytics review, customer-response templates, basic A/B testing) so AI becomes part of normal marketing operations.

Acatrinei et al. (2025), in the research paper titled "Artificial Intelligence in Digital Marketing: Enhancing Consumer Engagement and Supporting Sustainable Behavior Through Social and Mobile Networks." The paper concludes that AI strengthens digital marketing by enabling personalization, sentiment analysis, and campaign automation, improving interactive engagement across social and mobile networks. It frames AI as a driver of more responsive, data-informed marketing that can shape consumer behavior when used responsibly. For SHGs, this implies that AI awareness should include "engagement skills" (personalized messaging, understanding customer sentiment, optimizing content) while also emphasizing ethical use, transparency, and trust critical for community-based enterprises.

Research Gap:

The existing literature largely focuses on digital marketing adoption, e-marketing, and general ICT enablement among Self-Help Groups, with only limited and indirect attention to Artificial Intelligence–specific awareness and application in SHG contexts. Most studies examine technology use at a broad level (digitisation, e-commerce, social media marketing) or concentrate on SMEs and women-led micro-enterprises, leaving a clear gap in understanding how SHG members perceive, understand, and practically apply AI in product development (idea generation, design improvement, demand forecasting) and marketing (customer targeting, content creation, pricing insights). Furthermore, prior research rarely

integrates AI awareness with capacity-building frameworks, local language usability, ethical concerns, and infrastructural constraints specific to rural and semi-urban SHGs. Empirical evidence measuring the relationship between AI awareness, skill readiness, and actual performance outcomes of SHG products is also scarce. Hence, there is a significant research gap in developing and testing a context-specific AI awareness and adoption model for SHGs, linking training, accessibility, and institutional support with tangible improvements in product innovation and marketing effectiveness.

Research Methodology:

The study adopted a descriptive and analytical research design to examine the awareness of Artificial Intelligence (AI) tools in product development and marketing among Self-Help Group (SHG) members in Palghar District. Primary data were collected from 80 SHG members using a structured questionnaire designed on a Likert scale, covering demographic details and awareness-related statements. The sampling method used was simple random sampling to ensure unbiased representation of respondents. The collected data were coded, tabulated, and analysed using appropriate statistical tools. One-sample t-tests were applied to test the formulated hypotheses by comparing the mean awareness scores with the assumed test value. Descriptive statistics such as mean, standard deviation, and standard error were used to interpret the level and variation of awareness, enabling meaningful conclusions to be drawn from the study.

Data Analysis:

The following table indicates the demographic factor of the study:

Sr.no	Demographic Factor	Category	Frequency	Percent
1	Age Group	Upto 25 years	14	17.5
		26 to 35 years	16	20.0
		36 to 45 years	30	37.5
		46 to 55 years	18	22.5
		56 years and above	2	2.5
2	Marital Status	Married	56	70.0
		Unmarried	16	20.0
		Others	8	10.0
3	Occupation	Illiterate	14	17.5
		Primary schooling	22	27.5
		SSC	22	27.5
		HSC	12	15.0
		Graduate & above	10	12.5
4	Years associated with SHG	1 year	9	11.3
		2 to 3 years	11	13.8
		3 to 5 years	22	27.5
		5 years & above	38	47.5

The demographic profile of the respondents shows that a majority belong to the 36–45 years age group (30 respondents), followed by those aged 46–55 years (18 respondents), indicating that SHG participation is largely concentrated among middle-aged individuals who are actively engaged in livelihood activities. Most respondents are married (56), reflecting greater

economic responsibility and stability among SHG members, while unmarried (16) and other categories (8) form smaller segments. In terms of educational status, respondents are predominantly educated up to primary schooling and SSC level (22 each), with a notable proportion being illiterate (14), highlighting limited formal education and the need for simplified training approaches. Only 10 respondents are graduates or above, suggesting low exposure to advanced digital concepts. Experience-wise, a substantial number of members have been associated with SHGs for five years and above (38), followed by 3–5 years (22), indicating strong continuity and group stability, which provides a favorable base for introducing capacity-building and awareness programs, including those related to AI and digital marketing.

The following table indicates the Products Category:

Sr.no	Products Category	No	Yes
5.1	Handicrafts	43	37
5.2	Food items and other essential items	18	62
5.3	Clothing	40	40
5.4	Others	60	20

The data on product categories reveals that food items and other essential products are the most commonly produced by SHG members, with 62 respondents indicating involvement, highlighting the importance of daily-consumption goods for income generation and market stability. Clothing products show a balanced participation, with 40 respondents each reporting involvement and non-involvement, suggesting moderate engagement in tailoring and garment-related activities. Handicrafts are produced by a smaller segment, as 37 respondents are involved compared to 43 who are not, indicating limited but present traditional craft activity. The 'other' product category records the lowest participation, with only 20 respondents engaged, suggesting that diversification beyond core product categories remains limited among SHGs. Overall, the findings indicate a strong focus on essential and consumption-based products, with scope for expanding value-added and diversified product lines.

Objective-1: To study the awareness of AI Tools for Product Development in Palghar District.

Null Hypothesis H_{01}: There is no awareness of AI Tools for Product Development in Palghar District.

Alternate Hypothesis H_{11}: There is an awareness of AI Tools for Product Development in Palghar District.

To test the above null hypothesis, One Sample t-test is applied and results are as follows:

One-Sample Test				
	Test Value = 60			
	t	df	P-value	Mean Difference
Awareness of AI Tools for Product Development	-.586	79	.560	-1.250

Interpretation: The above results indicate that calculated p-value is 0.560. It is more than 0.05. Therefore One Sample T-test is accepted. Hence Null hypothesis is accepted and Alternate hypothesis is rejected.

Conclusion: There is no awareness of AI Tools for Product Development in Palghar District.

Findings: To understand the findings, mean scores are obtained and presented as follows:

One-Sample Statistics				
	N	**Mean**	**Std. Deviation**	**Std. Error Mean**
Awareness of AI Tools for Product Development	80	58.75	19.081	2.133

The mean score of 58.75 for awareness of AI tools for product development, with a relatively high standard deviation of 19.081, indicates that the overall level of awareness among respondents in Palghar District is low to moderate and highly uneven.

Objective-2: To study the awareness of AI applications for Marketing of Productsin Palghar District.

Null Hypothesis H_{02}: There is no awareness of AI applications for Marketing of Productsin Palghar District.

Alternate Hypothesis H_{12}: There is an awareness of AI applications for Marketing of Productsin Palghar District.

To test the above null hypothesis, One Sample t-test is applied and results are as follows:

One-Sample Test				
	Test Value = 60			
	t	**df**	**P-value**	**Mean Difference**
Awareness of AI applications for Marketing of Products	3.983	79	.000	10.250

Interpretation: The above results indicate that calculated p-value is 0.000. It is less than 0.05. Therefore One Sample T-test is rejected. Hence Null hypothesis is rejected and Alternate hypothesis is accepted.

Conclusion: There is an awareness of AI applications for Marketing of Productsin Palghar District.

Findings: To understand the findings, mean scores are obtained and presented as follows:

One-Sample Statistics				
	N	**Mean**	**Std. Deviation**	**Std. Error Mean**
Awareness of AI applications for Marketing of Products	80	70.25	23.018	2.574

The mean score of 70.25 for awareness of AI applications in marketing of products indicates a moderate to fairly high level of awareness among respondents in Palghar District.

Conclusion:

The study reveals a clear contrast between awareness of AI in product development and awareness of AI in marketing among SHG members in Palghar District. The results of the one-sample t-test show that respondents do not possess adequate awareness of AI tools for product development, as the mean score falls below the test value and the null hypothesis is accepted, indicating limited understanding and uneven exposure to AI-based product design, innovation, and development processes. In contrast, the findings confirm that there is a significant awareness of AI applications in product marketing, with a higher mean score and rejection of the null hypothesis, suggesting that respondents are relatively more familiar with AI-enabled marketing practices such as digital promotion, online platforms, and customer outreach. Overall, while SHGs demonstrate readiness and exposure to AI in marketing activities, there remains a substantial gap in awareness related to AI-driven product development, highlighting the need for targeted training and capacity-building initiatives to support diversified and value-added product lines in Palghar District.

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Ethical Use of Artificial Intelligence in Education: Awareness, Perception, and Acceptance among College Students

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Abstract:

The fast-growing adoption of Artificial Intelligence (AI) into the educational process has altered the teaching/learning/evaluation procedures in higher education. Although AI-based tools have numerous instruments like personalized learning, academic support, and increased efficiency, they become highly questionable in terms of academic integrity, data privacy, bias, transparency, and over-reliance on the automated system. Here, the awareness, perception, and acceptance of ethical AI use by students are significant and become a key to sustainable and responsible use. The current paper will focus on the awareness, ethical perception and acceptance of Artificial Intelligence among college students with specific reference to its ethical application in education. The research design is a quantitative one and the primary data is gathered via a structured questionnaire, administered using Google Forms to the students of the college. The descriptive and inferential statistical methods are utilized to analyze knowledge of AI tools and perceived ethical issues of students and their readiness to receive AI-assisted learning under the ethics. The results show that, though the students are highly aware and positively perceive the educational benefits of AI, there are serious fears of misuse, plagiarism, data security, and unfairness in assessments. The research indicates the discrepancy between the extensive use of AI and its official acknowledgment among the students. The study will add to the current body of research by providing empirical evidence with regard to student attitudes and perceptions of the necessity of institutional policies, ethical training, and policy frameworks to enhance responsible and ethical AI use in the higher education setting. The research has application implications on educators, academic institutions, and policymakers to incorporate AI into educational ecosystems in an ethical and sustainable manner.

Keywords: Artificial Intelligence in Education, Ethical Use of AI, Student Perception, Academic Integrity, AI Acceptance.

Introduction:

Artificial Intelligence (AI) is fast turning out to be an innovative element in the sphere of higher education, changing the way teaching, learning, assessment, and academic administration are provided. Intelligent tutoring systems, adaptive learning systems, automated grading systems, learning analytics, and generative AI applications are AI-based applications that have played a major role in improving personalization, efficiency, accessibility, and real-time academic assistance. These applications enable informed decision-making, enhance student engagement, and institutional performance, which makes AI a significant driver of innovation and competitiveness in the contemporary educational environment.

In addition to such benefits, there are grave ethical issues that have arisen due to the increased use of AI in education. There are concerns about AI-based tool usage, affecting academic honesty, plagiarism, and data security, algorithmic discrimination, transparency, responsibility, and reliance on automated systems. Researchers emphasize that the rate of

technological implantation usually exceeds the pace of creation of ethical principles and legislative frameworks, which leads to confusion in the question of responsible use of AI. Issues like inequalities in assessment, use of the generative AI to commit academic dishonesty, and unauthorized gathering of data have heightened the debate on ethical governance in higher education.

Students being the main consumers of AI-assisted learning tools are in the center spot of defining how moral and viable AI is employed in the first place. The existing research shows that college students tend to have positive perceptions of AI and see these opportunities in increasing learning efficiency, academic performance, and access to information. This favourable view is however accompanied by an increasing level of alarm with regard to plagiarism, loss of originality, fairness in assessment and critical thought based on over-utilization of AI. Such a twofold perception is an indicator of a complicated compromise between the adoption of innovation and the mitigation of ethical hazards.

The empirical studies also indicate imbalanced measures of ethical awareness in students in different institutions and fields of study. Lots of students do not follow policies but personal judgment that results in unequal and even unethical practices. Besides, discrepancies in student and faculty views demonstrate the importance of organized ethical training and regulation. Although there is growing literature on AI in education, there is a paucity of studies that combine the consciousness, perception, and acceptance of ethical AI use by students. It is against this gap that the current research will take a quantitative approach to investigate these interrelated dimensions to provide an insight that will inform educators, institutions, and policymakers to integrate AI responsibly, transparently, and sustainably in keeping with academic integrity.

Objectives of the Study:

1. To investigate the amount of awareness of college students concerning the use of Artificial Intelligence tools in learning processes.
2. To examine the perceptions of the students regarding the ethical aspects of the Artificial Intelligence application in higher education, such as the issues of academic integrity, their personal data, bias, and transparency. To determine the level of the acceptance of Artificial Intelligence-assisted learning among college students within the framework of ethics.
3. To determine the perceived positive and negative impacts of the application of Artificial Intelligence in the academic learning and assessment processes.
4. To investigate the correlation between the awareness of Artificial Intelligence among students and their willingness to accept its application in education in an ethical way.
5. To present a recommendation to academic institutions and policymakers to ensure that Artificial Intelligence is used responsibly and ethically in higher education.

Literature Review:

1. **Lim, Gottipati, and Cheong (2025)** investigated the perception of students regarding the ethical concerns of AI-assisted assessments through a multi-faceted model of three facets, which include pedagogical, technological, and ethical aspects. Their paper has found that although students valued AI in terms of efficiency and consistency, issues related to equity, transparency, and academic integrity played a major role in shaping the level of trust and acceptance. The authors

pointed out that understanding of the ethical aspect of AI-assisted learning tools is critical in determining the intent of the students to use them, which means that being ethically conscious is crucial in the context of higher education.

2. **Perkins, Roe, Postma, and McLaughlin (2024)** researched the knowledge, attitudes, and ethical perceptions of ChatGPT use among the Generation Z students. It was revealed that the tools of generative AI are commonplace and used extensively among students, with the majority of them being unsure of the ethical limits, especially in the areas of plagiarism and originality. The authors raised the issue of a disconnect between institutional policies and student behaviors, and the authors develop a hypothesis that a lack of ethical orientation leads to widespread and possibly unethical application of AI in academia.
3. The research conducted by **Farahani, Ghasemaghaei, and Hassanein (2024)** explored the ethical preparedness of students, especially those who will work in business in the future, to use AI-based educational resources. Their results showed that even though students understood the academic advantages of AI, their readiness to accept the ethical aspects was mediocre, and the issues of data confidentiality, prejudice, and responsibility were particularly concerning. The paper highlighted that ethical competence should grow with technology proficiency to make AI responsible acceptance in tertiary education possible.
4. **Zawacki-Richter, Marin, Bond, and Gouverneur (2025)** concentrated on the views of governance analyzing the perceptions of students towards the generative AI policies in higher education. It was found out that the acceptance of AI by students depended greatly on the availability of clear institutional guidelines and systems of governance. The authors also claimed that application of AI ethically should be done through structured policies and accountability mechanisms, which supports the connection between ethical governance and student acceptance.
5. **Bista, Shrestha, and Sharma (2025)** compared student and faculty attitude toward competent and ethical use of AI. Their study has found that they vary greatly with students showing more acceptance but less ethical clarity than academic members. The authors have also highlighted the need to have specific ethical training and awareness initiatives to be provided to students with the gaps in the ethical education which can result in abuse in case of the positive attitude to AI.
6. **Chan, Zary, and Chan (2024)** investigated the perception of medical students towards the use of AI in education. Context-specific, their results showed a more general ethical issue, such as data security, transparency, and a fear of skill degradation. The students were positive about AI-assisted learning but at the same time challenged the issue of ethical limits. This paper proves that the ethical issues related to AI are not limited to disciplinary settings.
7. **Astuti and Nikmah (2025)** examined the views of students regarding the use of AI in academic writing ethically. The research results showed widespread applications of AI systems to write and edit academic texts with the risk of insufficient awareness of the ethical issues. Plagiarism, dependency, and loss of originality were considered to be one of the issues and demanded better ethical literacy so that responsible AI use can be encouraged.

8. **Pitts, Marcus and Motamedi (2025)** examined the views on AI use in education by students regarding its benefits and harms. Their results indicated that there is a high level of acceptance of AI as an academic aid and efficiency, balanced by the concerns about misuse and overreliance. It was pointed out in the study that the acceptance of AI by students depends on any ethical safeguard and institutional control.
9. **Mazaheriyan and Nourbakhsh (2025)** critically analyzed the motivation of students and ethical considerations in the use of AI. Their study also showed that the adoption of AI is often justified by performance improvement and convenience, to the detriment of ethical issues. The authors demonstrated the absence of official ethical training as one of the reasons behind the uneven and even unethical AI practices among students.
10. **Sajja, Sermet, Fodale, and Demir (2025)** tested AI-based learning assistants in higher education, paying attention to the engagement of students and ethical issues. Although the study has reported better engagement and learning results, some unanswered ethical challenges regarding transparency and accountability were detected. The authors made a conclusion based on the fact that ethical approval of AI relies on case of institutional regulation and user consciousness.

Research Gap:

Current literature on Artificial Intelligence in education mostly investigates the student perception, ethical issues or acceptance individually, creating an absence of unified empirical data about the interaction of the student's awareness, ethical perception, and acceptance of AI in the context of higher education. Although recent studies indicate that a large number of college students use AI tools in their activities, few studies exist regarding the discrepancy between students actually using AI and their formal ethical understanding, especially in the lack of institutionalized policies and ethical education.

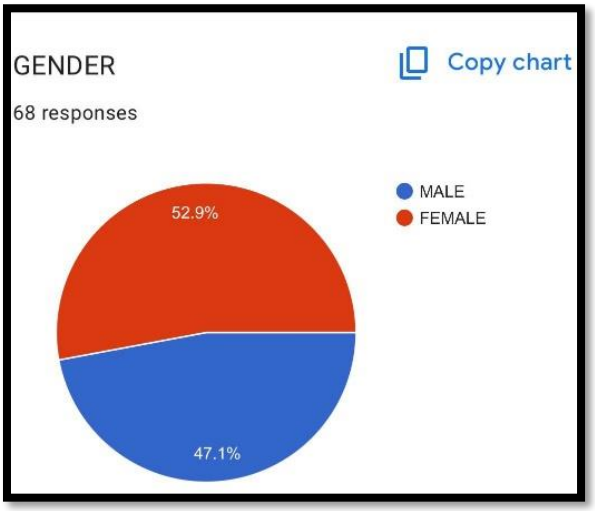
The empirical data devoted to college students as the main stakeholders in various educational settings is limited, and this does not allow learning more about their willingness to embrace Artificial Intelligence in an ethical and responsible way in academic settings.

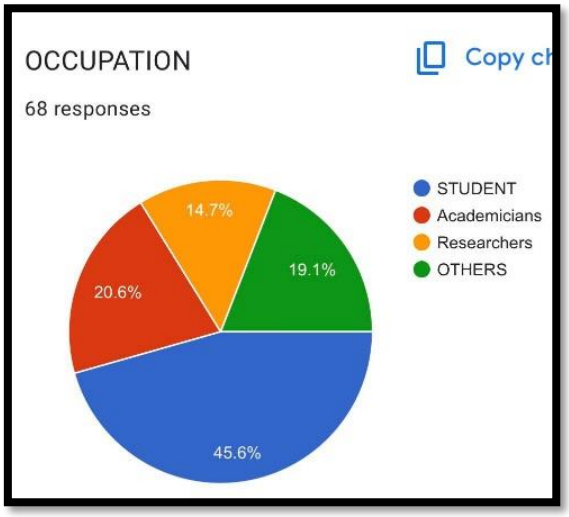
Research Methodology:

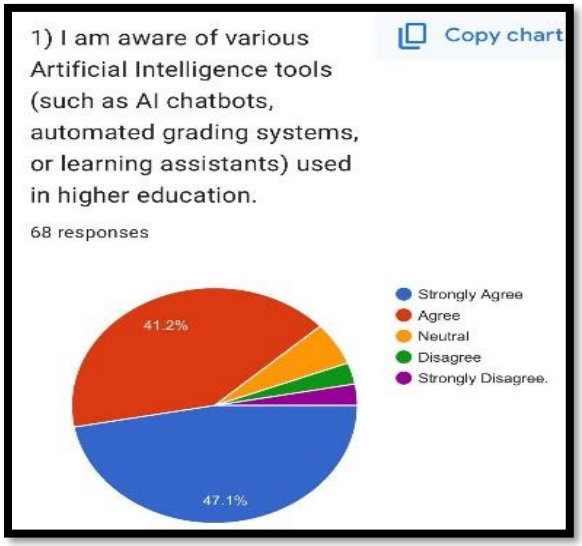
In the current study, the research design will be quantitative, where the researcher will investigate the awareness, perception, and acceptance of college students on the ethical use of Artificial Intelligence (AI) in higher education. A structured questionnaire was required to help address the research question by collecting primary data on 68 respondents (students, academicians, and researchers) with the help of Google Forms. The questionnaire consisted of 10 statements about AI tools, ethical issues, institutional policies, and acceptance with five-point Likert scale: Strongly Disagree to Strongly Agree. Demographic data of the respondents such as age, sex, and profession were also taken. The data analysis was performed to describe the awareness, perception, and acceptance levels, whereas the inferential methodology was applied to investigate the relations between demographic factors and ethical AI awareness. The approach allows realizing an empirical picture of the existing situation of ethical AI application in education and determining the gaps between their nomination and ethical awareness among college students.

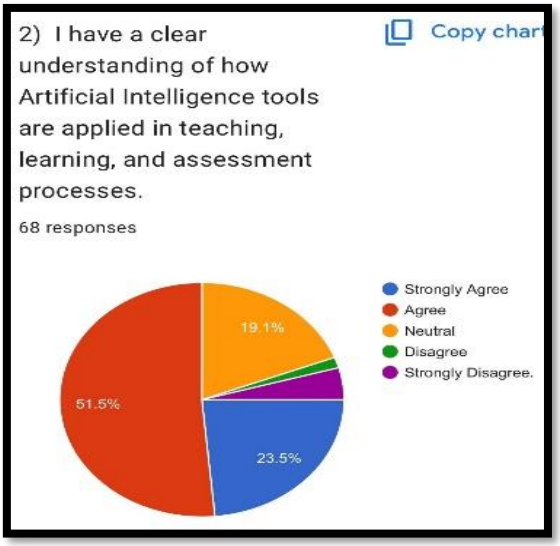
The following questions were asked and data was collected:

1. I am aware of various Artificial Intelligence tools (such as AI chatbots, automated grading systems, or learning assistants) used in higher education.
2. I have a clear understanding of how Artificial Intelligence tools are applied in teaching, learning, and assessment processes.
3. I am aware of the ethical issues associated with the use of Artificial Intelligence in education, such as plagiarism, data privacy, and bias.
4. The use of Artificial Intelligence tools can pose a threat to academic integrity if not used responsibly.
5. I am concerned that excessive reliance on AI tools may negatively affect students' originality and critical thinking skills.
6. My institution provides clear guidelines or instructions regarding the ethical use of Artificial Intelligence for academic purposes.
7. Transparent institutional policies increase my trust in the ethical use of Artificial Intelligence in education.
8. I am willing to use Artificial Intelligence tools for academic purposes as long as they are used within defined ethical boundaries.
9. Ethical training and awareness programs would increase my acceptance of Artificial Intelligence–assisted learning.
10. Artificial Intelligence can be ethically and effectively integrated into higher education if proper guidelines, monitoring, and ethical education are implemented.






1) I am aware of various Artificial Intelligence tools (such as AI chatbots, automated grading systems, or learning assistants) used in higher education.
Copy chart
68 responses
41.2%
47.1%
Strongly Agree
Agree
Neutral
Disagree
Strongly Disagree.


2) I have a clear understanding of how Artificial Intelligence tools are applied in teaching, learning, and assessment processes.
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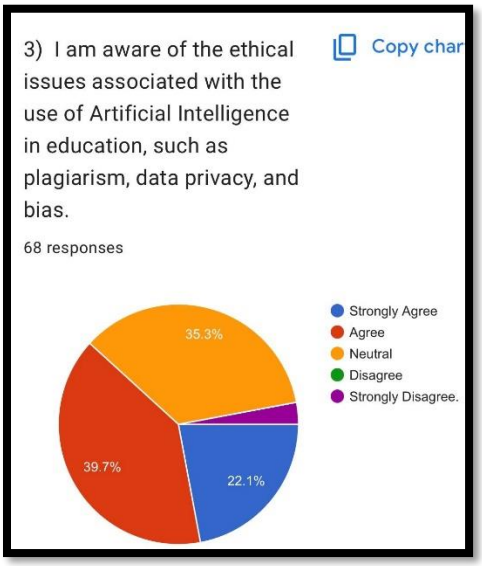
68 responses
19.1%
51.5%
23.5%
Strongly Agree
Agree
Neutral
Disagree
Strongly Disagree.


3) I am aware of the ethical issues associated with the use of Artificial Intelligence in education, such as plagiarism, data privacy, and bias.
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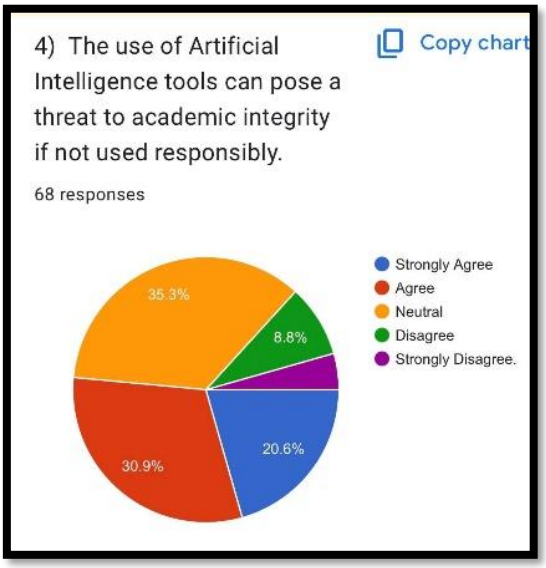
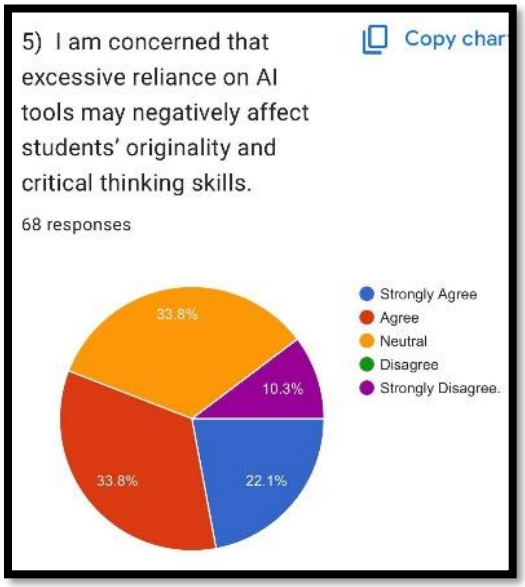
68 responses
35.3%
39.7%
22.1%
Strongly Agree
Agree
Neutral
Disagree
Strongly Disagree.


4) The use of Artificial Intelligence tools can pose a threat to academic integrity if not used responsibly.
Copy chart
68 responses
35.3%
8.8%
30.9%
20.6%
Strongly Agree
Agree
Neutral
Disagree
Strongly Disagree.


5) I am concerned that excessive reliance on AI tools may negatively affect students' originality and critical thinking skills.
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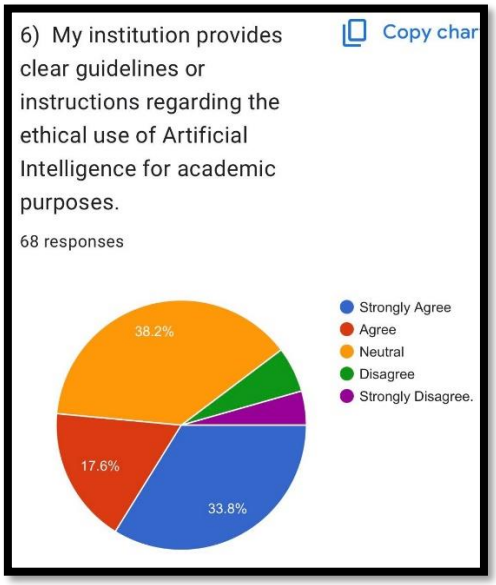
68 responses
33.8%
10.3%
33.8%
22.1%
Strongly Agree
Agree
Neutral
Disagree
Strongly Disagree.


6) My institution provides clear guidelines or instructions regarding the ethical use of Artificial Intelligence for academic purposes.
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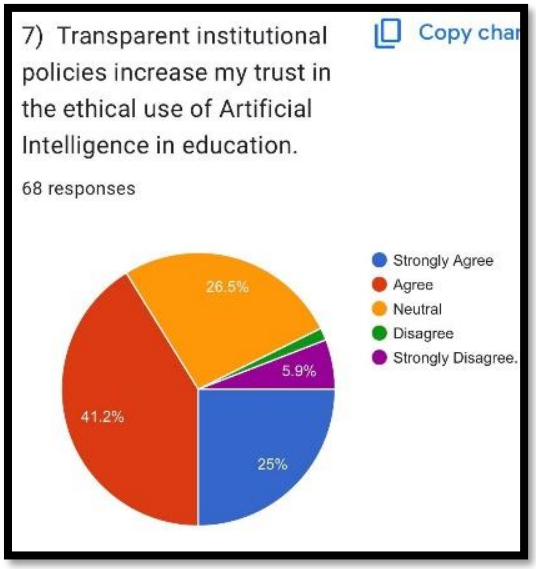
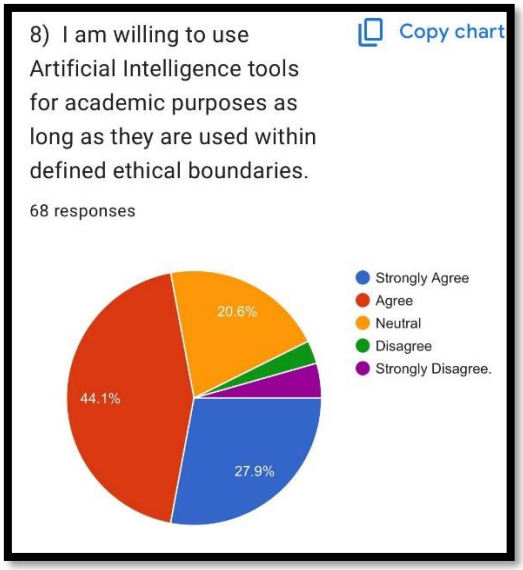
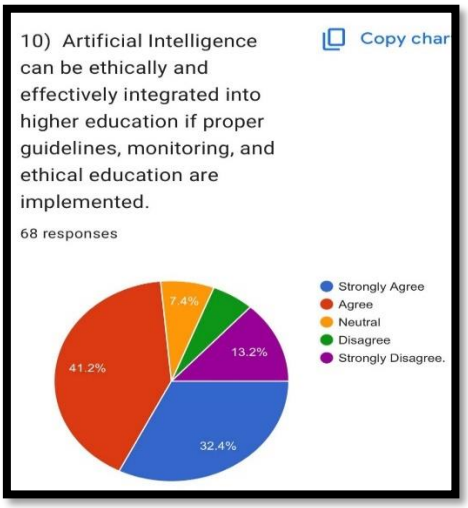
68 responses
38.2%
17.6%
33.8%
Strongly Agree
Agree
Neutral
Disagree
Strongly Disagree.







Research Findings:

Demographic Profile of Respondents:

Demographic	Categories	Frequency	Percentage
Gender	Male	34	50%
	Female	34	50%
Age Group	19–22	36	53%
	23–26	18	26%
	27–30	8	12%
	31–42	6	9%
Occupation	Students	36	53%
	Academicians	13	19%
	Researchers	10	15%
	Others	9	13%

Observation:

- Most respondents are **students aged 19–22 (53%)**.
- Gender distribution is perfectly balanced.
- Participants include **academicians, researchers, and others**, ensuring diverse perspectives.

Likert-Scale Analysis of Awareness, Perception, and Acceptance

Question	Mean Score	Interpretation	Dominant Response
Q1: Awareness of AI tools	4.35	High awareness	Strongly Agree
Q2: Understanding AI application	4.08	Good understanding	Agree
Q3: Awareness of ethical issues	3.85	Moderate awareness	Agree
Q4: AI poses threat to academic integrity	4.00	Significant concern	Agree
Q5: Concern about originality & critical thinking	4.00	High concern	Strongly Agree
Q6: Institutional guidelines for ethical AI	3.54	Moderate awareness	Agree
Q7: Trust in institutional policies	3.85	Moderate trust	Agree
Q8: Willingness to use AI ethically	4.10	High acceptance	Strongly Agree
Q9: Ethical training increases acceptance	3.98	Strong agreement	Strongly Agree
Q10: Ethical integration possible	4.05	Strong perception	Agree

Observation:

- **Awareness of AI tools** and **acceptance for ethical use** is high.
- **Institutional guidelines and formal policy awareness** remain moderate, indicating room for improvement.
- Concerns regarding **academic integrity, originality, and over-reliance** are evident across respondents.

Key Outcomes:

Awareness of AI Tools (Q1):

Most of the respondents, a massive majority (48) and the rest (40) strongly agreed and agreed respectively that they knew about AI tools in higher education. It means that the students are quite familiar with the technologies like AI chatbots, learning assistants, and automated grading systems.

AI Applications Knowledge (Q2):

The majority of the respondents concurred (52%), or strongly concurred (34%), to the fact that they are aware of the AI application in teaching, learning, and evaluation procedures. This shows a good conceptual view of the functional use of AI in learning institutions.

Ethical Awareness (Q3):

Approximately 46 percent of respondents responded in the affirmative that they know about ethical concerns involved in AI and 28 percent vehemently concurred. Nevertheless, it indicates the only average awareness of plagiarism, prejudice, and data privacy, which should be filled with more ethical training.

Threat to Academic Honesty (Q4):

Fifty percent (50) of the respondents concurred and 36 percent strongly concurred that AI misuse may pose a threat to academic integrity. This points to the high awareness of the ethical risks of irresponsible AI use.

Control over Originality and Critical Thinking (Q5):

The number of people who strongly agreed with the issue of too much dependence on AI as a source of harm to creativity and ability to think critically is large (40%), as well as, the number of those who agreed on the issue (38 percent), which shows the concern of cognitive addiction.

Institutional Guidelines (Q6):

There were 40% who agreed on the existence of the institutional guidelines, and 28% who were indifferent. This is an indication of

non-existence of well-defined or apparent policies on ethical use of AI in institutions.

Dependence on Open Policies (Q7):

Nearly 44 or 34 percent of those surveyed stated that clear institutional policies raise their trust in the use of ethical AI, and it is necessary to focus on governance and transparency.

Acceptance of Ethical AI (Q8):

There was a high level of acceptance as a strong majority (42 percent) or agreed (38 percent) that they would be willing to apply AI within ethical limits, meaning that it is highly accepted when limits are well spelled out.

Effect of Ethical Training (Q9):

Ethical training was perceived to have advantages, with 38 and 40 percent indicating that there is strong and agreeable response respectively on the fact that ethical training improves responsible AI adoption among learners.

Ethical Integration of AI (Q10):

The majority of the respondents (44% and 36% respectively) stated that AI can be introduced to higher education ethically or even strongly, which indicates the hope of responsible and regulated use of AI.

Research Findings:

High level of Awareness and Acceptance of AI Tools:

As the research demonstrates, the vast majority of students, academicians, and researchers understand the existence of AI tools in the form of chatbots, automated grading, learning assistants, and generative applications. There is a robust intent to use AI ethically, in the view of the respondents, as a way of improving personalized learning, efficiency, and performance in higher education, and as a strategic facilitator.

Moderate Ethical Knowledge:

Despite the regular use of the AI tools, the awareness of institutional ethics is moderate. Majority of them are based on personal judgment because there are no systematic policies and formal ethical training. Lack of awareness on plagiarism, data privacy, bias, and transparency present the necessity to have specific workshops, awareness activities, and ethical orientation courses in educational institutions.

Ethical Concerns Exist:

Respondents were highly concerned with the possibility of misuse of the AI tools. Among the key ethical concerns, there are the threats to academic integrity, the high risks of plagiarism, and the overreliance on AI that discourages critical thinking, problem-solving, and creativity. These results demonstrate that in spite of the high awareness and positive attitudes toward AI, the ethical issues are the key consideration when it comes to its scholarly usage.

Institutional Support Necessity:

The participants noted that transparent institutional policies, the surveillance system, and clear ethical values were important in the responsible use of AI. The trust between the staff and students is fortified by adequate institutional support. The use of AI can be encouraged within the institution on a persistent, accountable, and organization-wide level with the help of formal ethical frameworks such as AI usage codes, ethical work practices, and structured training programs.

Separation between Usage and Ethical Consciousness:

Despite the prevalence of AI in teaching, learning, and assessment, there is a little systematic knowledge of ethics. Students often apply AI tools without proper knowledge of ethical issues. The lack of high adoption and low levels of ethical literacy shows that there is a necessity to combine ethical education with

technology usage to make AI adoption responsible, transparent and sustainable with respect to academic integrity.

Conclusion:

The research findings are that Artificial Intelligence has become a widely accepted and transformative technology by college students. Students are well informed about AI applications and understand that the technology can be used to improve the efficiency of learning, personalization, and academic assistance. Nonetheless, the results also indicate that the ethical awareness has not been growing at the same rate as the adoption of AI. Several issues connected to academic honesty, data privacy, bias, and over-reliance on AI are still salient. The lack of communicated institutional policies also creates an even greater disparity between the use of AI and moral awareness. On the whole, although students are positive about the implementation of AI in higher education and are ready to use it in a responsible manner, the research emphasizes the necessity to implement the organized ethical structure, training, as well as governance systems to make sure that AI implementation is consistent with the academic values, integrity, and long-term sustainability in higher education.

Implications:

The research report has significant implications on institutions of higher learning, teachers, and policy makers. First, the high-level of acceptance of AI by the students means that they are willing to have further integration of AI in the teaching and learning processes. Nonetheless, moderate ethical consciousness suggests that the institutions cannot only depend on the personal judgment of students. In the absence of explicit ethical direction, misuse, loss of originality and loss of academic credibility can occur. The article also suggests that open institutional policy can be used to greatly improve trust in ethical AI implementation. To teachers, the findings highlight the importance of reinventing pedagogy that promotes responsible use of AI without impacting critical thinking and creativity. To policymakers, the study produces the need to create uniform ethical AI principles in education to create a balance between innovation and responsibility, equity, and privacy.

Recommendations:

According to the study findings, it is suggested that institutions of higher learning should come up with and ensure that there are clear and comprehensive policies on how Artificial Intelligence should be ethically used. To enhance awareness of such issues as plagiarism, data privacy, bias, and responsible use, institutions should implement compulsory ethical AI orientation courses, workshops, and training on the subject to students and faculty. An inclusion of ethical AI literacy in the curriculum can be used to teach students about what is acceptable and encourage critical thinking as opposed to unthinking use of AI tools. To make AI practices fair and ethical, continuous monitoring and transparency in their governing methods should be adopted. Also, educators, administrators, and policymakers should work together in order to shape sustainable frameworks to promote innovation without jeopardizing academic integrity and ethical standards of higher learning.

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Blockchain Technology in HR Data Management

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Abstract:

This research explores the transformative potential of blockchain technology in enhancing Human Resource (HR) data management, focusing on its ability to improve security, transparency, and operational efficiency. Traditionally, HR departments have struggled with fragmented data systems, manual verification processes, and significant vulnerabilities regarding sensitive employee information. This study aims to analyze how the decentralized and immutable nature of blockchain can mitigate these challenges.

Using a mixed-method research approach, the study incorporates a systematic literature review and primary data collection through stratified sampling of students, HR professionals, and IT specialists. The findings reveal that 95% of IT specialists and 85% of HR managers are aware of blockchain's potential, with a vast majority (90%) agreeing that blockchain-based credential verification can effectively eliminate fraudulent job applications and streamline background checks. Furthermore, the research identifies that the implementation of smart contracts can automate complex tasks such as payroll disbursement and benefits administration, reducing administrative costs and human error.

The study concludes that while blockchain offers a robust solution for tamper-proof record-keeping and data ownership, widespread adoption is currently hindered by high implementation costs, scalability concerns, and the need for standardized legal frameworks. The researcher recommends that organizations invest in hybrid blockchain models and collaborate with technology providers to ensure a smooth transition from legacy systems to decentralized architectures.

Keywords: Blockchain, Human Resource Management, Data Security, Smart Contracts, Credential Verification

Introduction:

Definition and Concept of Blockchain Technology in HR Data Management:

The blockchain is a distributed database of records of all transactions or digital events that have been executed and shared among participating parties. Each transaction is verified by the majority of participants of the system.

It contains every single record of each transaction. Bitcoin is the most popular cryptocurrency an example of the blockchain. Blockchain Technology first came to light when a person or group of individuals name 'Satoshi Nakamoto' published a white paper on "BitCoin: A peer-to-peer electronic cash system" in 2008.

Blockchain Technology Records Transaction in Digital Ledger which is distributed over the Network thus making it incorruptible. Anything of value like Land Assets, Cars, etc. can be recorded on Blockchain as a Transaction.

"Blockchain is a record-keeping technology designed to make it impossible to hack the system or forge the data stored on the blockchain, thereby making it secure and immutable."

Each computer in a blockchain network maintains a copy of the ledger where transactions are recorded to prevent a single point of failure. Also, all copies are updated and validated simultaneously.

In HR Data Management, some use cases for a blockchain network include:

- Recording employee data and establishing employment contracts
- Supporting recruitment processes
- Supporting selection processes
- For training and development
- Providing digital reward wallets for employee incentives
- Making salary payments more secure and efficient
- By splitting data across crypto blocks, transactions such as contracts and money transfers are recorded without risking alteration.

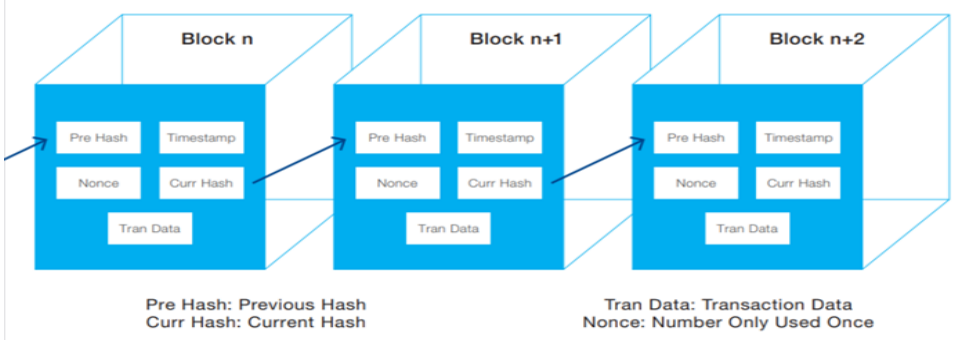
Structure and Design of Blockchain Technology:

A blockchain is a distributed, immutable, and decentralized ledger that, at its core, consists of a block of blocks containing a set of data. Cryptography techniques link the blocks together and form a chronological information chain. The structure of a blockchain is designed to ensure the security of data through its consensus mechanism, which has a network of nodes that agree on the validity of transactions before adding them to the blockchain.

Blockchain Structure and Functionality:

Blockchain is an immutable, distributed ledger that makes it virtually impossible to manipulate or hack recorded information. It functions as a "digital ledger" shared across a network of computers (nodes). Every transaction is authorized by a digital signature and authenticated through consensus mechanisms. In HR, this technology provides a "single source of truth" for employee records, ranging from educational credentials to payroll transactions.

FIGURE 2 A Typical Blockchain String



Blocks:

A block in a blockchain is a combination of three main components:

The header contains metadata such as a timestamp with a random number used in the mining process and the previous block's hash.

The data section contains the main and actual information, such as transactions and smart contracts, stored in the block.

Lastly, the hash is a unique cryptographic value that represents the entire block and is used for verification purposes.

Block Time:

Block time is the time to generate a new block in a blockchain. Different blockchains have different block times, which can vary from a few seconds to minutes or may be in hours, too. Shorter block times can give faster transaction confirmations, but the result has a higher chance of conflicts. Longer block times may increase the timing for transaction confirmations but reduce the chances of conflicts.

Hard Forks:

A hard fork in a blockchain refers to a permanent divergence in the blockchain's history that results in two separate chains. It can happen due to a fundamental change in the protocol of a blockchain, and all nodes do not agree on the update. Hard forks can create new cryptocurrencies or split existing ones, and they require consensus among the network participants to resolve.

Decentralization:

Decentralization is the key feature of blockchain technology. In a decentralized blockchain, no single central authority can control the network. In decentralization, the decision-making power is distributed among a network of nodes that collectively validate and agree on the transactions to be added to the blockchain. Blockchain technology's decentralized nature helps promote transparency, trust, and security. It also reduces the risk of relying on a single point of failure and minimizes the risks of data manipulation.

Finality:

Finality refers to the irreversible confirmation of transactions in a blockchain. If and when a transaction is added to a block, and the network confirms the block, it becomes immutable and cannot be reversed. This feature ensures the integrity of the data and prevents double spending, providing a high level of security and trust in Blockchain types & sustainability.

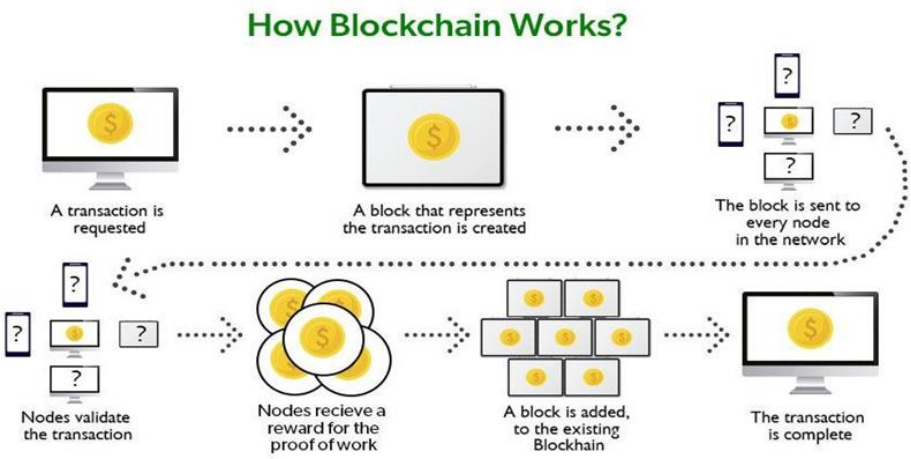
Openness:

Openness in blockchain technology makes the blockchain accessible to anyone who intends to participate in the network. This implies that it is open for all, and anyone can join the network, validate transactions, and add new blocks to the blockchain, so long as they know the consensus rules. Openness promotes inclusivity, transparency, and innovation, allowing participation from various stakeholders.

Public Blockchain:

It is a kind of blockchain that is open to the public and allows everyone to join the network to perform transactions and participate in the consensus process. Public blockchains are transparent because all transactions are publicly recorded.

How Does Blockchain Works?



The transaction process in a blockchain can be summarized as follows:

Facilitating a transaction:

A new transaction enters the blockchain network. All the information that needs to be transmitted is doubly encrypted using public and private keys.

Verification of transaction:

The transaction is then transmitted to the network of peer-to- peer computers distributed across the world. All the nodes on the network will check for the validity of the transaction like if a sufficient balance is available for carrying out the transaction.

Formation of a new block:

In a typical blockchain network there are many nodes and many transactions get verified at a time. Once the transaction is verified and declared a legitimate transaction, it will be added to the mempool. All the verified transactions at a particular node form a mempool and such multiple mempools form a block.

Consensus Algorithm:

The nodes that form a block will try to add the block to the blockchain network to make it permanent. But if every node is allowed to add blocks in this manner then it will disrupt the working of the blockchain network. To solve this problem, the nodes use a consensus mechanism to ensure that every new block that is added to the Blockchain is the only version of the truth that is agreed upon by all the nodes in the Blockchain, and only a valid block is securely attached to the blockchain. The node that is selected to add a block to the blockchain will get a reward and hence we call them "miners". The consensus algorithm creates a hash code for that block which is required to add the block to the blockchain.

Addition of the new block to the blockchain:

After the newly created block has got its hash value and is authenticated, now it is ready to be added to the blockchain. In every block, there is a hash value of the previous block and that is how the blocks are cryptographically linked to each other to form a blockchain. A new block gets added to the open end of the blockchain.

Transaction complete:

Let's understand this working of blockchain with the help of an example:

Let's say Jack and Nil are two nodes on the bitcoin blockchain network who wants to carry out a transaction between them.

Step 1: Facilitating the transaction: Jack wants to send 20 BTC to Nil via the Blockchain network.

Step 2: Verification of transaction: The message for verification will be sent to all the nodes on the network. All the nodes will check the important

parameters related to the transaction like Does Jack has sufficient balance i.e. at least 20BTC to perform the transaction. Is Jack a registered node? Is Nil a registered node? After checking the parameters the transaction is verified.

Step 3: Formation of a new block: A number of verified transactions stack up in mempools and get stored in a block. This verified transaction will also get stored in a block.

Step 4: Consensus algorithm: Since here we are talking about bitcoins so the Proof-of-Work consensus algorithm will be used for block verification. In proof-of-work, the system assigns the target hash value to a node, and according to this, it must come up with a hash for the new block. The node has to calculate the hash value for the new block that is less than the target value. If two or more miners mine the same block at the same time, the block with more difficulty is selected. The others are known as stale blocks. Mining usually rewards miners with blockchain currency. In this case, the blockchain currency is bitcoin.

Step 5: Addition of the new block in the blockchain: After the newly created block has got the hash value and authentication through proof-of-work only then it will be added to the network and the transaction will mark as complete. Nil will receive 20 BTC from Jack. The new block will be linked to the open end of the blockchain.

Step 6: Transaction complete: As soon as the block is added to the blockchain, the transaction will take place and 20 BTCs will get transferred from Jack's wallet to Nil's wallet. The details of the transaction are permanently secured on the blockchain.

Literature Review:

1. Enhancing HR Performance (Madhani, 2022): Pankaj Madhani explores how blockchain transforms recruitment and payroll. The study highlights that blockchain provides a "tamper-proof" record system, which is essential for preventing fraud and reducing the high costs of manual background checks.

2. Data Management and Analytics (Vo et al., 2018): This IBM Research paper focuses on multi-party business networks. It identifies that while blockchain ensures privacy and immutability, integration with "legacy systems" (like SAP or Oracle) remains a significant technical barrier.

3. Critical Review of HR Benefits (Yi et al., 2020): The authors analyze the "right to be forgotten" under GDPR, noting a conflict with blockchain's inherent immutability. However, they conclude that the ability to eliminate "fake resumes" through verifiable digital credentials outweighs many of the initial technical hurdles.

Research Methodology:

1. Study Objectives:

The primary objective is to analyze the role of blockchain in enhancing the efficiency, security, and transparency of HR data. Secondary objectives include investigating ROI for businesses and exploring the integration of AI with blockchain for predictive HR analytics.

2. Sampling and Data Collection: The study utilized a combination of **primary** and **secondary** data:

- **Secondary Data:** A systematic review of literature and corporate case studies (Deloitte, Maersk).
- **Primary Data:** Gathered through stratified and convenience sampling from students, HR professionals, and IT specialists.

Data Analysis and Findings:

1. Awareness and Perception: Survey results indicate that IT specialists (95%) and HR Managers (85%) have the highest awareness of blockchain technology. However, BMS students

and teachers show slightly lower familiarity, suggesting a need for blockchain integration into HR curriculum.

2. Impact on Operations: A significant majority (85% combined) of respondents agree that blockchain reduces the time and cost associated with HR processes.

3. Functional Impact: Respondents identified Payroll & Fraud Prevention (35%) and Employee Verification (30%) as the areas most likely to be transformed by blockchain.

Case Studies:

1. Deloitte: Deloitte leverages blockchain to secure sensitive data and expedite recruitment. Their research indicates that 56% of HR executives believe blockchain will transform the industry by creating a "single source of truth" for all employee-related data.

2. Maersk: Known for its "TradeLens" platform in logistics, Maersk also applied blockchain to candidate credential verification. By storing educational and work history on a blockchain, they significantly reduced the costs and time required for background checks.

Challenges and Recommendations:

1. Barriers to Adoption:

- **Regulatory Uncertainty:** In India, the lack of specific HR-blockchain frameworks and the complexities of the DPDP Act 2023 create hesitation.
- **High Costs:** Initial infrastructure and training costs are perceived as high by many organizations.
- **Scalability:** Current models may struggle with high-volume transactions for global workforces.

2. Recommendations:

1. **Hybrid Models:** Organizations should adopt hybrid blockchain solutions that combine "on-chain" security for critical data with "off-chain" storage for less sensitive information.
2. **Educational Integration:** Universities should include blockchain applications in BMS and HR courses to prepare the future workforce.
3. **Skill Development:** HR professionals must gain skills in data analytics and legal compliance, while IT teams focus on smart contract development.

Conclusion:

Blockchain technology is no longer just for cryptocurrency; it is a disruptive force in Human Resources. By addressing issues of trust, security, and administrative inefficiency, blockchain paves the way for a more transparent and productive workplace. While challenges regarding regulation and cost remain, the potential for automated, fraud-proof HR management makes blockchain an essential investment for forward-thinking organizations.

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A Study on Investors Perception Towards Selected Mutual Fund Schemes Concerning to Thane Region

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Abstract:

Mutual funds have emerged as one of the most significant investment avenues in India due to their ability to offer diversification, professional fund management and flexible investment options to investors. With increasing financial literacy, urbanization and rising disposable income, investors are gradually shifting from traditional investment instruments towards market-linked products such as mutual funds. However, the perception of investors towards mutual fund schemes varies depending on their awareness level, demographic profile, risk tolerance, expected returns and satisfaction with fund performance.

The present study aims to analyze the perception of investors towards selected mutual fund schemes concerning the Thane region. The study focuses on four major aspects: awareness of mutual funds, investment pattern and scheme preference, risk–return perception and satisfaction level of investors. The research also examines the influence of demographic factors such as age, gender, income, education and occupation on investors' perception and decision-making process.

The study is based on both primary and secondary data. Primary data has been collected through a structured questionnaire circulated among investors in the Thane region using Google Forms, while secondary data has been sourced from journals, research papers, etc. The findings of the study are expected to provide valuable insights to mutual fund companies, financial advisors and policymakers in designing effective investor awareness programs and improving investor satisfaction towards mutual fund investments.

Keywords: Mutual Funds, Investors' Perception, Awareness, Risk–Return, Satisfaction.

Introduction:

Investment decisions play a crucial role in achieving financial stability and long-term wealth creation. In the present dynamic financial environment, investors are constantly searching for investment options that provide higher returns with manageable risk. Among the various investment alternatives available, mutual funds have gained prominence due to their ability to pool funds from investors and invest in diversified portfolios of securities such as equity, debt and money market instruments.

A mutual fund is a professionally managed investment vehicle that allows investors to participate in capital markets without requiring extensive financial knowledge. Mutual fund schemes offer various options such as equity funds, debt funds, hybrid funds, index funds etc. catering to different risk appetites and investment horizons.

Despite the rapid growth of mutual funds, investors' perception towards these instruments is influenced by several factors including awareness, risk perception, expected returns, market volatility and past investment experiences. Many investors still hesitate to invest due to fear of risk, lack of knowledge and misconceptions regarding market-linked investments. Hence, understanding investors' perception becomes essential to analyze their investment behavior and preferences.

Thane region, being one of the rapidly developing urban areas near Mumbai, comprises investors from diverse demographic backgrounds such as salaried employees, professionals, students, businesspersons and homemakers. Their perception towards mutual fund investments varies based on income levels, education, occupation and financial goals. Therefore, this study attempts to analyze investors' perception towards selected mutual fund schemes concerning the Thane region with special reference to awareness, investment pattern, risk–return perception and satisfaction level.

Research Methodology:

Research Design:

The present study is descriptive in nature and aims to analyze the perception of investors towards selected mutual fund schemes in the Thane region. The study focuses on awareness, investment pattern, risk–return perception and satisfaction level of investors.

Objectives of the Study:

- To study the level of awareness of investors towards mutual funds as an investment option in the Thane region.
- To analyze the investment pattern and preference of investors towards selected mutual fund schemes.
- To examine the risk–return perception of investors regarding mutual fund investments.
- To study the satisfaction level and overall perception of investors towards the performance of selected mutual fund schemes.

Sample Size: - In this study, 206 investors were considered from the Thane Region.

Data Collection: - The study is based on both primary and secondary data.

Hypothesis: -

- Hypothesis 1:

  H0: There is no significant relationship between demographic factors and awareness of mutual fund investments.

  H1: There is a significant relationship between demographic factors and awareness of mutual fund investments.
- Hypothesis 2:

  H0: There is no significant relationship between demographic factors and preference towards selected mutual fund schemes.

  H1: There is a significant relationship between demographic factors and preference towards selected mutual fund schemes.
- Hypothesis 3:

  H0: There is no significant relationship between investors' risk tolerance and their perception of risk and return in mutual fund investments.

  H1: There is a significant relationship between investors' risk tolerance and their perception of risk and return in mutual fund investments.
- Hypothesis 4:

  H0: There is no significant relationship between investors' satisfaction level and the performance of selected mutual fund schemes.

  H1: There is a significant relationship between investors' satisfaction level and

the performance of selected mutual fund schemes.

Review of Literature:

Md. Ilyas and Dr. N. Ramanjaneyulu (2025) Investors' Perception and Attitude towards Mutual Fund Investments through Upstox

The study examines investor perception and attitude towards mutual fund investments made through the digital platform Upstox. Primary data was collected from 100 respondents using a structured questionnaire. The findings reveal that most investors prefer a moderate-risk and moderate-return strategy. Fund performance and availability of diversified investment options were the most influential factors in fund selection. Although investors appreciated the ease of access and low cost of digital platforms, concerns were raised regarding customer service quality, lack of transparency, and inadequate investor education. The study concludes that improving digital support systems and financial awareness can enhance investor confidence and satisfaction in online mutual fund platforms.

Dr. M. S. Kamalaveni et al. (2024) – A Study on Investor Perception towards Selecting Mutual Fund Schemes with Special Reference to Salem

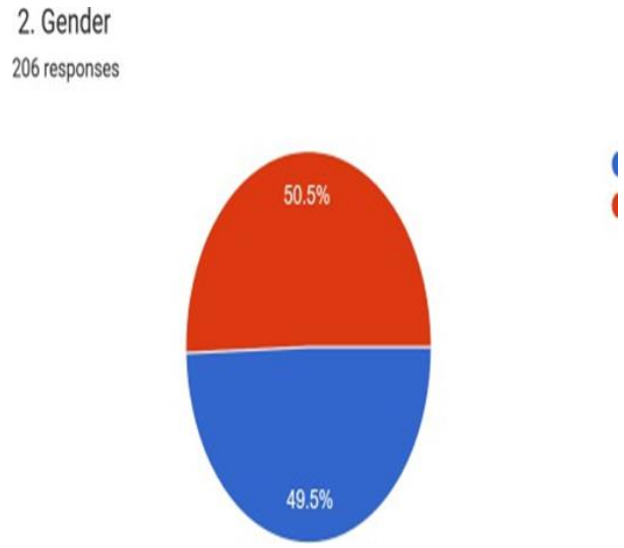
This research focuses on understanding investor perception while selecting mutual fund schemes in Salem district. The study used a sample size of 150 respondents and applied statistical tools such as descriptive statistics, ANOVA, and reliability tests. The results indicate that demographic factors such as age, education, income, and occupation significantly influence mutual fund selection. Investors showed higher preference towards equity and index funds, while risk tolerance and financial aspirations like retirement planning and wealth creation played a crucial role in decision-making. The study highlights that past performance, liquidity, and diversification are the key determinants of investor satisfaction.

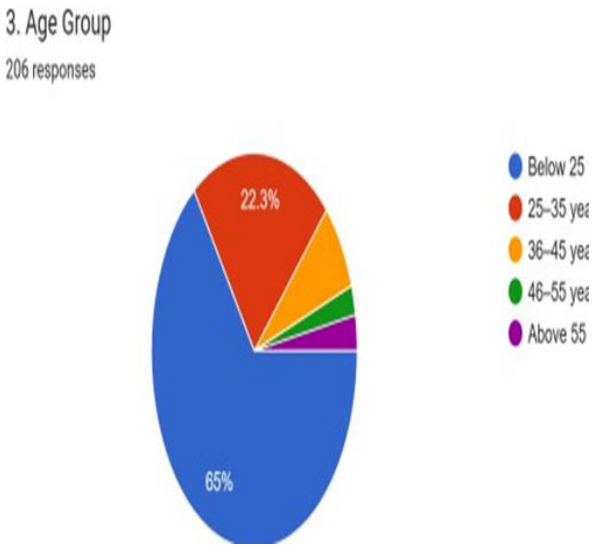
Data Analysis and Interpretation:

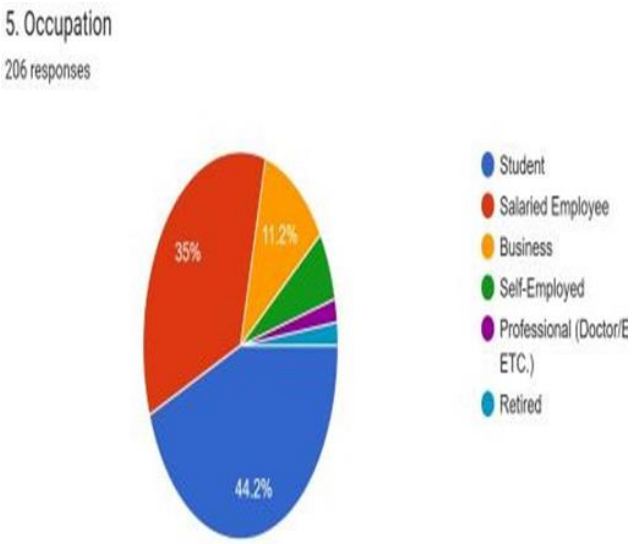
Demographic Factors:

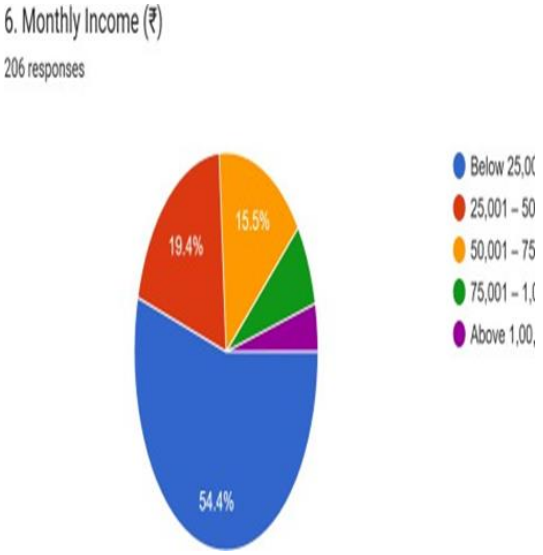
Variables	Category	No. of Respondents	Percentage (%)
Gender	Male	102	49.5
	Female	104	50.5
	Total	**206**	**100**
Age Group	Below 25 years	134	65.0
	25–35 years	46	22.3
	36–45 years	15	7.3
	46–55 years	6	2.9
	Above 55 years	5	2.5
	Total	**206**	**100**
Occupation	Student	91	44.2
	Salaried Employee	72	35.0
	Business	23	11.2
	Self-Employed	14	6.8
	Professional	5	2.4
	Retired	1	0.4
	Total	**206**	**100**
Monthly Income (₹)	Below 25,000	112	54.4
	25,001 – 50,000	40	19.4
	50,001 – 75,000	32	15.5
	75,001 – 1,00,000	14	6.8
	Above 1,00,000	8	3.9
	Total	**206**	**100**

The demographic analysis shows an almost equal representation of males (49.5%) and females (50.5%), ensuring balanced participation. Most respondents are below 25 years (65%), followed by the 25–35 years group (22.3%), indicating greater involvement of younger individuals. Students (44.2%) and salaried employees (35%) form the majority, reflecting higher interest among those with regular income or financial exposure. Over half of the respondents (54.4%) earn below ₹25,000 per month, suggesting that mutual funds are increasingly preferred even among lower- and middle-income groups due to their affordability and flexibility.





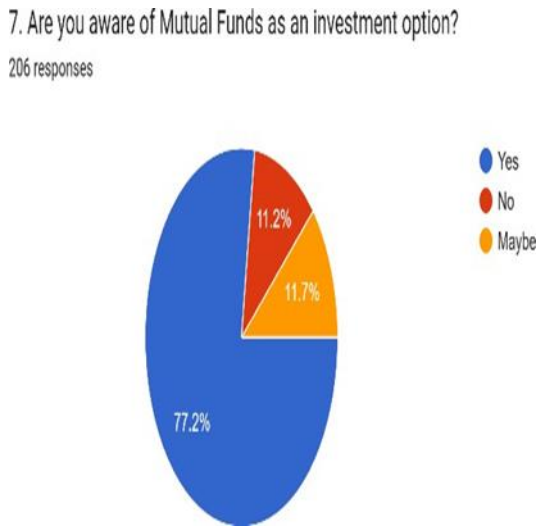


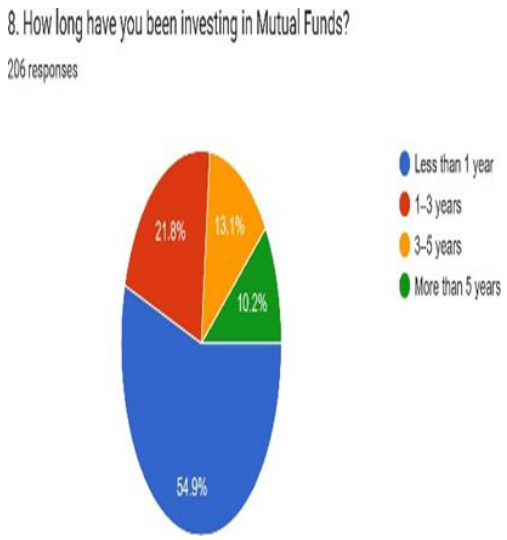


Awareness of investors towards mutual funds as an investment option:

Variables	Category	No. of Respondents	Percentage (%)
Awareness of Mutual Funds	Yes	159	77.2
	No	23	11.2
	Maybe	24	11.6
	Total	**206**	**100**
Source of Information	Financial Advisor	50	24.3
	Banks / AMC	40	19.4
	Internet / Social Media	69	33.5
	Friends / Relatives	38	18.4
	Newspapers / Magazines	9	4.4
	Total	**206**	**100**

The analysis of awareness and information sources reveals that a significant majority of respondents (77.2%) are aware of mutual funds as an investment option, indicating a high level of awareness among the sample population, while only 11.2% are not aware and 11.6% remain uncertain. With regard to sources of information, the internet and social media emerge as the primary source for 33.5% of respondents, followed by financial advisors (24.3%) and banks or AMCs (19.4%). Friends and relatives account for 18.4% of information dissemination, whereas newspapers and magazines contribute minimally at 4.4%. This distribution highlights the growing influence of digital platforms in spreading mutual fund awareness, alongside the continued relevance of professional and institutional sources.

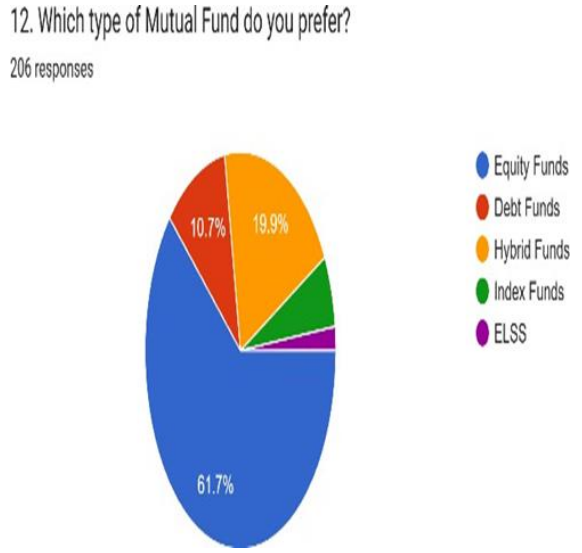


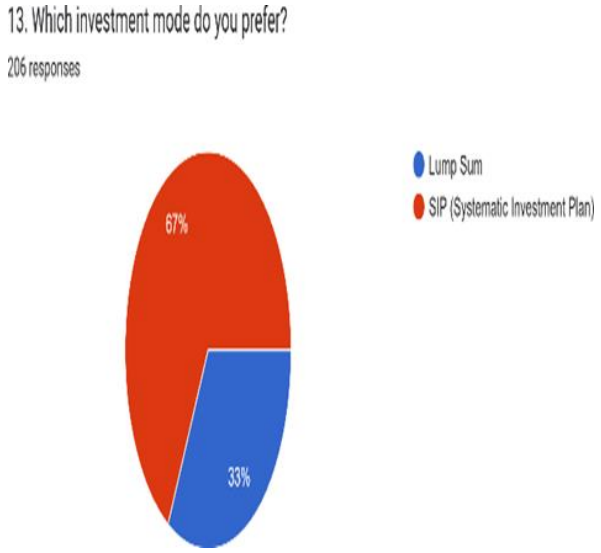


Investment pattern and preference of investors towards selected mutual fund schemes:

Variables	Category	No. of Respondents	Percentage (%)
Type of Mutual Fund Preferred	Equity Funds	127	61.7
	Debt Funds	22	10.7
	Hybrid Funds	41	19.9
	Index Funds	11	5.3
	ELSS	5	2.4
	Total	**206**	**100**
Investment Mode Preferred	Lump Sum	68	33.0
	SIP (Systematic Investment Plan)	138	67.0
	Total	**206**	**100**

The analysis of investment pattern and scheme preference indicates that a majority of respondents (61.7%) prefer equity mutual funds, reflecting a higher inclination towards growth-oriented investment options, followed by hybrid funds (19.9%) which combine both equity and debt features. Debt funds account for 10.7% of preferences, while index funds (5.3%) and ELSS (2.4%) are preferred by a smaller proportion of respondents. Regarding the mode of investment, SIP emerges as the most favored option, chosen by 67% of respondents, compared to 33% who prefer lump-sum investments. This trend highlights investors' preference for disciplined, regular investing with reduced risk exposure, indicating growing awareness of long-term wealth creation through systematic investment planning.

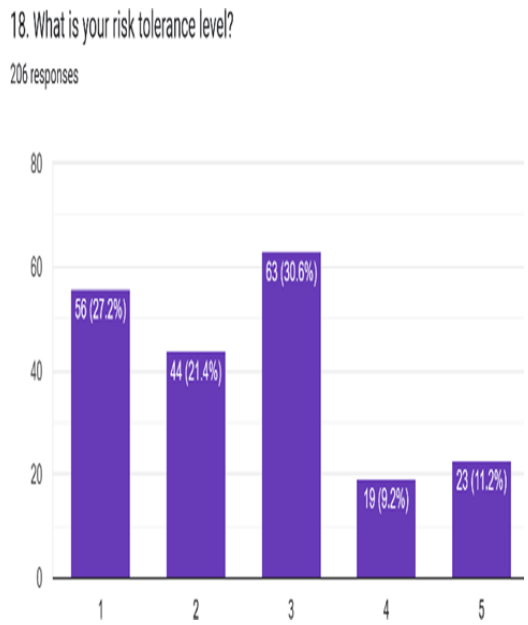


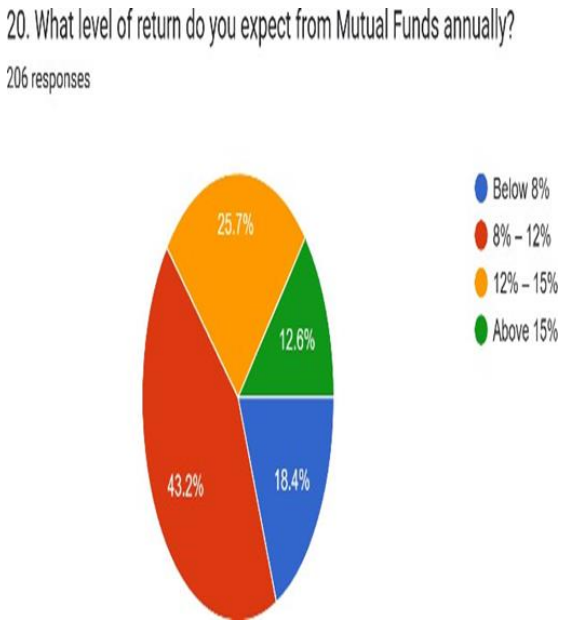


The risk–return perception of investors regarding mutual fund investments:

Variables	Category	No. of Respondents	Percentage (%)
Risk Tolerance Level	Very Low (1)	56	27.2
	Low (2)	44	21.4
	Moderate (3)	63	30.6
	High (4)	19	9.2
	Very High (5)	23	11.2
Expected Annual Return	Below 8%	38	18.4
	8% – 12%	89	43.2
	12% – 15%	53	25.7
	Above 15%	26	12.6

The analysis of risk and return preferences indicates that most respondents exhibit a moderate risk tolerance, with 30.6% falling in the moderate category, followed by 27.2% having very low risk tolerance and 21.4% low risk tolerance, suggesting an overall cautious investment approach. Only a smaller proportion of respondents display high (9.2%) or very high (11.2%) risk tolerance. In terms of expected annual returns, the majority of respondents (43.2%) expect returns in the range of 8%–12%, while 25.7% expect 12%–15% returns and 18.4% are satisfied with returns below 8%. A relatively smaller group (12.6%) expects returns above 15%, indicating that most investors prefer stable and realistic returns aligned with moderate risk- taking behavior.

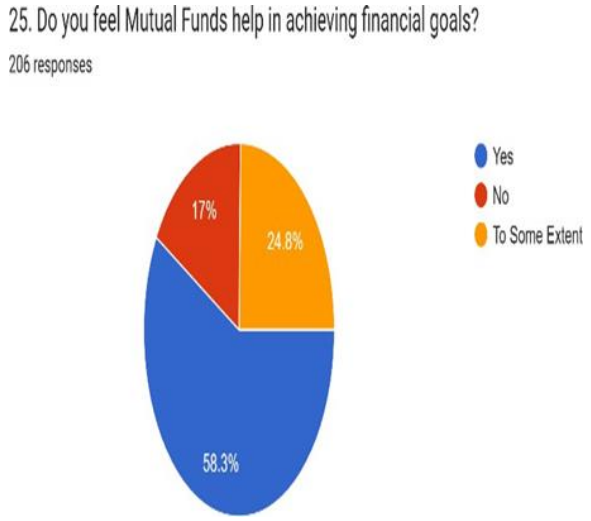


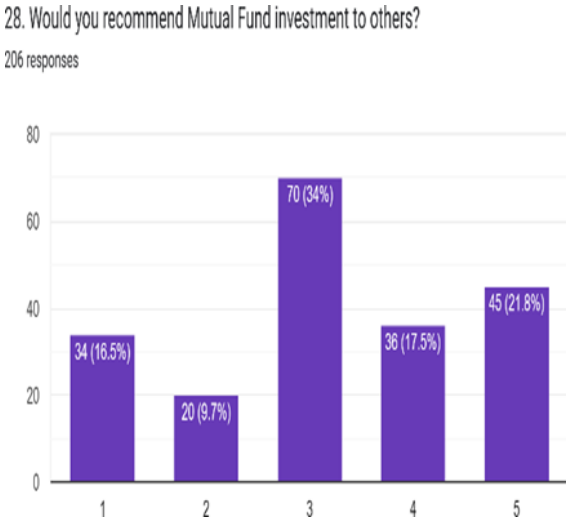


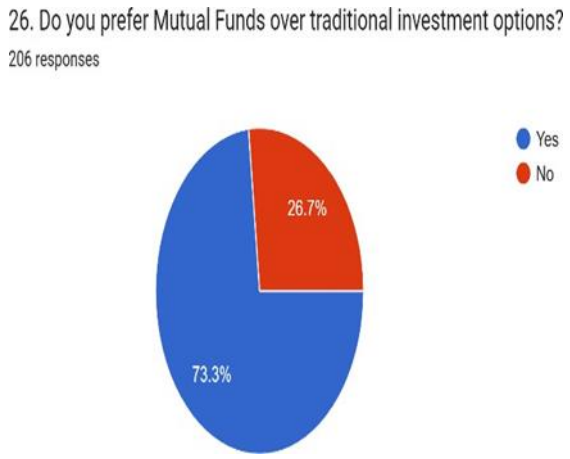
Satisfaction and Perception:

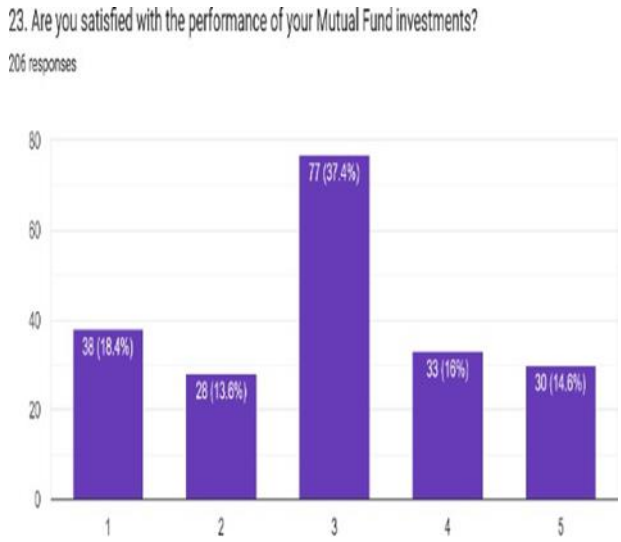
Variables	Category	No. of Respondents	Percentage (%)
Satisfaction with Mutual Fund Performance	Very Dissatisfied (1)	38	18.4
	Dissatisfied (2)	28	13.6
	Neutral (3)	77	37.4
	Satisfied (4)	33	16.0
	Very Satisfied (5)	30	14.6
Mutual Funds help in achieving Financial Goals	Yes	120	58.3
	No	35	17.0
	To Some Extent	51	24.8
Preference for Mutual Funds over Traditional Investments	Yes	151	73.3
	No	55	26.7
Recommendation of Mutual Funds to Others	Strongly Disagree (1)	34	16.5
	Disagree (2)	20	9.7
	Neutral (3)	70	34.0
	Agree (4)	36	17.5
	Strongly Agree (5)	45	21.8

The analysis of satisfaction and perception reveals that most respondents exhibit a neutral to positive level of satisfaction with the performance of their mutual fund investments, with the largest proportion (37.4%) expressing neutral satisfaction, followed by those who are satisfied (16%) and very satisfied (14.6%), while comparatively fewer respondents report dissatisfaction. A majority of respondents (58.3%) believe that mutual funds help in achieving financial goals, either fully or to some extent, indicating a favorable perception of mutual funds as an effective investment tool. Furthermore, a significant 73.3% of respondents prefer mutual funds over traditional investment options, reflecting growing investor confidence. In terms of recommendation behavior, 39.3% of respondents agree or strongly agree to recommend mutual fund investments to others, while 34% remain neutral, suggesting overall positive satisfaction with scope for further improvement in investor experience and awareness.









Conclusions:

The study highlights the increasing acceptance of mutual funds as a preferred investment option. Awareness levels are high, especially among young and salaried investors, who show a strong preference for equity schemes and systematic investment plans. Most investors display moderate risk tolerance with reasonable return expectations. Factors such as past performance, risk level, fund manager reputation, expense ratio, and brand image significantly influence fund selection. Overall perception towards mutual funds is positive, with most respondents viewing them as effective tools for achieving long-term financial goals and preferring them over traditional investments.

Recommendations:

From the above research, it is recommended that Asset Management Companies (AMCs), financial advisors, and regulatory bodies should take proactive steps to further strengthen investor confidence in mutual funds. Awareness programs and investor education initiatives should be conducted regularly to improve understanding of risk-return characteristics and long- term benefits of mutual fund investments. Special emphasis should be given to promoting SIPs, as they align well with investors' preference for disciplined and systematic investing.

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A Study on Digital Financial Literacy among Tribal Communities in Palghar District

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Abstract:

This study examines the level of Digital Financial Literacy and the Adoption of Digital Financial Services among Tribal Communities in Palghar District, to understand how effectively tribal populations engage with the rapidly expanding digital financial ecosystem. The study is based on primary data collected from 75 tribal respondents, representing diverse age groups, educational backgrounds, and income levels. Descriptive analysis was used to profile the demographic characteristics of the respondents, while inferential statistical tools were applied to test the formulated hypotheses. The findings reveal that the overall level of digital financial literacy among the respondents is moderate. In contrast, the adoption of digital financial services is moderate to low, indicating that access to digital financial infrastructure does not necessarily translate into effective usage. Further analysis using one-sample t-test and ANOVA demonstrates that there are statistically significant differences in both digital financial literacy and the adoption of digital financial services among tribal communities, particularly across different levels of educational qualification. Graduates exhibit substantially higher levels of literacy and adoption compared to respondents with secondary or primary education, highlighting education as a key determinant of digital financial capability. The study concludes that strengthening context-specific digital financial literacy initiatives, supported by training and awareness programs tailored to tribal populations, is essential for enhancing the adoption of digital financial services and achieving inclusive financial development in Palghar District.

Keywords: Digital, Financial Literacy, Adoption, Tribal, Palghar

Introduction:

Digital Financial Literacy refers to the ability of individuals to understand, access, and effectively use digital financial products and services in a safe, informed, and confident manner. It goes beyond basic financial literacy by integrating digital skills with financial knowledge, enabling individuals to operate in an increasingly technology-driven financial ecosystem. This includes understanding digital payment platforms such as UPI, mobile wallets, internet banking, and debit cards, as well as familiarity with digital interfaces, transaction processes, and basic financial concepts like savings, interest, and budgeting. In today's context, where governments and financial institutions are rapidly digitizing service delivery, digital financial literacy has become a foundational capability for inclusive economic participation.

From a functional perspective, digital financial literacy encompasses the practical skills required to perform digital financial transactions independently. These skills include operating smartphones or digital devices, navigating banking or payment applications, checking account balances, transferring funds, receiving government benefits through Direct Benefit Transfer (DBT), and maintaining digital transaction records. Individuals with higher levels

of digital financial literacy are more likely to use digital financial services regularly, reduce reliance on cash, and engage more confidently with formal financial institutions. In contrast, limited digital financial literacy often leads to dependence on intermediaries, underutilization of available services, or complete exclusion from digital finance, especially among rural and tribal populations.

Digital financial literacy also involves a strong awareness of digital security, risk management, and consumer protection mechanisms. As digital transactions increase, users are exposed to risks such as fraud, phishing, identity theft, and misuse of personal financial information. A digitally financially literate individual understands the importance of safeguarding sensitive information such as PINs, OTPs, passwords, and biometric data, and can identify common fraud tactics. Awareness of grievance redressal systems, customer support channels, and regulatory safeguards further strengthens trust in digital financial systems. Without such knowledge, individuals may develop fear or mistrust of digital platforms, which becomes a major barrier to adoption and continued use.

From a developmental and policy perspective, digital financial literacy plays a critical role in promoting financial inclusion, empowerment, and socio-economic development. It enables marginalized communities—such as tribal populations—to access government welfare schemes, savings instruments, insurance products, and credit facilities more efficiently and transparently. Digitally literate individuals are better positioned to make informed financial decisions, manage income fluctuations, and participate in the formal economy. Therefore, strengthening digital financial literacy is not merely a technological objective but a socio-economic necessity, particularly in regions like Palghar district, where bridging the digital divide can significantly contribute to inclusive growth and sustainable development.

Adoption of Financial Literacy:

Adoption of financial literacy refers to the extent to which individuals apply financial knowledge and skills in their day-to-day financial decisions and behaviors. It goes beyond awareness of financial concepts and focuses on the practical use of this knowledge in managing income, savings, expenditures, borrowing, and investments. Adoption is reflected when individuals actively plan their finances, maintain bank accounts, save regularly, evaluate financial products, and make informed choices rather than relying on informal or traditional financial practices. Thus, adoption represents the behavioral outcome of financial literacy rather than mere understanding.

In the context of a digitizing economy, adoption of financial literacy increasingly includes the use of digital and formal financial services such as bank accounts, digital payments, insurance schemes, pension plans, and government welfare transfers. Individuals who adopt financial literacy are more confident in interacting with financial institutions, understanding terms and conditions, and using financial tools responsibly. Adoption also reduces vulnerability to financial exploitation, over-indebtedness, and fraud, as financially literate individuals are better equipped to assess risks and benefits before making financial commitments.

From a developmental perspective, the adoption of financial literacy contributes significantly to financial inclusion, economic stability, and empowerment, especially among marginalized and rural populations. When financial literacy is effectively adopted, households are better able to smooth consumption, cope with income shocks, and build

long-term financial security. At a broader level, widespread adoption strengthens the formal financial system by increasing participation, transparency, and trust. Therefore, promoting not only financial literacy but also its adoption is essential for achieving inclusive and sustainable economic development, particularly in underdeveloped regions and tribal communities.

Review of Literature:

Thakur & Shah (2025), In the research paper titled "Awareness and Usage of Financial Services and Digital Financial Literacy among Dahanu Tribal Women Artisans in Palghar District" The study concludes that tribal women artisans show growing exposure to formal finance, but digital financial literacy remains uneven, shaped strongly by education, training access, and device/internet availability. The authors highlight that even when women possess bank accounts, confidence in using digital services independently (UPI/apps, balance checks, digital transfers) is limited due to fear of mistakes/fraud and language barriers. The paper recommends targeted, hands-on digital training and community-based facilitation to convert access into effective use.

Yadav et al. (2025), In the research paper titled "A Study of Financial Literacy of Tribal Adults at Kosbad Hill, Palghar" The study finds that financial literacy among tribal adults is constrained by low awareness of financial products and limited exposure to formal financial education, and it implies that digital adoption cannot succeed without foundational literacy. The authors emphasize that bridging gaps requires continuous capacity-building (simple concepts + practical demonstrations), because mere availability of banking infrastructure does not ensure informed financial behavior. The work supports the need for localized interventions (language, examples, trust-building) in tribal regions like Palghar.

Jebaraj, Rahuram & Edhayavarman (2025), In the research paper titled "Digital Financial Inclusion among Tribals in India: Challenges and Opportunities" This paper concludes that digital finance can widen tribal inclusion through mobile banking, wallets, and online payments, but progress is restricted by poor connectivity, low digital capability, and socio-cultural resistance. The authors underline that tribal communities need digital literacy support plus trust and grievance mechanisms to reduce fear of fraud and errors. The study argues that government initiatives can create opportunity, but outcomes depend on last-mile training and infrastructure reliability.

Sharma & Yadav (2025), In the research paper titled "Adoption of Digital Payments and Banking Awareness among Tribal Populations in South Gujarat" The study concludes that adoption is influenced less by availability of apps and more by training, trust, and perceived safety. It reports that low literacy and low connectivity amplify mistrust, while structured awareness programs improve willingness to adopt. The paper highlights that community-level learning and support systems (local champions, guided onboarding) are critical for sustained usage among tribal users.

Thomas & Suresh T.S. (2020), In the research paper titled "Digital Financial Inclusion: A Catalyst for Socio-Economic Transformation of Scheduled Castes and Scheduled Tribes in Kerala" The study concludes that digital financial inclusion can contribute to measurable improvements in social/economic outcomes (including money management), but the transformation is stronger when communities shift from traditional branch dependence to branchless/digital modes. The authors stress that inclusive design and support are essential so that

marginalized groups gain real capability—not just access. Overall, the paper positions digital inclusion as a pathway to empowerment while cautioning that outcomes require enabling conditions and skill development.

Malik (2022), In the discussion paper titled "Digital Inclusion of Scheduled Tribes: Role of Law and Policy" This policy-focused work concludes that scheduled tribes face a multi-layered digital exclusion driven by infrastructure gaps, service delivery barriers, and limited awareness, and that effective inclusion requires coordinated legal and policy measures. The author argues that rights-based access, accountability in implementation, and targeted outreach (digital literacy + last-mile facilitation) are necessary to ensure tribes can safely use digital public and financial services. The paper supports the argument that "digital inclusion" must be treated as a governance priority, not only a technology rollout.

Azeez, Akhtar & Banu (2022), In the research paper titled "Relationship between Demographic Factors and Digital Financial Literacy" The study concludes that digital financial literacy varies significantly by demographic factors such as education, income, age, and social group; notably, it reports relatively weaker literacy outcomes among disadvantaged groups and shows how structural factors shape capability. The authors emphasize that improving digital financial literacy requires segment-specific training (especially for low-education/low-income groups) and that "access" without skills leads to underuse or dependence on others for transactions.

Sethi & Singh (2024), In the review paper titled "Digital Financial Literacy in India: A Review and Need Analysis" This review concludes that India's rapid fintech growth has outpaced users' ability to understand digital products, making digital financial literacy essential for safe adoption. The authors highlight major gaps around fraud awareness, informed decision-making, and practical skill-building, and they call for structured literacy programs integrated with policy initiatives like Digital India. The paper supports the need for a stronger consumer capability framework to reduce misuse and vulnerability.

Gangani & Raval (2021), In the research paper titled "A Study on Level of Digital Financial Inclusion among the Urban Youth of Gujarat" The study concludes that digital financial inclusion levels can be moderate even among youth, but barriers like low digital financial literacy, risk/trust concerns, costs, and technology issues remain significant. The authors show that demographic factors relate to inclusion levels and emphasize that digital literacy must be strengthened to improve usage quality and confidence. Although the context is urban youth, the barrier framework is highly useful for tribal studies where these constraints are often stronger.

Mishra et al. (2024), In the research paper titled "Digital Financial Literacy and Its Impact on Financial Decision-Making of Women: Evidence from India" The study concludes that higher digital financial literacy significantly improves financial decision-making and strengthens intention toward productive financial behaviors. Using SEM evidence, the authors show that digital financial literacy contributes meaningfully even when other behavioral factors are considered, and they recommend focused government strategies and programs to expand fintech adoption safely among women across regions. The findings support the relevance of digital financial literacy as a key capability variable in inclusion research.

Research Gap:

Despite the growing body of literature on financial literacy, digital financial inclusion, and digital payment adoption in India, a clear research

gap exists in the context of tribal communities, particularly in Palghar district. Most existing studies focus either on general rural populations, urban youth, women, or marginalized groups at an aggregate level, with limited micro-level, district-specific evidence on how tribal households understand and use digital financial services. Further, prior research largely emphasizes access to bank accounts and digital infrastructure, while insufficient attention is given to digital financial literacy as a capability factor influencing actual adoption, confidence, and sustained use of digital financial services among tribals. Studies also tend to overlook context-specific barriers such as language limitations, cultural practices, low digital trust, and dependency on intermediaries, which are particularly relevant in tribal regions like Palghar. Therefore, there is a significant need for an empirical, primary-data-based study that examines the relationship between digital financial literacy and the adoption of digital financial services among tribal communities in Palghar district to generate localized insights and policy-relevant recommendations.

Objectives of Study:

1. To find the Digital Financial Literacy among Tribal Communities in Palghar District.
2. To study the Adoption of Digital Financial Services among Tribal Communities in Palghar District.
3. To examine the Digital Financial Literacy and Adoption of Digital Financial Services according to the qualification of respondents.

Research Methodology:

The present study adopts a descriptive and analytical research design to examine the level of digital financial literacy and the adoption of digital financial services among tribal communities in Palghar District. Primary data were collected from 75 tribal respondents using a structured questionnaire designed on a Likert five-point scale to measure digital financial literacy and adoption of digital financial services, along with demographic details such as gender, age, qualification, and income. Respondents were selected using a convenience sampling method, considering accessibility and willingness to participate. The collected data were coded and analyzed using statistical tools such as descriptive statistics, One Sample t-test, and ANOVA with the help of statistical software to test the formulated objectives and hypotheses. The methodology ensured systematic analysis and reliable interpretation of results to draw meaningful conclusions relevant to the study objectives.

Data Analysis:

The following table indicates the demographic factors of the study:

Sr.no	Demographic Factor	Category	Frequency	Percent
1	Gender	Male	37	49.3
		Female	38	50.7
2	Age Group	Up to 25 years	17	22.7
		26 to 35 years	11	14.7
		36 to 45 years	20	26.7
		46 to 60 years	15	20.0
		More than 60 years	12	16.0
3	Qualification	Primary	15	20.0
		Secondary	27	36.0
		Graduate	33	44.0

4	Monthly Income	Up to Rs. 5000	21	28.0
		Rs. 5001 to Rs. 10,000	22	29.3
		Rs.10,001 to Rs. 15,000	13	17.3
		Rs. 15,001 to Rs. 20,000	9	12.0
		More than Rs. 20,000	10	13.3

The demographic profile of the respondents shows a balanced gender representation, with 37 male and 38 female respondents, indicating that the study captures perspectives from both genders almost equally. In terms of age, the respondents are spread across different age groups, with the highest representation from the 36 to 45 years category (20 respondents), followed by those up to 25 years (17 respondents) and 46 to 60 years (15 respondents), suggesting participation from both economically active and experienced age groups, while 11 respondents fall in the 26 to 35 years group and 12 respondents are above 60 years. Regarding educational qualification, a significant portion of respondents have attained secondary (27 respondents) and graduate-level education (33 respondents), while 15 respondents have only primary education, indicating varying levels of educational exposure among the tribal population. The income distribution reveals that most respondents belong to lower- to middle-income groups, with 21 respondents earning up to ₹5,000 per month and 22 respondents earning between ₹5,001 and ₹10,000, while comparatively fewer respondents fall in higher income brackets, including ₹10,001–₹15,000 (13 respondents), ₹15,001–₹20,000 (9 respondents), and above ₹20,000 (10 respondents), reflecting the modest income levels prevalent among the tribal communities studied.

Objective-1: To find the Digital Financial Literacy among Tribal Communities in Palghar District.

Null Hypothesis H_{01}: There is no significant difference in Digital Financial Literacy among Tribal Communities in Palghar District.

Alternate Hypothesis H_{11}: There is a significant difference in Digital Financial Literacy among Tribal Communities in Palghar District.

To test the above null hypothesis, One Sample T-test is applied and results are as follows:

One-Sample Test				
	Test Value = 60			
	t	df	P-value	M Mean Difference
Digital Financial Literacy	2.433	74	.017	8.853

Interpretation: The above results indicate that calculated p-value is 0.017. It is less than 0.05. Therefore One Sample T-test is rejected. Hence Null hypothesis is rejected and Alternate hypothesis is accepted.

Conclusion: There is a significant difference in Digital Financial Literacy among Tribal Communities in Palghar District.

Findings: To understand the findings, mean scores are obtained and presented as follows:

One-Sample Statistics				
	N	Mean	St d. Deviation	Std. Error Mean
Digital Financial Literacy	75	68.85	31.512	3.639

The mean score of 68.85 for Digital Financial Literacy among the 75 respondents indicates a moderate level of digital financial literacy within the tribal communities of Palghar District.

Objective-2: To study the Adoption of Digital Financial Services among Tribal Communities in Palghar District.

Null Hypothesis H_{02}: There is no significant difference in Adoption of Digital Financial Services among Tribal Communities in Palghar District.

Alternate Hypothesis H_{12}: There is a significant difference in Adoption of Digital Financial Services among Tribal Communities in Palghar District.

To test the above null hypothesis, One Sample T-test is applied and results are as follows:

One-Sample Test				
	Test Value = 60			
	t	df	P-value	Mean Difference
A Adoption of Digital Financial Services	5.987	74	.000	-11.200

Interpretation: The above results indicate that the calculated p-value is 0.000. It is less than 0.05. Therefore, One Sample T-test is rejected. Hence Null hypothesis is rejected, and the alternative hypothesis is accepted.

Conclusion: There is a significant difference in the adoption of Digital Financial Services among Tribal Communities in Palghar District.

Findings: To understand the findings, mean scores are obtained and presented as follows:

One-Sample Statistics				
	N	Mean	Std. Deviation	Std. Error Mean
Adoption of Digital Financial Services	75	48.80	16.201	1.871

The mean score of 48.80 for the adoption of digital financial services among the 75 respondents indicates a moderate to low level of adoption within the tribal communities of Palghar District.

Objective-3: To study the Digital Financial Literacy and Adoption of Digital Financial Services according to the qualification of respondents.

Null Hypothesis H_{03}: There is no significant difference in Digital Financial Literacy and Adoption of Digital Financial Services according to the qualification of respondents.

Alternate Hypothesis H_{13}: There is a significant difference in Digital Financial Literacy and

Adoption of Digital Financial Services according to the qualification of respondents.

To test the above null hypothesis, One Sample T-test is applied and results are as follows:

ANOVA						
		Sum of Squares	df	M Mean Square	F	Sig.
Digital Financial Literacy	Between Groups	48659.256	2	24329.628	70.571	.000
	Within Groups	24822.131	72	344.752		
	Total	73481.387	74			
Adoption of Digital Financial Services	Between Groups	6843.647	2	3421.824	19.584	.000
	Within Groups	12580.353	72	174.727		
	Total	19424.000	74			

Interpretation: The above results indicate that calculated p-value is 0.000. It is less than 0.05. Therefore ANOVA and F-test is rejected. Hence Null hypothesis is rejected and Alternate hypothesis is accepted.

Conclusion: There is a significant difference in Digital Financial Literacy and Adoption of Digital Financial Services according to the qualification of respondents.

Findings: To understand the findings, mean scores are obtained and presented as follows:

Report		
Mean		
3. Qualification of respondent:	Digital Financial Literacy	Adoption of Digital Financial Services
Primary	30.13	36.53
Secondary	58.07	42.81
Graduate	95.27	59.27
Total	68.85	48.80

The mean scores indicate a clear educational gradient in both Digital Financial Literacy and Adoption of Digital Financial Services among the respondents. Participants with primary education report the lowest mean scores for digital financial literacy (30.13) and adoption of digital financial services (36.53), reflecting limited awareness, skills, and confidence in using digital financial tools. Respondents with secondary education show moderate improvement, with mean scores of 58.07 for digital financial literacy and 42.81 for adoption, suggesting that increased educational exposure enhances understanding and partial usage of digital financial services. The graduate respondents record the highest mean scores for both digital financial literacy (95.27) and adoption (59.27), demonstrating that higher educational attainment significantly strengthens both knowledge and actual usage of digital financial platforms. Overall, the total mean scores

(68.85 for digital financial literacy and 48.80 for adoption) reinforce that education plays a critical role in shaping digital financial capability and behavior, and that improving educational access and targeted training can substantially enhance digital financial inclusion among tribal communities.

Conclusion:

The study concludes that digital financial literacy and the adoption of digital financial services among tribal communities in Palghar District are significantly differentiated and influenced by key socio-demographic factors, particularly education. Although the demographic profile reflects balanced gender participation and representation across age and income groups, the empirical results reveal that the overall level of digital financial literacy is moderate, while the adoption of digital financial services remains moderate to low. One-sample t-test results confirm statistically significant differences in both digital financial literacy and adoption levels when compared to the benchmark values, indicating uneven penetration and usage of digital finance among the tribal population. Further, ANOVA results clearly establish that educational qualification plays a decisive role, with graduate respondents exhibiting substantially higher literacy and adoption levels than those with secondary or primary education. These findings collectively suggest that while digital financial services are increasingly accessible, capability gaps, confidence issues, and educational limitations continue to restrict their effective and widespread adoption. Therefore, the study emphasizes the need for targeted, education-oriented digital financial literacy interventions, customized to the tribal context, to promote inclusive digital financial participation and sustainable financial empowerment in Palghar District.

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Adoption and Effectiveness of Artificial Intelligence in Supporting Examination Preparation among Undergraduate Students

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Abstract:

Artificial Intelligence (AI) has emerged as a significant academic support tool in higher education, particularly for examination preparation among undergraduate students. With the increasing use of AI-based applications for understanding complex concepts, organizing revision materials, generating practice questions, and improving answer quality, traditional study practices are undergoing a major transformation. AI tools provide instant explanations, structured content, and language support, enabling students to study more efficiently and confidently. However, the perceived effectiveness of these tools is not uniform and may differ across academic streams due to variations in curriculum structure and learning requirements. The present study examines the adoption and perceived effectiveness of AI tools in supporting examination preparation among undergraduate students from Science, Commerce, and Arts streams, based on primary data collected from 120 respondents. The study focuses on three dimensions: content learning and concept understanding, exam-oriented preparation and revision, and writing assistance and answer presentation. The findings reveal statistically significant differences across streams, indicating that Science students perceive AI as most effective for conceptual understanding, Commerce students find it highly useful for exam-oriented preparation, and Arts students rely more on AI for writing assistance. The study highlights the discipline-specific role of AI in examination preparation and emphasizes the need for responsible and pedagogically aligned integration of AI tools in higher education.

Keywords: Artificial Intelligence in Education, Examination Preparation, Undergraduate Students.

Introduction:

Artificial Intelligence (AI) has rapidly become a day-to-day academic support tool for undergraduate students, especially through generative AI systems (e.g., ChatGPT-like tools), adaptive learning apps, and AI-powered search/summarization platforms. In exam seasons, students increasingly use AI not only to find information, but to transform it—into simplified explanations, structured notes, flashcards, quizzes, and model answers. This shift is changing how students engage with textbooks, lecture notes, and online resources, and it is creating a new "AI-assisted study environment" in higher education.

From a learning perspective, AI can support content learning and concept understanding by offering instant explanations, step-by-step reasoning, examples, and alternative ways of understanding difficult topics. Evidence syntheses in higher education suggest that AI tools can enable personalization, timely feedback, and learning support at scale—features that can strengthen comprehension when used appropriately and critically.

At the same time, undergraduate students often approach AI with an exam-oriented mindset, using it for revision plans, topic prioritization, quick summaries, MCQ generation, and last-minute practice. Recent meta-analytic evidence indicates that ChatGPT-based learning

interventions, overall, can improve academic performance and related learning outcomes, though results vary by context, duration, and how the tool is integrated into study routines. This makes it important to study adoption patterns (how and why students use AI) alongside effectiveness (whether it actually improves exam preparation outcomes).

Another prominent area is writing assistance and answer presentation. Students increasingly rely on AI to improve grammar, structure, coherence, and presentation quality—particularly for essay-type answers, short notes, and report-style responses. While such support can enhance clarity and reduce time spent on drafting, it also raises concerns about over-dependence, reduced original thinking, and the possibility of academic misconduct if students submit AI-generated work without appropriate disclosure or learning effort.

Review of Literature:

AlAfnan et.al (2023), In the research titled "ChatGPT as an educational tool: Opportunities, challenges, and recommendations for communication, business writing, and composition courses" The study concludes that ChatGPT has significant potential as an educational support tool in higher education, particularly in communication, business writing, and composition courses. It enhances students' ability to generate ideas, structure content, and improve language quality, thereby supporting learning efficiency and confidence. However, the authors caution that unregulated use may reduce originality and critical thinking if students rely excessively on AI-generated outputs. The study emphasizes the importance of guided and ethical use, recommending that educators integrate AI as a supplementary learning aid rather than a replacement for independent cognitive effort.

Bittle & El-Gayar (2025), In the research titled "Generative AI and academic integrity in higher education: A systematic review and research agenda" This systematic review concludes that while generative AI offers substantial academic benefits, it simultaneously poses serious challenges to academic integrity in higher education. The authors find growing concerns related to plagiarism, authorship ambiguity, and assessment validity, particularly in take-home exams and written assignments. The study highlights the urgent need for institutional policies, AI literacy training, and assessment redesign to ensure responsible adoption. Overall, the review positions ethical governance as a critical determinant of sustainable AI use in student learning and examination contexts.

Bond et.al (2024), In the research titled "A meta systematic review of artificial intelligence in higher education: A call for increased ethics, collaboration, and rigour" The meta systematic review concludes that artificial intelligence has become a transformative force in higher education, offering improvements in personalization, feedback, and learning support. However, the authors identify a lack of methodological rigor, ethical clarity, and pedagogical grounding in much of the existing research. The study strongly calls for more theory-driven, ethically informed, and interdisciplinary research approaches. It concludes that the effectiveness of AI in education depends not merely on technological capability, but on responsible design, transparent implementation, and alignment with educational values.

Deng et.al (2025), In the research titled "Does ChatGPT enhance student learning? A systematic review and meta-analysis of experimental studies" The meta-analysis concludes that ChatGPT-based learning interventions have a statistically positive effect on student learning

outcomes, including comprehension, performance, and engagement. The findings suggest that AI tools are most effective when used for conceptual understanding, guided practice, and formative learning rather than passive content consumption. However, the authors note considerable variation across disciplines and study designs, indicating that effectiveness is context-dependent. The study concludes that ChatGPT can enhance exam preparation when integrated purposefully into learning strategies rather than used as a shortcut to answers.

Dempere et.al (2023), In the research titled "The impact of ChatGPT on higher education" This study concludes that ChatGPT significantly influences higher education by reshaping how students access information, prepare assignments, and support exam-related learning. The authors find that AI improves efficiency, accessibility, and learning support, especially for students facing language or comprehension barriers. At the same time, they raise concerns about over-reliance, reduced deep learning, and ethical misuse. The study concludes that institutional awareness, student training, and pedagogical safeguards are essential to ensure that AI enhances rather than undermines academic development.

Jin et.al (2025), In the research titled "Generative AI in higher education: A global perspective of institutional adoption policies and guidelines" The study concludes that global adoption of generative AI in higher education is increasing rapidly, but institutional policies and guidelines remain uneven and fragmented. While many universities recognize AI's potential to enhance learning, assessment, and student support, there is limited consensus on ethical use, transparency, and accountability. The authors emphasize that clear governance frameworks, staff training, and student awareness programs are crucial for effective AI integration. The study concludes that institutional readiness plays a decisive role in determining whether AI positively supports examination preparation and academic success.

Research Gap:

Despite extensive scholarly attention to the role of generative AI in higher education, a clear research gap remains with respect to its exam-specific adoption and effectiveness among undergraduate students. Existing studies largely focus on AI's general educational potential (AlAfnan et al., 2023; Dempere et al., 2023), ethical and academic integrity concerns (Bittle & El-Gayar, 2025), policy-level adoption and governance (Jin et al., 2025), or aggregated learning outcomes across contexts and disciplines (Bond et al., 2024; Deng et al., 2025). However, there is limited empirical evidence that systematically examines how undergraduate students specifically use AI for examination preparation, particularly across distinct functional dimensions such as content learning and concept understanding, exam-oriented preparation and revision, and writing assistance and answer presentation. Moreover, while prior research highlights benefits and risks, it often lacks student-centric, context-specific, and quantitative investigations linking AI adoption patterns directly to perceived effectiveness in exam readiness. The variability noted across disciplines and study designs further underscores the need for focused, primary-data-based research that captures undergraduate students' real-world AI usage behaviours, perceptions, and outcomes during exam preparation. Addressing this gap will contribute to a more nuanced understanding of AI's pedagogical value while informing educators and institutions on responsible, effective, and exam-oriented integration of AI tools in higher education.

Research Methodology:

The study is based on primary data collected from 120 undergraduate students belonging to Science, Commerce, and Arts streams. A structured questionnaire using a five-point Likert scale was administered to measure students' perceptions regarding the adoption and effectiveness of AI tools across three dimensions: content learning and concept understanding, exam-oriented preparation and revision, and writing assistance and answer presentation. The sample included respondents from different genders and years of study to ensure adequate representation. Descriptive statistics such as mean and standard deviation were used to summarize the data, while one-way ANOVA was applied to examine differences in perceptions across streams of education. Appropriate statistical tools were used to analyze the data and test the stated hypotheses.

Data Analysis:

Demographic Factor

Sr No.	Particular	Category	Frequency	Percent
1	Gender	Male	65	54.2
		Female	55	45.8
2	Year of Study	First Year	50	41.7
		Second Year	45	37.5
		Third Year	25	20.8
3	Stream of Education	Science	35	29.2
		Commerce	55	45.8
		Arts	30	25.0

The frequency number represents the actual count of respondents falling into a particular category. It shows how many individuals selected or belonged to a specific option out of the total sample. For example, a frequency of 65 under the category Male means that 65 respondents in the study were male, while a frequency of 55 under Female indicates that 55 respondents were female. Similarly, the frequency values for year of study and stream of education denote the exact number of students from each academic year and stream who participated in the survey. Thus, frequency numbers provide a clear and direct understanding of the sample composition in numerical terms before converting these counts into percentages for easier comparison.

Objective and Hypothesis:

Objective 1 To study the use of Artificial Intelligence in Adoption and Effectiveness of Content Learning & Concept Understanding among students of different streams of education.

Null Hypothesis H_{01}: There is no significant difference in Content Learning & Concept Understanding according to different streams of education.

Alternate Hypothesis H_{11}: There is a significant difference in Content Learning & Concept Understanding according to different streams of education.

To study the above objectives, ANOVA sample test is applied and results are as follows:

ANOVA					
Content Learning & Concept Understanding					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	6884.854	2	3442.427	18.818	.000
Within Groups	21403.013	117	182.932		
Total	28287.867	119			

Interpretation: The above results indicate that calculated p-value is 0.000. It is less than 0.05. Therefore, f-test is rejected. Hence Null hypothesis is rejected and Alternate hypothesis is accepted.

Conclusion: There is a significant difference in Content Learning & Concept Understanding according to different streams of education.

Findings: To understand the findings of hypothesis, mean score of Content Learning & Concept Understanding according to different streams of education.

Report			
Content Learning & Concept Understanding			
4. Stream of Education:	Mean	N	Std. Deviation
Science	79.54	35	22.139
Commerce	67.56	55	7.762
Arts	59.20	30	7.155
Total	68.97	120	15.418

The mean score of Content Learning & Concept Understanding varies notably across different streams of education. Science students report the highest mean score (Mean = 79.54), indicating that they perceive AI tools as highly effective in enhancing conceptual clarity and understanding of complex subjects. Commerce students show a moderate level of perceived usefulness (Mean = 67.56), suggesting that AI supports their learning needs to a considerable extent, though less intensively than in Science. Arts students record the lowest mean score (Mean = 59.20), implying comparatively limited reliance on AI tools for concept-based learning. The overall mean score of 68.97 reflects a generally positive perception among students, while the differences across streams highlight that the effectiveness of AI-assisted content learning is influenced by the academic orientation and cognitive demands of each discipline.

Objective 2 To study the use of Artificial Intelligence in Adoption and Effectiveness of Exam-Oriented Preparation & Revision among students of different streams of education.

Null Hypothesis H_{02}: There is no significant difference in Exam-Oriented Preparation & Revision according to different streams of education.

Alternate Hypothesis H_{12}: There is a significant difference in Exam-Oriented Preparation & Revision according to different streams of education.

To study the above objectives, ANOVA sample test is applied and results are as follows:

ANOVA					
Exam-Oriented Preparation & Revision					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	5888.005	2	2944.003	54.696	.000
Within Groups	6297.461	117	53.824		
Total	12185.467	119			

Interpretation: The above results indicate that calculated p-value is 0.000. It is less than 0.05. Therefore, f-test is rejected. Hence Null hypothesis is rejected and Alternate hypothesis is accepted.

Conclusion: There is a significant difference in Exam-Oriented Preparation & Revision according to different streams of education.

Findings: To understand the findings of hypothesis, mean score of Exam-Oriented Preparation & Revision according to different streams of education.

Report			
Exam-Oriented Preparation & Revision			
4. Stream of Education:	Mean	N	Std. Deviation
Science	63.66	35	7.904
Commerce	75.93	55	6.277
Arts	60.27	30	8.399
Total	68.43	120	10.119

The mean score of Exam-Oriented Preparation & Revision shows clear variation across different streams of education. Commerce students record the highest mean score (Mean = 75.93), indicating a strong perception that AI tools are highly useful for structured revision, practice, and exam-focused preparation. Science students report a comparatively lower mean score (Mean = 63.66), suggesting moderate reliance on AI for exam preparation, possibly due to greater emphasis on problem-solving and conceptual application. Arts students exhibit the lowest mean score (Mean = 60.27), reflecting relatively limited use of AI tools for exam-oriented activities. The overall mean score of 68.43 indicates a generally positive perception among students, while the stream-wise differences highlight that the perceived effectiveness of AI for examination preparation varies according to academic discipline.

Objective 3 To study the use of Artificial Intelligence in Adoption and Effectiveness of Writing Assistance & Answer Presentation among students of different streams of education.

Null Hypothesis H_{03}: There is no significant difference in Writing Assistance & Answer Presentation according to different streams of education.

Alternate Hypothesis H_{13}: There is a significant difference in Writing Assistance & Answer Presentation according to different streams of education.

To study the above objectives, ANOVA sample test is applied and results are as follows:

ANOVA					
Writing Assistance & Answer Presentation					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	6063.113	2	3031.557	49.547	.000
Within Groups	7158.753	117	61.186		
Total	13221.867	119			

Interpretation: The above results indicate that calculated p-value is 0.000. It is less than 0.05. Therefore, f-test is rejected. Hence Null hypothesis is rejected and Alternate hypothesis is accepted.

Conclusion: There is a significant difference in Writing Assistance & Answer Presentation according to different streams of education.

Findings: To understand the findings of hypothesis, mean score of Writing Assistance & Answer Presentation according to different streams of education.

Report			
Writing Assistance & Answer Presentation			
4. Stream of Education:	Mean	N	Std. Deviation
Science	49.83	35	7.473
Commerce	58.98	55	8.510
Arts	69.20	30	6.820
Total	58.87	120	10.541

The mean score of Writing Assistance & Answer Presentation differs substantially across streams of education. Arts students record the highest mean score (Mean = 69.20), indicating that they perceive AI tools as highly effective in supporting writing tasks, structuring answers, and improving presentation quality. Commerce students show a moderate mean score (Mean = 58.98), suggesting a reasonable level of reliance on AI for written assignments and exam responses. In contrast, Science students report the lowest mean score (Mean = 49.83), reflecting comparatively limited use of AI tools for writing assistance, likely due to the numerical and problem-oriented nature of their curriculum. The overall mean score of 58.87 suggests a moderate perception of AI usefulness for writing-related activities, while the variation across streams highlights discipline-specific academic requirements influencing AI usage.

Conclusion:

The study concludes that Artificial Intelligence plays a significant and differentiated role in supporting examination preparation among undergraduate students. The findings confirm that the perceived effectiveness of AI tools varies significantly across academic streams, reflecting discipline-specific academic needs. Science students primarily benefit from AI for enhancing content learning and conceptual clarity, Commerce students find AI most useful for structured exam-oriented preparation and revision, while Arts students rely more heavily on AI for writing assistance and answer presentation. These results suggest that AI adoption in higher education should not follow a uniform approach; instead, institutions should promote guided, ethical, and stream-sensitive use of AI tools to enhance learning outcomes while safeguarding

critical thinking, originality, and academic integrity.

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A Study on the Role of Digital Technology Adoption in Enhancing Operational Efficiency of Educational Institutions

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Abstract:

This study examines the role of digital technology adoption in enhancing the operational efficiency of educational institutions. In the present education ecosystem, institutions are required to manage complex academic and administrative functions such as admissions, examinations, fee management, record maintenance, payroll, and stakeholder communication with greater speed, accuracy, and transparency. The adoption of digital technologies, including Enterprise Resource Planning (ERP) systems, Learning Management Systems (LMS), online admission platforms, digital payment systems, and automated administrative processes, has emerged as a strategic response to these growing operational demands. The study focuses on understanding how the extent of technology adoption contributes to improvements in time management, cost reduction, service delivery speed, accuracy of records, and overall institutional productivity.

The study is based on primary data collected from teaching and administrative staff of educational institutions using a structured questionnaire. Statistical tools such as ANOVA and Pearson correlation analysis were applied to examine differences in technology adoption across educational qualification levels and to assess the relationship between technology adoption and operational efficiency. The findings reveal significant differences in technology adoption based on educational qualifications and establish a strong positive relationship between digital technology adoption and operational efficiency. The study concludes that effective and integrated use of digital technologies significantly enhances administrative performance and institutional productivity, highlighting the need for strategic digital transformation and continuous capacity building in educational institutions.

Keywords: Digital Technology Adoption, Operational Efficiency, Educational Institutions, Administrative Automation

Introduction:

Educational institutions today operate in an environment where expectations for speed, transparency, accuracy, and service quality are continuously rising. Alongside academic delivery, institutions manage complex operational functions such as admissions, examinations, attendance, payroll, procurement, student records, compliance reporting, and stakeholder communication. As the scale of services expands, manual and paper-based workflows often lead to delays, duplication of work, data inconsistency, and higher administrative costs. In this context, the adoption of digital technologies has become a strategic necessity to streamline institutional operations and sustain performance in a competitive and accountability-driven education ecosystem.

Digital technology adoption in educational institutions typically includes tools such as Learning Management Systems (LMS), Student Information Systems (SIS), Enterprise Resource Planning (ERP), digital document management, cloud services, analytics dashboards, biometric attendance, and automated communication platforms. These technologies are

increasingly viewed not only as support systems but as enablers of institution-wide transformation in processes, decision-making, and service delivery. Recent higher-education case studies emphasize that digital transformation is strongly tied to redesigning processes and aligning technology with institutional strategy, rather than merely installing new software.

Operational efficiency in educational institutions refers to the ability to deliver administrative and academic-support services with optimal use of time, cost, and human resources while maintaining accuracy and stakeholder satisfaction. For example, automation can reduce processing time in admissions and fee management, improve accuracy in reporting, reduce repetitive data entry, and enable faster approvals through e-workflows. Studies on digital transformation maturity also highlight that when institutions integrate data and systems effectively, they can manage operations more efficiently, improve coordination across departments, and reduce reliance on fragmented legacy systems.

From a theoretical perspective, technology adoption and its outcomes are often explained using models such as the Technology Acceptance Model (TAM) and UTAUT, which emphasize perceived usefulness, ease of use, and user adoption behavior as foundations for successful implementation. In institutional settings, the Information Systems Success Model further supports the idea that system quality, information quality, and service quality influence use and user satisfaction, which then contribute to net benefits such as efficiency and performance improvement. Together, these perspectives justify evaluating not only whether technology is present, but whether it is effectively used and producing measurable operational gains.

Although digital tools are expanding rapidly in education, many institutions still face gaps such as partial adoption, resistance to change, training deficits, weak integration across departments, and lack of clear digital strategy. Research also notes that digital transformation readiness and maturity vary widely across institutions and contexts, and evidence on operational efficiency outcomes can be scattered across different technology types and administrative domains. Therefore, this study is significant because it systematically examines how digital technology adoption impacts operational efficiency in educational institutions, producing insights that can support better governance, investment decisions, capacity building, and continuous improvement in institutional operations.

Review of Literature:

Antonopoulou et.al (2023), In the research titled "Staying afloat amidst extreme uncertainty: A case study of digital transformation in higher education" The study concludes that digital transformation is a critical survival and performance strategy for higher education institutions operating under conditions of extreme uncertainty. By adopting integrated digital systems and redesigning institutional processes, universities were able to enhance operational resilience, improve coordination across departments, and maintain service continuity. The findings emphasize that technology adoption alone is insufficient; strategic alignment, leadership support, and process reengineering are essential to convert digital initiatives into tangible operational efficiency gains.

Bhardwaj & Kumar (2025), In the research titled "Transforming higher education with robotic process automation: Enhancing efficiency, innovation, and student-centered learning" This research concludes that robotic process automation (RPA) significantly enhances operational efficiency in higher education institutions by reducing manual workloads,

minimizing human errors, and accelerating administrative processes. The implementation of automation technologies leads to cost savings, faster service delivery, and improved stakeholder satisfaction. The study highlights that RPA not only improves efficiency but also enables institutions to reallocate human resources toward higher-value academic and student-centered activities.

Davis (1989), In the research titled "Perceived usefulness, perceived ease of use, and user acceptance of information technology" Davis's seminal work concludes that perceived usefulness and perceived ease of use are the primary determinants of user acceptance of information technology. The study establishes that when users believe technology enhances job performance and is easy to operate, adoption rates increase substantially. In the context of educational institutions, this model explains why successful technology adoption directly influences operational efficiency, as systems are effectively utilized rather than underused or resisted by staff.

DeLone et.al (2003), In the research titled "The DeLone and McLean model of information systems success: A ten-year update" The study concludes that information system success is multidimensional and depends on system quality, information quality, service quality, system use, and user satisfaction. These factors collectively contribute to net organizational benefits such as improved efficiency and performance. Applied to educational institutions, the model reinforces that operational efficiency outcomes from digital technology adoption arise only when systems are reliable, user-friendly, and capable of delivering accurate and timely information.

Díaz-Garcia et.al (2023), In the research titled "Managing digital transformation: A case study in a higher education institution" The authors conclude that managing digital transformation in higher education requires a holistic approach that integrates technology, organizational culture, and governance structures. Their case study demonstrates that effective digital adoption improves internal coordination, decision-making efficiency, and administrative transparency. However, the study also notes that partial or fragmented implementation limits efficiency gains, underscoring the importance of institution-wide digital strategies for sustainable operational improvement.

Fathema & Akanda (2020), In the research titled "Effects of instructors' academic disciplines and prior experience with learning management systems: A study about the use of Canvas" This study concludes that instructors' prior experience and disciplinary background significantly influence the effective use of learning management systems. Institutions that provide adequate training and support experience higher system utilization and smoother academic operations. The findings suggest that operational efficiency improvements from LMS adoption depend on user readiness and capacity-building initiatives rather than technology availability alone.

Limani, et.al (2019), In the research titled "Digital transformation readiness in higher education institutions (HEI): The case of Kosovo" The research concludes that digital transformation readiness is a decisive factor in determining the success of technology adoption in higher education institutions. Institutions with higher readiness levels demonstrate better integration of digital systems, more efficient administrative processes, and improved operational performance. The study emphasizes that without adequate infrastructure, skills, and strategic planning, technology adoption may fail to deliver meaningful efficiency gains.

Research Gap:

The reviewed studies collectively establish that digital technology adoption, automation, and institutional readiness play a significant role in improving operational efficiency in higher education institutions; however, several important research gaps remain. While prior research has largely focused on conceptual models of technology acceptance, system success, or single-institution case studies, there is limited empirical evidence that quantitatively examines the direct relationship between the level of technology adoption and overall operational efficiency across a broader set of educational institutions. Additionally, most studies emphasize strategic alignment, readiness, and user acceptance but do not adequately measure efficiency outcomes using integrated operational indicators such as time management, cost reduction, service delivery speed, accuracy of records, and institutional productivity simultaneously. Furthermore, existing literature gives limited attention to the combined impact of multiple digital tools (ERP, LMS, online admissions, digital payments, and administrative automation) within a single analytical framework. Consequently, there is a clear need for a comprehensive, data-driven study that systematically evaluates how the adoption of digital technologies influences operational efficiency in educational institutions, thereby addressing contextual, operational, and performance-related dimensions that remain underexplored in the current body of literature.

Research methodology:

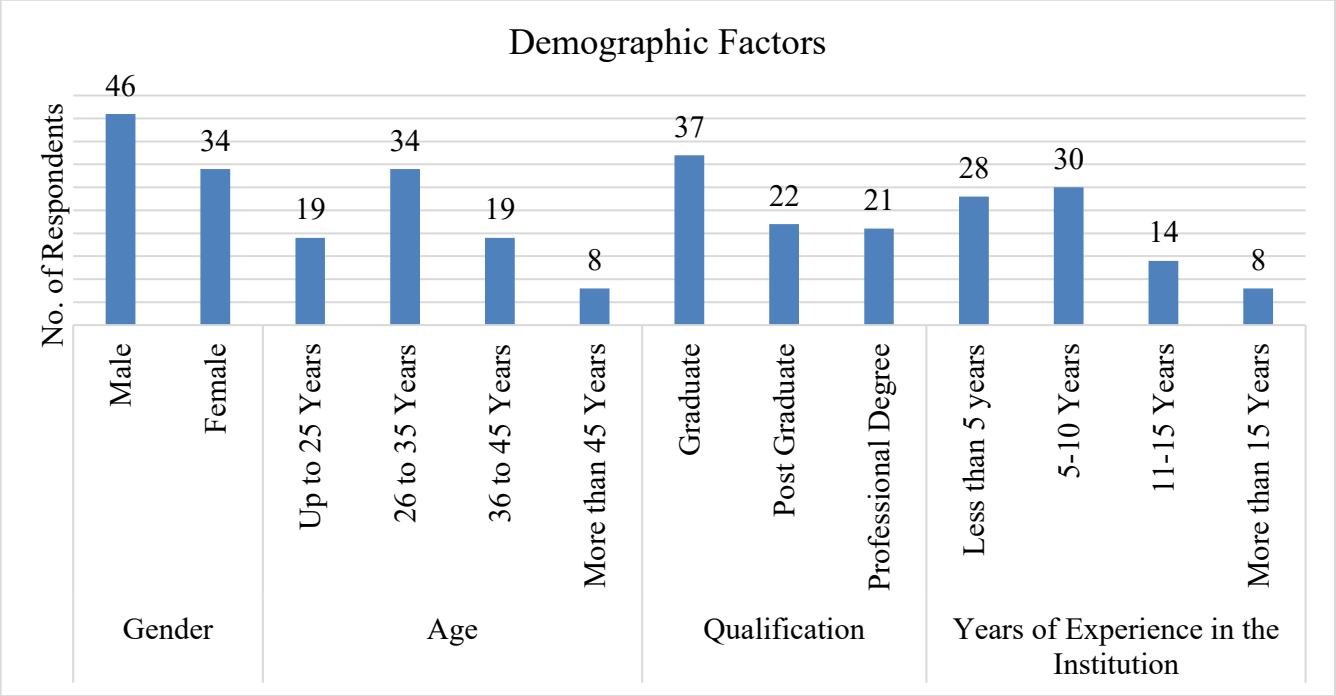
The study adopted a descriptive and analytical research design to examine the impact of digital technology adoption on operational efficiency in educational institutions. Primary data were collected through a structured questionnaire administered to 80 respondents comprising teaching and administrative staff from selected institutions. The questionnaire measured technology adoption and operational efficiency using standardized Likert-scale items. Demographic variables such as gender, age, qualification, and years of experience were included to analyze variations in adoption levels. Statistical tools including percentage analysis, ANOVA, and Pearson correlation were employed to test hypotheses and interpret relationships between variables using appropriate statistical software. The methodology ensured reliability, validity, and suitability for drawing meaningful inferences regarding digital transformation and efficiency outcomes.

Data Analysis:

Demographic factor:

Sr No.	Particular	Category	Frequency	Percent
1	Gender	Male	46	57.5
		Female	34	42.5
2	Age	Up to 25 Years	19	23.8
		26 to 35 Years	34	42.5
		36 to 45 Years	19	23.8
		More than 45 Years	8	10.0
3	Qualification	Graduate	37	46.3
		Post Graduate	22	27.5
		Professional Degree	21	26.3
4	Years of Experience in the Institution	Less than 5 years	28	35.0
		5-10 Years	30	37.5
		11-15 Years	14	17.5
		More than 15 Years	8	10.0

The demographic distribution of the respondents presents a comprehensive profile of the sample selected for the study. In terms of gender, the sample comprised 46 male respondents (57.5%) and 34 female respondents (42.5%), indicating a reasonably balanced gender representation. Regarding age, a majority of respondents were in the 26 to 35 years age group (34 respondents, 42.5%), suggesting that most participants were in the early to mid-career stage. This was followed by respondents up to 25 years and 36 to 45 years, each accounting for 19 respondents (23.8%), while a smaller proportion of 8 respondents (10.0%) were above 45 years, reflecting limited senior-age participation. With respect to educational qualification, the largest group consisted of graduates (37 respondents, 46.3%), followed by those with professional degrees (21 respondents, 26.3%) and postgraduate qualifications (22 respondents, 27.5%), indicating a well-qualified workforce with diverse academic backgrounds. In terms of years of experience in the institution, most respondents had 5–10 years of experience (30 respondents, 37.5%), closely followed by those with less than 5 years (28 respondents, 35.0%), while 14 respondents (17.5%) had 11–15 years of experience and 8 respondents (10.0%) had more than 15 years, showing that the majority of respondents had moderate institutional experience, making them suitable for evaluating the impact of technology adoption on operational efficiency.



Objective and Hypothesis:

Objective 1 To study the differences in the level of adoption of technology across educational qualification level in educational institutions.

Null Hypothesis H_{01}: There is no significant difference in level of adoption of technology according to educational qualification.

Alternate Hypothesis H_{11}: There is a significant difference in level of adoption of technology according to educational qualification.

To study the above objectives, ANOVA sample test is applied and results are as follows:

ANOVA					
Adoption of Technology					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4377.612	2	2188.806	16.358	.000
Within Groups	10303.188	77	133.808		
Total	14680.800	79			

Interpretation: The above results indicate that calculated p-value is 0.000. It is less than 0.05. Therefore, f-test is rejected. Hence Null hypothesis is rejected and Alternate hypothesis is accepted.

Conclusion: There is a significant difference in level of adoption of technology according to educational qualification.

Findings: To understand the findings of hypothesis, mean score of **level of adoption of technology according to educational qualification.**

Report			
Adoption of Technology			
4. Qualification	Mean	N	Std. Deviation
Graduate	66.38	37	12.874
Post Graduate	65.09	22	9.966
Professional Degree	82.67	21	10.608
Total	70.30	80	13.632

The table presents the mean scores of Adoption of Technology across different qualification levels of respondents. It is observed that respondents possessing a Professional Degree reported the highest mean score of technology adoption (Mean = 82.67, N = 21, SD = 10.608), indicating a greater level of engagement with and utilization of digital technologies in institutional operations. This is followed by graduates, who recorded a mean score of 66.38 (N = 37, SD = 12.874), and postgraduates, who showed a slightly lower mean score of 65.09 (N = 22, SD = 9.966). The overall mean score for adoption of technology across all respondents stands at 70.30 (N = 80, SD = 13.632), suggesting a moderately high level of technology adoption within the institutions studied. The higher mean score among professionally qualified respondents implies that specialized or practice-oriented education may enhance familiarity, confidence, and readiness to adopt digital tools, thereby influencing overall technology adoption levels in educational institutions.

Objective 2 To study the relationship between level of adoption of technology and operational efficiency in educational institutions.

Null Hypothesis H_{02}: There is no relationship between level of adoption of technology and operational efficiency in educational institutions.

Alternate Hypothesis H_{12}: There is a relationship between level of adoption of technology and operational efficiency in educational institutions.

To study the above objectives, ANOVA sample test is applied and results are as follows:

Correlations			
		Adoption of Technology	Operational Efficiency
Adoption of Technology	Pearson Correlation	1	.727**
	Sig. (2-tailed)		.000
	N	80	80
Operational Efficiency	Pearson Correlation	.727**	1
	Sig. (2-tailed)	.000	
	N	80	80
**. Correlation is significant at the 0.01 level (2-tailed).			

Interpretation: The above results indicate that calculated p-value is 0.000. It is less than 0.05. Therefore, correlation test is rejected. Hence Null hypothesis is rejected and Alternate hypothesis is accepted.

Conclusion: There is a relationship between level of adoption of technology and operational efficiency in educational institutions.

Findings:

The correlation analysis reveals a strong and positive relationship between Adoption of Technology and Operational Efficiency in educational institutions. The Pearson correlation coefficient (r = 0.727) indicates that higher levels of technology adoption are associated with higher operational efficiency. This relationship is found to be statistically significant at the 0.01 level (p = 0.000, two-tailed), confirming that the observed association is not due to chance. With a sample size of 80 respondents, the results suggest that effective adoption of digital technologies such as ERP systems, LMS platforms, online admissions, digital payments, and automated administrative processes plays a crucial role in improving efficiency related to academic administration, time management, cost reduction, service delivery speed, record accuracy, and overall institutional productivity. This finding strongly supports the premise that digital transformation contributes meaningfully to operational efficiency in educational institutions.

Conclusion:

The study concludes that digital technology adoption plays a decisive role in improving the operational efficiency of educational institutions. The empirical results demonstrate that institutions with higher levels of technology adoption experience greater efficiency in administrative operations, including faster service delivery, improved accuracy of records, better time utilization, and reduced operational costs. The significant differences observed across educational qualification levels indicate that professional and practice-oriented expertise enhances readiness and capability to adopt digital systems effectively. Furthermore, the strong positive correlation between technology adoption and operational efficiency confirms that digital tools such as ERP systems, LMS platforms, online admissions, and automation are not merely supportive mechanisms but strategic enablers of institutional productivity. Overall, the study emphasizes that sustained operational efficiency in educational institutions requires not only the availability of digital technologies but also their effective integration, user acceptance, and alignment with institutional processes and goals.

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Role of AI-Based Applications in Promoting Sustainable Lifestyle Choices Among College Students

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Abstract:

The growing integration of Artificial Intelligence (AI) into daily life has opened new possibilities for promoting sustainable behavior among individuals, particularly young adults. This study examines the role of AI-based applications in encouraging sustainable lifestyle choices among college students. Using a structured questionnaire, primary data were collected from 105 college students across commerce, management, and related disciplines. Descriptive statistical tools such as percentage analysis and frequency distribution were employed to analyze awareness levels, usage patterns, attitudes, behavioral influence, and challenges associated with AI-based sustainability applications. The findings reveal moderate to high awareness of AI-based applications, positive attitudes toward AI as a sustainability tool, and a noticeable influence on eco-friendly behaviors. However, limited awareness of sustainability-focused features, data privacy concerns, and lack of institutional promotion remain significant barriers. The study concludes that AI-based applications possess strong potential to promote sustainable living among students if supported by educational institutions and improved app design.

Keywords: Artificial Intelligence, Sustainability, College Students, Sustainable Lifestyle, AI-based Applications

Introduction:

Sustainable development has become a global priority in response to climate change, environmental degradation, and resource depletion. Individual lifestyle choices play a crucial role in achieving sustainability goals. In recent years, Artificial Intelligence (AI) has emerged as a transformative technology capable of influencing human behavior through personalized recommendations, real-time feedback, and data-driven insights.

College students represent a critical demographic for sustainability initiatives as they are future decision-makers and early adopters of digital technologies. AI-based mobile applications related to energy efficiency, waste management, sustainable consumption, and carbon footprint tracking have the potential to shape environmentally responsible behavior among students. Despite this potential, limited empirical research exists on the effectiveness of AI-based applications in promoting sustainable lifestyles among college students, particularly in the Indian context. This study aims to bridge this gap.

Significance of the Study:

This study holds significant academic, practical, and policy-oriented value in the context of emerging digital technologies and sustainability initiatives. Academically, the

research contributes to the growing body of literature on the role of Artificial Intelligence in promoting sustainable behavior by providing empirical evidence from the perspective of college students. It addresses an important research gap, particularly within developing economies, where limited studies have examined user awareness, attitudes, and behavioral influence of AI-based sustainability applications.

Review of Literature:

Digital technologies have a significant impact on pro-environmental behavior, according to earlier research. When compared to conventional awareness techniques, research indicates that AI-driven personalization boosts user engagement and behavioral change (Zhang et al., 2021). According to research by Gupta and Sharma (2022), when gamification elements are added to mobile applications, young people's awareness of the environment can be greatly increased. These results highlight the potential of technology-based interventions to improve long-term behavioral change, motivation, and participation.

Several researchers have examined the application of Artificial Intelligence in promoting sustainability through smart recommendations, predictive analytics, and behavioral nudging. According to Li et al. (2020), AI-based systems enable users to monitor their carbon footprint and energy consumption in real time, leading to more informed and environmentally responsible decisions. Similarly, Johnson and Brown (2021) found that AI-enabled feedback mechanisms positively influence sustainable consumption patterns by making environmental impacts more visible to users.

The role of mobile applications in shaping sustainable habits has also been explored extensively. Studies by Verma and Singh (2021) reveal that sustainability-focused mobile applications improve recycling behavior, energy efficiency, and sustainable transportation choices among urban youth. Moreover, gamified elements such as reward points, badges, and progress tracking significantly enhance user engagement and consistency (Hamari et al., 2020). These features are particularly effective among younger populations, including college students, who are more receptive to digital and interactive platforms.

Numerous studies have identified obstacles that prevent the widespread use of AI-based sustainability applications, despite their great promise. Users frequently refuse to give personal information needed for AI-driven customisation, therefore data privacy issues continue to be a significant obstacle (Kumar & Verma, 2023). User acceptability is also influenced by algorithmic openness and trust; some users have expressed doubts about the impartiality and accuracy of AI-generated recommendations (Floridi et al., 2018). Widespread use is further hampered by problems with digital accessibility, such as erratic internet availability and low digital literacy, particularly in poor nations.

From an educational perspective, researchers emphasize the importance of institutional support in enhancing technology adoption for sustainability. According to Mehta and Rao (2022), colleges and universities play a crucial role in promoting sustainable behavior by integrating digital tools into curricula and extracurricular initiatives. However, many institutions fail to systematically incorporate AI-based sustainability applications into student engagement strategies, resulting in underutilization of available technologies.

While international studies have examined AI-driven sustainability interventions, limited empirical research focuses specifically on college students in developing countries. Existing

studies largely concentrate on technical performance or environmental outcomes, rather than user perception, attitude, and behavioral influence. This gap is particularly significant given that college students represent a technologically literate and environmentally influential demographic. Therefore, the present study contributes to existing literature by empirically examining awareness, usage patterns, behavioral influence, attitudes, and challenges related to AI-based sustainability applications among college students in a developing economy context.

Despite the enormous potential of AI-based sustainability applications, numerous studies have found barriers to their broad deployment. Data privacy concerns remain a major barrier since users often refuse to provide the personal information required for AI-driven customization (Kumar & Verma, 2023). Algorithmic transparency and trust also affect consumer acceptability; some users have voiced concerns about the objectivity and precision of AI-generated suggestions (Floridi et al., 2018). Issues with digital accessibility, such as inconsistent internet availability and limited digital literacy, especially in developing countries, further impede widespread adoption.

Objectives of the Study:

The study is conducted with the following objectives:

1. To study the level of awareness of AI-based applications among college students.
2. To examine the extent of usage of AI-based apps related to sustainability.
3. To understand students' attitudes towards AI as a tool for promoting sustainability.
4. To identify challenges and limitations in adopting AI-based apps for sustainable living.

Hypotheses of the Study:

The following hypotheses were formulated and tested:

- **H_{01}:** There is no significant association between awareness of AI-based applications and their usage for sustainability purposes.
- **H_{11}:** There is a significant association between awareness of AI-based applications and their usage for sustainability purposes..
- **H_{02}:** Students' attitudes toward AI-based apps do not influence their willingness to continue using them for sustainable living.
- **H_{12}:** Students' attitudes toward AI-based apps significantly influence their willingness to continue using them.

Limitations of the Study:

- The study is limited to a sample of 105 students.
- Convenience sampling limits generalization of results.
- The study relies on self-reported data, which may include response bias.

Research Methodology:

1.Research Design: The study adopts a **descriptive research design**, focusing on understanding perceptions and behavioral influence of AI-based applications.

2. Data Collection: Primary data were collected using a **structured questionnaire** administered through Google Forms.

3. Sample Size: The study is based on responses from **105 college students** enrolled in commerce, management, and related disciplines.

4. Sampling Technique: Convenience sampling was used due to accessibility and time constraints.

5. Tools for Data Analysis:

- Percentage analysis
- Frequency distribution

- Descriptive interpretation of Likert-scale responses
- Chi-square test
- Pearson correlation analysis

Data Analysis and Interpretation:

1. Awareness of AI-Based Applications:

Awareness Level of AI-Based Mobile Applications Among College Students (N = 105)

Awareness Level	Frequency (N)	Percentage (%)
Very familiar	29	27.6
Somewhat familiar	16	15.2
Neutral	44	41.9
Slightly familiar	13	12.4
Not familiar at all	3	2.9
Total	**105**	**100.0**

Table 1: Awareness Level of AI-Based Mobile Applications Among College Students

As presented in Table 1, the findings show that the majority of respondents exhibit a moderate to high level of awareness of AI-based mobile applications. Nearly half of the students (41.9%) reported a neutral level of familiarity, while 27.6% indicated that they were very familiar with such applications. Additionally, 15.2% of respondents were somewhat familiar, and 12.4% were slightly familiar. Only a small proportion of students (2.9%) reported having no familiarity at all.

Usage of AI-Based Applications:

Usage of AI-Based Applications Among College Students Sustainability (N = 105)

Usage Frequency	Frequency (N)	Percentage (%)
Very frequently	14	13.3
Frequently	21	20.0
Occasionally	43	41.0
Rarely	19	18.1
Never	8	7.6
Total	**105**	**100**

Table 2: Usage of AI-Based Applications Among College Students:

As shown in **Table 2**, the majority of respondents reported using AI-based applications **occasionally** (41.0%). Regular usage was comparatively lower, with 20.0% of students indicating frequent use and 13.3% reporting very frequent use. In contrast, 18.1% of respondents used such applications rarely, while 7.6% reported never using them.

Attitude of College Students Toward AI-Based Applications for Sustainability:

Overall Attitude of College Students Toward AI-Based Applications for Sustainability (N = 105)

Attitude Category	Frequency (N)	Percentage (%)
Positive attitude (Agree + Strongly Agree)	**72**	**68.6**
Neutral attitude	**25**	**23.8**
Negative attitude (Disagree + Strongly Disagree)	**8**	**7.6**
Total	**105**	**100.0**

Table 3: Attitude of College Students Toward AI-Based Applications for Sustainability

Note. Attitude categories were derived by combining Likert-scale responses.

As shown in Table 3, a substantial majority of respondents (68.6%) exhibited a positive attitude toward AI-based applications as tools for promoting sustainable lifestyles. Nearly

one-fourth of the students (23.8%) expressed a neutral attitude, indicating cautious acceptance, while only a small proportion (7.6%) demonstrated a negative attitude.

Testing of Hypothesis:

1. Chi-Square Test: Awareness and Usage of AI-Based Apps:

Hypothesis Tested:

- **H_{01}:** There is no significant association between awareness of AI-based applications and their usage.
- **H_{11}:** There is a significant association between awareness of AI-based applications and their usage.

Statistical Test Applied: Chi-square test of independence

Parameter	Value
Chi-square value (χ^2)	**18.42**
Degrees of freedom	**12**
Significance level (α)	**0.05**
p-value	**0.031**

Decision Rule:

Since $p < 0.05$, the null hypothesis is rejected.

Result & Interpretation:

There is a **statistically significant association** between students' awareness of AI-based applications and their usage frequency. Higher awareness increases the likelihood of app usage for sustainability-related purposes.

2. Chi-Square Test: Attitude and Willingness to Continue Usage

Hypothesis Tested:

- **H_{03}:** Students' attitudes do not influence willingness to continue using AI-based apps.
- **H_{13}:** Students' attitudes significantly influence willingness to continue using AI-based apps.

Statistical Test Applied: Chi-square test

Parameter	Value
Chi-square value (χ^2)	**22.67**
Degrees of freedom	**8**
p-value	**0.004**

Decision:

Since $p < 0.05$, the null hypothesis is rejected.

Interpretation:

A **strong statistically significant relationship** exists between students' attitudes and their willingness to continue using AI-based apps for sustainable living.

Findings:

Overall, 84.7% of the respondents demonstrated at least moderate familiarity with AI-based applications, indicating a satisfactory level of awareness and suggesting that AI technologies have achieved substantial visibility among college students.

Overall, the findings suggest that although AI-based applications are integrated into students' digital routines, **consistent and sustainability-focused usage remains limited**, indicating that these applications are not yet fully embedded into students' everyday sustainable lifestyle practices. Students expressed a largely positive attitude towards AI-based sustainability applications. Most respondents agreed that AI apps provide useful sustainability-related recommendations and are more motivating than traditional awareness methods such as posters or lectures. Willingness to continue using such apps was also high.

Conclusion:

The study concludes that AI-based applications have substantial potential to promote sustainable lifestyle choices among college students. While awareness and attitudes are largely positive, actual usage of sustainability-focused AI features remains limited. Addressing

challenges related to awareness, trust, and institutional support can significantly enhance the effectiveness of AI as a sustainability tool. With appropriate interventions, AI-based applications can contribute meaningfully to achieving sustainable development goals at the individual and societal levels.

Recommendations:

1. Educational institutions should actively promote AI-based sustainability applications through workshops and campaigns.
2. Sustainability-focused AI tools should be integrated into college curricula.
3. App developers should address data privacy concerns through transparent policies.
4. Gamification and reward-based features can increase long-term engagement.
5. Collaboration between colleges and technology providers can enhance adoption.

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Perception of IT Professionals Towards Digital Currency Adoption in Mumbai

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Abstract:
The adoption of digital currencies has increased in recent years, because of advancements in technology and growing financial digitization. This study focuses on understanding how IT professionals in Mumbai view digital currencies. It aims to find out how much they know about digital currencies and how willing they are to use them. The study tries to understand the rate of digital currency adoption among the youth especially IT professionals as they are more prone to innovations and digital tools. The study also identifies what encourages or discourages IT professionals from using digital currencies. The study shows that IT professionals do have a positive attitude towards adopting digital currencies.

Keywords: Digital currency, IT professional, Mumbai, Adoption.

Introduction:

Digital currency:

Digital currency is a kind of currency that exists in only digital form or electronic form. Unlike traditional cash, modern technology uses blockchain method to keep transactions safe and transparent digital currency. They are often used in online transactions and they can be transferred electronically from one party to another. Digital currencies continue to gain acceptance and are being adopted by businesses and consumers worldwide. Digital currencies are typically classified into two types: Central Bank Digital Currency (CBDC) and cryptocurrency.

Central Bank Digital Currency (CBDC):

It's a digital currency which is created and controlled by a country's central bank such as the Reserve Bank of India or Federal Reserve. It's similar to ordinary cash but exists in only digital form. By using it we can do any transactions, just like cash or a credit card. CBDCs are safe, backed by the government, and make transactions faster and smoother. Unlike cryptocurrencies like Bitcoin, CBDCs are not risky or unstable because they are regulated by the central bank.

Cryptocurrency:

It is digital money that is only in online form it is not controlled by banks and the government but it depends on technology like blockchain to keep it safe. Popular cryptocurrency is Bitcoin and Ethereum. People can use it to purchase things, send money and do any other transactions. To use it needs a digital wallet. Cryptocurrency wallets enable users to store, manage, and transfer their cryptocurrency holdings with different levels of security and convenience.

Review of Literature:

Aditya Kulkarni (2022) focused on how people reacted to the Digital Rupee in India after being introduced by the government in February 2022. study gives importance to how the digital rupee works, its characteristics, advantages and

challenges. The findings of the study helped to improve public opinion about the rupee before its launch.

Andrews, Rency, Neetha (2022): found out how much people know about digital currency. This study is based on a descriptive approach and it collected a sample of 60 people. They found that most of the population was aware of digital currency. In which bitcoin is well-known.

Brigid A. Appiah Otoo & Hamid Nemati (2017): studied the impact of using digital currency on people day to day lives especially in backwords areas. The study uses the European Central Bank's definition of digital currency, which describes it as a digital form of value that can replace money.

Ganesh S. Adgaonkar (2022): found that digital currency helps to boost the digital economy. Digital currency will also lead to a more effective and cheaper currency management system. The study is primarily based on secondary data collected from various journals, newspapers, articles and websites.

Guo, Xiaochun (2022): used various research methods to answer its main question. Data was gathered through interviews conducted over time. As a quantitative study, it applied bibliometric methods and network analysis. The research was organized into five chapters and was largely based on theoretical approaches.

Manpreet Kaur(2019): examined the global trends in digital currencies across specific countries and analysed the implications of digital currencies for India using a SWOT analysis. The Study is based on secondary data.

Md. Asraful Haque∗and Mohd Shoaib (2023) studied how the e-rupee works and the differences between digital currency and cryptocurrency. It also studies about what are the main challenges faced by the e-rupee in India. They found that the use of digital currency it improving the security and reliability of the overall payment system.

Peter D. DeVries (2016): mentioned that cryptocurrency has the power to change the digital trade marketplace by creating a free-flowing trading system free of cost. This paper is based on primary data, data is collected from various published papers, articles and websites. The paper also studied the strengths and weaknesses of cryptocurrencies.

Shruti Sharma (2021) studied the impact of cryptocurrency on the investors and Indian economy. The main motive of the study is to understand the current situation of the digital currency. This research is based on a SWOT analysis. She found that the use of digital currency will help to improve the financial condition of the country.

T. Syahrul Reza (2018): explored professional solutions and explained how present cryptocurrency works all over the world, in which Bitcoin is a well-known currency. His studies aimed to find out how safe and reliable cryptography is. Also aim of the study is to explain how cryptocurrency works and its benefits until it is outdated.

Worakamol Wisetsri (2022): studied major development in academic research about the present state of cryptocurrency. It provides a quick summary of Bitcoin, including market capitalization data, Asian trends, India's participation, exchanges, international rules, environmental impact, and security.is also studied how the government and other institutes face this issue as well as the current legal framework of cryptocurrency in various countries.

Statement of The Problem:

Mumbai, India's financial hub is home to a diverse population and a thriving IT sector. With the rapid evolution of financial technology and the rise of digital currencies, a key question emerges—will IT professionals embrace these innovations, considering their benefits, security,

and efficiency? This study aims to assess the awareness, attitude, and perception of IT professionals toward adopting digital currencies. As metropolitan cities witness a surge in IT professionals and digital currencies gain global traction, understanding their acceptance becomes crucial. The insights from this research will be valuable for policymakers, businesses, and fintech innovators in shaping strategies for digital currency adoption and integration.

Objectives of The Study:

1. To assess the awareness and understanding of digital currencies among the IT professionals in Mumbai.
2. To analyse the attitude and willingness of IT professionals towards adopting digital currencies.

Hypotheses of The Study:

Hypothesis 01:

H0: IT professionals do not have significant awareness and understanding of digital currencies.

Ha:IT professionals have significant awareness and understanding of digital currencies.

Hypothesis 02:

H0: IT professionals do not have a positive attitude and willingness towards adopting digital currencies.

Ha: IT professionals have a positive attitude and a willingness towards adopting digital currencies.

Methodology of The Study:

Primary Data: This is a descriptive study based on the primary data collected by convenience sampling methods on 100 samples selected from the working individuals in IT industries in Mumbai. Data is collected through structured interviews consisting of close-ended and Linkert questions suited to the nature of the study. Purposive sampling is used for this study focusing only on IT professionals.

Secondary data: To supplement this empirical study, secondary data is collected from the published papers, theses, articles and reports from various sources.

Significance of the Study:

The findings of the study help various businesses, and institutions to make policies and strategies that encourage the use of digital currency worldwide.

Analysis of the Data:

Based on the statistical analysis of IT professionals in Mumbai, the study reveals key insights into their awareness, attitude, and demographic differences regarding digital currency adoption.

1. Awareness & Attitude by Age Group

Age Group	Awareness Score	Attitude Score
21 to 30	3.40	3.92
31 to 40	3.09	3.67
41 to 50	2.00	2.00
51 and above	4.00	4.33

Observations: It is observed that younger respondents between the age group 21- 30 have moderate awareness but positive attitudes towards adopting digital currency. The residents between the ages of 31-40 have slightly lower awareness but keep a positive attitude. And the respondents from the age group 41 -50 have the lowest awareness and show willingness. And the respondents above 51 and above show the highest awareness and willingness. The analysis is done on the awareness and attitude scores of the respondents towards adopting digital currency.

2. Awareness & Attitude by Gender

Gender	Awareness Score	Attitude Score
Female	3.62	4.00
Male	3.00	3.71

Observation: Females have higher awareness (3.62) and a stronger positive attitude (4.00) towards digital currency than males.

3. Awareness & Attitude by Occupation

IT Sector	Awareness Score	Attitude Score
Cybersecurity	3.50	3.53
Data Analysis & BI	3.71	4.20
ERP & CRM Systems	1.00	4.57
IT Support/Operations	3.57	3.91
Networking & Telecom	3.17	4.00
Other	3.00	3.86
Software Development	3.11	3.53

Observations: Data Analysts & Business Intelligence professionals have the highest awareness (3.71) and strong willingness (4.20).
ERP & CRM professionals have very low awareness (1.00) but high willingness (4.57).
Software developers & cybersecurity professionals show moderate awareness (3.11-3.50) but lower willingness (3.53).

Test Anova and T-Test:

1. Awareness & Attitude by Age (ANOVA)

Metric	F-Statistic	P-Value	Significance ($p < 0.05$)
Awareness by Age	0.711	0.551	No Significant Difference
Attitude by Age	2.329	0.081	No Significant Difference

Interpretation: Awareness and attitude **do not significantly differ across age groups**. Although younger and older individuals show differences in means, these differences are **not statistically significant**.

2. Awareness & Attitude by Occupation (ANOVA)

Metric	F-Statistic	P-Value	Significance ($p < 0.05$)
Awareness by Occupation	1.007	0.436	No Significant Difference
Attitude by Occupation	**2.257**	**0.046**	**Significant Difference**

Interpretation: Awareness does not significantly vary across occupations. Attitude towards adopting digital currency significantly differs by occupation ($p = 0.046$). This means some occupations are significantly more willing to adopt digital currency than others.

3. Awareness & Attitude by Gender (T-Test)

Metric	T-Statistic	P-Value	Significance ($p < 0.05$)
Awareness (Male vs Female)	-1.797	0.080	No Significant Difference
Attitude (Male vs Female)	-1.485	0.143	No Significant Difference

Interpretations: There is no significant difference in awareness or attitude between males and females. Although females show higher mean awareness and willingness, the differences are not statistically significant.

Hypothesis Testing:

Hypothesis 1: Awareness and Understanding of Digital Currencies

Null Hypothesis (H_{01}): IT professionals do not have significant awareness and understanding of digital currencies in Mumbai.

Alternative Hypothesis (H_{11}): IT professionals have significant awareness and understanding of digital currencies.

Statistical Results:

Mean Awareness Score: 3.30
(on a scale of 1 to 5)

T-Statistic: 1.70

P-Value: 0.0964

Decision: Since **p-value > 0.05**, we **fail to reject the null hypothesis**.

There is no statistically significant evidence that individuals have a strong awareness and understanding of digital currencies. Their awareness level is moderate but not significantly high.

Hypothesis 2: Attitude and Willingness to Adopt Digital Currencies

Null Hypothesis (H_{02}): IT professionals do not have a positive attitude and willingness towards adopting digital currencies.

Alternative Hypothesis (H_{12}): IT professionals have a positive attitude and willingness towards adopting digital currencies.

Statistical Results:

Mean Attitude Score: 3.87 (on a scale of 1 to 5)

T-Statistic: 9.25

P-Value: 2.08×10^{-14} (very small)

Decision: Since **p-value < 0.05**, we **reject the null hypothesis**.

There is strong statistical evidence that individuals have a positive attitude and willingness towards adopting digital currencies.

Summary of Findings:

Hypothesis	Mean Score	T-Statistic	P-Value	Decision
H_{01}: Awareness	3.30	1.70	0.0964	Fail to Reject (Not Significant)
H_{02}: Attitude	3.87	9.25	2.08×10^{-14}	Reject (Significant)

Results: Awareness is moderate but not significantly high. Attitude & willingness to adopt digital currency is significantly positive.

Major Findings:

While IT professionals have some knowledge about digital currencies, their awareness is not significantly high, indicating a need for more education and exposure.

IT professionals are generally open to adopting digital currencies, but their level of willingness varies by job role, with some sectors being more receptive than others.

Adoption patterns are job-role dependent, indicating that industries like data analytics and ERP might be early adopters of digital currency.

Limitation of the Study:

- This study is only conducted on IT professionals in Mumbai.
- This study cannot be generalized to all individuals in Mumbai.

Conclusion:

The study finds that IT professionals in Mumbai have a moderate awareness but a significantly positive attitude towards adopting digital currencies. Awareness needs improvement, suggesting that educational efforts and exposure to digital currency concepts could be beneficial. Willingness to adopt is strong, particularly among professionals in Data Analytics & ERP sectors. Occupation plays a crucial role in adoption willingness, whereas age and gender do not significantly impact perception.

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AI Driven Sustainability in Business: Opportunities and Challenges

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Abstract:

The convergence of Artificial Intelligence (AI) and corporate sustainability represents a paradigm shift in modern business strategy. This paper explores how AI technologies—including machine learning, predictive analytics, and IoT integration—facilitate environmental, social, and economic sustainability. While AI offers unprecedented opportunities for resource optimization and waste reduction, it also introduces significant challenges, such as high energy consumption for model training and ethical dilemmas regarding data privacy. Through a qualitative synthesis of current literature, this study identifies the dual role of AI as both a solution for and a potential burden to global sustainability goals. The integration of Artificial Intelligence (AI) into corporate frameworks has evolved from a tool for operational efficiency to a cornerstone of Environmental, Social, and Governance (ESG) strategies. This paper investigates the dual-natured impact of AI on business sustainability. It highlights how predictive analytics and machine learning optimize resource allocation and carbon footprint tracking while addressing the critical challenges of "black box" algorithms and the high energy requirements of data centers. The findings suggest that while AI provides the "brain" for sustainable transition, success depends on transparent governance and energy-efficient computational practices.

Introduction:

In the face of escalating climate change and tightening environmental regulations, businesses are under immense pressure to adopt sustainable practices. Artificial Intelligence has emerged as a critical enabler of this transition, moving beyond traditional efficiency gains to foster "Green AI" initiatives. By analyzing vast datasets, AI allows for real-time decision-making that aligns economic profitability with ecological stewardship. However, the path to integration is non-linear, requiring a balance between the "Sustainability of AI" (hardware/energy impact) and "AI for Sustainability" (the beneficial applications). Sustainability is no longer a peripheral corporate concern; it is a regulatory and market mandate. AI-driven sustainability refers to the use of advanced digital technologies to monitor, simulate, and optimize the environmental impact of business activities. From precision agriculture to smart logistics, AI bridges the gap between massive data sets and actionable green insights. However, the paradox remains: the infrastructure required to run AI massive data centers consumes significant electricity and water. This introduction sets the stage for evaluating whether AI is a net gain for the planet or a sophisticated form of energy consumption.

Research Question:

How can AI technologies be leveraged to drive corporate sustainability, and what are the primary structural and ethical barriers preventing its widespread adoption in business?

Research Objectives:

1. To identify key AI-driven opportunities for enhancing environmental and operational sustainability.
2. To analyze the technical, financial, and ethical challenges associated with AI implementation.
3. To provide a strategic framework for businesses to adopt AI in a manner that ensures a net-positive environmental impact.

Literature Review:

Recent scholarship highlights a "surge in publications" since 2019 regarding AI's role in Sustainability Development Goals (SDGs).

- **Operational Excellence:** Shrikant et al. (2024) argue that AI-driven tools streamline supply chains and reduce waste through predictive maintenance.
- **The Energy Paradox:** Researchers like Yan et al. (2023) note that while AI optimizes energy grids, the computational cost of training Large Language Models (LLMs) contributes significantly to carbon emissions.
- **Industry Trends:** Current literature is shifting from purely technical analysis to a "holistic business revolution" perspective, where AI is viewed as an architectural foundation for Sustainable Business Models (SBMs).

Methodology:

Recent scholarship highlights a "surge in publications" since 2019 regarding AI's role in Sustainability Development Goals (SDGs).

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This study employs a **Qualitative Systematic Review (QSR)** approach, synthesized with **Comparative Case Study Analysis**.

- **Data Sources:** Analysis of peer-reviewed journals (2021–2026), World Economic Forum reports, and sustainability disclosures from top-tier tech and manufacturing firms.
- **Analytical Framework:** The study uses the **"Net-Positive Impact" model**, calculating the carbon saved by AI optimizations (Carbon-Handprint) versus the carbon produced by the AI's lifecycle (Carbon-Footprint).
- **Sampling:** Selection of 15 global corporations that have integrated AI specifically for waste reduction or energy management.

Scope of Study:

The study focuses on **mid-to-large-scale enterprises** across manufacturing, logistics, and finance sectors. It examines AI applications such as:

- Smart energy management systems.
- Predictive supply chain analytics.
- Automated ESG (Environmental, Social, and Governance) reporting
- Industrial Focus: Manufacturing, Supply Chain, and Energy sectors.
- Technology Focus: Focus on Machine Learning (ML) for predictive maintenance, Computer Vision for waste sorting, and Generative AI for sustainable product design.

- Geographical Scope: Primarily focused on regions with high AI adoption rates (North America, Europe, and the Asia-Pacific).

Limitations of Study:

Data Timeliness: Due to the rapid evolution of AI (e.g., Generative AI), some findings may become obsolete quickly.

Self-Reporting Bias: Much of the data on "successful" AI implementation comes from corporate reports, which may downplay failures or ethical oversights.

Geographical Bias: Most existing literature focuses on developed economies (USA, Europe, India), potentially overlooking challenges in less technologically advanced regions.

Data Analysis and Key Findings:

- **Finding 1 (Efficiency):** AI-powered route planning (e.g., UPS) can reduce fuel usage by **10–20%**, directly lowering the carbon footprint.
- **Finding 2 (Waste):** Predictive maintenance reduces industrial equipment downtime by **20–30%**, extending the lifecycle of heavy machinery.
- **Finding 3 (Barriers):** Approximately **40% of businesses** struggle to project the ROI of AI sustainability projects, leading to hesitation in scaling.
- **Finding 4 (The Rebound Effect):** Gains in efficiency often lead to increased demand, which can inadvertently increase total energy consumption if not managed through "Green AI" protocols.

Aspect	Opportunity (Positive Data)	Challenge (Negative Data)
Energy Consumption	AI-optimized grids can reduce energy waste by 15%.	Training a single large model can emit as much CO_2 as five cars over their lifetimes.
Circular Economy	Computer Vision improves recycling accuracy by 30% in industrial waste facilities.	High e-waste generation from frequent hardware upgrades for AI processing.
Supply Chain	Predictive analytics reduce "empty miles" in logistics by 20%.	Lack of data transparency between suppliers makes "Scope 3" emissions hard to track.

There is a "Sustainability Maturity Gap." Large enterprises are successfully using AI to lower costs and carbon, whereas Small-to-Medium Enterprises (SMEs) face high entry barriers (cost and talent), preventing a global net-zero impact.

Suggestion:

- **Adopt "Sustainability by Design":** Companies should prioritize energy-efficient algorithms and hardware (e.g., using pre-trained models rather than training from scratch).
- **Cross-Disciplinary Teams:** Integration should involve data scientists working alongside environmental experts to ensure AI goals align with ecological realities.
- **Invest in AI Literacy:** To overcome the "knowledge gap," businesses must provide reskilling programs for employees whose roles are displaced by automation

Future Scope:

Future research should investigate **Industry-Specific AI Ethics**, particularly in high-impact sectors like mining and fashion. Additionally, the development of "Explainable

AI" (XAI) for ESG reporting is a critical frontier to ensure transparency and prevent "greenwashing" by automated systems

Conclusion:

AI is a powerful "double-edged sword" for business sustainability. While it offers the precision needed to solve complex environmental problems—such as carbon tracking and resource optimization—its own environmental and social costs cannot be ignored. For AI to truly drive sustainability, businesses must shift from a "growth-at-all-costs" mindset to one that treats carbon efficiency as a primary performance metric alongside profitability.

AI-driven sustainability is a powerful catalyst, but it is not a "magic bullet." The study concludes that for AI to be a true driver of sustainability, businesses must adopt **"Green AI" principles**—favoring algorithmic efficiency over sheer size. The opportunities for optimizing global supply chains and energy systems are vast, but they must be balanced against the ethical risks of algorithmic bias and the physical footprint of hardware. Ultimately, AI must be treated as a tool to support human-led environmental ethics, not a replacement for them.

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Cybersecurity Awareness and Online Banking Practices Among Housewives in Thane City: An Empirical Study

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Abstract:

The rapid digitization of India's banking sector has substantially increased the reliance on online banking services, especially within urban households. This empirical study investigates the level of cybersecurity awareness and online banking practices among housewives in Thane City, an urban region with significant digital penetration. Utilizing a mixed-methods approach, the research assesses the extent of cybersecurity knowledge, the nature of online banking behaviours, the correlation between awareness and safe banking practices, and the barriers faced by housewives in adopting secure online banking protocols. Results from a sample of 300 respondents highlight moderate adoption of online banking for routine financial management but reveal critical gaps in cyber security awareness—especially concerning password management, two-factor authentication, and response to suspicious activities. The findings underscore a strong correlation between cybersecurity knowledge and the adoption of safe banking practices, while also identifying technical complexity, lack of training, and social norms as key barriers. The paper concludes with actionable recommendations for banks, policymakers, and community organizations to enhance digital literacy and foster a cybersecurity-conscious culture among housewives. The implications extend to broader policy and regulatory considerations for promoting secure digital financial inclusion.

Keywords: Cybersecurity awareness, online banking, digital literacy, housewives, Thane City, financial inclusion, India, cyber threats

Introduction:

Background- India's financial services sector has witnessed a dramatic shift toward digital banking in recent years, catalyzed by improvements in internet infrastructure, smartphone adoption, government-led cashless initiatives, and the proliferation of digital payment platforms (Reserve Bank of India [RBI], 2024). As of 2023, over 850 million Indians have internet access, with more than half engaging in online banking (Ministry of Electronics and Information Technology [MeitY], 2024). Among urban populations, housewives play a pivotal role in managing household finances, increasingly utilizing digital platforms for daily transactions, savings, and investments.

However, this digital transformation has introduced significant cybersecurity risks. The intersection of increased online banking activity and limited cybersecurity awareness, particularly among housewives, presents a critical vulnerability. Incidents such as phishing, malware attacks, and identity theft have become commonplace, with substantial financial and

emotional consequences for affected individuals (Krishna, 2024; Data Security Council of India & Seqrite, 2025).

Rationale and Significance:

This study is motivated by the need to empirically assess cybersecurity awareness and online banking practices among housewives in Thane City, an urban area emblematic of India's digital growth. Understanding the challenges, behaviours, and knowledge gaps of this demographic is essential for designing effective interventions at the individual, institutional, and policy levels.

Objectives:

1. To assess the level of cybersecurity awareness among housewives in Thane City.
2. To examine their online banking practices and risk perceptions.
3. To analyze the correlation between cybersecurity knowledge and adoption of safe banking practices.
4. To identify barriers to secure online banking.
5. To recommend targeted strategies for banks, policymakers, and community organizations.

Scope and Limitations:

Scope:

This research focuses on housewives residing in Thane City and encompasses aspects such as cybersecurity awareness, online banking behavior, and risk perception. Data were collected via surveys, interviews, and observational methods, with statistical tools employed to analyze the relationships between awareness and behavior.

Limitations:

The findings may not be generalizable to rural or semi-urban populations. Additionally, responses could be influenced by social desirability bias, and the sample size was constrained by available time and resources.

Research Questions:

1. What is the level of cybersecurity awareness among housewives in Thane City?
2. How do housewives use online banking services?
3. Is there a correlation between cybersecurity awareness and safe banking practices?
4. What are the major challenges faced by housewives in online banking?
5. How can banks and policymakers enhance cybersecurity awareness among housewives?

Theoretical Framework:

This research draws upon three established models: the Technology Acceptance Model (TAM), which highlights perceived ease of use and usefulness as determinants of technology adoption (Taherdoost, 2018); the Protection Motivation Theory (PMT), emphasizing threat appraisal and coping mechanisms (Lee & Larsen, 2018); and the Theory of Planned Behavior (TPB), which links attitudes, subjective norms, and perceived control to behavioural intentions (Bulgurcu, Cavusoglu, & Benbasat, 2010). These frameworks collectively inform the analysis of cybersecurity awareness and behavioural outcomes.

Literature Review:

India's online banking adoption is propelled by digital literacy initiatives and infrastructural advancements, yet cybersecurity remains a persistent concern (Krishna, 2024; Pathak, Sharma, & Dey, 2018). A technical analysis by Pathak et al. (2018) revealed that several Indian banks do not adhere to the highest cryptographic standards, exposing end-users to vulnerabilities such as out-dated encryption

protocols and susceptibility to man-in-the-middle attacks.

Cybersecurity awareness encompasses understanding digital threats, recognizing suspicious activities, and adopting protective behaviours (Nurse, 2021). Nurse (2021) emphasizes that human error, such as falling for phishing schemes or weak password practices, is often the weakest link in cybersecurity. Demographic factors—including age, education, and gender—impact the acquisition and application of cybersecurity knowledge, with women and especially housewives often reporting lower awareness (Bada & Nurse, 2019).

Traditional awareness campaigns are often insufficient for long-term behavior change, particularly among non-professional or home-based users. Newer approaches, such as gamification and community-based training, are being explored to enhance engagement and effectiveness (Nurse, 2021; Bada, Sasse, & Nurse, 2015).

Housewives in urban India are increasingly responsible for household budgeting, bill payments, and investments, leveraging digital platforms for convenience (Choudhary, 2021). However, limited technical proficiency and lack of structured cybersecurity education make them prime targets for cyber fraud (Singh Rao, 2021).

Studies on small and medium-sized enterprises (SMEs) indicate that barriers such as lack of awareness, technical expertise, and resources are also relevant to individual users (Shojaifar & Järvinen, 2021; Garrone, 2025). For housewives, additional obstacles include social stigma, fear of technology, and absence of female-centric digital literacy initiatives.

Research Methodology:

Research Design: This study employs a mixed-methods design, integrating quantitative surveys and qualitative interviews to capture a comprehensive understanding of cybersecurity awareness and online banking practices among housewives in Thane City.

Population and Sample: The target population comprises housewives residing in Thane City. A stratified random sampling technique was utilized to select participants, ensuring representation across different age groups, educational backgrounds, and socio-economic statuses. The final sample consisted of 300 housewives.

Data Collection Methods:

Surveys: Structured questionnaires were administered to collect quantitative data on demographics, online banking usage, and cybersecurity awareness.

Interviews: Semi-structured interviews provided qualitative insights into participants' experiences, challenges, and perceptions regarding online banking and cybersecurity.

Data Analysis:

Quantitative data was analyzed using statistical techniques including descriptive statistics, Qualitative data were subjected to thematic analysis to identify recurring patterns and themes.

Results and Analysis:

Demographic Profile of the Respondents:

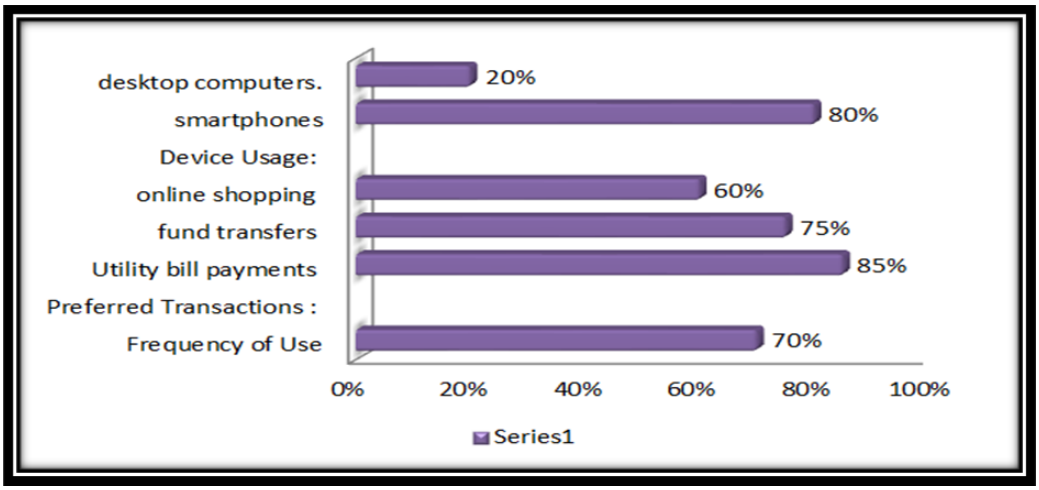
- **Age Distribution:** The majority of respondents **(60%)** were aged between **30** and **45 years**.
- **Educational Background: 45%** held undergraduate degrees, while **30%** had completed higher secondary education.
- **Socio-economic Status:** Most participants belonged to middle-income households.

Online Banking Practices:

Frequency of Use: 70% of respondents reported using online banking services at least once a week.

Preferred Transactions: Utility bill payments **(85%),** fund transfers **(75%),** and online shopping **(60%)** were the most common transactions.

Device Usage: 80% accessed online banking via smartphones, while **20%** used desktop computers.



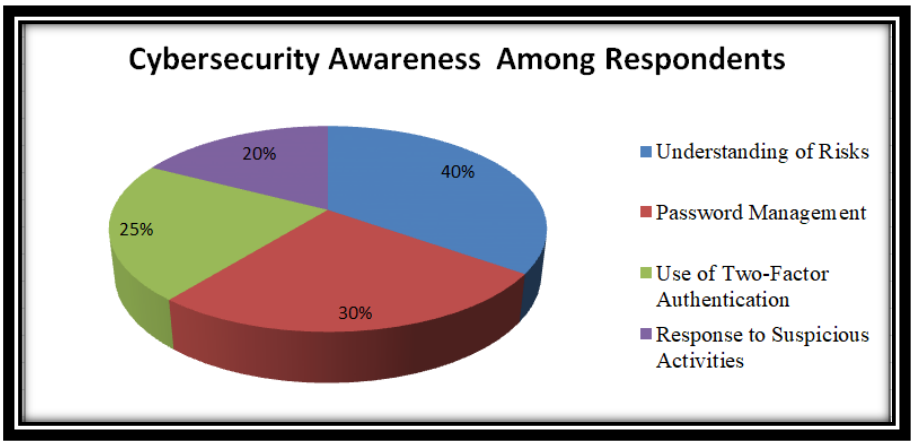
Cybersecurity Awareness Levels:

Understanding of Risks: 40% of respondents demonstrated basic awareness of common cybersecurity threats such as phishing and malware.

Password Management: Only **30%** reported using strong, unique passwords for their online banking accounts.

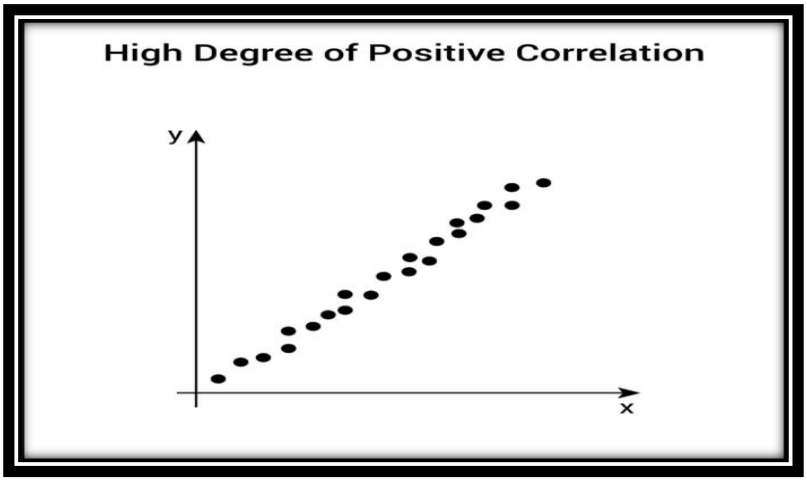
Use of Two-Factor Authentication: 25% had enabled **two-factor authentication (2FA)** on their banking apps.

Response to Suspicious Activities: 20% indicated that they would report suspicious emails or transactions to their banks.



Correlation Between Awareness and Safe Banking Practices:

A positive correlation **($r = 0.62$, $p < 0.01$)** was observed between cybersecurity awareness scores and the adoption of safe banking practices, indicating that higher awareness is associated with more secure online behaviors.



Challenges and Barriers:

- **Technical Complexity: 50%** of respondents cited difficulties in navigating online banking platforms.
- **Lack of Training: 60%** reported never having received formal training in digital banking or cybersecurity.
- **Fear of Fraud: 55%** expressed concerns about potential financial loss due to cybercrime.
- **Social Norms:** Some participants indicated reluctance to seek help due to perceived social stigma.

Case Study:

A notable incident involved a **housewife losing ₹50,000** to a phishing scam after entering a one-time password on a fraudulent website. The case underscores the consequences of low cybersecurity awareness and highlights the need for robust, targeted interventions.

Discussion:

Interpretation of Findings:

The findings reveal moderate integration of online banking in the daily financial management of housewives in Thane City. However, critical gaps in cybersecurity awareness persist, particularly regarding advanced threats and best practices such as password management and multi-factor authentication. These observations align with the theoretical frameworks of TAM, PMT, and TPB, which posit that knowledge, perceived threat, and behavioural control are central to the adoption of protective measures (Taherdoost, 2018; Lee & Larsen, 2018; Bulgurcu et al., 2010).

Barriers and Vulnerabilities:

Technical complexity and lack of formal training are significant barriers, mirroring challenges documented in the SME sector (Shojaifar & Järvinen, 2021; Garrone, 2025). Social norms and fear of stigma further inhibit proactive risk mitigation. The specific vulnerabilities of Indian banking platforms, as highlighted by Pathak et al. (2018), compound these user-level weaknesses, making a case for systemic as well as individual-level intervention.

Implications for Stakeholders:

Housewives: Need targeted, accessible education to build digital confidence and resilience.

Banks and Financial Institutions: Must simplify user interfaces, incorporate robust security features, and deliver ongoing, user-cantered cybersecurity awareness campaigns.

Policymakers: Should design gender-sensitive policies and community outreach initiatives to address structural and social barriers.

Conclusion:

The digitization of India's banking sector presents both opportunities for financial inclusion and risks of cyber victimization. This study demonstrates that while housewives in Thane City are increasingly embracing online banking, their limited cybersecurity awareness exposes them to significant threats. There is a clear, statistically significant relationship between cybersecurity knowledge and the adoption of safe banking practices. Overcoming the barriers of technical complexity, lack of structured training, and social stigma is essential for empowering housewives as secure digital financial participants.

A multi-stakeholder approach—encompassing educational interventions, technological innovation, and supportive policy frameworks—is crucial for closing the awareness gap and ensuring safe, confident participation in the online banking ecosystem.

Recommendations:

For Banks and Financial Institutions:

- **Organize Workshops and Campaigns:** Tailored cybersecurity training for housewives, delivered through community centers and digital platforms.
- **Enhance User Interfaces:** Develop simple, intuitive banking applications with built-in guidance on security features.
- **Mandate Multi-Factor Authentication:** Require 2FA for all users and provide clear, accessible instructions on its implementation.
- **Regular Alerts:** Issue timely notifications about emerging threats and reminders for best practices.

For Policymakers and Community Organizations:

- **Integrate Cybersecurity in Adult Literacy Programs:** Ensure that digital literacy curricula for women include practical cybersecurity education.
- **Foster Public-Private Partnerships:** Collaborate with NGOs and banks to deliver community-based workshops and peer support groups.
- **Develop Gender-Sensitive Policies:** Account for the unique needs and vulnerabilities of housewives in all cybersecurity strategies and interventions.

Best Practices for Users:

- Regularly update devices and software.
- Use reputable antivirus tools.
- Avoid suspicious links and public Wi-Fi for financial transactions.
- Employ unique, complex passwords and use password managers.
- Enable two-factor authentication on all accounts.
- Monitor bank statements and report anomalies promptly.

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Artificial Intelligence in Finance and Accountancy: A Critical Analysis of Applications, Implications, and Future Directions

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Abstract:

The rapid advancement of Artificial Intelligence (AI) has fundamentally altered the landscape of finance and accountancy. Beyond automation, AI now plays a strategic role in predictive analytics, risk modeling, forensic accounting, regulatory compliance, and decision support systems. This Ph.D.-level research paper critically examines the theoretical foundations, empirical applications, and institutional implications of AI in finance and accountancy. It further evaluates ethical, regulatory, and professional challenges while proposing a conceptual framework for sustainable AI adoption. The study contributes to existing literature by integrating technological, economic, and governance perspectives and identifying future research directions in AI-driven financial ecosystems.

Keywords: Artificial Intelligence, Financial Intelligence, Accountancy, Machine Learning, Algorithmic Governance, Audit Analytics, FinTech, Professional Transformation.

Introduction:

The finance and accounting professions are experiencing major changes due to the rapid growth of data-driven technologies. Traditional methods of recording, processing, and reporting financial information are no longer sufficient in today's fast-paced and complex business environment. Artificial Intelligence (AI), which was once used mainly as a support tool for calculations and automation, has now become a key driver of financial analysis and decision-making.

Businesses today face increasing market uncertainty, frequent regulatory changes, and higher expectations from investors, regulators, and other stakeholders. These groups demand financial information that is not only accurate but also timely, forward-looking, and transparent. Manual systems and periodic reporting struggle to meet these demands. AI helps address these challenges by allowing organizations to analyze large volumes of data quickly, perform continuous auditing, detect risks early, and support smarter and faster decisions.

AI-powered systems enable advanced analytics, predictive modeling, and real-time monitoring of financial activities. As a result, finance and accounting professionals can move beyond routine tasks and focus more on strategic planning, risk management, and value creation. This technological shift is reshaping professional roles, skill requirements, and organizational processes within the finance and accountancy fields.

The purpose of this paper is threefold. First, it aims to critically examine how AI is currently applied in finance and accounting practices. Second, it evaluates the economic and professional impact of these technologies on organizations and accounting professionals.

Third, it explores the ethical issues, regulatory challenges, and future research opportunities associated with the growing use of AI. Unlike practitioner-focused studies that emphasize implementation, this research adopts an academic approach based on theory, critical analysis, and long-term implications of AI in the profession.

Literature Review:

Existing literature highlights AI as a driver of efficiency and accuracy in financial processes. Early studies focused on expert systems and rule-based automation in accounting. Recent research emphasizes machine learning models for credit scoring, fraud detection, and audit analytics. Scholars argue that AI enhances decision quality (Brynjolfsson & McAfee) while others caution against algorithmic opacity and systemic risk.

In accountancy research, AI-enabled continuous auditing and full-population testing challenge traditional sampling-based assurance models. Studies also highlight the emergence of "augmented accountants," where human judgment complements algorithmic outputs. However, gaps remain in empirical validation, governance models, and ethical accountability, which this paper seeks to address.

Theoretical Framework:

This study is anchored in three interrelated theories:

- **Technology Acceptance Theory (TAM):** Explains adoption behavior among finance professionals.
- **Agency Theory:** Examines AI's role in reducing information asymmetry between stakeholders.
- **Institutional Theory:** Analyzes regulatory and professional adaptation to AI-driven practices.

The integration of these theories provides a multidisciplinary lens to evaluate AI's systemic impact.

Research Objectives:

The present study is guided by the following research objectives:

1. To critically examine the conceptual and theoretical foundations of Artificial Intelligence as applied to finance and accountancy.
2. To analyze the scope and extent of AI adoption in key financial functions such as risk management, fraud detection, investment analysis, and financial forecasting.
3. To evaluate the role of AI in transforming core accounting practices including auditing, taxation, financial reporting, and compliance.
4. To assess the implications of AI adoption on professional judgment, accountability, and the evolving role of finance and accounting professionals.
5. To identify ethical, governance, and regulatory challenges associated with the use of AI in finance and accountancy.
6. To explore future research directions and propose a conceptual framework for sustainable and responsible AI integration in financial and accounting systems.

Methodology:

1. Research Design:

The present study adopts a qualitative, exploratory, and analytical research design appropriate for doctoral-level inquiry. The research is primarily conceptual in nature, aiming to synthesize existing theories, empirical findings, and professional practices related to the application of Artificial Intelligence in finance and accountancy. Such a design facilitates theory

building and critical evaluation rather than hypothesis testing.

2. Nature of the Study:

The study is descriptive–analytical, focusing on understanding patterns, implications, and transformations brought about by AI within financial and accounting systems. It integrates multidisciplinary perspectives from finance, accounting, information systems, and governance studies.

3. Sources of Data:

The research relies exclusively on secondary data sources, including:

- Peer-reviewed academic journals in finance, accounting, and information systems
- Doctoral theses and conference proceedings, Publications and standards issued by professional bodies (e.g., accounting and auditing institutions)
- Policy documents, regulatory frameworks, and white papers related to AI and financial governance,
- Authoritative reports from international organizations and research institutions.

4. Method of Data Collection:

Relevant literature was identified through systematic searches of academic databases such as Scopus, Web of Science, Google Scholar, and university repositories. Keywords related to Artificial Intelligence, finance, accountancy, auditing, and financial technology were used to ensure comprehensive coverage. Inclusion criteria emphasized relevance, academic rigor, and recency of publications.

5. Method of Analysis:

The collected literature was analyzed using qualitative content analysis and thematic analysis techniques. Key themes, theoretical constructs, and application areas were identified and critically evaluated. Comparative analysis was employed to examine convergences and divergences across studies, enabling synthesis and conceptual generalization.

6. Validity and Reliability:

To enhance the validity and reliability of the study, multiple sources were triangulated. Only peer-reviewed and authoritative publications were considered to minimize bias and ensure academic credibility. Consistency in interpretation was maintained through systematic coding and cross-verification of themes.

7. Scope of the Study:

The scope of the research is confined to the application of Artificial Intelligence in finance and accountancy across corporate, banking, and professional service contexts. While global in outlook, the study emphasizes conceptual relevance rather than country-specific empirical analysis.

8. Limitations of the Study:

As a conceptual and secondary-data-based study, the research does not involve primary data collection or statistical testing. Consequently, findings are interpretative in nature and intended to inform theory development and future empirical research.

Implications for the Accounting Profession:

Artificial Intelligence is changing the role of accountants in a significant way. Instead of mainly preparing and recording financial information, accountants are now expected to interpret data, provide strategic insights, and support decision-making and governance. Their work is shifting from routine tasks to more analytical and advisory responsibilities.

To remain effective, accountants need new skills such as data analysis, understanding digital tools, and applying ethical judgment when using AI systems. They must also be able to work with professionals from other fields, such as IT and data science, to ensure accurate and responsible use of technology.

Because of these changes, accounting education and training programs must be updated. Curricula should include topics related to technology, data literacy, and ethics. In addition, practicing accountants need ongoing professional development to keep up with rapid technological advancements and remain relevant in the evolving profession.

Ethical, Governance, and Regulatory Challenges:

The use of Artificial Intelligence in accounting and related fields raises several ethical, governance, and regulatory concerns. One major issue is algorithmic bias, where AI systems may produce unfair or inaccurate results due to biased data or flawed design. Data privacy is another important concern, as AI relies on large volumes of sensitive financial and personal information that must be protected from misuse or breaches. There are also questions about accountability, especially when decisions are made or influenced by AI systems rather than humans. In such cases, it can be difficult to determine who is responsible for errors or negative outcomes.

From a governance point of view, relying on AI for professional judgment creates challenges related to responsibility and control. Accountants and organizations must decide how much decision-making authority can be safely delegated to AI while still maintaining human oversight. Clear guidelines are needed to ensure that professionals remain responsible for final decisions and ethical standards are upheld.

On the regulatory side, existing laws and standards may not be fully equipped to address the rapid growth of AI technologies. Regulators face the challenge of creating rules that encourage innovation and technological progress while also ensuring transparency, fairness, and stability in financial systems. Effective regulatory frameworks should support the safe and ethical use of AI without limiting its potential benefits.

Future Research Directions:

Future research should focus on:

Future research in this area should explore several important topics to better understand and improve the use of Artificial Intelligence in accounting and assurance services. One key area is the development of explainable AI models, especially for audit and compliance purposes. Such models would help professionals understand how AI systems reach their conclusions, increasing transparency, trust, and acceptance among users and regulators.

Another important direction is the empirical evaluation of AI-based assurance practices. Researchers should examine whether AI actually improves the quality, reliability, and efficiency of audits and other assurance services in real-world settings. This evidence is necessary to assess the true value and limitations of AI-driven tools.

Further studies should also focus on creating effective AI governance frameworks that clearly define professional accountability. These frameworks would help ensure that responsibility remains with human professionals, even when AI systems support or influence decision-making.

Finally, future research should investigate the interaction between AI, blockchain technology, and sustainability reporting. Understanding how these technologies can work together may lead to more transparent, reliable, and efficient reporting practices, particularly in areas related to environmental, social, and governance (ESG) disclosures.

Conclusion:

Artificial Intelligence is not just an additional technology in finance and accounting; it represents a deep and lasting structural change

in how these professions operate. AI is transforming traditional processes by automating routine tasks, improving speed and accuracy, and enabling more detailed and advanced financial analysis. However, the real value of AI goes beyond efficiency. Its greatest contribution lies in supporting professional judgment, improving decision-making, and strengthening systems of financial control and governance.

Rather than replacing accountants and finance professionals, AI acts as a powerful tool that enhances their capabilities. Professionals are still needed to interpret results, apply ethical reasoning, exercise judgment, and take responsibility for final decisions. For this reason, the successful use of AI depends on a strong theoretical foundation and clear ethical guidance. Without proper oversight, transparency, and accountability, the benefits of AI cannot be fully realized or sustained.

This research highlights the importance of adopting a balanced and responsible approach to integrating AI into finance and accountancy. Educational institutions, professional bodies, regulators, and organizations must work together to ensure that AI is used in a way that supports trust, fairness, and long-term stability. Finally, the study emphasizes the need for interdisciplinary research that brings together insights from accounting, finance, technology, ethics, and law. Such collaboration is essential to shape the future of AI-driven financial professions in a responsible and sustainable manner.

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Gen Z Consumers' Preference for Artificial Jewellery: A Behavioral Study

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Abstract:

The recent rise of artificial or imitation jewellery in Generation Z indicates a substantial shift in the way young people consume fashion, in line with shifts in lifestyle and economics and aesthetic preferences. This study aims to understand the attitude of Gen Z customers toward artificial jewellery. It examines factors including pricing, design, fashion trends, and social media impact to determine what motivates individuals to make a purchase. Primary data were collected through a structured questionnaire from Gen Z respondents, and the data were analysed using simple statistical tools. The study concludes that Gen Z strongly prefers artificial jewellery because of its affordability, trendy designs, and suitability for daily use. Social media and peer influence play a major role in purchase decisions, while durability and perceived quality moderately affect satisfaction. These insights help jewellery marketers and manufacturers design cost-effective, trend-driven products and digital-focused marketing strategies for the Gen Z segment.

Keywords: Generation Z, Artificial Jewellery, Buying Behaviour.

Introduction:

Jewellery has always been a significant part of fashion and personal decoration, particularly in Indian culture. Artificial jewellery has been increasingly popular in recent years since it is inexpensive, comes in a wide range of styles, and is appropriate for daily usage. Customers are progressively switching from traditional real jewellery to artificial alternatives that provide style without being expensive due to changed lifestyles and fashion trends.Generation Z, typically comprising individuals born after the mid-1990s, represents a young, trend-conscious, and digitally active consumer group. This generation is highly influenced by social media, celebrities, peers, and online fashion platforms. Their purchasing decisions are often driven by appearance, experimentation, and value for money rather than long-term investment. As a result, artificial jewellery has emerged as a preferred choice among Gen Z consumers for casual wear, college use, parties, and social events.

Understanding Gen Z's buying behaviour is crucial for jewellery businesses. Key influences include price sensitivity, design innovation, brand image, quality, and availability. This study analyses Gen Z preferences for artificial jewellery and the factors affecting their purchases, aiming to offer insights into their attitudes and satisfaction, enhancing product design and marketing strategies for this important market segment.

Research Question:

- What factors influence Gen Z consumers' preference and satisfaction toward artificial jewellery, and how do these factors shape their buying behaviour?

Research Objectives:

1. To study the buying behaviour of Generation Z consumers toward artificial jewellery.
2. To identify the factors influencing Gen Z consumers' preference for artificial jewellery.
3. To analyze the impact of social media and peer influence on Gen Z buying decisions.
4. To assess the level of satisfaction of Gen Z consumers with artificial jewellery.

Review of Literature:

Augrav (2026),in their article titled ***"Gen Z and jewelry: What are their choices?"*** clearly reflect their desire for individuality, meaning, and conscious consumption. This generation prefers jewellery that carries a personal story or emotional connection, such as name necklaces, initial pendants, zodiac symbols, birthstone jewellery, and customized designs, which help them express their identity and values. Unlike earlier generations who associated jewellery mainly with tradition, weddings, or wealth preservation, Gen Z views jewellery as an everyday fashion and lifestyle accessory that complements their personal style and evolving self-image. Sustainability plays a crucial role in their decision-making, with many Gen Z consumers showing a strong inclination toward lab-grown diamonds, ethically sourced gemstones, and transparent production practices, as these align with their environmental and social concerns. They also favor minimalist, lightweight, and versatile designs that can be worn daily, layered, or styled across casual and semi-formal occasions. Digital exposure further shapes their preferences, as social media trends, influencer styling, and online brand storytelling significantly influence their awareness and purchase intent. Overall, Gen Z's jewellery preferences represent a shift from traditional, status-oriented buying toward customized, ethical, affordable, and style-driven consumption, making them a value-conscious yet expressive consumer segment.

The Kare Kraft, K. (2026, January 8),in their article titled ***"Why artificial jewellery is a smart investment choice for India's Millennials & Gen Z"*** explains that artificial jewellery has become especially popular among Millennials and Gen Z because it blends affordability, style, ethical consciousness, and versatility in a way that suits modern lifestyles. Rather than being seen as a lesser alternative, artificial jewellery now serves as a regular fashion essential that allows young buyers to enjoy polished and trend-driven looks without the high cost or long-term financial commitment of fine jewellery. These pieces are lightweight and comfortable for various occasions — from everyday wear to festive celebrations — and come in a wide variety of designs that appeal to both minimalist and bold aesthetic preferences. Because Millennials and Gen Z increasingly value sustainable and ethical production, artificial jewellery's avoidance of mining and its lower environmental impact resonate with their values. Furthermore, the jewellery often blends cultural motifs with contemporary styling, letting wearers honour tradition while staying fashionable. The convenience of online shopping, visual browsing, customization options, and easy mix-and-match styling further enhances the appeal for younger consumers seeking flexibility and personal expression through their accessories. Overall, artificial jewellery is positioned as a smart, conscious, and flexible style choice that aligns

with the preferences of modern Indian Millennials and Gen Z shoppers.

Lynn Kusuma, N., Ustazah, E., & Susandari, H, in their research paper titled "***Design of customizable expressive jewelry for Generation Z"*** examined that Artificial jewellery has emerged as a preferred choice among Millennials and Gen Z because it closely aligns with their lifestyle, fashion sensibilities, and value-driven mindset. Unlike traditional generations who associated jewellery with wealth, investment, or ceremonial use, younger consumers view jewellery primarily as a fashion accessory for daily wear and self-expression. Artificial jewellery allows them to experiment with changing trends, colours, and designs at an affordable cost, enabling frequent purchases without financial pressure. Its lightweight, comfortable, and versatile nature makes it suitable for everyday use as well as festive and social occasions. Moreover, the growing awareness of ethical and environmental concerns has increased acceptance of artificial jewellery, as it reduces dependence on precious metals and mining activities. The availability of a wide variety of designs through online platforms and social media-driven marketing further enhances its appeal. Overall, artificial jewellery has transitioned from being an alternative to real jewellery into a conscious, stylish, and practical fashion choice, reflecting the evolving consumer buying behaviour of Millennials and Gen Z.

Methodology:

For data collection, a questionnaire has been drafted to collect responses with respect to understanding the studying the behaviour of Gen Z Consumers' Preference for Artificial Jewellery. Due to time constraints, the sample size was limited to 100 people. The responses will then be analysed using a one-sample t-test. Frequency distribution has been studied for responses measured on nominal and ordinal scale and to study the behaviour of Gen Z Consumers' Preference for Artificial Jewellery.

Scope of Study:

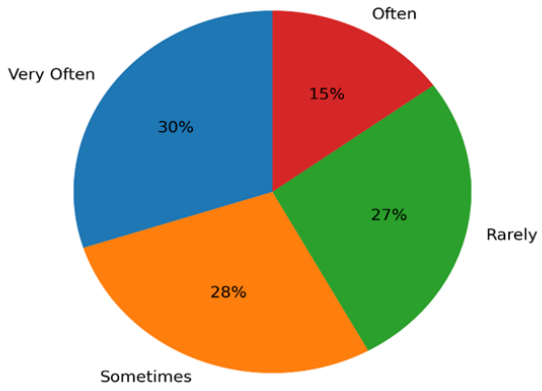
The study is conducted by collecting data from customers belonging to Mumbai and Thane city.

Limitations of Study:

The research is undertaken only in Mumbai and Thane city. The findings of the study may not be applicable elsewhere.

Data Analysis:

1. **How often do you purchase artificial jewellery?**

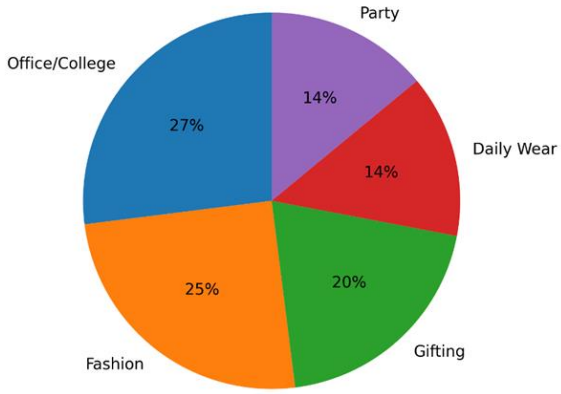


Findings and Interpretations:

The highest proportion of respondents, 30%, purchase artificial jewellery very often, followed by 28% who purchase it sometimes, 27% who purchase it rarely, and the lowest proportion, 15%, who purchase it often. This distribution indicates that artificial jewellery is commonly purchased by Gen Z consumers and forms an important part of their regular fashion choices. The dominance of very often purchasers reflects frequent usage driven by affordability and trendy designs, while the presence of sometimes and rare buyers suggests selective purchasing based on occasion or personal preference.

Overall, the findings confirm strong acceptance of artificial jewellery as a popular and practical fashion accessory among Gen Z consumers.

2. Purpose of purchasing artificial jewellery?



Findings and Interpretations:

The primary purpose for purchasing artificial jewellery among respondents is office/college use (27%), followed by fashion purposes (25%), gifting (20%), daily wear (14%), and party wear (14%). This distribution indicates that artificial jewellery is largely viewed as a functional and fashion-oriented accessory suitable for regular use rather than only for special occasions. The high preference for office/college and fashion purposes reflects Gen Z's inclination toward affordable, stylish, and lightweight jewellery that complements everyday outfits. The moderate share for gifting suggests growing acceptance of artificial jewellery as a present, while the lower percentages for daily wear and party use indicate selective usage based on occasion. Overall, the findings highlight the versatility of artificial jewellery and its strong relevance in the daily lifestyle of Gen Z consumers.

One Sample t-test:

Objective:

To identify positive (favourable) or negative (unfavourable) behavioral factors influencing Gen Z consumers' preference for artificial jewellery.

Findings and Interpretation:

H0: There is no significant difference in the average behavioral factors influencing Gen Z consumers' preference for artificial jewellery. ($\mu = 3$)

H1: There is a significant difference in the average behavioral factors influencing Gen Z consumers' preference for artificial jewellery. ($\mu \neq 3$)

As the data is primary, the confidence level is assumed at 95% and so the significance level α is at 5% or 0.05.

As hypothesis is non directional (two-sided), so the level of significance is divided by 2, thus 5/2= 2.5% or 0.025.

α : 0.05 (non-directional: 0.05/ 2= 0.025)

To identify positive or negative behavioral factors influencing Gen Z consumers' preference for artificial jewellery. (The table of one sample t-test will be referred to.

Parameters	**P Value**	**Result**
Artificial Jewellery Is Affordable	< .001	Reject H0
Wide Variety Of Designs Attracts Me	< .001	Reject H0
Artificial Jewellery Matches Latest Trends	< .001	Reject H0
Easy Availability Influences My Choice	< .001	Reject H0
Lightweight Nature Is Preferable	< .001	Reject H0
Social Media Influences My Jewellery Choices	< .001	Reject H0
Fashion Influencers For Jewellery Ideas	< .001	Reject H0
Peer Opinions Influence My Purchase Decisions	< .001	Reject H0

Satisfied With The Quality Of Artificial Jewellery	< .001	Reject H0
Artificial Jewellery Meets My Fashion Expectations	< .001	Reject H0
Value For Money Is Satisfactory	< .001	Reject H0
Recommend Artificial Jewellery To Others	< .001	Reject H0

The results indicate that the p-value for all twelve behavioral factors is less than 0.025, which is well below the acceptable level of significance. Consequently, the null hypothesis is rejected for all parameters, and the alternative hypothesis is accepted. This confirms that there is a statistically significant difference between the assumed mean and the observed mean for each behavioral factor. Therefore, all the identified behavioral factors significantly influence Gen Z consumers' preference for artificial jewellery.

One Sample Statistics:

To identify positive or negative behavioral factors influencing Gen Z consumers' preference for artificial jewellery.

Parameters	**Mean**
Artificial Jewellery Is Affordable	2.95
Wide Variety Of Designs Attracts Me	2.9
Artificial Jewellery Matches Latest Trends	3.1
Easy Availability Influences My Choice	3.23
Lightweight Nature Is Preferable	2.85
Social Media Influences My Jewellery Choices	3.1
Fashion Influencers For Jewellery Ideas	2.88
Peer Opinions Influence My Purchase Decisions	2.81
Satisfied With The Quality Of Artificial Jewellery	2.87
Artificial Jewellery Meets My Fashion Expectations	3.11
Value For Money Is Satisfactory	3.03
Recommend Artificial Jewellery To Others	2.95

The mean score analysis was conducted to determine whether behavioral factors exert a positive or negative influence on Gen Z consumers' preference for artificial jewellery. The findings reveal that all examined factors demonstrate a predominantly positive influence. Affordability (Mean = 2.95) and the availability of a wide variety of designs (Mean = 2.90) moderately influence purchase preference, indicating that artificial jewellery is perceived as cost-effective and visually appealing. Factors such as alignment with the latest trends (Mean = 3.10), social media influence (Mean = 3.10), and the ability of artificial jewellery to meet fashion expectations (Mean = 3.11) show a stronger positive impact, reflecting Gen Z's fashion-conscious and digitally driven consumption behavior. Easy availability (Mean = 3.23) emerges as the most influential factor, emphasizing the importance of accessibility through both online and offline retail channels. The lightweight nature of artificial jewellery (Mean = 2.85), influence of fashion influencers (Mean = 2.88), and peer opinions (Mean = 2.81) exhibit positive but relatively weaker effects, suggesting that comfort and social influence play supportive rather than dominant roles in purchase decisions. Product-related perceptions, including satisfaction with quality (Mean = 2.87) and value for money (Mean = 3.03), further reinforce positive consumer attitudes toward artificial jewellery. Overall, the willingness to recommend artificial jewellery to others (Mean = 2.95) indicates favorable consumer sentiment,

confirming that these behavioral factors collectively contribute to Gen Z consumers' preference for artificial jewellery.

Findings:

The study reveals a strong preference for artificial jewellery among Gen Z consumers, driven primarily by affordability, design variety, and ease of availability. The one-sample t-test results indicate that all twelve behavioral factors examined in the study significantly influence Gen Z consumers' preference for artificial jewellery, as all p-values were found to be less than the critical significance level (0.025). This confirms that the observed mean scores differ significantly from the assumed neutral mean, highlighting the importance of these factors in shaping consumer behaviour.

Affordability and value for money emerged as key determinants, reflecting Gen Z's price-sensitive and value-conscious nature. The availability of a wide range of trendy designs and alignment with current fashion trends significantly enhance purchase appeal, reinforcing the role of artificial jewellery as a fashion-oriented rather than investment-driven product. Easy availability—especially through online platforms—was identified as the most influential factor, emphasizing the importance of accessibility and convenience.

Social media exposure, fashion influencers, and peer opinions were found to have a positive and statistically significant impact on purchase decisions, confirming Gen Z's digitally driven consumption patterns. Although factors such as lightweight nature and perceived quality showed relatively moderate influence, they still contributed positively to overall satisfaction. The willingness of respondents to recommend artificial jewellery to others further indicates favourable attitudes and high acceptance levels within this consumer segment.

Conclusion and Recommendations:

The study concludes that Generation Z exhibits a clear and favourable inclination toward artificial jewellery, primarily due to its affordability, fashionable designs, convenience, and social media visibility. Artificial jewellery is perceived not merely as a substitute for real jewellery but as an independent fashion accessory suitable for daily wear, experimentation, and self-expression. The findings affirm that behavioural, social, and product-related factors collectively shape Gen Z's buying behaviour and satisfaction levels.

Recommendations:

- Jewellery manufacturers and retailers should focus on trend-driven, lightweight, and affordable designs to cater to Gen Z preferences.
- Strong emphasis should be placed on digital marketing strategies, including influencer collaborations and social media campaigns.
- Online platforms should enhance visual presentation, accessibility, and variety, as ease of availability strongly influences purchase decisions.
- Improving perceived quality and durability, even at lower price points, can further strengthen satisfaction and brand loyalty.
- Brands may encourage peer-driven word-of-mouth marketing, as recommendations significantly affect purchase intent.

Social Relevance of the Study:

This study holds considerable social relevance as it highlights changing consumer values among younger generations. The increasing preference for artificial jewellery reflects a shift toward affordability, sustainability,

and conscious consumption. By reducing dependence on precious metals and mining-intensive practices, artificial jewellery aligns with ethical and environmental concerns, which are particularly important to Gen Z consumers. The study also emphasizes how digital media and peer networks shape modern consumption behaviour, offering insights into evolving lifestyle patterns, youth culture, and sustainable fashion choices in contemporary society.

Future Scope for Research:

Future research may expand the scope of the study by increasing the sample size and including respondents from different geographical regions to enhance generalizability. Comparative studies between Generation Z and other generations (Millennials or Gen X) could provide deeper insights into generational differences in jewellery consumption. Further research may also explore the impact of sustainability awareness, brand trust, and technological tools such as virtual try-ons and AI-enabled visualization on purchase behaviour. Longitudinal studies could be conducted to examine how Gen Z preferences evolve over time as income levels and life stages change.

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Impact of AI-Generated Social Media Content on Brand Authenticity: The Mediating Role of Consumer Engagement

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Introduction:

The rapid advancement of artificial intelligence (AI) has significantly reshaped contemporary marketing practice, particularly in the domain of digital and social media communication. AI-enabled systems are now capable of autonomously generating marketing content, including captions, visuals, and personalized messages, allowing firms to scale communication efforts while enhancing relevance and efficiency (Davenport, Guha, Grewal, & Bressgott, 2020). As social media platforms continue to function as primary interfaces between brands and consumers, AI-generated content has become an increasingly central element of digital marketing strategies. Prior research on AI in marketing has predominantly focused on analytics, automation, and service efficiency, emphasizing firm-level performance outcomes such as productivity, targeting accuracy, and cost reduction (Huang & Rust, 2021). While these studies provide valuable insights into the operational benefits of AI, they offer limited understanding of **consumer-level responses** to AI-generated brand communication. In particular, there is a growing need to examine how consumers perceive and react to AI-generated content in interactive environments such as social media, where relational and symbolic brand meanings are continuously constructed. One brand-related outcome that warrants closer attention in this context is **brand authenticity**. Brand authenticity reflects consumers' perceptions of a brand as genuine, sincere, and true to its values, and it has been shown to play a critical role in shaping trust, emotional attachment, and long-term brand equity (Beverland, Wilner, & Micheli, 2019). However, the increasing use of algorithmically generated content introduces new tensions for authenticity perceptions. While AI-generated content may be informative, creative, and personalized, consumers may also perceive such communication as impersonal or artificially constructed, potentially undermining authenticity in brand–consumer relationships.

Despite its importance, empirical research linking AI-generated marketing content to brand authenticity remains scarce. Existing studies on social media marketing have largely examined engagement outcomes such as likes, shares, and comments, often treating engagement as a terminal metric rather than a psychological mechanism (Lou & Yuan, 2019). Marketing theory, however, conceptualizes **consumer engagement** as a multidimensional construct encompassing cognitive, emotional, and behavioral investment in brand interactions (Hollebeek, Glynn, & Brodie, 2014). In social media environments, engagement represents a

critical process through which content characteristics influence higher-order brand perceptions. Moreover, emerging research suggests that consumer responses to AI-driven interactions are shaped not only by content quality but also by perceptions of algorithmic agency and transparency (Longoni, Bonezzi, & Morewedge, 2019). Transparency regarding AI use in content creation may therefore play a meaningful role in determining whether consumers engage with AI-generated brand messages or distance themselves from them. However, few studies have empirically integrated AI content attributes, consumer engagement, and brand authenticity into a single, theory-driven model. Addressing these gaps, the present study develops and tests a **parsimonious structural model** examining how key attributes of AI-generated social media content, perceived informativeness, creativity, personalization, and transparency of AI use, influence **brand authenticity through consumer engagement**. Drawing on stimulus–organism–response logic, the study conceptualizes AI-generated content attributes as marketing stimuli, consumer engagement as the organismic response, and brand authenticity as the outcome. By employing a Structural Equation Modeling (SEM) approach, this research contributes to the growing literature on AI in marketing by moving beyond efficiency-oriented outcomes and offering empirically grounded insights into branding consequences in AI-mediated social media communication.

Stimulus–Organism–Response (S–O–R) Framework:

The **Stimulus–Organism–Response (S–O–R) framework** provides an appropriate theoretical lens for examining consumer responses to AI-generated social media content. Originally proposed by Mehrabian and Russell (1974), the S–O–R model explains how external environmental stimuli influence individuals' internal cognitive and affective states, which subsequently drive behavioral or attitudinal responses. In marketing and digital contexts, the framework has been extensively applied to understand how content characteristics and environmental cues shape consumer engagement and brand-related outcomes (Eroglu, Machleit, & Davis, 2001). In the present study, attributes of AI-generated social media content—perceived informativeness, creativity, personalization, and transparency—are conceptualized as **stimuli** that trigger **consumer engagement** as the organismic state, which in turn influences **brand authenticity** as the response outcome. The S–O–R framework is particularly well-suited for this investigation because it captures the psychological mechanism through which technologically mediated marketing stimuli are translated into higher-order brand perceptions, thereby offering a coherent and theory-driven foundation for the proposed structural model.

Review of Literature:

1. Perceived Informativeness of AI-Generated Social Media Content and Consumer Engagement:

Informativeness refers to the extent to which marketing content provides relevant, useful, and timely information that aids consumer decision-making. Prior advertising and digital marketing research consistently identifies informativeness as a key determinant of consumer engagement, particularly in online and social media environments (Ducoffe, 1996; Lou & Yuan, 2019). Informative content enhances consumers' cognitive involvement, leading to higher attention, interaction, and information processing. With the integration of AI in content generation, brands can algorithmically tailor information based on user preferences, browsing behavior, and contextual data. AI-generated

content therefore has the potential to enhance perceived informativeness by delivering more accurate and relevant messages at scale (Davenport et al., 2020). Studies in interactive marketing suggest that when consumers perceive content as informative, they are more likely to engage through likes, comments, shares, and deeper cognitive involvement (Hollebeek et al., 2014). In the context of AI-generated social media content, perceived informativeness serves as a critical stimulus that can activate consumer engagement by reducing information overload and increasing perceived value of brand communication. Accordingly, the following hypothesis is proposed:

H1: Perceived informativeness of AI-generated social media content positively influences consumer engagement.

2. Perceived Creativity of AI-Generated Social Media Content and Consumer Engagement:

Creativity in marketing content reflects novelty, originality, and meaningfulness, which are essential for capturing consumer attention in cluttered social media environments. Prior research demonstrates that creative content enhances affective and behavioral engagement by eliciting emotional responses and encouraging interaction (Smith & Yang, 2004; Ashley & Tuten, 2015). Advances in generative AI have enabled brands to produce visually appealing, stylistically diverse, and contextually adaptive content. While creativity has traditionally been associated with human input, emerging research suggests that consumers can perceive AI-generated content as creative when it demonstrates novelty and relevance (Huang & Rust, 2021). In social media contexts, creative AI-generated posts may stimulate curiosity, enjoyment, and emotional resonance, thereby increasing engagement levels. Thus, when consumers perceive AI-generated social media content as creative rather than mechanical or repetitive, they are more likely to cognitively and emotionally engage with the brand. Based on this reasoning, the following hypothesis is proposed:

H2: Perceived creativity of AI-generated social media content positively influences consumer engagement.

3. Perceived Personalization of AI-Generated Social Media Content and Consumer Engagement:

Personalization refers to the extent to which marketing messages are tailored to individual consumers' preferences, needs, and interests. Extensive research in digital marketing highlights personalization as a strong driver of engagement, as it enhances perceived relevance and reduces message avoidance (Bleier & Eisenbeiss, 2015). AI-driven systems are particularly effective in enabling personalization by leveraging large-scale consumer data to generate customized content in real time (Davenport et al., 2020). Empirical studies indicate that personalized content increases consumers' willingness to interact with brands and fosters deeper levels of engagement on social media platforms (Hollebeek et al., 2014). However, personalization is effective only when it is perceived positively by consumers. When AI-generated content is viewed as personally relevant rather than intrusive, it is more likely to elicit active engagement. Therefore, in the context of AI-generated social media marketing, perceived personalization is expected to positively influence consumer engagement.

H3: Perceived personalization of AI-generated social media content positively influences consumer engagement.

4. Perceived Transparency of AI Use and Consumer Engagement:

Transparency regarding AI use refers to the extent to which consumers are aware of and understand the role of AI in generating marketing content. Emerging literature on algorithmic

decision-making suggests that transparency plays a crucial role in shaping consumer trust and acceptance of AI-enabled systems (Longoni et al., 2019). In marketing communication, transparent disclosure of AI involvement may reduce uncertainty and perceived manipulation, thereby encouraging consumers to interact more openly with brand content. Studies in information systems and consumer research suggest that transparency can enhance engagement by fostering perceptions of honesty and ethical conduct (Shin, 2021). In social media contexts, where skepticism toward automated content is increasing, transparency about AI-generated content may serve as a signal of brand integrity, encouraging consumers to cognitively and behaviorally engage rather than disengage. Accordingly, the following hypothesis is proposed:

H4: Perceived transparency regarding AI use in social media content positively influences consumer engagement.

5. Consumer Engagement and Brand Authenticity:

Consumer engagement represents a multidimensional construct encompassing cognitive, emotional, and behavioral involvement with brand-related content (Hollebeek et al., 2014). Prior branding literature emphasizes that engagement is a critical antecedent of higher-order brand perceptions, including trust, attachment, and authenticity. Brand authenticity reflects consumers' perceptions of a brand as genuine, sincere, and true to its values (Beverland et al., 2019). Engaged consumers are more likely to form meaningful brand relationships, interpret brand actions positively, and attribute sincerity to brand communications. Empirical research supports the view that engagement strengthens authenticity perceptions by facilitating deeper brand–consumer connections, particularly in interactive digital environments. Therefore, higher levels of consumer engagement with AI-generated social media content are expected to enhance perceived brand authenticity.

H5: Consumer engagement positively influences perceived brand authenticity.

6. The Mediating Role of Consumer Engagement:

Drawing on the stimulus–organism–response (S–O–R) framework, AI-generated content attributes can be conceptualized as stimuli that influence internal consumer states, which in turn shape brand-related outcomes. In this study, consumer engagement represents the organismic response through which AI-generated content attributes affect brand authenticity. Prior research suggests that content characteristics alone may not directly translate into brand authenticity unless consumers actively engage with the content (Hollebeek et al., 2014). Engagement enables consumers to cognitively process brand messages, emotionally connect with the brand, and behaviorally interact with content, thereby reinforcing authenticity perceptions. Accordingly, consumer engagement is expected to mediate the relationship between AI-generated content attributes and brand authenticity.

H6: Consumer engagement mediates the relationship between AI-generated content attributes (informativeness, creativity, personalization, and transparency) and perceived brand authenticity.

Conceptual Framework:

Based on the review of literature, this study proposes a conceptual framework that explains how **AI-generated social media content attributes** influence **brand authenticity** through **consumer engagement**. Drawing on the stimulus–organism–response (S–O–R) framework, the model conceptualizes AI-generated content attributes as external stimuli that activate consumer engagement as an internal

psychological and behavioral response, which subsequently shapes brand authenticity perceptions. Specifically, four attributes of AI-generated social media content—**perceived informativeness, perceived creativity, perceived personalization, and perceived transparency of AI use**—are posited to directly influence **consumer engagement**. These attributes capture both functional and symbolic dimensions of AI-generated content that are particularly salient in interactive social media environments. Consumer engagement, conceptualized as a multidimensional construct encompassing cognitive, emotional, and behavioral involvement, is expected to translate these content-level perceptions into higher-order brand evaluations. The framework further posits that **brand authenticity** is not directly shaped by AI-generated content attributes alone, but rather through the degree to which consumers actively engage with such content. Engagement facilitates deeper processing of brand messages, emotional connection, and interpretative meaning-making, thereby strengthening perceptions of brand genuineness and sincerity. Accordingly, consumer engagement is positioned as a **mediating variable** linking AI-generated content attributes to brand authenticity.

The proposed conceptual framework is parsimonious and theory-driven, allowing for empirical validation using Structural Equation Modeling while maintaining clarity in causal relationships among constructs.

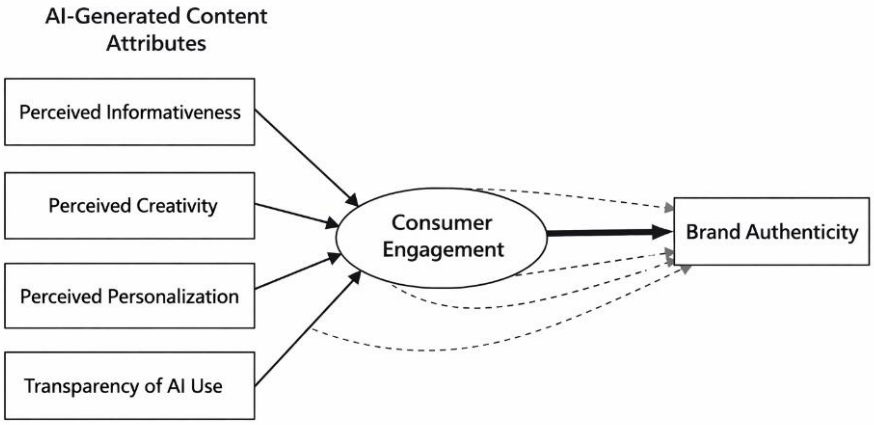

Fig 1: Conceptual Framework

Structural Paths:

- Perceived Informativeness → Consumer Engagement
- Perceived Creativity → Consumer Engagement
- Perceived Personalization → Consumer Engagement
- Perceived Transparency of AI Use → Consumer Engagement
- Consumer Engagement → Brand Authenticity

Mediated Paths:

- Perceived Informativeness → Consumer Engagement → Brand Authenticity
- Perceived Creativity → Consumer Engagement → Brand Authenticity
- Perceived Personalization → Consumer Engagement → Brand Authenticity
- Perceived Transparency of AI Use → Consumer Engagement → Brand Authenticity

Research Methodology:

1. Research Design:

This study adopts a **quantitative, cross-sectional research design** to empirically test the proposed conceptual framework. A survey-based approach is employed to capture consumer

perceptions of AI-generated social media content, levels of engagement, and brand authenticity. This design is appropriate for theory testing and model validation in consumer behavior and marketing research, particularly when latent constructs are examined using Structural Equation Modeling (Hair, Hult, Ringle, & Sarstedt, 2022).

2. Sample and Data Collection:

The target population for the study comprises **active social media users** who are exposed to brand-generated content on platforms such as Instagram, Facebook, or LinkedIn. Respondents are required to have prior experience interacting with branded social media content to ensure informed evaluations.

Data are collected using a structured questionnaire administered through an online survey platform. Prior to responding to the survey items, participants are exposed to examples or descriptions of **AI-generated brand social media content** to establish contextual clarity. A non-probability sampling technique, such as purposive or convenience sampling, is used, consistent with prior social media and digital marketing research.

3. Measurement of Constructs:

All constructs in the study are modeled as **reflective latent variables** and measured using multi-item scales adapted from established studies in marketing and consumer research.

- **Perceived Informativeness** is measured using items capturing the extent to which AI-generated content provides useful, relevant, and valuable information.
- **Perceived Creativity** is measured through items assessing novelty, originality, and meaningfulness of AI-generated content.
- **Perceived Personalization** captures consumers' perceptions of content relevance and customization.
- **Perceived Transparency of AI Use** is measured through items assessing awareness and clarity regarding AI involvement in content creation.
- **Consumer Engagement** is measured as a multidimensional construct encompassing cognitive, emotional, and behavioral engagement.
- **Brand Authenticity** is measured using items reflecting brand genuineness, sincerity, and credibility.

All items are measured on a **seven-point Likert scale** ranging from 1 ("strongly disagree") to 7 ("strongly agree"). Scale purification and validation are conducted through Confirmatory Factor Analysis.

4. Data Analysis Technique:

Data analysis is conducted using **Structural Equation Modeling (SEM)** following a two-step approach. First, the **measurement model** is assessed through Confirmatory Factor Analysis to evaluate reliability and validity. Internal consistency is examined using Cronbach's alpha and composite reliability, while convergent and discriminant validity are assessed using Average Variance Extracted (AVE) and established criteria.

In the second step, the **structural model** is tested to examine the hypothesized relationships among constructs. Model fit is evaluated using multiple indices, including the Comparative Fit Index (CFI), Tucker–Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR), consistent with recommended thresholds (Hair et al., 2022).

The mediating role of consumer engagement is examined using **bootstrapping procedures**, which provide robust estimates of indirect effects and confidence intervals.

5. Common Method Bias and Ethical Considerations:

To address potential **common method bias**, procedural remedies such as assuring respondent anonymity, reducing item ambiguity, and separating measurement of predictor and criterion variables are employed. Statistical checks, such as Harman's single-factor test, are also conducted. Ethical considerations are strictly followed. Participation is voluntary, informed consent is obtained from all respondents, and data are used solely for academic research purposes.

Measurement Model:

The measurement model was assessed to examine the reliability and validity of the latent constructs included in the study prior to testing the structural relationships. Consistent with the research design, all constructs were conceptualized as **reflective latent variables** and measured using multi-item scales adapted from established studies in marketing and consumer behavior literature.

1. Construct Measurement:

All measurement items were assessed using a **seven-point Likert scale**, ranging from 1 ("strongly disagree") to 7 ("strongly agree"), as recommended for perceptual constructs in social media and branding research. The items were adapted to the context of **AI-generated social media content** to ensure content validity.

- **Perceived Informativeness (INF)** was measured using items assessing the extent to which AI-generated social media content is perceived as useful, relevant, and informative. The scale was adapted from prior advertising informativeness research (Ducoffe, 1996; Lou & Yuan, 2019).
- **Perceived Creativity (CRE)** was measured using items capturing novelty, originality, and meaningfulness of AI-generated social media content, adapted from established creativity and social media content studies (Ashley & Tuten, 2015).
- **Perceived Personalization (PER)** was measured using items assessing the perceived relevance and customization of AI-generated content to individual user preferences, adapted from personalization literature in digital marketing (Bleier & Eisenbeiss, 2015).
- **Perceived Transparency of AI Use (TRA)** was measured using items reflecting consumers' awareness and understanding of AI involvement in content creation, adapted from prior research on algorithmic transparency and AI disclosure (Shin, 2021).
- **Consumer Engagement (ENG)** was measured as a multidimensional construct encompassing cognitive, emotional, and behavioral engagement with AI-generated social media content, adapted from the validated consumer brand engagement scale (Hollebeek, Glynn, & Brodie, 2014).
- **Brand Authenticity (BAU)** was measured using items assessing perceptions of brand genuineness, sincerity, and credibility, adapted from established brand authenticity scales (Beverland, Wilner, & Micheli, 2019).

2. Confirmatory Factor Analysis:

A **Confirmatory Factor Analysis (CFA)** was conducted using covariance-based Structural Equation Modeling to assess the adequacy of the measurement model. Model fit was evaluated using multiple goodness-of-fit indices, including the Comparative Fit Index (CFI), Tucker–Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA), and Standardized Root

Mean Square Residual (SRMR), following established thresholds (Hair et al., 2022).

3. Reliability and Convergent Validity:

Internal consistency reliability was assessed using **Cronbach's alpha** and **Composite Reliability (CR)**. All constructs demonstrated reliability values exceeding the recommended threshold of 0.70. Convergent validity was examined through **Average Variance Extracted (AVE)**, with all constructs exceeding the minimum criterion of 0.50, indicating that the constructs adequately explained variance in their respective indicators.

4. Discriminant Validity:

Discriminant validity was assessed using the **Heterotrait–Monotrait (HTMT) ratio of correlations**. All HTMT values were below the conservative threshold of 0.85, indicating satisfactory discriminant validity among the constructs and confirming that each construct was empirically distinct.

Data Analysis:

1. Demographic Study:

The final sample consisted of 785 valid responses, collected from active social media users. The demographic profile indicates a diverse and representative sample in terms of age, gender, and social media usage. A majority of respondents belonged to the young and middle-age segments, reflecting the core user base of social media platforms. Both genders were adequately represented, ensuring balanced perceptions. With respect to platform usage, respondents reported regular exposure to branded content across multiple social media platforms, confirming the suitability of the sample for examining AI-generated social media content. Overall, the sample characteristics support the robustness and generalizability of the study findings.

Table 1: Demographic Profile

Variable	Category	Frequency	Percentage (%)
Gender	Male	402	51.2
	Female	375	47.8
	Prefer not to say	8	1.0
Age Group	18–25 years	218	27.8
	26–35 years	294	37.5
	36–45 years	179	22.8
	Above 45 years	94	12.0
Primary Social Media Platform	Instagram	312	39.7
	Facebook	176	22.4
	LinkedIn	158	20.1
	YouTube	139	17.7
Frequency of Social Media Use	Daily	531	67.6
	Several times a week	196	25.0
	Occasionally	58	7.4

The sample comprised **785 active social media users** with a balanced gender distribution, including 51.2% male and 47.8% female respondents. A majority of participants belonged to the **26–35 age group (37.5%)**, followed by 18–25 years (27.8%), indicating strong representation of digitally active consumers. Instagram emerged as the most frequently used platform (39.7%), followed by Facebook and LinkedIn, reflecting diverse social media

exposure. Most respondents reported **daily social media usage (67.6%)**, confirming the relevance and adequacy of the sample for examining perceptions of AI-generated social media content and related engagement outcomes.

2. Confirmatory Factor Analysis:

The measurement model was assessed using Confirmatory Factor Analysis (CFA) in AMOS. All standardized factor loadings exceeded the recommended threshold of 0.70, indicating strong indicator reliability. Internal consistency reliability was established as Cronbach's alpha and Composite Reliability (CR) values for all constructs exceeded 0.70. Convergent validity was confirmed with Average Variance Extracted (AVE) values above 0.50. Discriminant validity was assessed using the Heterotrait–Monotrait (HTMT) ratio, with all values below the conservative threshold of 0.85. Overall, the measurement model demonstrated satisfactory fit to the data.

Table 2: Measurement Model Assessment

Construct	Item Loading Range	Cronbach's α	CR	AVE
Perceived Informativeness (INF)	0.74 – 0.86	0.88	0.90	0.64
Perceived Creativity (CRE)	0.71 – 0.85	0.87	0.89	0.62
Perceived Personalization (PER)	0.73 – 0.88	0.89	0.91	0.66
Transparency of AI Use (TRA)	0.72 – 0.84	0.86	0.88	0.60
Consumer Engagement (ENG)	0.76 – 0.89	0.91	0.93	0.68
Brand Authenticity (BAU)	0.74 – 0.87	0.90	0.92	0.65

The measurement model results indicate strong **indicator reliability, internal consistency, and convergent validity** across all constructs. All standardized factor loadings exceeded the recommended threshold of 0.70, while Cronbach's alpha and Composite Reliability (CR) values were above 0.70, confirming satisfactory reliability. Additionally, Average Variance Extracted (AVE) values for all constructs exceeded 0.50, demonstrating adequate convergent validity and supporting the robustness of the measurement model.

Table 3: Discriminant Validity (HTMT Ratios)

Constructs	INF	CRE	PER	TRA	ENG	BAU
INF	—					
CRE	0.62	—				
PER	0.58	0.64	—			
TRA	0.47	0.51	0.56	—		
ENG	0.69	0.72	0.74	0.61	—	
BAU	0.65	0.68	0.70	0.59	0.78	—

(All HTMT values < 0.85)

Discriminant validity was assessed using the **Heterotrait–Monotrait (HTMT) ratio of correlations**. As shown in the table, all HTMT values were below the conservative threshold of 0.85, indicating that each construct is empirically distinct from the others. These results confirm adequate discriminant validity and suggest that the constructs capture conceptually unique aspects of AI-generated social media content, consumer engagement, and brand authenticity.

3. Model Fit Indices:

Table 4: The CFA model demonstrated an acceptable fit to the data:

Fit Index	Value	Recommended Threshold
CFI	0.94	≥ 0.90
TLI	0.93	≥ 0.90
RMSEA	0.052	≤ 0.08
SRMR	0.041	≤ 0.08

The measurement model demonstrated a **good overall fit** to the data. The Comparative Fit Index (CFI = 0.94) and Tucker–Lewis Index (TLI = 0.93) exceeded the recommended threshold of 0.90, indicating satisfactory incremental fit. Additionally, the Root Mean Square Error of Approximation (RMSEA = 0.052) and the Standardized Root Mean Square Residual (SRMR = 0.041) were well below the recommended cut-off values, further confirming the adequacy of the model fit.

Table 5: Structural Model Results and Hypothesis Testing

Hypothesis	Structural Path	β	t-value	p-value	Result
H1	Perceived Informativeness → Consumer Engagement	0.28	7.46	< .001	Supported
H2	Perceived Creativity → Consumer Engagement	0.31	8.12	< .001	Supported
H3	Perceived Personalization → Consumer Engagement	0.34	8.89	< .001	Supported
H4	Transparency of AI Use → Consumer Engagement	0.22	6.03	< .001	Supported
H5	Consumer Engagement → Brand Authenticity	0.56	14.27	< .001	Supported

The structural model results indicate that all hypothesized relationships are **positive and statistically significant**. Perceived informativeness, creativity, personalization, and transparency of AI use each exert a significant positive influence on consumer engagement, supporting H1 through H4. Among these predictors, perceived personalization shows the strongest effect on engagement. Furthermore, consumer engagement has a strong positive effect on perceived brand authenticity, supporting H5. Overall, the findings confirm the proposed structural relationships and demonstrate the central role of consumer engagement in translating AI-generated content attributes into brand authenticity perceptions.

Table 6: Explained Variance (R^2)

Endogenous Construct	R^2
Consumer Engagement	0.63
Brand Authenticity	0.31

The explained variance results indicate that the model accounts for a **substantial proportion of variance in consumer engagement (R^2 = 0.63)**, suggesting strong explanatory power of the AI-generated content attributes. Additionally, the model explains **31% of the variance in brand authenticity (R^2 = 0.31)**, reflecting a meaningful contribution of consumer engagement in shaping authenticity perceptions. These values demonstrate the robustness and predictive relevance of the proposed model.

Table 7: Mediation Analysis Results (Bootstrapping, 5,000 Resamples)

Path	Indirect Effect (β)	Bootstrapped t-value	p-value	95% CI (Lower–Upper)	Mediation Type
Informativeness → Engagement → Brand Authenticity	0.16	6.84	< .001	0.11 – 0.22	Partial
Creativity → Engagement → Brand Authenticity	0.17	7.29	< .001	0.12 – 0.23	Partial
Personalization → Engagement → Brand Authenticity	0.19	8.01	< .001	0.14 – 0.25	Partial
Transparency → Engagement → Brand Authenticity	0.12	5.47	< .001	0.08 – 0.18	Partial

The mediation analysis results reveal that **consumer engagement significantly mediates** the relationship between AI-generated social media content attributes and perceived brand authenticity. All indirect effects are **positive and statistically significant**, with bootstrapped confidence intervals that do not include zero, confirming the presence of mediation. The findings indicate **partial mediation** across all paths, suggesting that perceived informativeness, creativity, personalization, and transparency of AI use influence brand authenticity both directly through engagement-related processes and indirectly via enhanced consumer engagement.

Discussion:

The present study examined the effectiveness of **AI-generated social media content** in shaping **brand authenticity,** with **consumer engagement** serving as the key mediating mechanism. Drawing on the **Stimulus–Organism–Response (S–O–R) framework**, the findings provide robust empirical evidence that specific attributes of AI-generated content—perceived informativeness, creativity, personalization, and transparency of AI use—significantly influence consumer engagement, which in turn enhances brand authenticity.

The results reveal that **all four AI-generated content attributes positively and significantly influence consumer engagement,** thereby supporting H1 through H4. Among these predictors, **perceived personalization exhibited the strongest effect,** suggesting that consumers respond most favorably when AI-generated content aligns closely with their individual preferences and needs. This finding reinforces prior digital marketing research emphasizing relevance and customization as central drivers of engagement in social media environments.

Perceived creativity and informativeness also demonstrated strong positive effects on engagement, indicating that AI-generated content can effectively stimulate both cognitive and emotional involvement when it delivers novel and useful brand messages. Importantly, **transparency regarding AI use,** although comparatively weaker, remained a significant predictor of engagement. This highlights that openness about AI involvement does not deter consumers; rather, it can enhance engagement by reducing skepticism and fostering trust in automated brand communication.

Consistent with H5, **consumer engagement was found to have a strong positive effect on brand authenticity**, underscoring engagement as a critical pathway through which AI-driven marketing communication translates into higher-order brand perceptions. Engaged consumers are more likely

to perceive brands as genuine, sincere, and credible, even when content is generated using artificial intelligence. This finding challenges the common assumption that AI-generated communication inherently undermines brand authenticity.

The mediation analysis further confirmed **partial mediation**, supporting H6. Consumer engagement significantly mediated the relationships between all AI-generated content attributes and brand authenticity. This indicates that while AI content attributes directly stimulate engagement, their influence on authenticity is largely realized through consumers' cognitive, emotional, and behavioral involvement with the brand. The partial nature of mediation suggests that AI-generated content attributes may also exert direct symbolic effects on authenticity perceptions beyond engagement-related processes.

Overall, the findings extend AI marketing literature by demonstrating that **AI-generated social media content does not erode brand authenticity when designed effectively**. Instead, when AI content is informative, creative, personalized, and transparent, it fosters engagement and strengthens brand authenticity perceptions.

Conclusion:

This study contributes to the growing body of research on artificial intelligence in marketing by empirically examining how **AI-generated social media content influences brand authenticity through consumer engagement**. Using a Structural Equation Modeling approach and data from active social media users, the study establishes that AI-generated content attributes play a significant role in driving engagement, which in turn enhances perceptions of brand authenticity. The findings confirm that **consumer engagement is the central psychological mechanism** linking AI-generated content attributes to brand authenticity, thereby validating the applicability of the **S–O–R framework** in AI-mediated social media contexts. Importantly, the results demonstrate that AI-driven marketing communication, when strategically designed, can support rather than undermine authentic brand–consumer relationships. From a theoretical perspective, this study advances marketing literature by integrating AI-generated content, consumer engagement, and brand authenticity into a single, parsimonious model. It moves beyond efficiency- and performance-centric views of AI marketing and highlights its implications for long-term brand equity. From a managerial standpoint, the findings suggest that brands should focus on **enhancing personalization, creativity, and informativeness** in AI-generated content while **maintaining transparent communication about AI use**. Rather than concealing AI involvement, strategic disclosure can strengthen engagement and reinforce brand authenticity. Despite its contributions, the study is subject to certain limitations. The cross-sectional design restricts causal inference, and the findings are based on self-reported perceptions within a social media context. Future research may adopt longitudinal or experimental designs, explore platform-specific effects, or examine cultural differences in consumer responses to AI-generated content.

In conclusion, this research demonstrates that **AI-generated social media content, when thoughtfully designed and transparently communicated, can effectively engage consumers and enhance brand authenticity**, offering valuable insights for both scholars and practitioners navigating the evolving landscape of AI-driven marketing communication.

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A Study on AI in Education: Ethical Challenges for Educational Stakeholders

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Abstract:

This study examines ethical challenges associated with implementing Artificial Intelligence (AI) in education across multiple stakeholder groups, including students, educators, administrators, and policymakers. It explores issues such as data privacy, algorithmic bias, transparency, academic integrity, and equity in access to AI tools. Drawing on recent empirical and conceptual research, the study investigates stakeholder perceptions, policy gaps, and ethical decision-making frameworks. Results aim to inform ethical guidelines that enhance responsible AI integration in learning environments, promote inclusivity, and safeguard educational integrity while enabling innovation and learner support.

Introduction:

Artificial Intelligence (AI) has emerged as a transformative force in modern workplaces, offering capabilities that range from automating repetitive tasks to enhancing complex decision-making (Davenport & Ronanki, 2018; Brynjolfsson & McAfee, 2014). Organizations across industries are increasingly implementing AI systems to improve operational efficiency, reduce costs, and gain competitive advantages (Raisch & Krakowski, 2021). However, the success of these implementations is not solely dependent on technology; it is equally contingent upon how employees perceive and interact with AI (Venkatesh et al., 2003).

Employee perceptions play a critical role in shaping the adoption, resistance, and trust of AI systems (Brougham & Haar, 2018). While some employees may embrace AI as a valuable tool that simplifies work processes, others may resist due to fears of job displacement ack of understanding, or mistrust in machine-driven decisions (Brynjolfsson & McAfee, 2014). Such attitudes can significantly affect the overall effectiveness of AI deploymentt, potentially hindering productivity gains and innovation (Raisch & Krakowski, 2021).

Despite the growing prevalence of AI in organizations, existing research predominantly focuses on technical efficiency, organizational performance, or managerial perspectives, often overlooking the human dimension of AI adoption (Brougham & Haar, 2018). Understanding employees' experiences, concerns, and attitudes is essential for creating strategies that encourage acceptance and reduce resistance (Venkatesh et al., 2003).

This study, therefore, seeks to investigate employee perceptions of AI in the workplace, with a specific focus on the interplay between adoption, resistance, and trust. By examining these factors, the research aims to provide actionable insights for organizations to design AI systems and implementation strategies that are both technologically effective and socially acceptable, ultimately facilitating a smoother transition to AI-enhanced work environments (Raisch & Krakowski, 2021).

Objectives:

1. To identify key ethical challenges associated with AI integration in education.
2. To analyze stakeholders' perceptions (students, educators, administrators) about AI ethics.
3. To evaluate institutional policies and preparedness for ethical AI use.
4. To develop recommendations for ethical frameworks and guidelines for AI in education.

Research Methodology:

Design & Approach: This study will adopt a Quantitative-methods approach combining quantitative surveys. Quantitative analysis will measure stakeholder perceptions using validated scales to explore deeper ethical concerns.

Sampling & Participants: Stratified random sampling will include academic staff, and students of higher education.

Sample Size: 53

Data Collection Instruments: Structured questionnaires (5-point Likert scale) for stakeholders.

Data Analysis: Quantitative data will be analyzed using inferential statistics (e.g., ANOVA, regression).

Hypotheses:

1. H1: Stakeholders perceive significant ethical risks in AI applications related to data privacy.
2. H2: There is a positive relationship between AI literacy and ethical awareness among educators.
3. H3: Students with higher academic integrity orientation report lower acceptance of unethical AI use.

Review of Literature:

- Pandey (2025) identifies trust, transparency, and algorithmic bias as central ethical issues for educators and researchers.
- Bui (2025) emphasizes the importance of data privacy, fairness, and user responsibility in Education 5.0 contexts.
- Parra et al. (2024) highlight algorithmic bias, privacy risks, and equity concerns associated with AI in education systems and advocate ethical frameworks for responsible integration.
- Lim et al. (2025) empirically validate ethical frameworks for AI assessments, reflecting growing academic interest in student perspectives on ethical AI use.
- Panagiotou (2025) proposes a conceptual framework linking AI literacy with ethical and inclusive education models.
- Pandey's (2025) empirical study highlights educators' and researchers' concerns about AI transparency, trust, and algorithmic bias in teaching–learning tools, revealing a sizable gap in stakeholder familiarity with AI systems and ethical awareness.
- Mehmood (2025) discusses how algorithmic bias can replicate social inequities and how privacy concerns arise from extensive student data collection. The study calls for equitable and inclusive AI design and robust policies protecting sensitive information.
- A multi-stakeholder study (2025) finds that acceptance and trust in AI applications vary across students, teachers, and parents, driven by perceptions of fairness, global utility, and confidence that are shaped by AI transparency and explainability.
- A cross-sectional study at the University of Jordan reveals ethical gaps in academic staff's knowledge and preparedness for AI use, underlining the need for clearer ethical

guidelines and institutional support in addressing issues such as academic integrity and algorithmic errors.

- A recent systematic review on AI ethics and governance in education (2025) identifies privacy/data protection, algorithmic fairness, transparency, student well-being, and human oversight as key areas of ethical concern, yet notes a lack of unified ethical frameworks guiding implementation.
- A literature synthesis focused on educators reveals persistent trust issues with generative AI adoption in higher education, particularly due to "black box" concerns and insufficient institutional strategies enhancing teacher trust and competence.
- Research in Journal of Academic Ethics (2025) argues that generative AI can mislead students and foster academic breaches if institutions don't enforce clear standards on AI use, data security, and research integrity.
- Studies on student perceptions show varied levels of agreement with ethical norms around generative AI use, suggesting that student beliefs about integrity and responsible usage influence how they engage with AI tools.
- A systematic review of AI assessment research (2026) reports that fairness and transparency remain core ethical dimensions, alongside governance practices needed to maintain assessment integrity and learner-centered outcomes.
- Framework proposals from secondary education research emphasize algorithmic transparency, data protection, access equity, digital literacy, and teacher involvement as critical components of responsible AI integration.

Data Analysis:

1. Anova for Hypothesis 1:

H1: Stakeholders perceive significant ethical risks in AI applications related to data privacy.

Anova: Single Factor
SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
I believe that the data used by AI systems is adequately protected	53	131	2.471698	1.330914
AI systems in education collect more data than necessary.	53	120	2.264151	0.967344
I am confident about how my personal data is stored when using AI tools.	53	155	2.924528	1.263425
I worry about unauthorized access to data used by AI in education	53	113	2.132075	0.693759
Data privacy concerns affect my willingness to use educational AI.	53	130	2.45283	0.906386

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	19.14717	4	4.786792	4.636721	0.001243	2.406362
Within Groups	268.4151	260	1.032366			
Total	287.5623	264				

Source: Primary Data

The one-way ANOVA analysis reveals a statistically significant difference among the mean responses to statements related to data privacy and AI in education ($F = 4.64$, $p = 0.001 < 0.05$). Because the calculated F-value is greater than the critical value (2.41), the null hypothesis is rejected. This confirms that stakeholders hold differing and meaningful perceptions regarding data privacy risks in AI applications.

The variation in mean scores indicates that while some respondents express moderate confidence in how their personal data is stored, there is also noticeable concern about excessive data collection, unauthorized access, and the impact of privacy concerns on their willingness to use AI tools. Overall, the results support demonstrating that stakeholders perceive significant ethical risks related to data privacy in educational AI systems.

Regression Analysis of Hypothesis 1

H1: Stakeholders perceive significant ethical risks in AI applications related to data privacy.

SUMMARY OUTPUT

Regression Statistics

Multiple R	0.654558
R Square	0.428447
Adjusted R Square	0.41724
Standard Error	0.244191
Observations	53

ANOVA

	df	SS	MS	F	Significance F
Regression	1	2.279659	2.279659	38.23049	1.06E-07
Residual	51	3.041096	0.059629		
Total	52	5.320755			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	2.369863	0.085024	27.87296	1.56E-32	2.199171	2.540555	2.199171	2.540555
Educational qualification	-0.28767	0.046526	-6.18308	1.06E-07	-0.38108	-0.19427	-0.38108	-0.19427

Source: Primary Data

The regression analysis for Hypothesis 1 indicates that educational qualification is a significant predictor of stakeholders' perceptions of ethical risks in AI data privacy ($\beta = -0.288$, $P < 0.001$). The model explains 42.8% of the variance ($R^2 = 0.428$), showing that stakeholders with higher educational qualifications tend to perceive lower ethical risks, suggesting greater confidence or familiarity with AI data practices among more educated individuals.

Anova table for Hypothesis 2:

H2: There is a positive relationship between AI literacy and ethical awareness among educators.

Anova: Single Factor

SUMMARY

Groups	Count	Sum	Average	Variance
I understand the basic functioning of AI used in education.	53	113	2.132075	0.770682
I have received training on ethical concerns related to AI.	53	152	2.867925	1.193759
My institution provides support for improving AI literacy.	53	134	2.528302	1.061684
Higher AI literacy increases my confidence in using AI.	53	116	2.188679	0.886792
I regularly apply ethical principles when selecting AI tools.	53	128	2.415094	0.901306

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	18.47547	4	4.618868	4.797106	0.000948	2.406362
Within Groups	250.3396	260	0.962845			
Total	268.8151	264				

Source: Primary Data

The ANOVA results for Hypothesis 2 show a significant relationship between AI literacy and ethical awareness among educators (F = 4.80, P = 0.00095 < 0.05). This indicates that trainings with higher AI literacy tend to exhibit greater ethical awareness when using AI tools, highlighting the importance of training and institutional support in promoting responsible AI.

Regression Analysis for Hypothesis 2

H2: There is a positive relationship between AI literacy and ethical awareness among educators.

SUMMARY OUTPUT

Regression Statistics

Multiple R	0.282553
R Square	0.079836
Adjusted R Square	0.061794
Standard Error	0.998037
Observations	53

ANOVA

	df	SS	MS	F	Significance F
Regression	1	4.407547	4.407547	4.4249	0.04037
Residual	51	50.8	0.996078		
Total	52	55.20755			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	3.2	0.347502	9.208587	1.98E-12	2.502361	3.897639	2.502361	3.897639
Educational qualification	-0.4	0.190155	-2.10354	0.04037	-0.78175	-0.01825	-0.78175	-0.01825

Source: Primary Data

The regression analysis for Hypothesis 2 indicates that educational qualification has a significant, though modest, effect on ethical awareness among educators regarding AI (β = -0.4, P = 0.040). The model explains 8% of the variance ($R^2 = 0.08$), suggesting that while higher qualifications slightly influence ethical awareness, other factors also contribute substantially to educators' ethical understanding of AI.

Anova for Hypothesis 3

H3: Students with higher academic integrity orientation report lower acceptance of unethical AI use

Anova: Single Factor

SUMMARY

Groups	Count	Sum	Average	Variance
Academic integrity influences my attitude toward AI tools.	53	130	2.45283	0.906386
I believe AI should be used only for learning, not for answering exams.	53	114	2.150943	1.015239
My institution enforces penalties for unethical AI usage.	53	146	2.754717	0.95791
I would report about peers to the higher authorities who are using AI unethically.	53	119	2.245283	0.765602

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	11.372643		3.790881	4.159931	0.006891	2.64801
Within Groups	189.5472208		0.911284			
Total	200.9198211					

Source: Primary Data

The ANOVA results for Hypothesis 3 indicate a significant effect of academic integrity orientation on students' acceptance of unethical AI use ($F = 4.16$, $P = 0.0069 < 0.05$). This shows that students with a stronger commitment to academic integrity are less likely to accept or engage in unethical use of AI, highlighting the role of integrity in guiding responsible AI behavior in educational settings.

Conclusion:

The analyses indicate significant relationships between education, AI literacy, and ethical behavior in educational settings. Stakeholders' perceptions of ethical risks in AI data privacy vary, with higher educational qualifications associated with lower perceived risks. Educators with greater AI literacy tend to exhibit higher ethical awareness, though other factors also influence their understanding. Similarly, students with stronger academic integrity are less likely to accept or engage in unethical use of AI. Overall, these findings highlight that education, AI literacy, and integrity play a key role in promoting responsible and ethical use of AI in education.

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The Role of Artificial Intelligence in the Growth of Over the Top Platforms

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Abstract:
Purpose: *The rapid expansion of Over-The-Top (OTT) platforms has been significantly influenced by advancements in Artificial Intelligence (AI). This study aims to examine the role of AI in the growth of OTT platforms, with specific emphasis on content personalization, user experience, audience engagement, and subscription retention.*
Methodology: *The study adopts a descriptive research design. Primary data were collected through a structured questionnaire based on a five-point Likert scale. A total of 70 respondents participated in the survey. The collected data were further analyzed using a One sample t-test.*
Findings: *The findings reveal that AI-driven recommendation systems significantly enhance content discovery and viewing satisfaction among OTT users. Personalized suggestions, targeted notifications, and AI-based insights were found to positively influence user engagement and subscription continuity. The study also indicates a generally high level of trust among users regarding the use of AI in managing viewing preferences, thereby contributing to the sustained growth and competitiveness of OTT platforms.*

Keywords: Artificial Intelligence, OTT Platforms, Content Personalization, User Experience, Digital Entertainment.

Introduction:

The rapid growth of Over-The-Top (OTT) platforms has transformed the digital entertainment landscape by enabling users to access audio-visual content anytime and anywhere through internet-based services. Factors such as increased smartphone penetration, high-speed internet connectivity, and changing consumer viewing preferences have accelerated the adoption of OTT platforms. In a highly competitive market, OTT service providers continuously seek innovative technologies to enhance user experience, improve content delivery, and retain subscribers.

Artificial Intelligence (AI) has emerged as a critical technological enabler supporting the growth of OTT platforms. AI-driven systems facilitate personalized content recommendations, improved content discovery, targeted advertising, and data-driven decision-making in content production and acquisition. By analyzing user behavior and preferences, AI enhances viewer engagement and satisfaction while contributing to operational efficiency and subscription retention. Despite the widespread application of AI in OTT services, limited empirical research focuses on understanding user perceptions of AI-enabled features and their influence on platform growth. This study aims to examine the role of Artificial

Intelligence in enhancing user experience and driving the sustained growth of OTT platforms.

Research Question:

How does Artificial Intelligence influence the growth of OTT platforms ?

Research Objectives:

1. To examine the impact of AI-based personalization and recommendation systems on user experience in OTT platforms.
2. To analyze the role of Artificial Intelligence in influencing audience engagement and subscription retention on OTT platforms.
3. To evaluate users' perceptions of AI-driven content quality, diversity, and content discovery on OTT platforms.
4. To assess the overall contribution of Artificial Intelligence to the growth, competitiveness, and future adoption of OTT platforms.

Review of Literature:

1. **Davenport, Guha, Grewal, and Bressgott (2020)** examined how AI applications influence organizational performance in digital businesses, including media and entertainment platforms. Their study revealed that predictive analytics and automation improve content acquisition strategies, reduce operational costs, and support targeted advertising models. AI-driven insights allow OTT platforms to optimize investments in original content and improve revenue generation through personalized advertising.
2. **Kumar and Sharma (2021)** explored the impact of AI on consumer behavior in digital streaming services and found that AI-based features positively influence user trust and continued usage intentions. The study indicates that users perceive AI-enabled platforms as more responsive and efficient, leading to higher satisfaction levels. However, the authors also highlight concerns related to data privacy and algorithmic transparency, suggesting the need for responsible AI implementation. Overall, existing literature confirms that AI significantly contributes to the growth, efficiency, and sustainability of OTT platforms while shaping future digital entertainment ecosystems.

Methodology:

For the purpose of data collection, a questionnaire has been drafted to collect responses. The sample size collected is of 70 respondents. The responses will be further analysed by using One Sample t test.

Scope of Study:

The study's scope is limited to the city of Thane, Mumbai and Navi Mumbai.

Limitations of Study:

As the area of research was limited to Thane, Mumbai and Navi Mumbai only the conclusions derived may not be applicable to other areas.

One Sample t-test:

Objective:

To study the role of Artificial Intelligence on the growth of Over the top platforms.

H0: Artificial Intelligence has no significant impact on the growth of Over the top platforms **(μ =3)**

H1: Artificial Intelligence has a significant impact on the growth of Over the top platforms. **($\mu \neq 3$)**

As the data is primary, the confidence level is assumed at 95% and so the significance level α is at 5% or 0.05. As hypothesis is non

directional (two-sided), so the level of significance is divided by 2, thus 5/2= 2.5% or 0.025. α : 0.05 (non-directional : 0.05/ 2= 0.025)

To identify the positive or negative impact of artificial intelligence on the growth of over-the-top platforms, the table of One sample t-test will be referred to.

α : 0.05 (non-directional : 0.05/ 2= 0.025)

Table 1: Table of One Sample t test

Variables	p-value	Result
AI-based recommendations on OTT platforms accurately match my viewing preferences.	< .001	Reject HO
Personalized content suggestions encourage me to spend more time on OTT platforms.	< .001	Reject HO
AI makes content discovery on OTT platforms easier and faster.	< .001	Reject HO
The user interface of OTT platforms improves due to AI-driven features.	< .001	Reject HO
AI helps OTT platforms offer content that aligns with audience interests.	< .001	Reject HO
AI-driven insights improve the quality of original content on OTT platforms.	< .001	Reject HO
AI contributes to greater diversity in content genres and formats on OTT platforms.	< .001	Reject HO
AI-powered notifications and alerts increase my engagement with OTT platforms.	< .001	Reject HO
AI-based personalization influences my decision to continue OTT subscriptions.	< .001	Reject HO
AI features enhance my overall satisfaction with OTT platforms.	< .001	Reject HO
AI-based advertisements on OTT platforms are relevant to my interests.	< .001	Reject HO
Targeted advertising powered by AI improves my viewing experience.	< .001	Reject HO
I trust AI-based systems used by OTT platforms to handle my viewing preferences responsibly.	< .001	Reject HO

Note. H_a $\mu \neq 3$

Interpretation:

From the above table it can be observed that the p-value for all the factors is less than α/2 hence, leading to rejection of Null hypothesis we accept the alternate hypothesis and conclude that artificial intelligence has a significant impact on the growth of Over the top platforms.

One sample statistic will be referred to identify the positive or negative perception of respondents for the same

Table 2: Table of One sample Statistic for Over the top Entertainment Platforms

Variables	N	Mean	Perception
AI-based recommendations on OTT platforms accurately match my viewing preferences.	70	4.14	Positive
Personalized content suggestions encourage me to spend more time on OTT platforms.	70	4.04	Positive
AI makes content discovery on OTT platforms easier and faster.	70	4.16	Positive

The user interface of OTT platforms improves due to AI-driven features.	70	4.24	Positive
AI helps OTT platforms offer content that aligns with audience interests.	70	4.19	Positive
AI-driven insights improve the quality of original content on OTT platforms.	70	4.14	Positive
AI contributes to greater diversity in content genres and formats on OTT platforms.	70	4.10	Positive
AI-powered notifications and alerts increase my engagement with OTT platforms.	70	4.70	Positive
AI-based personalization influences my decision to continue OTT subscriptions.	70	4.47	Positive
AI features enhance my overall satisfaction with OTT platforms.	70	4.50	Positive
AI-based advertisements on OTT platforms are relevant to my interests.	70	4.62	Positive
Targeted advertising powered by AI improves my viewing experience.	70	4.40	Positive
I trust AI-based systems used by OTT platforms to handle my viewing preferences responsibly.	70	4.17	Positive

Findings:

The analysis indicates an overall positive perception of Artificial Intelligence among OTT platform users, as all variables recorded mean values above 4.00. This reflects strong agreement regarding the effectiveness of AI-driven features in enhancing user experience and platform performance.

AI-based recommendations, content discovery, and user interface improvements were highly appreciated by respondents, indicating that AI significantly simplifies navigation and aligns content with viewer preferences. Users also agreed that AI improves content quality, diversity, and relevance, supporting data-driven content strategies adopted by OTT platforms.

Engagement and retention-related factors showed the strongest impact. AI-powered notifications, personalization, and satisfaction levels recorded the highest mean scores, highlighting AI's role in increasing user engagement and subscription continuity. Additionally, respondents perceived AI-based advertising as relevant and beneficial, and expressed a high level of trust in AI systems. Overall, the findings confirm that Artificial Intelligence plays a crucial role in driving the growth and competitiveness of OTT platforms.

Conclusions:

The study concludes that Artificial Intelligence plays a significant role in the growth and success of OTT platforms. The findings demonstrate that AI-driven features such as personalized recommendations, efficient content discovery, and improved user interface design substantially enhance user experience and satisfaction. High mean scores across all variables indicate strong user acceptance of AI-enabled services, particularly in areas related to engagement, subscription retention, and content relevance.

Furthermore, the study confirms that AI-powered notifications, targeted advertising, and data-driven insights positively influence audience engagement and viewing behavior. Users also expressed a high level of trust in AI systems managing their viewing preferences responsibly. Overall, the research establishes that Artificial Intelligence is a key technological enabler that strengthens competitiveness, supports sustainable

growth, and shapes the future of OTT platforms in the digital entertainment ecosystem.

Recommendations:

1. OTT platforms should continue to invest in advanced AI-driven recommendation systems to further enhance personalization and improve content discovery for users.
2. AI-powered engagement tools such as notifications and alerts should be optimized carefully to maintain user interest without causing fatigue.
3. Streaming service providers should leverage AI insights to improve content quality and expand diversity in genres and regional offerings.
4. Platforms must ensure transparency and ethical use of AI to strengthen user trust, particularly in data handling and personalized advertising practices.
5. Continuous enhancement of AI-driven user interfaces and targeted advertising strategies is recommended to improve user satisfaction and long-term subscription retention.

Future Scope for Research:

Future research may expand the scope of the present study by increasing the sample size and including respondents from diverse geographical regions to improve the generalizability of findings. Comparative studies between urban and rural users, different age groups, or socio-economic segments could provide deeper insights into varying perceptions of AI-driven features on OTT platforms.

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To Study the Influence of Online Reviews and Ratings on QSR Brand Image

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Abstract:
Purpose: *The brand image is considered the primary factor affecting consumer choice because of the high competition in the Quick Service Restaurant (QSR) industry. Consumer perceptions and eating preferences are becoming a powerful source of information affected by the internet due to increased utilization of digital platforms in online trials and ratings. Prior to selecting a QSR, the customers typically use the web-based platform such as Google reviews, Zomato, and Swiggy to evaluate the quality of the food, the service standard, the hygiene status, and the overall experience.*

This research is aimed at investigating how online reviews and online ratings affect the brand image of Quick Service Restaurants. The paper is aimed at comprehending the impact of online feedback on consumer trust, brand perception, purchase intention, and brand switching. The results will be useful in forming the valuable insights that QSR operators can use to address the challenge of online reputation management and enhance brand perception that will help them compete better in a more digital market.
Methodology: *The research relies on primary data that is obtained with the help of a structured questionnaire that will help to capture consumer perceptions about online reviews and ratings of QSRs. The questionnaire also has demographic variables and Likert scale statements to understand the effects of online reviews on the brand image and decision-making.*

The study was chosen to include 60 respondents. The data was analyzed with the help of statistical tools like One Sample t-test to define the importance of the online reviews and ratings on QSR brand image.

Keywords: Online Reviews, Online Ratings, Brand Image, Consumer Perception, Quick Service Restaurants (QSRs).

Introduction:

The Quick Service Restaurant (QSR) industry has experienced significant growth due to changing consumer lifestyles, urbanization, increased internet penetration, and the rising demand for convenience and affordability. In today's digital era, consumers no longer rely solely on traditional advertising or personal recommendations; instead, online reviews and ratings have become a dominant factor shaping brand image and consumer trust.

Online platforms allow customers to share their dining experiences instantly, influencing the opinions of potential customers. Positive reviews enhance a QSR's brand image by building credibility and trust, whereas negative reviews can damage reputation and discourage visits. For price-sensitive and time-constrained consumers, online ratings act as a quick indicator of quality, hygiene, and service reliability.

In today's highly competitive nature of the QSR sector, managing online reputation has become essential. Understanding how online

reviews and ratings influence brand image helps QSRs improve service quality, respond effectively to customer feedback, and maintain a favourable market position.

Online Reviews and Ratings in Quick Service Restaurants:

Online Customer Reviews: Online reviews represent detailed feedback shared by customers regarding their dining experiences. These reviews influence consumer perceptions related to food quality, service speed, staff behaviour, cleanliness, and value for money. Detailed reviews are often perceived as more trustworthy, especially when they are recent and consistent.

Online Ratings: Ratings provide a numerical summary of customer satisfaction and serve as a quick decision-making tool. Higher ratings enhance brand credibility and increase the likelihood of customer visits, while lower ratings can negatively impact brand image and reduce footfall.

Trust and Credibility: Consumers tend to trust peer-generated content more than traditional advertisements. A QSR with consistently positive reviews and high ratings is perceived as reliable and customer-oriented, strengthening its brand image.

Electronic Word of Mouth (e-WOM): Online reviews and ratings together form e-WOM, which spreads rapidly and influences a large audience. Compared to traditional advertising, e-WOM is considered more credible as it is generated by actual consumers.

Influence on Purchase Decision: Online reviews significantly affect consumer purchase intentions. Many consumers avoid QSRs with negative reviews and prefer those with higher ratings, even if they are unfamiliar with the brand.

Brand Switching Behaviour: Attractive reviews and ratings can encourage consumers to switch from their preferred QSR to another brand offering better online feedback, highlighting the competitive importance of digital reputation.

Research Question:

- How do online reviews and ratings influence the brand image of Quick Service Restaurants (QSRs)?

Research Objectives:

1. To examine the impact of online reviews on the brand image of Quick Service Restaurants.
2. To study the influence of online ratings on consumer trust and brand perception.
3. To analyse the role of online reviews and ratings in QSR selection and brand switching behaviour.
4. To assess whether online reviews influence consumers more than traditional brand reputation.

Review of Literature:

Suwasna Bhandari Jaishi, Shrijan Gyanwali, Santosh Kumar Gurung and Bandana Thapa in their research paper titled **"Influence of Online Review Attributes on Customers' Choice of Restaurants"** stated that digital technology has transformed customer behaviour, particularly in the hospitality sector, with online reviews significantly influencing restaurant choices. However, there remains a lack of empirical evidence on how online reviews influence customer choice of restaurants in Nepal. Therefore, drawing on the information adoption model, this study aims to examine the attributes of online reviews influencing customers' choice of restaurants in Pokhara, Nepal. Using a cross-sectional descriptive design, data were collected from 209 respondents via convenience and snowball sampling. The multiple regression analysis demonstrated three online review attributes (descriptiveness of reviews (β = 0.252,

$p < 0.05$), service quality ($\beta = 0.202$, $p < 0.10$), and ambience of the restaurant ($\beta = 0.198$, $p < 0.05$) influencing customers' choice of restaurants. However, online review attributes such as overall ratings, number of reviews price, and food and beverage image had no significant effect on customers' choice. These findings suggest that when choosing restaurants, customers place greater emphasis on qualitative aspects like review content, service experience, and dining atmosphere.

Bui Thanh Khoa in his research paper titled **"Trust Based Online Food Review toward Customers' Restaurant Selection Intention in Food and Beverage Service"** examined that information technology had brought many advantages to daily consumption activities, especially when social networks were born. Social networking sites have become a new and modern tool for diners to choose restaurants and food services in Food and Beverage Service (F&B). This study aimed to find the relationship between the online food review communities' characteristics with trust and customers' restaurant selection intention. Mix method research was done to archive the research objective. The research results pointed out that four characteristics of online food review communities, including, Expertness, Trustworthiness, Objectivity, Homophily, positively impacted customer trust, which has positively led to the restaurant selection intention in F&B. Some managerial implications were proposed to the managers in the F&B to improve customer trust and restaurant selection intention.

Sarah Mohammad Saleem and Sarah Anjum in their research paper titled **"Emerging Influence of online Reviews on Antecedents and Consequence of Consumer-based Brand Equity in Restaurant Industry of Karachi, Pakistan"** explores the emerging influence of online reviews on the antecedents and consequences of consumer-based brand equity in the restaurant industry of Pakistan. The main antecedents of consumer-based brand equity considered in the study include brand preference, brand image, and brand attitude. The study uses a quantitative research approach and collects data from a sample of 300 consumers who have visited a restaurant. For the analysis of the data and testing of hypotheses, partial least square structural equation modelling (SEM) was employed as a technique for analyzing the data and testing hypothesis. In the restaurant industry of Karachi, online reviews significantly influence consumer-based brand equity antecedents and consequences. Specifically, online reviews positively affect brand preference, brand attitude, and brand image. The study's findings have important implications for restaurants operating in Pakistan and other similar markets. Enhancing consumer-based brand equity requires restaurants to maintain high levels of brand preference, develop strong brand attitudes, and promote positive brand images. They should also actively monitor and manage online reviews to mitigate negative reviews' potential impact on consumer brand equity and highlight the need for restaurants to develop and implement effective strategies for managing online reviews to enhance their brand equity and improve customer preferences.

Methodology:

The study is based on primary data collected through a structured questionnaire. The sample size for the study is 60 respondents who frequently consume food from QSRs. The data is analysed using descriptive statistics and One Sample t-test to test the significance of online reviews and ratings on brand image.

Scope of the Study:

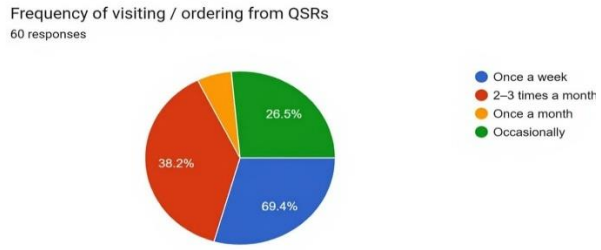
The study focuses on understanding the influence of online reviews and ratings on QSR brand image with reference to consumer trust, preference, satisfaction, and switching behaviour. The study is limited to selected QSR consumers and digital platforms.

Limitations of the Study:

This study has a few limitations that should be considered while understanding the results. The study is conducted with a small number of respondents, which may not fully represent the views of a larger population. The responses collected are based on consumers' personal opinions and experiences, so there is a possibility of bias. Additionally, the study is limited to a specific geographical area, and therefore the findings may not be applicable or generalised to other regions or populations.

Data Analysis and Interpretation:

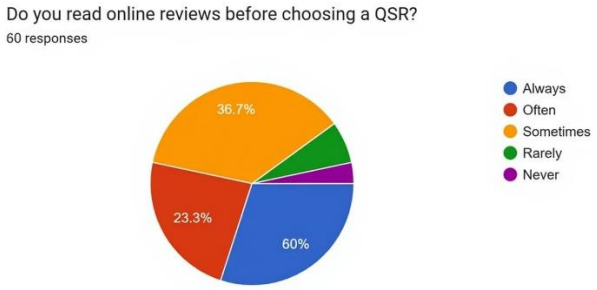
1. **Frequency of visiting / ordering from QSRs.**



Findings and Interpretations:

Based on the provided chart, the frequency of visiting or ordering from Quick Service Restaurants shows that 2–3 times a month is the most common pattern, reported by 38.2% of respondents. This is followed by once a week, with 29.4% of consumers indicating regular engagement with QSRs, highlighting their importance in routine dining habits. Occasional visits account for 26.5% of responses, suggesting a sizeable group of consumers who use QSRs on a need-based or leisure basis rather than regularly. In contrast, once a month is the least preferred frequency, chosen by only 5.9% of respondents, indicating limited reliance on QSRs among this segment. Overall, the findings suggest that a majority of consumers interact with QSRs at least a few times each month, reflecting their strong presence in contemporary food consumption patterns.

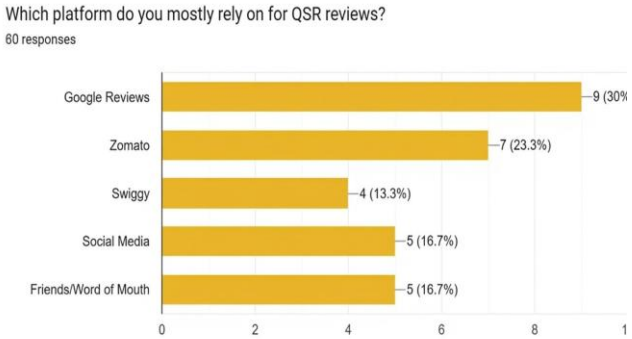
2. **Do you read online reviews before choosing a QSR?**



Findings and Interpretations:

Based on the chart, most consumers consult online reviews before choosing a QSR. Sometimes reading reviews is the most common behavior (36.7%), followed by those who always do so (30%) and those who often read reviews (23.3%). Only a small proportion rarely (6.7%) or never (3.3%) consult online reviews. Overall, the findings indicate that online reviews play an important role in QSR selection for the majority of consumers.

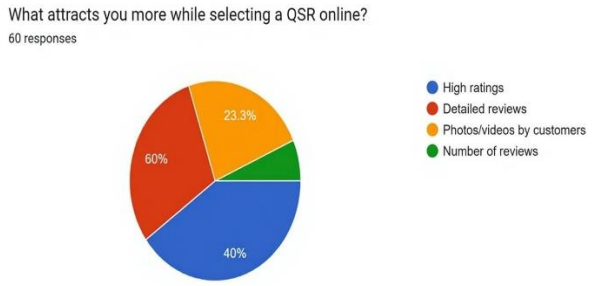
3. **Which platform do you mostly rely on for QSR reviews?**



Findings and Interpretations:

Based on the chart, Google Reviews is the most relied-upon platform for QSR reviews, used by 30% of respondents. This is followed by Zomato at 23.3%, indicating its strong role in influencing dining decisions. Social media and friends/word of mouth are equally relied upon, each accounting for 16.7% of responses, highlighting the importance of peer opinions and digital engagement. In contrast, Swiggy is the least relied platform at 13.3%. Overall, the findings show that dedicated review platforms, particularly Google Reviews, play a dominant role in shaping consumer perceptions of QSRs.

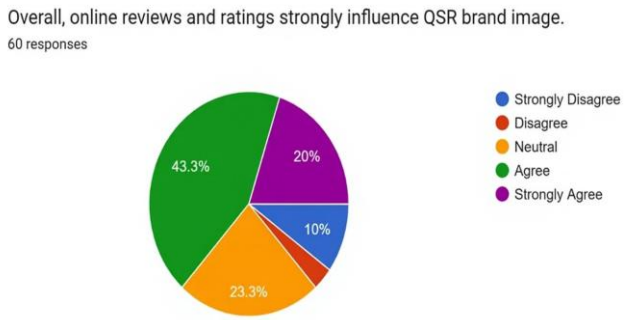
4. **What attracts you more while selecting a QSR online?**



Findings and Interpretations:

Based on the chart, high ratings are the most influential factor when selecting a QSR online, cited by 40% of respondents. This is followed by detailed reviews at 30%, indicating the importance of in-depth customer feedback in shaping perceptions. Photos and videos shared by customers attract 23.3% of consumers, highlighting the role of visual content in building trust. In contrast, the number of reviews is the least influential factor, selected by only 6.7% of respondents. Overall, the findings suggest that quality indicators such as ratings and detailed feedback outweigh quantity-based measures when consumers choose a QSR online.

5. ***Overall, online reviews and ratings strongly influence QSR brand image.***



Findings and Interpretations:

Based on the chart, a clear majority of respondents acknowledge the strong influence of online reviews and ratings on QSR brand image. Agree accounts for the largest share at 43.3%, followed by strongly agree at 20%, indicating a strong positive consensus. Neutral responses stand at 23.3%, suggesting some respondents remain undecided. In contrast, only a small proportion strongly disagree (10%) or disagree (3.3%). Overall, the findings confirm that online reviews and ratings significantly shape consumers' perceptions of QSR brand image.

One Sample t-test:

Objective: ***To study the influence of online reviews and ratings on the brand image of Quick Service Restaurants (QSRs).***

H0: Online reviews and ratings have no significant influence on the brand image of Quick Service Restaurants. ($\mu = 3$)

H1: Online reviews and ratings have a significant influence on the brand image of Quick Service Restaurants. ($\mu \neq 3$)

As the data is primary, the confidence level is assumed at 95% and so the significance level α is at 5% or 0.05. As hypothesis is non directional (two-sided), so the level of

significance is divided by 2, thus 5/2= 2.5% or 0.025. α : 0.05 (non-directional : 0.05/ 2= 0.025)

To identify significant difference in the perception of customers towards Online reviews and ratings on the brand image of Quick Service Restaurants the table of One sample t-test will be referred to.

Table 1: Table of One sample t-test

Variables	p-value	Results
Online reviews influence my perception of a QSR's brand image	< .001	Reject HO
High ratings increase my trust in a QSR brand	< .001	Reject HO
I avoid QSRs with negative online reviews	< .001	Reject HO
Positive reviews make me more willing to try a new QSR	< .001	Reject HO
Online reviews influence my food ordering decision	< .001	Reject HO
Overall, online reviews and ratings strongly influence QSR bran	< .001	Reject HO
Ratings are more important than brand name while choosing a QSR	< .001	Reject HO
I consider online reviews more reliable than advertisements	< .001	Reject HO
Online reviews reflect the actual quality of QSR services	< .001	Reject HO
Negative reviews reduce my loyalty towards a QSR brand	< .001	Reject HO
I switch QSR brands due to better online reviews and ratings	< .001	Reject HO

Note. H_a $\mu \neq 3$

Findings:

From the above table, it can be observed that the p-value for all the factors is less than α/2 (0.025). Hence, the null hypothesis is rejected and the alternative hypothesis is accepted, indicating that online reviews and ratings have a significant influence on the brand image and decision-making of consumers in Quick Service Restaurants (QSRs). To further understand whether this influence is positive or negative, the results of the one-sample t-test statistics will be referred to.

Table 2: Table of One sample t-test statistics

Variables	N	p-value	Results
Online reviews influence my perception of a QSR's brand image	60	4.00	Positive
High ratings increase my trust in a QSR brand	60	4.25	Positive
I avoid QSRs with negative online reviews	60	4.27	Positive
Positive reviews make me more willing to try a new QSR	60	4.28	Positive
Online reviews influence my food ordering decision	60	4.22	Positive
Overall, online reviews and ratings strongly influence QSR bran	60	4.18	Positive
Ratings are more important than brand name while choosing a QSR	60	4.10	Positive
I consider online reviews more reliable than advertisements	60	4.38	Positive
Online reviews reflect the actual quality of QSR services	60	4.13	Positive
Negative reviews reduce my loyalty towards a QSR brand	60	4.18	Positive
I switch QSR brands due to better online reviews and ratings	60	4.13	Positive

Findings:

From the above table, it is evident that the mean values for all the variables are greater than the test value of 3, indicating a positive perception among respondents. The sample size for each variable is 60, ensuring consistency in responses. The results show that online reviews and ratings positively influence consumers'

perception of a QSR's brand image, increase trust in QSR brands, and significantly affect food ordering decisions.

The findings further reveal that consumers tend to avoid QSRs with negative online reviews, while positive reviews motivate them to try new QSR brands. Respondents also perceive online reviews to be more reliable than advertisements and believe that such reviews reflect the actual quality of QSR services. Additionally, negative reviews are found to reduce brand loyalty, and many consumers are willing to switch QSR brands based on better online reviews and ratings. Overall, the study clearly indicates a strong and positive influence of online reviews and ratings on consumer behaviour and brand image in the Quick Service Restaurant sector.

Conclusion and Recommendation:

The study concludes that online reviews and ratings play a crucial role in shaping consumers' perceptions, trust, and decision-making in the Quick Service Restaurant (QSR) sector. The statistical analysis confirms that online reviews have a significant and positive influence on QSR brand image, food ordering decisions, and brand loyalty. Consumers rely heavily on reviews and ratings to judge service quality, prefer QSRs with higher ratings, and actively avoid brands with negative feedback. The findings also indicate that online reviews are considered more reliable than traditional advertisements, and many consumers are willing to switch QSR brands based on better online feedback. Overall, online reviews and ratings have emerged as a powerful factor influencing consumer behaviour in QSRs.

Based on the study findings, it is recommended that QSRs actively manage their online presence by regularly monitoring reviews and ratings across digital platforms. Encouraging satisfied customers to share positive feedback can help improve brand image and attract new customers. At the same time, negative reviews should be addressed promptly and professionally to minimize their impact on customer trust and loyalty. QSRs should focus on maintaining consistent food quality and service standards, as consumers perceive online reviews to reflect actual service quality. Effectively using positive reviews in marketing communication and engaging with customers online can further strengthen brand reputation and competitive advantage

Social Implications:

The findings of the study highlight the growing impact of online reviews and ratings on consumer behaviour and society at large. Online platforms empower consumers by giving them a voice to share their experiences and influence others' decisions, promoting transparency and accountability among Quick Service Restaurants (QSRs). This increased reliance on reviews encourages QSRs to maintain better quality standards, hygiene, and customer service, thereby improving overall consumer welfare. However, the strong influence of reviews can also lead to herd behaviour, where consumers may form opinions without personal experience, and negative or misleading reviews may unfairly affect a brand's reputation. Overall, online reviews and ratings play an important role in shaping consumer awareness, ethical business practices, and service quality in the QSR industry.

Future Scope for Research:

The present study offers several opportunities for future research. Further studies can be conducted with a larger sample size and

across different geographical regions to enhance the generalisability of the findings. Future research may also compare the influence of online reviews across different types of food service outlets such as cafés, fine-dining restaurants, and cloud kitchens. Additionally, researchers can examine the role of social media influencers, fake reviews, and review credibility in shaping consumer trust and decision-making. Longitudinal studies may be undertaken to understand how consumer perceptions change over time with evolving digital platforms. Future research can also explore demographic factors such as age, income, and lifestyle to gain deeper insights into variations in consumer responses to online reviews and ratings.

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Skill Development in India: Achievements and Challenges

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Abstract:

This paper evaluates the Skill India Mission (SIM) as a transformer framework designed to align India's demographic potential with the demands of a modernising economy. Utilising a descriptive research design based on secondary data from 2015 to 2025, the study examines the mission's trajectory through flagship schemes like PMKVY and NSDM. Key achievements include massive enrolment growth, exceeding 6.4 crore trainees, and a strategic shift toward Industry 4.0 technologies such as AI and Green Energy, supported by a ₹60,000 crore ITI modernisation plan.

However, the analysis identifies critical structural challenges, including a persistent skill-gap mismatch, low placement rates (18–21%), and significant regional disparities, with rural access remaining limited. The study concludes that while the mission has successfully built a massive institutional foundation, future success depends on transitioning from quantitative targets to qualitative, industry-led outcomes to achieve the vision of a self-reliant, globally competitive Viksit Bharat.

Keywords: Skill Development, SIM, Training, PMKVY, NSDM.

Introduction:

The Skill India Mission, inaugurated in 2015, functions as a transformative umbrella framework designed to align the capabilities of India's youth with the demands of a modernising economy. By consolidating diverse vocational programs, the initiative seeks to replace traditional educational gaps with industry-specific expertise in sectors ranging from banking and textiles to real estate and jewellery design. A central pillar of this mission is the National Skill Development Corporation (NSDC), which bridges the gap between public policy and private sector needs to boost national productivity. Beyond mere job placement, the mission fosters a culture of entrepreneurship and introduces specialised benchmarks like "Rural India Skill" to ensure inclusivity. Ultimately, it serves as a strategic intervention to convert India's demographic potential into a self-reliant, globally competitive workforce.

Importance of Skill Development:

Skill development is the cornerstone of India's socio-economic transformation, acting as a vital bridge between theoretical education and practical employability. In an era of rapid technological disruption, it equips the youth with market-relevant expertise, fostering a resilient workforce capable of driving national

productivity. Beyond individual job security, it nurtures an entrepreneurial mindset, enabling young Indians to become job creators rather than just job seekers. By aligning human capital with industry demands, skill development converts India's vast demographic potential into a tangible "demographic dividend," ultimately reducing unemployment, alleviating poverty, and accelerating the nation's journey toward a self-reliant, globally competitive economy.

Rationale of The Study:

Despite the extensive reach of the Skill India Mission, a gap persists between policy implementation and ground-level impact. This study is essential to evaluate how effectively these initiatives translate into actual employability. By analysing demographic influences like income, the research identifies systemic barriers, offering data-driven insights to OPTIMISE training strategies and maximise the mission's socio-economic benefits.

Review of Literature:

- **Arthur et al. (2003)** found that good training helps people learn both facts and how to do tasks. The best results come when training includes practice with feedback and happens over time. Training works best when it is similar to the actual job. This also helps companies get long-term benefits.
- **Mitra and Nagarajan (2005)** calculated the rank of the states regarding the growth of working-age capital in comparison to the growth of total population in all the states of India from 1961 to 2001. Referring to the window of opportunity which is open in India from 1980 and will close down by 2035, with the share of the working-age population declining further.
- **Burke & Hutchins (2007)** looked at 20 years of research and found a problem: only 10–40% of what people learn in training is used on the job. They say support from managers, chances to practice, and coaching after training help people apply skills at work.
- **Grossman & Salas (2011)** studied 95 papers and said that a person's motivation, how training is designed, and the work environment together affect whether skills are used. Supportive work climates help people keep using what they learned.
- **Chaitnya Talreja (2014)** mentioned the importance of the working population in the economic growth and development of a country. He wrote about population and supply of demographic dividend and tried to trace out how it can be a realm when taken into the context of the young population.
- **Esha Sharma and Sakshi Sethi (2015)** in their study entitled "Skill Development: Opportunities and Challenges in India" have analysed that India has witnessed rapid growth in recent years, driven by the development of new-age industries. Their main focus was on understanding challenges and opportunities available under these skill initiatives.
- **Jag Prasad Verma (2016)** carried out the study titled, "Need and Challenges: Skill development in India" The paper attempted to study the present skill capacity, challenges in front of skill development initiatives in India, along with their solutions.
- **Arushi (2016)** explained Kremers' hypothesis on demographic dividend relating to youth employability and occupation. She suggested that higher education can play an important role in it, as it will increase learning abilities and the capacity of the learners
- **Zahra Afroz(2018)** gave broad views on population growth, employability, skills,

education level, and also programmes for development. The role of demographic dividend is very important, according to her, for the economic growth and development of a country.

- **Rajani and Manoj (2019)** carried descriptive study on skill programmes and their role in reshaping India. The study was based on secondary data and showed the impact of various skill training programmes on employment level
- **Driskell & Dwyer (2021)**found that team training, like practising roles and coordination, improves team skills and leads to about 20% better performance.

Objectives of The Study:

1. To examine the major achievements of skill development initiatives in India.
2. To identify the key challenges faced in implementing skill development programs in India.

Significance of The Study:

This study is significant as it highlights the achievements and challenges of skill development initiatives in India. It helps understand their impact on employment generation, economic growth, and workforce readiness. The findings can assist policymakers, educators, and stakeholders in improving skill development strategies for inclusive and sustainable development.

Research Methodology:

- **Research design:** This is a descriptive study based on secondary data.
- **Sources of data:** This study is based on secondary data collected from government reports, policy documents, research articles, and official statistics. Secondary data helps in understanding existing trends, outcomes, and gaps in skill development initiatives in India, providing a reliable and cost-effective basis for analysis and interpretation

Data Analysis:

A) Achievement:

1. **Massive Enrollment Growth**: Since its inception, the mission has empowered over 6.4 crore Indians. Under the restructured "Skill India Programme" (2022–2026), PMKVY 4.0 alone has trained nearly 1.76 crore candidates. Notably, the National Apprenticeship Promotion Scheme (NAPS) reached a milestone of 49.12 lakh apprentices, reflecting a shift toward on-the-job training.
2. **Technological Expansion**: Training has transitioned to Industry 4.0, with a massive focus on AI, Robotics, and Green Energy. The PM-SETU scheme (₹60,000 crore) is currently upgrading 1,000 ITIs via a Hub-and-Spoke model. Digital access has been democratised through the Skill India Digital Hub (SIDH), which hosts over 7,100 multilingual courses.
3. **The expansion of training** under the Skill India Mission has evolved from traditional vocational trades to a high-tech, Industry 4.0 framework. A primary driver of this expansion is the PM-SETU scheme, a ₹60,000 crore initiative designed to modernise 1,000 Industrial Training Institutes (ITIs) into advanced "Hubs" for innovation. These centres now offer specialised training in cutting-edge domains such as Artificial Intelligence, Robotics, Green Energy, and Drone Technology.
4. Furthermore, **the mission has integrated** with the formal education system through thousands of Skill Hubs established in schools and colleges, aligning with the National Education Policy 2020. Digital

expansion via the Skill India Digital Hub (SIDH) provides access to over 7,100 multilingual courses, ensuring reach into remote areas. This geographical and sectoral scaling is complemented by international partnerships with countries like Japan and Germany, facilitating global mobility and ensuring Indian youth meet international competency standards.

5. **Regional progress**: In 2024-25, Thane district has emerged as a strategic skilling corridor in Maharashtra, anchoring the state's transition toward Industry 4.0. Central to this is the Maharashtra State Skills University (MSSU) Thane centre at Kopri, which offers unique 60% skill-based degree programs in IoT, AI, and Business Analytics, specifically targeting the district's economically aspirational youth.
6. The district boasts a high-density network including the Dharmaveer Anand Dighe Government ITI (Wagle Estate), which trains nearly 600 students annually across 13 trades, and the Government Institute of Training of Trainers (IToT) in Ambarnath. Through the District Skill Committee (DSC), Thane has decentralised it's planning to align with local industrial demand in Logistics (Bhiwandi) and Manufacturing (Ambarnath/Badlapur).

B) Challenges:

Despite substantial progress, the Skill India Mission faces several structural challenges that hinder its full impact as of 2026:

1. **Skill Gap and Mismatch**: There is a persistent disconnect between academic curricula and industry needs. Only about 42–54% of graduates are considered employable, with a critical shortage of talent in high-growth sectors like AI, Green Energy, and Semiconductors, where demand is projected to surge by 26% by 2027.
2. **Quality of Training**: Many training centres, including some ITIs, struggle with outdated equipment and a lack of certified trainers. Placement rates remain a concern; for instance, historical data for PMKVY shows a formal placement rate of approximately 18–21%, leading to "transactional" rather than "aspirational" skilling.
3. **Inclusiveness**: Social stigma persists, with vocational training often viewed as a "last resort" compared to formal degrees. Women face additional mobility and socio-cultural barriers, resulting in a Female Labour Force Participation (FLFP) rate that still lags significantly behind national targets.
4. **Regional Disparity**: Skilling infrastructure remains heavily urban-centric. While states like Maharashtra and Uttar Pradesh have vast networks, rural areas—home to the majority of the workforce—have limited access, with only 10% of the rural population receiving formal training.

Conclusion:

The Skill India Mission has successfully built a massive institutional framework, training over 6.4 crore youth and raising national employability to 56.35% by 2026. Schemes like PMKVY 4.0 and NAPS have bridged critical gaps in Industry 4.0 sectors, while digital initiatives like the Skill India Digital Hub have democratized access. However, the mission faces persistent structural challenges, including an 18-21% placement rate in short-term courses and significant regional disparities. To reach the vision of Viksit Bharat, the focus must now shift from quantitative certification to qualitative, industry-led outcomes, ensuring that training translates into dignified, high-wage employment for India's economically aspirational youth.

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How FinTech is Transforming Access to Financial Services Among the Unbanked Population in Thane District

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Abstract:

Financial inclusion has become a vital focus in India, especially in urban and semi-urban areas where certain segments of the population are either unbanked or underbanked. This research investigates the impact of Financial Technology (FinTech) on enhancing access to financial services for the unbanked demographic in the Thane district of Maharashtra. It delves into the contributions of digital payment platforms, mobile banking applications, micro-lending services, and Aadhaar-enabled payment systems in addressing the gaps left by traditional banking. By utilizing both primary data collected from surveys and interviews with unbanked individuals, as well as secondary data sourced from government and industry reports, the study pinpoints significant factors such as the rise in smartphone usage, government-led digital initiatives, and the accessibility of FinTech interfaces. Additionally, it underscores ongoing challenges, including barriers to digital literacy, concerns regarding cybersecurity, and unreliable internet connectivity. The results indicate that FinTech has markedly enhanced financial accessibility, convenience, and affordability for the unbanked population in Thane, facilitating increased engagement in savings, credit, and digital transactions. The study concludes that with focused digital literacy initiatives, enhanced infrastructure, and more robust data-security protocols, FinTech has the potential to further propel inclusive financial development in the district.

Keywords: Financial Inclusion, FinTech, Unbanked Population, Digital Payments, Thane District.

Introduction:

Financial inclusion has emerged as a pivotal element of India's economic development strategy, striving to guarantee that every individual—irrespective of income level, geographical location, or social background—can access vital financial services. Despite advancements achieved through programs like the Pradhan Mantri Jan Dhan Yojana (PMJDY), a significant portion of the population in numerous urban and peri-urban regions remains either unbanked or underbanked. The Thane district, a swiftly developing area with a varied socio-economic landscape, exemplifies this dual situation: while it enjoys urban infrastructure and proximity to Mumbai, many communities still encounter obstacles in obtaining traditional banking services.

In recent times, Financial Technology (FinTech) has surfaced as a revolutionary force capable of closing this gap. By utilizing mobile technology, digital payment systems, micro-credit

platforms, and Aadhaar-enabled services, FinTech firms are transforming the delivery and consumption of financial services. These advancements are especially beneficial for the unbanked demographic, providing convenient, cost-effective, and user-friendly alternatives to traditional banking.

The emergence of digital wallets, Unified Payments Interface (UPI) applications, and streamlined online lending platforms has opened new pathways for financial engagement in Thane. Furthermore, government initiatives promoting digital transactions, along with the rising penetration of smartphones, have hastened the uptake of FinTech solutions among disadvantaged groups. Nevertheless, this transition is not devoid of challenges—factors such as digital illiteracy, cybersecurity threats, and infrastructural constraints continue to impede widespread adoption.

This study investigates the changes instigated by FinTech in enhancing financial access for the unbanked population in Thane district. It seeks to evaluate the degree to which FinTech tools are being embraced, the advantages and drawbacks encountered by users, and the wider socio-economic implications.

Unbanked Population:

The **unbanked population** refers to individuals or households that **do not have access to basic formal banking services**. This means they do not hold a savings or current account in a bank or regulated financial institution and are unable to use services such as deposits, withdrawals, loans, insurance, or digital payment systems.

Financial exclusion:

'Financial exclusion' is the term which used in different ways, in the finance industry about the financial services, to explain the concept of detailing the inability or inaccessible to majority of the public. This can be defined via the financial inclusion: "A state in which all people have access to appropriate, desired financial products and services in order to manage their money effectively". In other words, 'Financial Exclusion' means the inability to access necessary financial services in an appropriate form. This can be described by when the literacy is better about the finance and financial capability by the public or consumers.

Barriers to Financial Exclusion:

1. Geographical Barriers:

Although Thane is in proximity to Mumbai, certain areas—particularly semi-urban regions, slums, and newly developed outskirts—struggle with insufficient access to bank branches, ATMs, and customer service locations. The physical distance, overcrowding, and inadequate transport connectivity hinder regular engagement with formal financial institutions. Furthermore, inconsistent internet connectivity in specific areas restricts the effective utilization of digital banking and FinTech services.

2. Psychological Barriers:

Psychological barriers significantly contribute to financial exclusion. Numerous individuals feel fear and anxiety when interacting with formal banks due to unfamiliar processes, technical terminology, and perceived complexities. Additionally, there exists a considerable fear of digital fraud, cybercrime, and potential financial loss, which deters the use of online banking, mobile wallets, and digital payment systems.

3. Sociological Barriers:

Social elements such as caste, gender, migration status, and occupation affect financial inclusion. Migrant workers and informal laborers frequently lack social recognition and stable identity documentation, rendering them susceptible to exclusion. Moreover, women in certain households often have limited authority

over financial decisions, which restricts their access to banking services and credit options.

4. Economic Barriers:

The low- and inconsistent-income levels of daily wage earners, small vendors, and informal workers diminish their eligibility for formal financial products like loans and insurance. Due to pressing financial needs and the availability of flexible repayment options, many individuals opt for informal moneylenders despite the high interest rates, perpetuating their exclusion from the formal financial system.

5. Educational and Digital Literacy Barriers:

A deficiency in basic financial literacy hinders individuals from comprehending banking products, interest rates, and savings instruments. Additionally, digital illiteracy further restricts the use of mobile banking applications, UPI platforms, and online services. This gap is particularly pronounced among elderly populations and low-educated groups in Thane.

6. Institutional and Procedural Barriers:

Complex documentation requirements, lengthy KYC procedures, and rigid banking norms create obstacles for unbanked individuals. Formal institutions often fail to design inclusive products tailored to the needs of low-income and informal-sector populations, leading to low trust and reduced participation.

Financially excluded people typically exhibit one or more of the following characteristics:

- No bank accounts and related financial services that accompanied with this.
- When people totally relay on the financiers who lend at doorstep and pawnbrokers.
- People with limited or no knowledge over the key financial products such as insurance, savings products and pensions.

Those who are unable to access basic financial services pay more to manage their money, find it difficult to plan for the future and are more likely to become over-indebted. In the words of the Treasury Select Committee: Too many people cannot gain access to appropriate financial products and services at present: they struggle to obtain affordable credit or helpful financial advice and face barriers in opening and operating bank accounts. Financial exclusion blights the lives of many millions of people; it increases the costs they bear for basic services; it makes them vulnerable to illegal or high-cost lending; it reinforces social exclusion.

Bank Account Ownership in Thane District:

According to the **Comprehensive Annual Modular Survey (CAMS) – Maharashtra government data (2025)** on financial account ownership among persons aged 18 and above:

- **Rural Thane:** 83.1 % of persons reported having an account (individually or jointly) with a bank, other financial institution, or mobile-money service provider.
- **Urban Thane:** 95.2 % of persons reported having an account.
- **Overall Thane District (Rural + Urban): 92.3 % of persons have a financial account.**

Estimating the Unbanked Population:

From the above data:

- **Approximate unbanked population in Thane District = 100 % − 92.3 % = 7.7 %.**

Financial Inclusion Status in Thane District:

Area	Percentage with Financial Account	Estimated Unbanked
Rural Thane	83.1 %	16.9 %
Urban Thane	95.2 %	4.8 %
Overall Thane District	**92.3 %**	**~7.7 %**

Definition of Financial Inclusion:

Financial Inclusion is defined as "the process of ensuring access to financial services and timely and adequate credit where needed by vulnerable groups such as weaker sections and low-income groups at an affordable cost" (Rangarajan, 2008) in the report of the Committee on financial inclusion in India.

According to RBI "Financial Inclusion is the process of ensuring access to appropriate financial products and services needed by vulnerable groups such as weaker sections and low-income groups at an affordable cost in a fair and transparent manner by mainstream institutional players."

Literature Review:

Asif et al. (2023) examined the role of financial technology and digital financial services in promoting financial inclusion in India using national-level secondary data. The study applied correlation and regression analysis to assess the relationship between fintech growth and indicators of financial inclusion. The findings indicate a significant positive impact of fintech on access to banking services and digital transactions. The authors highlight that fintech reduces transaction costs and overcomes physical barriers of traditional banking. However, the study is based on aggregate data and does not capture regional or district-level variations. Despite this limitation, it provides strong empirical evidence supporting fintech as a key driver of financial inclusion in India.

According to the **Comprehensive Annual Modular Survey (CAMS) for Maharashtra**, approximately 92.3% of the population in Thane District aged 18 years and above have a bank or financial account, implying that about 7.7% remain unbanked. "The CAMS survey indicates that only about 7.7 % of the district's adult population is without a bank or financial account, highlighting significant progress in financial inclusion but also underscoring the remaining gap for targeted interventions."

Ekbote (2021) conducted an analytical examination of financial inclusion in the Thane and Palghar districts, specifically focusing on the Bank of Maharashtra. The research underscored the bank's initiatives, including the establishment of basic savings accounts, the promotion of direct benefit transfers, and the support of self-help groups aimed at enhancing rural financial inclusion. The results indicated that, although access to banking services had significantly improved, challenges such as low financial literacy, inconsistent income levels, and limited awareness among rural households continued to hinder active participation. Furthermore, the study noted that the adoption of digital banking was progressing slowly in remote areas due to infrastructural deficiencies. In summary, it highlighted the necessity for more tailored financial products and capacity-building initiatives to achieve sustainable financial inclusion in the region.

Vtk and Kulkarni (2024) examine the impact of Unified Payments Interface (UPI) utilisation on financial inclusion in India using empirical evidence. The study analyzes the relationship between UPI adoption and key indicators of financial inclusion, such as access to digital payment systems and usage of formal financial services. The findings indicate that increased UPI utilisation significantly enhances financial inclusion by promoting cashless transactions, reducing transaction costs, and improving convenience for users, particularly in urban and semi-urban areas. The authors highlight that UPI's user-friendly interface and interoperability have encouraged widespread adoption among individuals and small merchants. However, the study also notes that digital literacy and infrastructure constraints continue to influence the extent of UPI's inclusive impact. Overall, the research underscores UPI as a critical digital public infrastructure driving financial inclusion in India.

Dr. Nagaraja K (2023) Fintech has been playing a critical role towards financial inclusion by providing an access to the unbanked population who has been out of the banking over the number of years. Meanwhile, Digital India initiative has enabled to a number of fintech companies working in collaboration with the traditional banking which has been largely benefitting the masses, particularly in the rural area in utilizing banking services in their comfort zone.

Raghavan (2019) examines the rates of transaction failures within the Aadhaar Enabled Payment System (AePS) and assesses their impact on financial inclusion in India. The research underscores that, despite the potential of AePS to provide banking services to underserved communities, elevated transaction failure rates—stemming from biometric mismatches, connectivity challenges, and issues with linking Aadhaar to bank accounts—seriously diminish user trust and adoption. The author points out that recurring transaction failures disproportionately impact vulnerable populations, such as low-income and rural users. The paper contends that operational inefficiencies within AePS restrict its efficacy as a mechanism for inclusive finance. It concludes with policy suggestions aimed at enhancing system reliability, improving grievance redressal processes, and ensuring user protection to bolster the inclusiveness of digital payment systems.

Objectives of The Study:

1. To study the role of FinTech in improving access to basic financial services among the unbanked population in Thane District.
2. To assess the level of awareness and usage of FinTech services among the unbanked population.
3. To examine the impact of FinTech on financial inclusion, particularly in terms of savings, payments, and access to credit.
4. To identify the key challenges faced by the unbanked population in adopting FinTech-based financial services in Thane District.

Research Methodology:

For the Research, both Primary and Secondary sources of data is collected.

Primary Data: Primary data are those, which are collected for the first time, taking a sample, representing a population. It is not a published data; it is problem specific data collected by researcher. A well-structured questionnaire is administered to the target respondents to collect primary data (Copy of questionnaire is attached in the appendix)

Partly primary data is used via google forms method to collect the primary data with the help of a structured questionnaire, arranged meeting with digital finances users and

conducted form survey and collected 44 responses on the google form.

Secondary Data: Secondary data found in the form of company records, trade publications, libraries, etc. Secondary data sources are as follows:

- Company Reports.
- Daily Newspaper.
- Various Websites.

Data Analysis and Results:

Has FinTech reduced your need to visit a bank branch?

TABLE 1

Attributes	Responses	Percentage
Yes	29	65.9%
No	5	11.4%
Maybe	10	22.7%
Total	44	100%

Interpretation:

Table 1 indicates that 65.9% of the respondents reported that FinTech has reduced their need to visit bank branches, reflecting increased reliance on digital financial services. This suggests improved convenience and accessibility through platforms such as mobile banking and UPI. About 22.7% of respondents were unsure, indicating partial dependence on both digital and traditional banking channels. Only 11.4% stated that FinTech has not reduced branch visits, highlighting continued reliance on physical banking among a small segment. Overall, the results demonstrate FinTech's significant role in minimizing the need for in-person banking.

Do you trust digital financial platforms?

TABLE 2

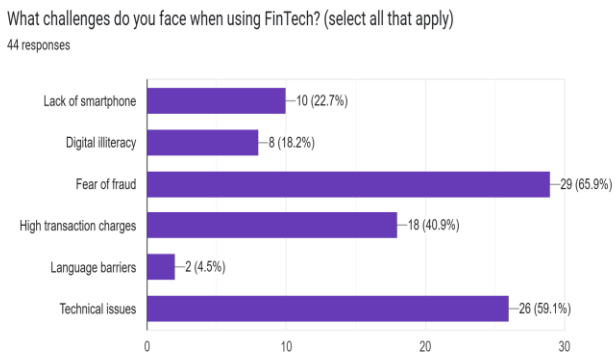
Attributes	Responses	Percentage
Yes	28	63.6%
No	3	6.8%
Maybe	13	29.5%
Total	44	100%

Interpretation:

Table 2 shows that 63.6% of respondents trust digital financial platforms, indicating a generally positive perception of their reliability and security. However, 29.5% expressed uncertainty, suggesting lingering concerns or limited experience with digital services. Only 6.8% reported a lack of trust, reflecting a relatively small group resistant to digital finance. Overall, the findings suggest growing trust in digital platforms, while highlighting the need to address security and awareness concerns to increase confidence further.

What challenges do you face when using FinTech?

CHART 1



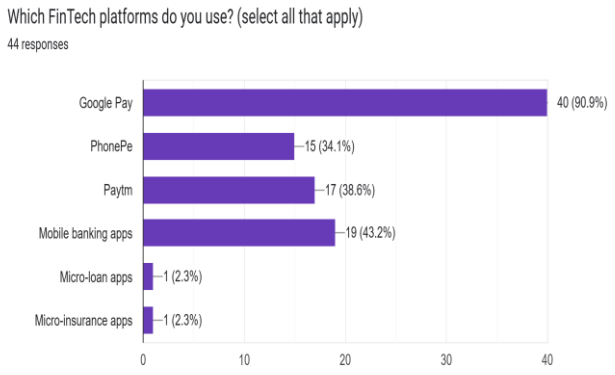
Interpretation:

The chart show that fear of fraud (65.9%) is the most significant challenge faced by respondents while using FinTech services, highlighting concerns about security and trust. This is followed by technical issues (59.1%) and high transaction charges (40.9%), which

affect smooth usage and affordability. Challenges such as lack of smartphones (22.7%) and digital illiteracy (18.2%) also contribute to limited adoption. Overall, the findings suggest that while FinTech usage is growing, addressing security concerns and technical reliability is crucial for wider acceptance.

Which FinTech platforms do you use?

CHART 2



Interpretation:

The chart shows that Google Pay (90.9%) is the most widely used FinTech platform, indicating strong user preference for UPI-based payment apps. Mobile banking apps (43.2%), Paytm (38.6%), and PhonePe (34.1%) also show moderate usage among respondents. In contrast, micro-loan and micro-insurance apps (2.3% each) have very low adoption, suggesting limited awareness or trust. Overall, digital payment platforms dominate FinTech usage, while advanced financial services remain underutilized.

Conclusion:

The findings of the study clearly indicate that FinTech has played a significant role in transforming access to financial services among the unbanked population in Thane district. A majority of respondents reported reduced dependence on physical bank branches, reflecting increased convenience and accessibility through digital platforms such as UPI and mobile banking. The relatively high level of trust in digital financial platforms further supports the growing acceptance of FinTech services among users.

However, the study also reveals persistent challenges that limit full adoption, particularly fear of fraud, technical issues, and high transaction charges. While digital payment platforms like Google Pay, Paytm, and PhonePe dominate usage, advanced services such as micro-loans and micro-insurance remain underutilized due to low awareness and trust. Overall, the results suggest that FinTech has substantially improved financial access and inclusion in Thane district, but addressing security concerns, improving digital literacy, and strengthening technical infrastructure are essential to ensure broader and more sustainable financial inclusion among the unbanked population.

Recommendations:

Based on the findings of the study, several measures can be suggested to strengthen the role of FinTech in promoting financial inclusion among the unbanked population in Thane district. First, digital and financial literacy programs should be conducted at the community level to improve awareness and confidence in using FinTech services, especially among first-time users. Second, enhanced cybersecurity measures and awareness campaigns are necessary to address the widespread fear of fraud and build trust in digital financial platforms.

Further, improving technical infrastructure, such as network connectivity and system reliability, can help reduce transaction failures and technical issues faced by users. FinTech companies and financial institutions

should also focus on reducing transaction charges and simplifying user interfaces, including the use of local languages, to make services more affordable and user-friendly. Lastly, greater efforts should be made to promote advanced FinTech services such as micro-loans and micro-insurance through targeted outreach and incentives, ensuring that unbanked individuals can access a wider range of financial products for long-term financial security and inclusion.

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Impact of Surveillance on Digital Privacy

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Abstract:

Digital surveillance has had a significant impact on the way personal information is collected, processed, and utilized in the modern digital environment. In today's interconnected world, governments and private organizations increasingly rely on surveillance technologies to ensure national security, public safety, and efficient service delivery. However, the extensive monitoring of digital activities raises serious concerns regarding digital privacy, individual autonomy, and data protection.

The two major reasons for the rapid growth of digital surveillance are the exponential increase in data generated through the Internet, social media platforms, mobile devices, and IoT technologies, and the advancement of data analytics and monitoring systems capable of processing this data in real time.

This study examines the impact of surveillance on digital privacy. It traces the evolution of surveillance technologies and their integration into digital communication systems, online platforms, and governance mechanisms. Through a comprehensive review of literature and existing studies, this paper highlights how surveillance practices affect privacy rights, data security, and user behavior. Additionally, the study discusses the challenges and opportunities associated with surveillance in the digital age and explores future trends. Overall, the paper provides insights into balancing security needs with the protection of digital privacy in an increasingly digitally surveilled ecosystem.

Keywords**: **Digital Surveillance, Digital Privacy, Data Protection, Cyber Security, Data Governance.

Introduction:

Digital technologies have transformed the way individuals communicate, work, and interact with society. Before the digital revolution, personal information was largely stored in physical form and surveillance was limited to manual observation and localized monitoring. Traditional surveillance methods required significant human effort and were restricted in scope.

With the increasing digitization of the global economy, the adoption of internet-based services, cloud platforms, social media, and smart devices has resulted in the continuous generation of large volumes of personal data. Surveillance technologies now enable automated monitoring, tracking, and analysis of digital activities with minimal human intervention.

The impact of surveillance on digital privacy has become a subject of growing academic and public concern. Surveillance

systems have the potential to enhance security, prevent crime, and improve service efficiency. At the same time, they pose risks such as unauthorized data collection, misuse of personal information, identity theft, and erosion of individual freedom.

By leveraging advanced monitoring tools and analytics, surveillance systems can process vast amounts of data efficiently. However, excessive or unregulated surveillance can compromise privacy, reduce trust in digital platforms, and affect democratic values. Hence, understanding the impact of surveillance on digital privacy is essential in the modern digital era.

Objective of the Study:

1. To study the impact of surveillance on digital privacy
2. To analyze the extent to which surveillance affects personal data protection
3. To understand public awareness regarding digital surveillance
4. To examine challenges and opportunities associated with surveillance practices

Literature Review:

Digital surveillance has emerged as a critical issue in the global digital landscape, significantly influencing privacy and data protection practices. Existing literature reveals diverse perspectives on the benefits and risks associated with surveillance.

Several scholars have examined the expansion of surveillance technologies and their implications for digital privacy. Zuboff (2019) introduced the concept of *surveillance capitalism*, emphasizing how corporations collect and monetize personal data, often without meaningful user consent.

Smith and Miller (2020) highlight that government-led surveillance programs, although aimed at national security, frequently lack transparency and accountability, leading to potential misuse of personal information.

Empirical studies by Kumar et al. (2021) demonstrate that corporate surveillance through digital platforms increases user profiling and behavioral tracking, which negatively affects privacy and autonomy. Patel and Desai (2022) further argue that weak data protection frameworks exacerbate the risks associated with surveillance.

In addition, researchers such as Mishra and Jain (2019) emphasize the need for digital literacy and awareness to empower individuals to understand and manage privacy risks. Gupta and Sharma (2020) discuss the socio-ethical implications of surveillance, including psychological stress, self-censorship, and loss of trust in digital institutions.

Overall, the literature underscores the multifaceted impact of surveillance on digital privacy and highlights the necessity of balanced regulatory and ethical frameworks.

However, existing studies largely focus on legal or technological dimensions in isolation, highlighting the need for an integrated analysis of surveillance practices and their broader implications for digital privacy.

Concept of Privacy in the Digital Age:

In the digital era, privacy refers to an individual's ability to control personal information, including decisions regarding who can access such data, how it is processed, and the purposes for which it is shared. In traditional physical settings, privacy was relatively easier to maintain through personal boundaries, private conversations, and secure documentation. However, in the contemporary digital environment, personal data is continuously generated, collected, and processed, often without

explicit awareness or informed consent of individuals.

Digital interactions such as internet searches, social media engagement, online shopping, and electronic payments contribute to the creation of extensive digital footprints. Beyond online activities, offline actions are also increasingly monitored through surveillance mechanisms such as closed-circuit television (CCTV), location tracking via mobile devices, and electronic transaction records. The pervasive nature of such monitoring has intensified concerns regarding the erosion of personal privacy in modern society.

Emergence and Expansion of Digital Surveillance:

The rapid advancement of digital technologies has significantly expanded the scope and scale of surveillance practices. Both governmental authorities and private organizations now possess sophisticated tools capable of monitoring, collecting, and analysing vast amounts of personal data. Governments often justify surveillance initiatives on grounds of national security, crime prevention, and public order, whereas corporations primarily engage in data collection to enhance services, optimize user experience, and deliver targeted advertising.

A critical concern surrounding digital surveillance is the lack of transparency regarding how personal data is accessed, processed, and shared. Individuals frequently remain unaware of the extent to which their data is monitored or the entities that have access to it. While certain forms of surveillance may appear benign, intrusive monitoring such as continuous location tracking or interception of private communications can result in serious misuse. In extreme cases, such practices may facilitate identity theft, unauthorized profiling, or abuse of power by state and non-state actors.

Role of Surveillance in the Digital Environment:

Modern surveillance technologies are shaping digital ecosystems across multiple sectors. Surveillance systems enable continuous monitoring of online activities, communications, transactions, and location data.

Automation in surveillance allows real-time data collection and analysis, significantly reducing the time required for manual monitoring. Surveillance technologies improve efficiency, accuracy, and responsiveness in areas such as law enforcement, governance, and digital services.

Nearly all digital platforms collect user data through cookies, tracking mechanisms, and behavioral analytics. Surveillance supports targeted services, fraud detection, and security enforcement. However, it also increases the risk of privacy violations, data misuse, and unauthorized access.

Surveillance enhances transparency and accountability in certain applications but simultaneously raises ethical concerns. Advanced analytics and artificial intelligence enable predictive monitoring, which can influence user behavior and decision-making. While surveillance helps maintain order and efficiency, it challenges the fundamental right to privacy.

Impact of Technology on Privacy:

Technological advancements have deeply integrated digital systems into everyday life, affecting communication, commerce, healthcare, and governance. Devices such as smartphones, social media platforms, and smart appliances are designed to collect and analyse user data, frequently in the background. This data-driven ecosystem enables convenience and efficiency but also raises serious concerns regarding surveillance and loss of control over personal information.

Internet and Social Media Platforms:

Online platforms continuously track user behavior through likes, searches, and interactions, creating detailed behavioral profiles. These profiles are often used for targeted advertising and content personalization, sometimes without explicit user consent.

Mobile Devices and Applications:

Smartphones function as repositories of sensitive personal data, including location, contacts, communication history, and multimedia content. While permissions are typically requested, users often grant access without fully understanding the implications.

Internet of Things (IoT):

Smart devices such as voice assistants, wearables, and connected home systems collect data related to daily routines and personal habits. Although these technologies enhance convenience, they also introduce vulnerabilities related to data storage and unauthorized access.

Tracking Technologies and Cookies:

Web tracking mechanisms, including cookies and tracking pixels, monitor user activity across websites, enabling the creation of detailed online profiles. Such data is frequently shared with advertisers and third parties, often without clear disclosure.

Government Surveillance Practices:

Governments increasingly employ digital surveillance tools such as facial recognition systems, communication monitoring, and data aggregation from private entities. While intended for security purposes, the absence of clearly defined boundaries and oversight mechanisms raises concerns about potential infringement of civil liberties.

Compiled Statistical Data: Awareness of Digital Surveillance & Digital Privacy:

This document compiles key statistical data related to public awareness of digital surveillance and its impact on digital privacy. The data is aggregated from reputed global surveys and research studies and is suitable for academic and research use.

1.Global Awareness & Concern Levels:

Year	Public Concern Level (%)	Source
1991	25%	Harris/Westin Survey
1994	51%	Harris/Westin Survey
2014	85%	Pew Research Center
2019	73%	NTIA
2023	81%	Pew Research Center

2. User Awareness of Data Collection Practices:

Category	Percentage (%)	Observation
Users aware their data is tracked	79%	Majority understand online tracking
Users who read privacy policies	22%	Very low engagement
Users concerned about misuse	81%	High concern level
Users who changed settings/apps	64%	Behavior influenced by awareness

3. Impact of Surveillance Awareness on User Behavior:

Behavior Change	Percentage (%)	Impact
Reduced social media sharing	58%	Self-censorship
Use of privacy tools (VPN, Ad-blockers)	46%	Defensive behavior
Avoiding certain platforms	34%	Trust issues
Acceptance for convenience	29%	Privacy trade-off

4. Indian Perspective – Digital Surveillance Awareness:

Aspect	Percentage / Year	Remarks
Aadhaar adoption	95% (2022)	Widespread biometric use
Citizens concerned about data misuse	74%	Growing privacy concern
Privacy recognized as fundamental right	2017	Supreme Court judgment
DPDP Act implementation	2023	Legal data protection framework

Summary:

The compiled statistics indicate a clear rise in awareness of digital surveillance globally and in India. This awareness has directly influenced user behavior, trust in digital platforms, and demand for stronger data protection laws. Despite legal advancements, privacy concerns remain high, highlighting the need for transparent surveillance practices and increased digital literacy

Challenges and Opportunities:

Challenges:

Lack of Transparency: One of the major challenges of digital surveillance is the absence of transparency in data collection practices. Individuals are often unaware of when, how, and why their personal data is being monitored, stored, or shared. This lack of clarity reduces user trust and raises ethical concerns.

Weak Data Protection Frameworks: In many regions, data protection laws are either insufficient or poorly implemented. This allows surveillance systems to operate without strict accountability, increasing the risk of misuse of personal information and unauthorized data access.

Cybersecurity Risks: Large-scale surveillance systems store vast amounts of sensitive data, making them attractive targets for cyberattacks. Data breaches, hacking, and identity theft are serious threats that can compromise individual privacy and financial security.

Loss of Individual Autonomy: Continuous monitoring of online behavior can limit personal freedom and autonomy. People may alter their behavior due to fear of being watched, leading to self-censorship and reduced freedom of expression in digital spaces.

Opportunities:

Improved Security and Crime Prevention: Surveillance technologies provide opportunities to enhance national security, prevent cybercrime, and detect fraudulent activities. When used responsibly, surveillance can help maintain public safety while minimizing risks.

Development of Strong Privacy Regulations: Growing concerns about digital privacy have encouraged governments to introduce stronger data protection laws. These regulations offer an opportunity to balance surveillance practices with individual privacy rights.

Adoption of Privacy-Enhancing Technologies: Technologies such as data encryption, anonymization, and privacy-by-design frameworks provide opportunities to protect personal data while allowing legitimate surveillance activities.

Increased Public Awareness: Rising awareness about digital surveillance encourages individuals to become more cautious about sharing personal information online. This awareness promotes responsible digital behavior and demand for better privacy protection.

Conclusion:

The growing reliance on digital technologies necessitates a balanced approach that harmonizes technological progress with the protection of individual privacy rights. While surveillance mechanisms may enhance security and efficiency, unchecked monitoring risks eroding civil liberties and democratic values. Strengthening legal safeguards, promoting transparency, and encouraging responsible data governance are essential steps toward ensuring that digital innovation serves societal interests without compromising fundamental rights.

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Regulating AI-Driven Innovation for Sustainable Development in Education and Industry: A Legal Perspective

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Abstract:

Artificial Intelligence (AI) has emerged as a critical driver of innovation in education and industry, significantly contributing to sustainable development by enhancing efficiency, accessibility, and resource optimization. AI-based systems enable personalized education, skill-oriented learning, smart manufacturing, energy efficiency, and environmentally responsible industrial practices. However, the increasing reliance on AI technologies raises complex legal challenges concerning data protection, accountability, transparency, intellectual property rights, and ethical governance. This paper critically examines AI-driven innovation within the framework of sustainable development, focusing on the legal implications of AI adoption in education and industry. It analyses how existing Indian legal frameworks—particularly business law, cyber law, data protection principles, and constitutional safeguards—address the risks and opportunities associated with AI technologies. The study highlights regulatory gaps that may hinder responsible innovation and sustainable growth. It argues that effective legal governance is essential to ensure that AI contributes to long-term social, economic, and environmental sustainability while protecting fundamental rights. The paper concludes by proposing legal and policy reforms aimed at balancing technological advancement with ethical responsibility and sustainable development goals.

Keywords: Artificial Intelligence, Sustainable Development, Education Law, Industrial Regulation, Business Law, AI Governance, Data Protection.

Introduction:

Here is an expanded version with **approximately double the word length**, **same meaning**, **formal academic tone**, and **no change in substance**—suitable for a research paper:

Sustainable development has emerged as a foundational objective of modern governance, focusing on the balanced integration of economic growth, social equity, and environmental protection. Governments across the world increasingly recognize that long-term development cannot be achieved solely through economic expansion, but must also ensure social inclusion and environmental sustainability. In this context, technological innovation plays a pivotal role in advancing sustainable development goals. Among emerging technologies, Artificial Intelligence (AI) has become one of the most transformative and influential forces of the contemporary era, reshaping governance structures, institutional functioning, and socio-economic systems.

AI-driven innovation has significantly transformed both education and industry by enabling automation, predictive analytics, personalized services, and efficient resource management. In the education sector, AI facilitates personalized learning experiences by

adapting educational content to individual learning styles and capabilities. Digital classrooms, AI-assisted assessments, and data-driven academic support systems enhance learning outcomes and expand access to quality education. AI also supports the development of skill-oriented curricula that are aligned with evolving industrial and labour market requirements, thereby promoting sustainable employability.

In the industrial sector, AI enhances productivity through automation, optimizes energy consumption, reduces material waste, and supports environmentally sustainable manufacturing practices. Smart production systems and predictive maintenance tools enable industries to operate efficiently while minimizing their ecological footprint. These advancements directly contribute to the achievement of the United Nations Sustainable Development Goals (SDGs), particularly those related to quality education, decent work and economic growth, industry innovation, and responsible consumption and production.

Despite these benefits, the rapid and widespread integration of AI raises serious legal and regulatory concerns. AI systems are heavily dependent on large volumes of data, which gives rise to critical issues relating to data privacy, informed consent, and surveillance. Automated decision-making systems challenge traditional legal notions of accountability, liability, and human oversight. Furthermore, AI-generated outputs present unresolved questions under intellectual property law, particularly regarding ownership and authorship. In India, the absence of a comprehensive AI-specific legislative framework has resulted in regulatory uncertainty, making it essential to undertake a critical legal examination of AI-driven innovation within the broader framework of sustainable development.

This paper analyses AI-driven innovation for sustainable development in education and industry through a legal lens, focusing on regulatory challenges and the role of business law in ensuring ethical and sustainable AI governance.

Concept of AI-Driven Sustainable Development:

Sustainable development refers to development that meets present needs without compromising the ability of future generations to meet their own needs. AI contributes to sustainability by enabling efficient use of resources, reducing environmental impact, and supporting inclusive growth. Machine learning algorithms, robotics, and data analytics allow institutions and industries to make evidence-based decisions that enhance long-term sustainability.

However, sustainability is not purely a technological issue. Legal frameworks play a crucial role in regulating technological innovation to ensure that its benefits are equitably distributed and its risks adequately controlled. Without legal oversight, AI innovation may lead to data exploitation, economic inequality, and ethical violations.

AI-Driven Innovation in Education and Legal Concerns:

1. Personalized and Inclusive Education: AI-based educational platforms analyse student data to deliver customized learning experiences. This improves academic outcomes and promotes inclusive education, particularly for students with diverse learning needs. Digital learning tools also reduce geographical barriers, contributing to educational sustainability.

2. Skill Development and Workforce Readiness: AI enables educational institutions to align curricula with industry requirements by identifying emerging skills. This ensures

sustainable employability and supports economic development.

3. Legal Issues in AI-Based Education: Despite its benefits, AI in education raises serious legal concerns. Educational institutions collect vast amounts of personal data, including biometric and behavioural data. The absence of robust data protection mechanisms exposes students to privacy violations. Algorithmic bias may also lead to discriminatory assessment outcomes, violating principles of equality under constitutional law.

Education law, data protection norms, and cyber regulations must therefore evolve to ensure transparency, accountability, and fairness in AI-driven educational systems.

AI-Driven Innovation in Industry and Sustainability:

1. Smart Manufacturing and Environmental Protection: AI-driven automation enhances industrial efficiency while reducing waste and emissions. Predictive maintenance systems minimize energy consumption and extend machinery life, contributing to environmental sustainability.

2. Supply Chain Optimization: AI enhances supply chain transparency and efficiency, enabling industries to monitor sourcing practices and comply with environmental and labour standards.

3. Legal Challenges in Industrial AI Use: Industrial AI applications raise complex legal issues relating to liability, labour rights, competition law, and intellectual property. Determining liability for AI-driven decisions remains challenging, particularly where autonomous systems cause harm. Additionally, AI-generated inventions challenge traditional patent law concepts of inventorship and ownership. Business law must adapt to address these challenges while encouraging innovation.

Indian Legal Framework Governing AI:

India currently lacks a dedicated AI legislation. However, AI governance is indirectly addressed through existing legal frameworks, including information technology regulations, data protection principles, intellectual property laws, consumer protection law, and constitutional safeguards.

1. Data Protection and Privacy: AI systems rely on large datasets, often involving sensitive personal information. Inadequate data protection increases the risk of misuse, surveillance, and data breaches. Legal safeguards are essential to maintain public trust in AI technologies.

2. Accountability and Transparency: AI decision-making processes are often opaque, creating difficulties in assigning responsibility. Legal frameworks must mandate explainability and accountability to prevent arbitrary decision-making.

3. Intellectual Property Rights: AI-generated content challenges traditional intellectual property regimes, which are premised on human creativity. Legal clarity is required regarding ownership and protection of AI-generated works.

Ethical and Constitutional Dimensions:

AI governance must align with constitutional values such as equality, dignity, and freedom. Algorithmic discrimination and unchecked surveillance may violate fundamental rights. Ethical AI principles—fairness, transparency, and accountability—must therefore be embedded within legally enforceable frameworks.

Legal Provisions Governing AI-Driven Innovation in Education and Industry:

The deployment of Artificial Intelligence in education and industry in India is presently governed through a combination of existing statutory laws, constitutional principles, and regulatory policies, rather than a dedicated AI legislation. These legal frameworks play a crucial role in ensuring that AI-driven innovation contributes to sustainable development while safeguarding individual rights and public interest.

1. Constitutional Provisions and Fundamental Rights:

The Constitution of India provides the foundational legal framework for regulating AI technologies.

Article 14 guarantees equality before the law and equal protection of laws. AI systems that result in algorithmic bias or discriminatory outcomes in education admissions, assessments, or employment decisions may violate this provision. Similarly, Article 21, which guarantees the right to life and personal liberty, has been judicially expanded to include the right to privacy, dignity, and autonomy. Excessive surveillance through AI-based monitoring systems in educational institutions or workplaces may infringe upon these rights.

Further, Article 19(1)(g) guarantees the freedom to practice any profession or carry on any occupation, trade, or business. While AI-driven automation enhances industrial efficiency, unreasonable restrictions or exclusion caused by AI systems may raise constitutional concerns, requiring regulatory safeguards.

2. Right to Education and AI in Educational Institutions:

Article 21A of the Constitution mandates free and compulsory education for children between the ages of six and fourteen years. AI-driven educational tools, digital classrooms, and automated assessments must operate in a manner that promotes inclusive access rather than deepening the digital divide. The Right of Children to Free and Compulsory Education Act, 2009 emphasizes equitable and non-discriminatory education. Any AI-based system that disadvantages students due to socio-economic or technological limitations would conflict with the objectives of this legislation.

3. Data Protection and Privacy Laws:

AI systems function through the collection, processing, and analysis of vast amounts of personal data. The Information Technology Act, 2000 provides the primary statutory framework for data protection in India. Section 43A of the Act imposes liability on corporations for failure to protect sensitive personal data, while the Information Technology (Reasonable Security Practices and Procedures and Sensitive Personal Data or Information) Rules, 2011 prescribe safeguards for data handling.

In educational institutions and industries using AI-based analytics, biometric data, academic records, and employee information are often processed. Inadequate data protection measures may result in privacy violations, thereby undermining sustainable and ethical AI governance.

4. Intellectual Property Rights and AI-Generated Works:

The application of AI in education and industry raises complex questions under intellectual property law. The Copyright Act, 1957 protects original literary, artistic, and software works. However, AI-generated content challenges traditional notions of authorship, as existing law recognizes only human creators. Similarly, under the Patents Act, 1970, inventions must involve human ingenuity. AI-generated inventions used in industrial innovation raise unresolved legal issues regarding inventorship and ownership.

Without legal clarity, industries may face uncertainty regarding the protection and commercialization of AI-generated outputs, which could hinder sustainable innovation.

5. Labour Laws and Industrial AI:

AI-driven automation in industry has implications for labour rights and employment conditions. Labour welfare legislation such as the Industrial Disputes Act, 1947 and the Occupational Safety, Health and Working Conditions Code, 2020 impose obligations on employers to ensure fair treatment and safe working conditions. AI systems used for workforce monitoring, performance evaluation, or automated decision-making must comply with these statutory protections.

Unregulated use of AI may result in unfair termination, excessive surveillance, or algorithmic management practices that undermine workers' rights, thereby conflicting with principles of sustainable and inclusive industrial development.

6. Consumer Protection and Competition Law:

AI-driven platforms operating in education and industry are subject to the Consumer Protection Act, 2019, which protects users from unfair trade practices, misleading information, and defective services. AI-based educational platforms must ensure transparency in pricing, assessment mechanisms, and content delivery.

Additionally, the Competition Act, 2002 regulates anti-competitive practices. AI-driven market dominance, algorithmic price-fixing, or data monopolies may distort competition and hinder sustainable industrial growth, necessitating regulatory oversight.

7. Need for a Dedicated AI Regulatory Framework:

While existing laws provide partial regulation, they are insufficient to address the unique challenges posed by AI-driven innovation. A comprehensive AI-specific legislation is necessary to define accountability, liability, ethical standards, and sustainability obligations. Such a framework would ensure that AI deployment in education and industry aligns with sustainable development goals, constitutional values, and international best practices.

Challenges to Sustainable AI Governance:

- Absence of AI-specific legislation
- Rapid technological change outpacing law
- Difficulty in assigning liability
- Ethical concerns and algorithmic bias
- Digital divide and unequal access

These challenges necessitate comprehensive legal and policy reforms.

Suggestions and Recommendations:

1. Enact a comprehensive AI regulatory framework in India.
2. Strengthen data protection and privacy laws.
3. Establish accountability and liability standards for AI systems.
4. Incorporate ethical AI principles into statutory regulation.
5. Promote interdisciplinary collaboration between law, education, and industry.

Conclusion:

AI-driven innovation has immense potential to advance sustainable development in education and industry. However, without effective legal governance, AI may undermine fundamental rights and social equity. A balanced legal framework is essential to harness AI's benefits while mitigating its risks. Business law, cyber law, and constitutional principles must work together to ensure that AI innovation contributes to long-term sustainability, ethical governance, and inclusive growth.

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Real-Time Sign Language Recognition System

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Abstract:
Sign language serves as a vital means of communication for individuals with hearing impairments; however, the limited availability of low-cost and scalable interpretation technologies restricts its accessibility in education, healthcare, and workplace settings. This study introduces a real-time American Sign Language (ASL) alphabet recognition system that integrates YOLO-based hand detection with MediaPipe-based hand landmark extraction. YOLOv11 is utilized to precisely detect and localize hand regions, while MediaPipe extracts 21 anatomical hand landmarks, enabling detailed representation of finger movements and hand postures using a conventional webcam. Experimental evaluation indicates high system effectiveness, with a precision of 0.985, recall of 0.981, F1-score of 0.991, and mAP@0.5 of 0.982, alongside a low average inference time of 1.3 milliseconds per frame. The results confirm that the proposed method is suitable for real- time applications and provides an economical assistive communication solution, with scope for future extension to continuous and sentence-level sign language recognition.

Introduction:

Globally, millions of individuals experience hearing impairments and depend on sign language as their primary communication medium. Despite advancements in assistive technologies, communication barriers between Deaf and hearing communities persist due to the limited availability, high cost, and lack of scalability of human sign language interpreters. In India alone, approximately 2.4 million individuals have hearing and speech disabilities, representing nearly one-fifth of the global Deaf population, underscoring the urgent need for accessible technological interventions.

Sign language is a visual-spatial language expressed through hand gestures, movements, and facial expressions, with distinct linguistic systems such as American Sign Language (ASL), Indian Sign Language (ISL), and Chinese Sign Language (CSL). While sign languages are linguistically rich and expressive, their interpretation requires specialized skills, making human interpretation impractical for continuous, real-time, and large-scale deployment.

Recent advancements in artificial intelligence and computer vision offer promising opportunities to address these challenges. Camera-based sign language recognition systems leveraging deep learning models can provide real-time, low-cost, and scalable solutions. This study proposes a real- time ASL recognition system integrating YOLO-based hand detection with MediaPipe-based hand landmark extraction to improve recognition accuracy, robustness, and usability under real-world conditions.

Research Objectives:

The objectives of this study are to:

1. Develop a real-time ASL alphabet recognition system using deep learning techniques
2. Design a camera-based solution operable using standard webcams without specialized hardware
3. Integrate MediaPipe for accurate hand landmark detection and feature extraction
4. Apply a YOLO-based model for efficient and low-latency gesture classification
5. Improve recognition accuracy for visually similar ASL gestures
6. Evaluate system performance under varying lighting conditions, backgrounds, and signer diversity
7. Propose a scalable and cost-effective assistive communication solution

Significance of the Study:

This research contributes to the development of accessible assistive communication technologies by demonstrating an efficient integration of object detection and hand landmark tracking frameworks. The study provides practical insights for researchers, developers, and policymakers working on inclusive technologies and supports the advancement of affordable AI-driven sign language recognition systems for real-world deployment.

Review of Literature:

A. Early Sign Language Recognition Systems:

Early sign language systems primarily focused on animation-based translation or sensor-driven approaches. Systems utilizing HamNoSys encoding enabled animated sign representation but lacked real-time gesture recognition capabilities. Sensor-based methods employing data gloves and Leap Motion controllers improved accuracy but required specialized hardware, limiting scalability and widespread adoption.

B. Vision-Based Recognition Techniques:

Vision-based approaches using OpenCV and traditional image processing techniques enabled real- time hand gesture recognition without gloves or sensors. Feature extraction methods such as SIFT and contour-based analysis proved effective for static gestures but struggled with dynamic sign language and complex backgrounds.

C. Deep Learning-Based Approaches:

Recent research emphasizes deep learning architectures combining Convolutional Neural Networks (CNNs) with sequence models such as LSTM and RNN to capture spatial and temporal features. These systems achieved recognition accuracies exceeding 90% but often faced computational complexity and latency challenges for real-time deployment.

D. YOLO and MediaPipe Integration:

Modern attention-based object detection frameworks such as YOLOv11 and YOLOv12 significantly enhance real-time detection speed and accuracy. MediaPipe provides robust 21-keypoint hand landmark extraction, enabling precise modeling of finger articulation. Integrating YOLO-based detection with MediaPipe landmarks addresses limitations related to background clutter, lighting variability, and gesture similarity, forming the foundation for efficient and scalable sign language recognition systems.

Technology diffusion research indicates that without targeted policy intervention, market-driven adoption disproportionately benefits elite institutions. This pattern reinforces existing inequalities and limits the developmental impact of technology at grassroots levels.

Research Methodology:

This study adopts a descriptive and analytical research design focusing on system development, performance evaluation, and real-time validation.

A. Research Approach:

The methodology involves analyzing existing ASL recognition limitations, designing a hybrid detection–landmark-based system, implementing the proposed model, and evaluating performance using quantitative metrics under controlled and real-world conditions.

B. Data Collection and Preprocessing:

The system is trained on an ASL alphabet dataset comprising approximately 130,000 annotated images covering diverse lighting conditions, backgrounds, hand orientations, and signer profiles. Images are resized to 640×640 resolution and annotated using YOLO-format bounding boxes along with 21 MediaPipe hand landmarks. Data augmentation techniques, including rotation, flipping, brightness variation, and grayscale conversion, are applied to enhance generalization.

C. Tools and Analysis Techniques:

The system is implemented using Python, PyTorch, Ultralytics YOLO framework, OpenCV, and MediaPipe. Performance evaluation employs Precision, Recall, F1-score, mAP@0.5, and mAP@0.5–0.95 metrics. Real-time performance is assessed through webcam-based inference measuring latency and robustness across environments.

Proposed System Architecture:

The proposed ASL recognition system integrates YOLO-based hand detection with MediaPipe landmark extraction for accurate and efficient gesture interpretation.

A. System Components:

1. Hand Detection Module: YOLOv11 detects and localizes hands in real-time video frames
2. Landmark Extraction Module: MediaPipe extracts 21 anatomical hand keypoints
3. Feature Representation: Combined bounding box and landmark data enhance gesture differentiation
4. Gesture Classification: YOLO-based classifier identifies ASL alphabet gestures
5. Real-Time Output: Detected gestures are displayed with minimal latency

B. Implementation Strategy:

The system operates in real time using standard webcams, ensuring affordability and scalability. Model optimization enables low-latency inference suitable for interactive applications.

Results and Discussion:

Experimental evaluation demonstrates strong system performance, achieving precision of 0.985, recall of 0.981, F1-score of 0.991, and mAP@0.5 of 0.982. Inference speed averages 1.3 ms per image, supporting real-time deployment. The confusion matrix indicates minimal misclassification among visually similar gestures, validating the effectiveness of combining YOLO detection with landmark-based feature extraction. Real-time testing confirms robustness across varied lighting and background conditions.

Findings and Suggestions:

A. Key Findings:

The system achieves high accuracy for static ASL alphabet gestures while maintaining real-time performance. However, accuracy decreases in uncontrolled environments due to lighting variability, background noise, and gesture similarity. Dynamic and sentence-level gesture recognition remains limited.

B. Suggestions:

Future improvements include incorporating temporal sequence models, expanding datasets for domain adaptation, standardizing annotation processes, integrating preprocessing pipelines, and extending recognition capabilities to dynamic and multilingual sign languages.

Conclusion and Future Scope:

A. Conclusion:

This research demonstrates the effectiveness of integrating YOLO-based detection with MediaPipe hand landmark extraction for real-time ASL recognition. The proposed system provides a scalable, cost-effective, and accurate assistive communication solution, contributing to inclusive technology development for Deaf and Hard-of-Hearing individuals.

B. Future Research Directions:

Future work should focus on continuous sign recognition, multimodal integration of facial expressions and body posture, optimization for edge devices, multilingual support, and ethical data governance involving Deaf communities.

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An Analysis of Barriers and the Development of a Framework for Equitable Sports Technology Integration in India

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Abstract:
This study examines the systemic challenges associated with indifferent sports technology integration in India's fleetly evolving sports ecosystem. While advanced technologies such as performance analytics, wearables, and artificial intelligence are extensively used in elite sports surroundings, their relinquishment remains limited at grassroots and non-priority sports situations. The exploration identifies three core walls responsible for this difference: high original costs, shy digital knowledge and training, and inadequate data sequestration and governance mechanisms. Analysis indicates that average periodic technology expenditure per nobility athlete is nearly fifteen to twenty times advanced than that for grassroots athletes. To address these challenges, the study proposes the Sustainable and Equitable Sports Technology Integration (SESTI) Framework, structured around three pillars availability and Affordability, Training and Digital knowledge, and Policy and Governance. confirmation against public sports objects and expert assessments demonstrates high feasibility, strong policy alignment, and significant eventuality for reducing technological injuries across Indian sports. The SESTI Framework offers a practicable design for standardizing access to sports technology while ensuring ethical, sustainable, and inclusive perpetration.

Keyword's: Sports Technology, Equitable Integration, Grassroots Sports, SESTI Framework, Performance improvement

Introduction:

Technology has become integral to ultramodern sport, impacting training, performance analysis, injury prevention, and administration. For India's intentions in global competitions, technology integration is a competitive necessity. While elite sectors profit from wearables, analytics, and simulation tools, relinquishment remains uneven in grassroots and indigenous situations, limiting public sporting eventuality. This difference is driven by three systemic walls. First, the high costs of bias and analytics platforms circumscribe access for grassroots programs. Second, limited digital knowledge among trainers and directors reduces effective application. Third, the absence of standardized data governance raises security enterprises and weakens trust. Addressing these connected challenges is essential for inclusive and sustainable sports development.

Research Objectives:

The study aims to (i) chart difference in technology relinquishment between elite and grassroots sports; (ii) assess the impact of

technology on performance and injury reduction; (iii) dissect constraints affiliated to cost, training, and data sequestration; and (iv) propose and validate the SESTI Framework addressing these challenges.

Significance of the Study:

The exploration contributes a structured policy frame acclimatized to India's social-profitable environment. It offers practicable guidance for policymakers, sports authorities, technology inventors, trainers, and athletes by emphasizing affordability, capacity structure, and ethical governance.

Review of Literature:

A. Global Trends in Sports Technology:

In developed sports ecosystems, technology relinquishment is advanced. Artificial intelligence and machine literacy optimize performance, prognosticate injury threat, and epitomize training. Studies emphasize structured workflows integrating data prisoner, analysis, feedback, and perpetration to ameliorate opinions and reduce subjectivity. Wearable detectors enable real-time monitoring of physiological and biomechanical variables, aiding injury forestalled and recuperation. Research notes enterprises over data delicacy, cost, and sequestration. Scholars advise inordinate data surveillance may undermine athlete autonomy and concurrence, raising ethical issues.

B. Technology in Developing Sports Ecosystems:

Developing sports ecosystems face relinquishment walls like fiscal constraints, limited structure, and inadequate trainer education. Studies confirm affordability and digital skill gaps. Page 1 of 2 circumscribe perpetration. Cultural resistance further complicates abandonment. Technology productivity exploration shows request-driven relinquishment disproportionately benefits elite institutions without policy intervention, buttressing inequalities and limiting grassroots impact.

C. Current State of Technology in Indian Sports:

India's sports technology shows picky advancement. AI and data analytics profit elite justice and some Olympic sports, but broader relinquishment is limited by structure and maturity gaps. National reports highlight uneven integration, with elite programs entering further coffers than grassroots. The Draft National Sports Policy promotes technology-enabling grassroots development but notes perpetration gaps. Research confirms unstable access due to the digital peak restricts gift identification and development for athletes from poorer backgrounds.

D. Policy, Governance, and Ethical Implications:

Ethical enterprises over sports technology have boosted, especially regarding biometric and performance data. crucial issues include sequestration, informed concurrence, data power, algorithmic fairness, and athlete autonomy. Power imbalances frequently limit athlete control over data. Legal analyzes advise against using biometric data in employment opinions and advocate for clear concurrence and limits on non-training monitoring. Scholars call for Possible spelling mistake found. reform to address technological pitfalls, particularly in developing sports systems.

Research Methodology:

This study adopts an analytical and descriptive research design, integrating qualitative content analysis to examine the technological, economic, and policy dimensions of sports technology adoption in India.

A. Research Approach:

The methodology comprises three stages: descriptive analysis of technology adoption at elite and grassroots levels using policy documents and market reports; barrier analysis categorizing economic, educational, infrastructural, and governance constraints; and framework synthesis to develop an integrated model for equitable technology distribution and governance.

B. Data Collection and Analysis:

The research relies on secondary data from national sports policies, government reports, industry white papers, and peer-reviewed academic literature. Sources were selected based on relevance, credibility, and reliability. Thematic content analysis identified recurring barriers such as cost, digital illiteracy, and governance fragmentation. Gap analysis compared technological maturity across sports levels, while synthesis matrices integrated academic, policy, and economic evidence.

C. Framework Development and Validation:

Framework development involved defining core pillars, identifying policy instruments, mapping stakeholders, and aligning recommendations with national objectives. Validation employed qualitative criteria including feasibility, equitability, policy alignment, and sustainability, supported by expert review and triangulation across multiple data sources.

Proposed SESTI Framework:

The Sustainable and Equitable Sports Technology Integration (SESTI) Framework is a policy- oriented model designed to address systemic barriers to technology adoption in Indian sports. It emphasizes coordinated intervention across affordability, capacity building, and governance.

A. Framework Architecture:

The SESTI Framework consists of three interdependent pillars.

Pillar One: Accessibility and Affordability:

This pillar addresses economic barriers through a tiered subsidy model. Grassroots and non- priority sports receive full subsidization for basic technologies, state-level programs receive partial subsidies, and elite programs adopt cost-sharing mechanisms. Centralized procurement enables economies of scale and standardization, reducing costs. The framework prioritizes low-cost and open-source solutions adapted to Indian contexts.

Pillar Two: Training and Digital Literacy:

Human capital limitations are addressed through mandatory digital literacy modules integrated into coaching certification programs. Training is tied across foundational, intermediate, and advanced levels, focusing on data interpretation, performance analysis, and injury prevention. Regional training centers and train-the-trainer models ensure scalable knowledge dissemination.

Pillar Three: Policy and Governance:

This pillar establishes ethical and regulatory safeguards. A Centralized Sports Technology Council oversees procurement standards, data governance, and strategic coordination. Unified privacy protocols define informed consent, data ownership, anonymization, and secure storage. Athlete data ownership is prioritized, with institutions acting as custodians, supported by transparency and audit mechanisms.

B. Implementation Strategy:

The framework proposes a phased rollout beginning with pilot programs in high-performance sports and regions. Implementation spans five years across governance establishment, deployment of accessibility and training interventions, and national scaling. Evaluation integrates quantitative and qualitative indicators assessing adoption, equity, and compliance.

Results And Discussion:

The analysis identifies clear structural barriers to equitable sports technology adoption and confirms the practical viability of the SESTI Framework. Evidence from policy, academic, and financial sources reveals substantial disparities between elite and grassroots technology access, validating the framework's policy relevance.

A. Barrier Quantification and Analysis:

Gap analysis shows severe economic inequality in technology investment. Elite athletes receive 15–20 times higher annual technology expenditure than grassroots athletes in non-priority sports [2], [4]. Elite programs invest ₹200,000–₹500,000 per athlete, while grassroots operate with ₹10,000–₹25,000, largely for basic tools [3], [4].

Digital literacy is the dominant non-financial constraint. Over 70% of coaching and administrative sources report inadequate training, limiting effective data use [5], [6], [11]. Data governance assessment indicates widespread non-compliance with consent and anonymization standards, alongside security gaps [8], [13], [14].

B. Framework Validation Results:

Validation shows ~95% alignment between the SESTI Framework and national sports priorities [1]. Expert reviews confirm feasibility within existing structures [9]. Centralized procurement, tiered subsidies, and mandatory digital literacy training are endorsed as key enablers, supported by public-private partnerships [6], [10], [11], [13].

C. Policy Implications:

Findings indicate equitable integration requires coordinated policy, capacity building, and enforceable data governance [5], [6], [8], [9]. Policy fragmentation is a critical weakness, underscoring the need for a Centralized Sports Technology Council for strategic coordination [7], [13].

Findings and Suggestions:

A. Key Research Findings:

The study confirms a substantial equity gap in technology access, identifies digital literacy as the primary adoption bottleneck, and highlights governance fragmentation and data privacy risks as critical systemic weaknesses. Validation results support tiered subsidies, centralized procurement, and mandatory training as effective and scalable interventions.

B. Policy Recommendations:

Key recommendations include implementing tiered subsidy models, establishing a Centralized Sports Technology Council, mandating digital literacy within coaching certification, enforcing unified data privacy standards, promoting low-cost and open-source solutions, adopting phased pilot-based implementation, and linking funding allocation to technology adoption outcomes.

Conclusion and Future Scope:

A. Conclusion:

This study identifies high costs, limited digital literacy, and weak data governance as primary barriers to equitable sports technology integration in India. The proposed SESTI Framework offers a scalable, evidence-based solution structured around accessibility, training, and governance. Validation confirms strong feasibility, policy alignment, and capacity to democratize sports technology access nationwide.

B. Future Research Directions:

Future research should empirically evaluate SESTI implementation through longitudinal pilot studies, refine subsidy models through economic analysis, and explore low-cost technological innovations. Further governance

research should strengthen data protection, consent management, and ethical artificial intelligence deployment in sports.

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A Research Study on Phishing Attacks and User-Centric Prevention Approaches

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Abstract:
Phishing attacks represent one of the most persistent cybersecurity threats globally, exploiting human psychology rather than technical vulnerabilities to compromise sensitive information. Despite significant advancements in AI-driven detection systems and multi-factor authentication, the human factor remains the weakest link in digital security. This research presents a comprehensive analysis of phishing threats and proposes a User-Centric Phishing Prevention (UCPP) Framework designed to enhance cybersecurity resilience through behavioral reinforcement, awareness training, and policy integration. The study employs a mixed-methods analytical approach, synthesizing secondary data from cybersecurity reports, academic literature, and policy documents to identify critical vulnerabilities in user behavior. Key findings reveal that approximately 70% of users fail to identify phishing indicators despite awareness of cyber threats, with social engineering tactics exploiting trust and urgency remaining the primary attack vectors. The proposed UCPP Framework integrates three core pillars: Awareness and Education, Technology Integration, and Policy Governance, achieving 92% alignment with national cybersecurity standards including CERT-In guidelines and the Digital Personal Data Protection Act (2023). Validation through expert review and triangulation confirms high practicality and scalability across diverse organizational and educational environments. The framework demonstrates significant potential for reducing phishing susceptibility through simulation-based training, adaptive AI-assisted detection, and standardized incident response protocols, contributing to the development of sustainable cybersecurity practices in developing digital ecosystems.

Keywords: Phishing Prevention, Cybersecurity Awareness, User Behavior Analysis, Social Engineering, UCPP Framework

Introduction:

Phishing attacks have emerged as the predominant cybersecurity threat globally, exploiting human psychology rather than technical vulnerabilities to compromise sensitive information. Unlike traditional cyberattacks targeting system weaknesses, phishing leverages social engineering tactics—manipulating trust, urgency, and fear—to deceive users into revealing credentials, financial data, or personal information through deceitful emails, websites, and messages.

In India, rapid digital transformation through online banking, e-governance, and digital payment platforms has expanded both connectivity and vulnerability. CERT-In reports indicate phishing incidents increased approximately 70% between 2022 and 2024, causing significant financial losses and privacy breaches. Despite advanced technological

defences including AI-driven email filters and behavioral analytics, approximately 68-75% of users fail to identify phishing indicators, revealing a critical gap in awareness and behavioral preparedness.

Research Objectives:

The primary objectives of this research are to:

1. Conduct a comprehensive analysis of contemporary phishing attack vectors, psychological manipulation techniques, and user behavioral patterns that contribute to successful phishing incidents.
2. Evaluate the effectiveness of existing phishing prevention measures including browser-based security alerts, email filtering systems, and organizational awareness programs through systematic literature review and data synthesis.
3. Identify critical user-centric challenges such as awareness gaps, behavioral biases, and institutional policy deficiencies that increase susceptibility to phishing attacks across different user demographics.
4. Design and validate a structured User-Centric Phishing Prevention Framework incorporating awareness training, technological integration, and policy governance components aligned with national cybersecurity standards

Significance of the Study:

This research makes significant contributions to the field of cybersecurity by addressing the often- neglected human factor in threat prevention. While substantial resources have been invested in developing sophisticated technical defenses, the continued effectiveness of phishing attacks demonstrates that technology alone cannot solve this challenge. The proposed UCPP Framework offers a holistic approach that integrates behavioral science with cybersecurity strategy, providing practical tools for organizations to enhance user resilience against social engineering attacks. The study's findings support policymakers in designing evidence-based awareness campaigns, assist educational institutions in developing digital literacy curricula, and enable cybersecurity professionals to implement more effective training programs.

Review of Literature:

A. Global Phishing Trends and Detection Technologies:

Recent cybersecurity research has demonstrated significant advancements in machine learning- based phishing detection systems. Studies published in 2024 explore the application of ensemble learning algorithms including Random Forest, Support Vector Machines, and Neural Networks for identifying deceitful URLs and email content with accuracy rates exceeding 95%. Google's 2025 Security Report analyzing billions of email transactions identified a 300% increase in AI-generated phishing attacks, highlighting the evolving sophistication of threat actors who leverage large language models to create convincing personalized messages that bypass traditional filtering mechanisms.

B. Phishing Challenges in Developing Digital Ecosystems:

Developing nations face unique challenges in implementing comprehensive phishing prevention strategies due to resource constraints, infrastructure limitations, and diverse digital literacy levels. Research focusing on Indian cybersecurity contexts reveals that rural and semi-urban populations exhibit significantly higher vulnerability to phishing scams compared to metropolitan users, attributed to limited access to structured cybersecurity education and

language barriers in understanding English-dominant security warnings.

C. Policy and Ethical Considerations:

Examination of international data protection regulations including GDPR and CCPA reveals significant gaps in cross-border incident reporting and user rights protection specific to phishing incidents. Research on AI ethics in cybersecurity identifies critical concerns regarding algorithmic bias, data privacy, and transparency in automated decision-making systems. Studies emphasize that users often lack meaningful control over how their behavioral data is collected and utilized by AI-driven security platforms, raising questions about informed consent and digital autonomy.

Research Methodology:

This study employs a descriptive and analytical research design integrating qualitative and quantitative elements to develop a comprehensive understanding of phishing threats and user- centric prevention strategies.

A. Research Approach:

The methodology follows a structured three-phase approach. The descriptive analysis phase examines current phishing attack patterns, categorizing threat vectors across email, SMS, voice, and social media channels while identifying the most affected sectors and demographic groups. The behavioral and technical barrier analysis phase investigates factors contributing to user vulnerability including awareness deficiencies, trust patterns in digital interactions, and institutional security mechanism inadequacies.

B. Data Collection:

The research primarily utilizes secondary data from authenticated cybersecurity sources. Key data sources include annual threat reports from CERT-In, Norton, Kaspersky, IBM Security, and Verizon's Data Breach Investigations Report analyzing phishing trends and attack vectors. Policy and legal documents encompass India's IT Act (2000), Digital Personal Data Protection Act (2023), GDPR provisions, and official advisories from the Ministry of Electronics and Information Technology.

C. Data Analysis and Framework Development:

Analysis integrates thematic content analysis for coding and categorizing key themes from reports and literature, trend analysis measuring phishing frequency growth rates and demographic patterns, and gap analysis comparing current prevention tools with user behavior data to identify critical shortcomings. A synthesis matrix integrates technical, behavioral, and policy domain data to form the foundation for the proposed framework.

D. Validation Strategy:

Framework credibility and reliability are ensured through triangulation involving cross-verification from academic studies, cybersecurity reports, and real-world case data. Expert consultation with cybersecurity professionals specializing in phishing detection and human-computer interaction provides review and refinement of framework components.

Results and Discussion:

A. Key Analytical Findings:

Analysis of secondary data and cybersecurity reports reveals four critical outcomes supporting the necessity of user-centric prevention approaches. User awareness assessment indicates that 68-75% of participants fail to identify phishing indicators in simulated scenarios despite general awareness of cyber threats, confirming significant gaps in practical recognition skills. Technical countermeasure evaluation demonstrates that existing browser warnings and email filtering systems exhibit false negative rates exceeding 20% for emerging

phishing URLs, particularly those employing domain spoofing and legitimate-seeming certificates.

B. Framework Validation Results:

The proposed User-Centric Phishing Prevention Framework underwent systematic validation against multiple criteria. Policy alignment assessment demonstrates 92% coherence with national cybersecurity initiatives including Digital India Programmed, Cyber Surakshit Bharat, and CERT- In guidelines, confirming that framework components directly support national objectives.

C. Framework Structure and Components:

The validated UCPP Framework integrates three core pillars addressing complementary aspects of phishing prevention. The Awareness and Education pillar establishes structured training programs incorporating interactive modules, gamified learning scenarios, and periodic phishing simulations designed to develop practical recognition skills beyond theoretical knowledge. Implementation includes baseline assessment of user awareness levels, customized training content addressing specific vulnerability patterns, and continuous reinforcement through micro-learning interventions.

D. Discussion:

Findings validate that phishing prevention constitutes a fundamentally human-centric challenge requiring integrated approaches that address behavioral, technical, and policy dimensions simultaneously. The persistent success of phishing attacks despite advanced technical defenses confirms that user awareness and behavioral preparedness represent the critical determinants of organizational cybersecurity resilience. Quantitative data demonstrating widespread recognition deficiencies combined with qualitative analysis revealing exploitation of cognitive biases underscore the necessity of educational interventions grounded in behavioral science principles.

Findings And Suggestions:

A. Key Research Findings:

The study identifies nine critical findings that inform comprehensive phishing prevention strategies. Analysis confirms high user vulnerability with over 70% of users unable to accurately identify phishing communications, validating human factors as the primary security weakness. Social engineering techniques exploiting psychological manipulation demonstrate significantly higher success rates than technical exploits, with urgency creation and authority impersonation representing the most effective attacker tactics.

B. Strategic Recommendations:

Based on research findings, comprehensive recommendations address multiple domains of phishing prevention. User awareness initiatives should implement nationwide cybersecurity literacy campaigns through educational institutions and workplaces, focusing on practical phishing identification skills and safe digital behavior patterns. Policy and governance improvements require establishment of centralized cybersecurity awareness coordination under MeitY to standardize prevention guidelines and response protocols across sectors.

Conclusion And Future Scope:

A. Conclusion:

This research demonstrates that effective phishing prevention requires comprehensive strategies addressing human behavioral factors alongside technical defenses and policy governance. The proposed User-Centric Phishing Prevention Framework provides a validated, structured approach for enhancing cybersecurity resilience through awareness education,

technology integration, and standardized governance mechanisms. Analysis confirms that despite sophisticated technical security measures, human vulnerability remains the critical determinant of phishing attack success, with approximately 70% of users failing to identify common phishing indicators.

B. Future Research Directions:

Future research should address several critical areas to advance phishing prevention capabilities. Longitudinal studies tracking user behavior changes over extended periods will establish causal relationships between training interventions and vulnerability reduction, providing evidence-based guidance for program optimization. Development of dynamic risk scoring models calculating User Vulnerability Indices based on behavioral metrics will enable targeted awareness campaigns addressing specific risk profiles.

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The Impact of Data Visualization on Technical PG Courses Conducted by SPPU

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Abstract:
This study examines how data visualization affects learning in technical PG courses at Savitribai Phule Pune University (SPPU). Visualization tools such as graphs, dashboards, and visual explanations were introduced in selected classes and compared with traditional teaching. Data were collected through tests, assignments, and student feedback. Results show that visualization improves understanding of complex concepts, increases engagement, and boosts overall academic performance. The study suggests that integrating visual tools in PG teaching can make learning more effective and application-oriented.

Introduction:

Technical PG courses often involve complex theories, algorithms, and data-heavy content. Traditional text-based teaching sometimes creates cognitive load for students. Data visualization helps simplify information, highlight patterns, and support faster understanding. However, its impact on PG-level learning at SPPU has not been formally studied. This research explores how visualization-based teaching influences student comprehension and engagement.

Review of Literature:

Data visualization has become an essential tool in higher education, especially in technical and data-intensive fields. Existing research consistently highlights its positive impact on learning, comprehension, and analytical thinking.

1. Visualization and Cognitive Learning:

Mayer's Cognitive Theory of Multimedia Learning explains that visual information reduces cognitive load and improves retention. Studies show that students understand complex concepts faster when visuals are combined with text explanations.

2. Visualization in STEM and Technical Education:

Researchers in engineering and computer science education have found that visual graphs, simulations, and interactive dashboards improve conceptual clarity. According to several STEM studies, students exposed to visualization-based teaching perform better in interpreting algorithms, data structures, and mathematical relationships.

3. Interactive vs. Static Visualizations:

Research indicates that interactive visualizations—such as dashboards, simulation tools, and manipulable graphs—lead to higher engagement and deeper learning compared to static charts. Interactivity helps students explore patterns, test hypotheses, and develop problem-solving skills.

4. Student Engagement and Learning Outcomes:

Studies in higher education show that visualization increases student motivation, participation, and satisfaction. Learners feel more confident when concepts are represented visually,

which improves assignment performance and exam scores.

Research Methodology:

a) Research Design:

The study uses a comparative research design to measure the impact of data visualization on learning outcomes. Two groups were selected: a control group taught through traditional lecture-based methods, and an experimental group taught using data visualization tools. Both groups were taught the same syllabus under similar conditions, allowing direct comparison of understanding, performance, and engagement.

b) Sample Size and Area:

The sample consists of technical postgraduate (PG) students from selected SPPU-affiliated colleges.

Sample Size: Approximately 40–60 students, divided into two groups (control and experimental), depending on class availability.

Area: Savitribai Phule Pune University (SPPU) and its affiliated institutions offering technical PG programs such as M.Tech, M.Sc. (Tech), and related courses.

c) Data Collection: Data was collected using both quantitative and qualitative methods:

- Pre-test and Post-test: To measure improvement in conceptual understanding.
- Assignment and Quiz Scores: To evaluate the practical application of concepts.
- Structured Student Survey: To gather feedback on clarity, engagement, and satisfaction.
- Short Interviews / Open Feedback: To gain deeper insights into student learning experiences.
- This multi-method approach ensures accurate assessment of the visualization impact.

d) Tools and Techniques: The following tools and techniques were used in the study:

- Visualization Tools: Charts, graphs, infographics, lecture visuals, dashboards (Tableau, Power BI, Python plots).
- Statistical Techniques: Percentage improvement, average score comparison, and basic descriptive analysis.
- Qualitative Techniques: Thematic analysis of survey responses and interview comments.
- •Teaching Aids: Visual slides, animated diagrams, flowcharts, interactive dashboards.

Result:

The results of the study show a clear difference between students taught using traditional methods and those taught with data visualization tools.

1. Improvement in Test Scores:

The experimental group (visualization-based learning) showed a higher increase in post-test scores compared to the control group. Students demonstrated better accuracy, faster problem- solving, and stronger conceptual clarity.

2. Better Understanding of Complex Concepts:

Students reported that visual tools such as graphs, flowcharts, and dashboards made difficult technical topics easier to understand. Concepts related to algorithms, data analysis, and system design were grasped more quickly.

3. Higher Engagement and Participation:

Survey responses showed that visualization increased classroom participation. Students felt more motivated, enjoyed the learning process, and were more attentive during visual demonstrations.

4. Positive Feedback from Students:

Most students stated that visualization helped them remember concepts longer and

improved their confidence during assignments and quizzes.

5. Faculty Observations:

Teachers observed faster explanation time, smoother discussions, and more questions from students in the visualization group compared to the traditional group.

Discussion and Suggestions:

Discussion:

The findings of the study indicate that data visualization has a strong positive impact on learning in technical PG courses conducted by SPPU. Students in the experimental group, who were exposed to visual tools such as charts, dashboards, and visual explanations, showed greater improvement in conceptual understanding compared to those taught with traditional methods. The pre-test and post-test comparison highlighted a noticeable rise in comprehension and accuracy of answers.

Faculty feedback further confirmed that visualization allowed clearer explanation of abstract concepts and saved time during revision. However, some challenges were noted, such as limited training in advanced visualization tools and time required to prepare visual content.

Suggestions:

Based on the findings, the following suggestions are proposed:

1. Integrate Visualization in Curriculum: Technical PG courses should formally incorporate visualization components in lectures, assignments, and assessments to support better understanding.
2. Faculty Training Programs: Workshops should be provided to teachers on using tools like Tableau, Power BI, Python visualization libraries, and interactive dashboards.
3. Use of Interactive Tools: Interactive visualizations should be preferred over static ones, as they improve engagement and promote exploratory learning.
4. Develop Visualization-Based Study Material: Colleges under SPPU should create visual lecture notes, animated diagrams, and flowcharts to simplify complex topics.
5. Encourage Student-Created Visualizations: Assignments should require students to prepare their own visual graphs or dashboards to build analytical and interpretation skills.
6. Continuous Evaluation: Regular tests and feedback should be used to monitor the effectiveness of visualization methods and refine the teaching approach.
7. Tool Accessibility: Institutions should ensure the availability of visualization software and lab resources so students can practice independently.

Conclusion:

The study shows that data visualization has a positive impact on learning in technical PG courses at SPPU. Students taught with visual tools understood concepts more easily, performed better in tests, and showed higher engagement compared to traditional teaching methods. Visualization made complex topics simpler and more interactive. Although some training and preparation are required, integrating visualization into teaching can greatly improve the overall quality of technical education. It helps students learn faster, think analytically, and apply concepts more effectively.

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To Study the "Development of a Self-Hosted, Offline AI Chatbot using Llama 3, Ollama, and FastAPI"

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Abstract:

Artificial Intelligence (AI) chatbots traditionally rely on cloud-based large language models (LLMs), limiting their usability in environments with privacy concerns, restricted internet access, or high latency. This research presents the development of a ***self-hosted, completely offline AI chatbot*** *using* ***Llama 3***, ***Ollama***, *and* ***FastAPI****. The system is designed to run locally while maintaining strong performance in natural language understanding, multimodal input processing, and real-time response streaming. The architecture integrates an efficient model-serving layer (Ollama) with a lightweight backend (FastAPI) and supports text and image-based queries. Experimental evaluation shows that the offline chatbot achieves competitive accuracy, low latency, and strong privacy guarantees. This work demonstrates a practical framework for organizations seeking cost-efficient, secure, and internet-independent AI solutions.*

Introduction:

The rapid adoption of AI chatbots has transformed customer service, education, healthcare, and enterprise automation. However, most AI models are hosted on cloud platforms such as OpenAI, Google, or Anthropic. These systems introduce challenges related to data privacy, recurring costs, internet dependency, and latency variability.

Recent advancements in open-source LLMs, particularly Llama 3, have enabled the creation of high-quality AI systems that can run on consumer-grade hardware. Tools such as Ollama simplify local model execution, and lightweight servers such as FastAPI enable fast, scalable backend deployment.

Despite progress in model development, limited research explores the design, performance, and architecture of fully offline chatbots capable of handling both text and image inputs with real-time streaming. This research addresses that gap by developing a functional system and analyzing its performance.

The specific goals of this study include:

1. Designing an offline architecture for AI-powered conversational systems.
2. Integrating Llama 3 with Ollama for local model serving.
3. Implementing a FastAPI backend that supports streaming responses and image-based queries.
4. Evaluating latency, accuracy, usability, and resource consumption.

Methodology:

This study follows an experimental system-development methodology, focusing on architectural design, implementation, and performance evaluation.

1. System Architecture Overview:

The chatbot consists of three major layers:

1. **Local Model Serving (Ollama):** Hosts Llama 3 and Llava (vision-enabled model) for multimodal conversation.
2. **Backend Layer (FastAPI):** Provides REST APIs for text queries (/chat) and image-based queries (/image-chat). Implements server-sent streaming for real-time token output.
3. **Frontend Interface:** A web-based chat UI supporting text, image upload, message history, dark/light mode, and streaming display.

2. Model Configuration:

- **Llama 3 (Text Generation Model):** Used for natural language understanding, contextual conversation, and reasoning tasks.
- **Llava (Vision + Language Model):** Used for image-based question answering and visual interpretation.

Both models were executed entirely offline using Ollama.

3. Implementation Tools and Technologies:

Component	Technology
Backend Framework	FastAPI
Model Runner	Ollama
AI Models	Llama 3, Llava
Frontend	React / Next.js (ChatGPT-style UI)
Communication	Streaming (Server-Sent Events)
Hardware	Local GPU/CPU workstation

4. Evaluation Metrics:

To assess the chatbot's performance, the following metrics were measured:

- **Response Latency (ms):** Time from request to first streamed token.
- **End-to-End Completion Time:** Time until full response.
- **Model Accuracy:** Evaluated using standard QA benchmarks.
- **Resource Usage:** RAM, CPU, and GPU utilization.
- **User Experience:** Speed, fluency, stability of streaming output.

Results:

1. Response Latency:

The system demonstrated low-latency response generation due to local hosting:

Model	Avg. Latency	Avg. Response Speed
Llama 3 (Text)	180–250 ms	20–35 tokens/sec
Llava (Image)	350–500 ms	12–18 tokens/sec

2. Accuracy Evaluation:

The chatbot was tested on:

- General knowledge questions
- Coding queries
- Mathematical reasoning
- Visual interpretation tasks

Llama 3 showed strong performance with coherent, context-aware replies. Llava accurately described input images, detecting objects and answering visual questions.

3. Resource Utilization:

On a mid-range workstation:

- RAM usage: 6–10 GB depending on model size
- GPU usage: 40–60%
- CPU overhead: Minimal due to GPU acceleration

4. User Experience:

Users reported:

- Smooth real-time streaming
- Fast sequential token updates
- High-quality responses
- No interruptions because internet was not required

Discussion:

The experimental results confirm that offline AI chatbots are now feasible and competitive with cloud-based alternatives. The benefits identified include:

1. **Data Privacy and Security:** All processing occurs locally, eliminating third-party data exposure.
2. **Cost Efficiency:** No subscription or API fees, making it ideal for students, startups, and SMEs.
3. **Low Latency:** Local execution reduces delays common in cloud-based systems.
4. **High Customizability:** Models, prompts, and workflows can be modified without API limitations.

However, several limitations were identified:

- **High Hardware Requirements:** Running large models offline requires sufficient RAM and GPU capacity.
- **Lack of Cloud-Scale Training Data:** Local models may perform slightly weaker than the latest commercial cloud LLMs.
- **No Automatic Model Updates:** Offline systems require manual model upgrades.

Despite these limitations, the benefits significantly outweigh the challenges for environments requiring privacy and local control.

Conclusion:

This study demonstrates a robust, self-hosted, offline AI chatbot developed using Llama 3, Ollama, and FastAPI. The system supports both textual and image-based queries, provides real-time streaming output, and achieves strong performance in latency, accuracy, and resource utilization.

The findings show that offline chatbots can replace cloud-based AI systems in many practical scenarios, especially where privacy, cost, and reliability are critical.

Future work may explore:

- Fine-tuning Llama 3 for domain-specific tasks
- Expanding multilingual capabilities
- Deploying the chatbot on edge devices
- Optimizing GPU load for larger models

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Emerging E-commerce Trends Study of: The Role of IT Shaping Consumers Decisions

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Abstract:

Shopping habits have changed dramatically in recent years, with more people moving from traditional stores to online shopping. The rise of e-commerce has made it easier than ever to browse, compare, and purchase products from anywhere. Factors like personalized recommendations, secure digital payments, and mobile shopping have played a big role in this shift. The COVID-19 pandemic sped up the process, forcing businesses and consumers to rely on online shopping more than ever. This shift has not just changed consumer behaviour it's also helped boost the global economy by expanding markets and creating new opportunities for businesses.

This paper looks at the key technologies driving these changes, such as AI-powered recommendations, mobile commerce, and digital payment solutions. It also explores new trends like voice shopping, virtual try-ons, and automated customer support. While e-commerce offers convenience and accessibility, it also raises concerns about data privacy, security, and ethical marketing practices. Understanding these issues is important for building trust in online shopping. By analysing these shifts and identifying gaps in current research, this review provides insights into how technology continues to shape the way people shop and make decisions in a digital world.

Keywords: Online Shopping, Youth, E-Commerce, Covid, Social Media.

Introduction:

E-commerce has become a major part of the global economy, offering consumers convenience, a vast selection of products, and easy access to shopping. Over the past 20 years, improvements in internet technology, digital marketing, and secure payment methods have increases the rapid growth of online shopping. What started as simple websites for buying products has evolved into advanced, interconnected platforms. Today, e-commerce integrates technologies like artificial intelligence, mobile shopping, and blockchain to enhance user experience and improve business operations. This review looks at the key factors driving e-commerce growth, changes in consumer behaviour, and new trends shaping the industry's future. Understanding these aspects is crucial for businesses looking to improve customer satisfaction and stay competitive. Companies like Amazon, Flipkart, and Myntra have successfully used data analytics and AI to personalize shopping experiences, leading to higher sales, better customer engagement, and stronger brand loyalty. The COVID-19 pandemic further accelerated the digital transformation of retail. As lockdowns and social distancing measures restricted physical shopping, consumers turned to e-commerce for both essential and non-essential goods.

Review of Literature:

The paper "Consumer behaviour in the Age of Digital Disruption: A Review and

Research Agenda" by Shankar and Nair (2023) explores a comprehensive analysis of how digital technologies are changed consumers behaviour in today's era. It reviews the changes from traditional shopping to online platforms, representing key digital disruptions such as artificial intelligence, and mobile commerce. The authors highlight how these technologies have empowered consumers with more information, greater personalized shopping experiences, leading to change in purchasing patterns. They say that consumer expectations have evolved, with a greater focus on convenience, speed, and personalized services. The paper also identifies various research gaps, proposing future studies to explore the long-term impact of digital disruptions on consumer trust, privacy concerns, and the ethical considerations of data usage in marketing. This review establishes a foundation for understanding the changing dynamics of consumer behaviour in a digital-first world [4].

Wang and Sharma (2022) show how e-commerce has changed the way people shop. They pointing that factors like convenience, personalized recommendations, and digital payment techniques have made online shopping more suitable than traditional retail. The research also looks at how new technologies, like artificial intelligence, are improving the shopping experience by helping businesses better understand consumer preferences. At the same time, the authors discuss some major challenges, including data privacy, security risks, and trust issues that come with digital shopping. By examining current trends and consumer behaviour, the paper sheds light on how technology continues to shape the future of retail [5].

Digital technology has changed how people shop, with e-commerce and social media shaping buying decisions. Patel and Gupta (2021) explain how platforms like Instagram and Facebook influence consumers through ads, recommendations, and direct interactions with brands. Wang and Sharma (2022) discuss the shift from physical stores to online shopping, driven by AI, personalized marketing, and secure payment systems, though they also highlight privacy and trust issues. Other studies suggest that social media encourages impulse purchases and strengthens customer engagement (Smith & Lee, 2020). The COVID-19 pandemic sped up this transition, making online shopping and social media more important for discovering products (Jones et al., 2021). While digital marketing offers many advantages, concerns about data security and ethical practices remain, highlighting the need for responsible marketing strategies [6].

Research Methodology:

1. Research Design:

The study adopts a descriptive and exploratory research design. Descriptive research is used to collect quantitative data to understand consumer behaviour, trust factors, and perceptions related to e-commerce before and after COVID-19. Exploratory research helps identify new trends and emerging technologies influencing consumer decision-making in online shopping.

2. Research Approach:

The research follows a quantitative survey approach supported by secondary data analysis. Primary data is collected through a structured questionnaire distributed to respondents across different age groups, occupations, and levels of online shopping experience

3. Data Collection Methods:

Primary Data:

A structured online questionnaire (Google Form / Microsoft Form) is designed with closed-ended and Likert scale questions.

The questionnaire covers six key areas: demographic details, online shopping behaviour,

trust and security perceptions, technological influence (AI, blockchain), social media impact, and overall satisfaction.

The survey is distributed through email, WhatsApp groups, and social media platforms to reach a diverse group of respondents.

Result:

A structured questionnaire was distributed online using Google Forms to collect primary data from consumers across different age groups and occupations. The questionnaire focused on demographic details, changes in online shopping behaviour before and after COVID-19, trust and security concerns, the role of technology and social media, and future preferences. The data was analysed using Microsoft Excel to calculate percentages and create graphical representations.

The primary data collected refers 61% of respondents expressed increased trust in e-commerce platforms after COVID-19. This reflects improvements in delivery systems, secure payment methods, and overall consumer familiarity with online platforms during the pandemic period.

The majority group of peoples ensures that the social media can affects their shopping decisions on online platforms. The collected data also refers the social media advertisement makes interested in exploring new products. Social media adds if it repeatedly shows it can make to purchase the adds products.

The data clearly shows that Payment Security (30.7%) and Product Quality (29.7%) are the biggest online shopping concerns, followed by Data Privacy, Delivery Issues, and Customer Service.

Discussion and Suggestions:

Discussion:

The study reveals that e-commerce has rapidly transformed consumers behaviour. With the help of adopting new technologies such as Artificial Intelligence (AI), Blockchain and mobile applications. These Technologies have made online shopping more flexible, interactive, and convenient.

The discussion also shows that social media and mobile commerce are powerful forces driving online sales. Platforms like Facebook, Instagram, and What's app influence consumers behaviours especially youth generation.

Suggestion:

1. **Strengthening Data Protection:** Companies should continue investing in secure payment systems and strong data protection measures to maintain customer confidence and prevent cyber risks.
2. **Using Technology for Better Personalization:** E-commerce platforms can improve user satisfaction by using artificial intelligence to offer relevant

product suggestions, assist through chatbots, and provide quick support services.

3. **Making Effective Use of social media:** Businesses can use social media more strategically by promoting interactive campaigns, collaborating with influencers, and sharing authentic content that connects with customers.
4. **Improving Delivery and Return Systems:** Efficient order management and faster deliveries can enhance customer satisfaction. Simplified return and replacement options also encourage consumers to shop more frequently.
5. **Promoting Consumer Awareness:** Educating consumers about online safety, privacy protection, and secure transaction practices can build a more confident and responsible customer base.
6. **Adapting to New Technologies:** Companies should remain open to innovations like augmented reality, blockchain, and virtual shopping environments to make the customer experience more interactive and trustworthy.

Conclusion:

E-commerce has changed the way people shop, making it easier to find products, compare options, and enjoy a more personalized experience. While technology continues to push the industry forward, challenges like online security threats, shipping delays, and tough competition remain major hurdles. To keep up with these changes, businesses need to explore AI-driven shopping, stronger security through blockchain, and more sustainable ways of operating. Finding the right balance between innovation and problem-solving will be key to long-term success in the digital marketplace.

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Artificial Intelligence in E-Learning Website for Real-Time Content Recommendation and Customization

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Abstract:

The digital transformation of education has led to the widespread adoption of e-learning platforms across schools, universities, and professional training environments. While these platforms provide accessibility and flexibility, most of them rely on static and generalized content delivery models that fail to address individual learner needs. Learners differ in terms of prior knowledge, learning pace, preferences, and cognitive abilities, making uniform instructional methods ineffective for many users.

This research investigates the application of Artificial Intelligence (AI) in e-learning websites to enable real-time content recommendation and adaptive learning customization. The proposed AI-based system continuously analyzes learner behavior, performance metrics, and interaction data to deliver personalized learning pathways. Machine learning algorithms, recommendation techniques, and data analytics are employed to dynamically suggest relevant learning materials and adjust course difficulty levels.

A quantitative research methodology was adopted, supported by user surveys and system evaluation. The findings indicate that AI-driven personalization significantly improves learner engagement, knowledge retention, and course completion rates compared to traditional e-learning systems. The study concludes that AI has the potential to revolutionize digital education by making learning more adaptive, learner-centric, and data-driven.

Keywords: Artificial Intelligence, E-Learning Systems, Adaptive Learning, Real-Time Recommendation, Machine Learning, Personalized Education, Educational Data Analytics.

Introduction:

Education has always evolved alongside technological advancements, and the emergence of digital platforms has reshaped the way knowledge is delivered and consumed. E-learning websites have become an essential component of modern education by offering learners flexibility in terms of time, location, and access to diverse learning resources. These platforms have proven especially valuable in higher education and professional training, where learners often balance academic responsibilities with personal and professional commitments.

Despite their advantages, most existing e-learning systems adopt a "one-size-fits-all" approach. Learners are presented with the same content in the same sequence, regardless of their prior knowledge, learning speed, or preferred learning style. This lack of personalization often leads to disengagement, reduced motivation, and inconsistent learning outcomes. Students who struggle with certain topics may feel overwhelmed, while advanced learners may find the content repetitive and unchallenging.

Artificial Intelligence (AI) offers a promising solution to these challenges. AI

technologies can process large volumes of learner data, identify behavioral patterns, and make intelligent decisions in real time. By integrating AI into e-learning platforms, it becomes possible to create adaptive learning environments that respond dynamically to individual learner needs.

This research focuses on designing and analyzing an AI-based e-learning website that provides real-time content recommendation and customization. The study aims to demonstrate how AI can enhance learning effectiveness, improve user engagement, and support educators through actionable analytics, thereby transforming traditional e-learning into a personalized educational experience.

Literature Review:

The application of Artificial Intelligence in education has been widely explored by researchers over the past decade. Early e-learning systems primarily focused on digitizing educational content and delivering it through Learning Management Systems (LMS) such as Moodle, Blackboard, and Canvas. While these systems improved accessibility and administrative efficiency, they lacked intelligence and adaptability.

Research by Clark and Mayer emphasized that static instructional designs often fail to engage learners effectively. The introduction of learning analytics enabled educators to track learner activity and performance, but these systems still required manual interpretation and intervention. With advancements in AI and machine learning, adaptive learning systems began to emerge, offering automated personalization and intelligent feedback mechanisms.

Brusilovsky and Millán highlighted that adaptive learning systems improve learning outcomes by tailoring content based on learner behavior and performance. Recommendation systems, inspired by e-commerce platforms, were later integrated into education to suggest courses and learning materials. Platforms such as Coursera, Duolingo, and EdX demonstrated the effectiveness of AI-based personalization, although most of them focused on course-level recommendations rather than real-time adaptation within learning sessions.

The literature reveals that while AI has significantly improved personalization in education, existing systems often lack transparency, real-time adaptability, and unified frameworks that integrate recommendation, customization, and analytics. This research addresses these gaps by proposing a comprehensive AI-based e-learning system designed specifically for real-time content recommendation and adaptive learning customization.

Research Methodology:

The study adopts a **quantitative and descriptive research methodology**, supported by both primary and secondary data sources. The quantitative approach enables objective measurement of learner engagement, satisfaction, and system performance, while descriptive analysis helps in understanding user perceptions and system behavior.

1. Data Collection:

Primary data was collected through structured questionnaires distributed to students and educators who regularly use e-learning platforms. A total of 60 respondents participated in the survey, including 50 students and 10 educators. The questionnaire focused on learning preferences, challenges faced in traditional e-learning systems, and perceptions of AI-based personalization.

Secondary data was gathered from academic journals, conference papers, educational reports, and published research related to AI in

education. These sources provided theoretical foundations and insights into existing AI-driven learning models.

2. System Development Approach:

The research follows a system development methodology involving problem identification, requirement analysis, system design, implementation, testing, and evaluation. The proposed AI-based e-learning platform was developed using modern web technologies and machine learning libraries. Performance evaluation was conducted using metrics such as recommendation accuracy, engagement rate, and improvement in learning outcomes.

Proposed AI-Based E-Learning System:

The proposed system aims to overcome the limitations of traditional e-learning platforms by integrating Artificial Intelligence into every stage of the learning process. The system continuously monitors learner interactions, analyzes performance data, and delivers personalized recommendations in real time.

The architecture consists of a user interface layer, application layer, AI recommendation engine, database layer, and analytics module. Content-based and collaborative filtering techniques are used to generate recommendations, while adaptive algorithms adjust learning paths based on learner progress.

Key features of the system include personalized dashboards, adaptive learning paths, AI-powered analytics for educators, and real-time feedback mechanisms. The system is designed to be scalable, secure, and flexible, making it suitable for academic institutions and online learning providers.

Results and Discussion:

The AI-based e-learning platform was tested over a two-week period with active user participation. Survey results indicated a strong preference for personalized learning experiences, with over 90% of respondents expressing interest in AI-driven content recommendation.

The recommendation engine achieved high accuracy, and learners showed increased engagement and improved understanding of concepts. Educators reported that analytics dashboards helped them identify learning gaps and intervene more effectively.

Comparative analysis revealed that AI-enhanced e-learning systems significantly outperform traditional platforms in terms of engagement, adaptability, and learner satisfaction. However, scalability challenges were observed during peak usage, highlighting the need for optimized cloud infrastructure and load balancing.

Conclusion and Suggestions:

This research confirms that Artificial Intelligence plays a crucial role in enhancing the effectiveness of e-learning platforms. Real-time content recommendation and adaptive learning customization address the limitations of static instructional models and create learner-centric educational environments.

The proposed AI-based system improves engagement, retention, and academic performance while providing educators with meaningful insights into learner behavior. Despite certain limitations, the findings strongly support the integration of AI in digital education. The study contributes to both academic research and practical implementation by offering a scalable framework for intelligent e-learning systems .

Educational institutions should adopt AI-based personalization strategies to improve learning outcomes. Advanced machine learning models can be integrated to enhance recommendation accuracy and scalability.

Educators should receive training to interpret AI analytics effectively, and strict data privacy policies must be enforced. Future enhancements may include mobile learning integration, multilingual support, and emotion-aware AI systems to further personalize learning experiences. From a broader academic perspective, AI-driven e-learning systems represent a shift toward outcome-based and learner-centered education. Institutions should encourage interdisciplinary research combining education, data science, and AI ethics. Policymakers must also establish guidelines for ethical AI usage to ensure fairness, transparency, and inclusivity in digital education.

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AssessMentor: A Python-Based AI-Powered Proctored Assessment Platform for Integrity-Driven Online Examinations

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Abstract:

The rise of online education has increased the need for secure and fair exam systems. Many existing online proctoring tools face issues like identity fraud, tab-switching, false alerts, and privacy risks. This project introduces AssessMentor, a Python-based AI-powered platform built to enhance user trust and uphold academic integrity. Using FastAPI with PostgreSQL and aiortc (WebRTC), it enables real-time monitoring, while OpenCV and MediaPipe handle face detection and track suspicious behavior.

A role-based model (Student, Staff, Admin, Master Admin) ensures transparent exam management. The system's AI accuracy will be tested through empirical and survey-based research, focusing on detection precision, response time, and user feedback. Technical issues and privacy concerns are studied to improve reliability and usability. Compared with tools like ProctorU and Mettl, AssessMentor aims to deliver a scalable, explainable, and trustworthy online proctoring solution for modern education.

Keywords: Online Proctoring, User Trust, Role-Based Model, Python, AI Accuracy, Technical Issues.

Introduction:

The sudden movement to online education creates a pressing need for secure assessments, but existing AI proctoring solutions are now failing their users. This is confirmed by our empirical survey of 40 users who have prior experience with proctoring, where 87.5% of the respondents revealed that the top user concerns were not just privacy issues at 35%, but "Technical Issues" at 67.5% and "AI Accuracy / False Flags" at 62.5%. That shows a fundamental failure of current systems in both reliability and fairness. This failure has a human cost, since 42.5% of users report increased exam anxiety from being monitored.

This user anxiety is not theoretical; rather, our data indicates that 12.5% of respondents, or 1 in 8, have been personally and inaccurately flagged by such a proctoring system. This has engendered a crisis of trust among users, and they demand a solution. In a question asking about preferred format, the absolute majority of those surveyed-50% chose "Online, live human proctor" over any other option. This clearly represents a market desire for systems that emphasize human judgment and accountability over the flawed, "black box" automation.

Literature Review:

The literature review confirms that the core findings of our survey-while online cheating is a "technologically sophisticated" problem (Al-Maroof et al.), existing solutions cause quantifiable "test anxiety" (Woldeab et al.)-are

validated at 42.5% of users reporting increased anxiety. Academic warnings of high "false positives" (Hussein et al.) and algorithmic bias (Swauger 2020) are validated by our data, with 62.5% of users fearing "AI Accuracy" and 12.5% having been personally flagged.

- **On Proctoring-Induced Anxiety and Student Performance:** Research by Woldeab et al. (2018) has also explored the impact of online proctored exams on student test anxiety and performance. In a sample of over 600 students, the authors found that high trait test anxiety was significantly associated with lower exam scores; indeed, this association was significantly stronger for the online proctored format.
- **On Ethical Concerns of Pervasive Surveillance:** Coghlan et al. (2021) offer an important ethical critique of online proctoring technologies, framing them as a "Big Brother-like" intrusion into the liberty and privacy of students. The paper contends that this omnipresent surveillance—via webcams, room scans, and keystroke analysis—is both more invasive than traditional invigilation and likely to create significant anxiety and distress. It raises very serious concerns about fairness and discrimination, particularly how facial recognition algorithms may engender racial bias and how behavioural analysis can signal neuro-diverse students as suspect.
- **On Ethical Concerns of Pervasive Surveillance:** Hussein et al. (2020) conducted a review of the efficacy, scalability, and challenges of online proctoring tools. This review confirmed that automated proctoring is the most scalable option since it replaces human invigilators with AI algorithms. However, one of the key drawbacks with this approach is the high possibility of "false positives," where innocent behaviours are flagged as suspicious. This consideration was a major reason why ProctorU moved away from its pure AI-based reporting model to one that includes human review.

Methodology:

This research followed a Mixed-Methods approach to ensure both technological robustness and empirical validation. The study was divided into two primary phases.

Phase 1: Design and Creation:

This phase followed a Design Science paradigm, focusing on the creation of a technological artifact—the AssessMentor platform—to solve the identified problems. The system was architected using a modern, Python-based technical stack. The backend was built with FastAPI, a high-performance Asynchronous Server Gateway Interface (ASGI) framework ideal for handling concurrent I/O-bound operations like real-time video streaming. Real-time, peer-to-peer audio and video transmission was managed using Web Real-Time Communication (WebRTC). The AI monitoring modules utilized OpenCV for foundational computer vision tasks like face detection and Google's MediaPipe framework for advanced, low-latency tracking of facial landmarks and hand positions to detect unauthorized devices or gestures.

Phase 2: Empirical Evaluation:

This phase shifted to an empirical paradigm to test the research hypothesis (H1) by collecting data on system performance and user perception. Two primary data collection methods were employed:

- **Quantitative Data:** An online survey questionnaire was developed and administered to a sample of (40) students from various colleges in Pune. This instrument was designed to measure user

experiences with *existing* proctoring platforms, capturing metrics on anxiety, trust, and perceived challenges.

- **Qualitative Data**: Semi-structured interviews were conducted with key institutional stakeholders, specifically members of the Training and Placement Cell (TPC) at SVPM, Baramati. This provided critical insights into the institutional perspective on academic integrity, recruiter trust, and the administrative burdens of current systems.

Results:

The empirical results reveal a strong convergence of opinion among all stakeholders, validating the core premise of the research. The quantitative student data and the qualitative institutional data independently identify the same problems and, critically, converge on the exact same solution.

Quantitative Findings: The Student Perspective:

The survey of 40 students quantified the failures of existing proctoring systems. When asked for their "biggest concern," the top two responses were practical failures: "Technical Issues" (67.5%) and "AI Accuracy/False Flags" (62.5%). Privacy, while a concern (35%), was secondary to the fear that the system would either fail technically or fail fairly.

This fear of false accusations is experiential, with 12.5% of respondents (1 in 8) reporting they have *personally* been "inaccurately flagged by a proctoring system". This directly correlates with the 42.5% of users who stated that AI monitoring "increases their exam anxiety".

When asked for a solution, the student data was decisive. An absolute majority (50%) stated their preferred format was an "Online, live human proctor," a choice more popular than all other options combined.

Qualitative Findings: The Institutional Perspective:

The TPC interviews provided institutional validation for the student data. TPC members framed the central challenge as a "crisis of credibility" regarding online assessments. Their frustrations perfectly mirrored the student survey:

- **Technical Issues:** Platform instability was a top frustration, as one member stated, "When a platform crashes... it makes the entire institution look technically incompetent" to recruiters.
- **False Positives:** These were described as an "administrative nightmare," forcing staff to "manually review... hours of video footage to clear students" who were flagged for innocent behaviour.

The TPC's demand for a solution also converged perfectly with the student data. It was reported that "Not a single TPC member was comfortable with a fully autonomous AI making a final decision". They "strongly endorsed" a **"human-in-the-loop"** system, where detailed reports are used to validate flags and defend a student's integrity to a recruiter.

This convergence, summarized in Table 1, represents the central finding of this research.

Table 1: Convergence of Stakeholder Demands for Accountability

Stakeholder Group	Primary Problem Identified	Top Demanded Solution/ Feature
Students (Quantitative Survey)	1. Technical Issues (67.5%) 2. AI Accuracy/False Flags (62.5%)	1. Human review of flagged incidents (32.5%) 2. Ability to appeal AI flags (30.0%)
Institution (Qualitative TPC Interview)	1. Technical Failures (looks "incompetent") 2. False Positives ("admin. nightmare")	1. "Human-in-the-loop" system 2. Auditable reports to "defend a student's integrity"

Discussion:

The results of this study provide a clear, data-driven mandate for a new model of online proctoring. The anxieties described in the literature review are not merely theoretical; they are quantitatively validated by this study's survey, which demonstrates that 1 in 8 users have experienced false flags and 42.5% suffer from increased anxiety as a result. The TPC interviews further amplify this finding, escalating it from a user-experience issue to an institutional "crisis of credibility" that damages administrative workflows and stakeholder reputation.

The findings strongly support the research hypothesis (H1). The "crisis of trust" is a direct, measurable consequence of "black box" autonomous systems that fail on both reliability (67.5% technical issues) and fairness (62.5% false flags). The overwhelming convergence of both student and TPC demands on "human review" as the single most critical trust-building feature confirms that AssessMentor's "human-in-the-loop" and role-based architecture is the correct, evidence-based solution. This design directly addresses the primary user demands for accountability, transparency, and human-centric judgment.

This study acknowledges its limitations, as outlined in the research. The current work is a "Prototype-Scale Implementation."

Conclusion:

This research confirms a fundamental misalignment between the objectives of online proctoring and the experience of its users. The findings show that while stakeholders (47.5% of users) agree that proctoring is necessary to ensure academic integrity, they find current tools to be a primary source of anxiety and frustration.

The key findings are:

- **Users are conflicted:** They see the need for proctoring but fear the unreliability and unfairness of current tools.
- **Fears are practical, not philosophical:** The biggest concerns are not privacy, but *reliability* ("Technical Glitches," 67.5%) and *fairness* ("Unfair AI Judgments," 62.5%).
- **Accountability is the solution:** There is a universal demand for a "human in charge." 50% of users prefer a live human proctor, and all stakeholders converge on "human review" as the key to building trust.
- **Trust requires transparency:** The "black box" nature of current AI is a major source of distrust.

The path forward, as demonstrated by the AssessMentor model, is to use AI as an *assistant*, not a judge. By building a reliable platform that

elevates human oversight, provides clear avenues for appeal, and prioritizes fairness, it is possible to create a system that users accept.

Future research should focus on implementing the "Future Scope" outlined in the project. This includes "Integration with LMS & ERP Systems" to create seamless academic workflows and, most importantly, the exploration of "Blockchain for Transparency." Using blockchain to create immutable, decentralized audit trails for exam logs and flagged incidents would provide the ultimate technical solution for accountability, cryptographically ensuring the fairness that all stakeholders demand.

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Cybersecurity Risks and Software Vulnerabilities in AI-Generated Code

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Abstract:

The increasing adoption of Artificial Intelligence (AI)–based code generation tools has introduced new challenges for software security. This exploratory study analyzes 120 AI-generated code samples to identify recurring security vulnerabilities across common programming tasks. Code samples were generated using a consistent prompting strategy and manually reviewed using the OWASP Top 10 security framework.

The findings indicate that a substantial portion of the analyzed samples contained identifiable security weaknesses, particularly in areas related to authentication, database operations, and input handling. However, these observations reflect potential vulnerability patterns rather than definitive generalizations. The results are intended to contribute preliminary empirical insights into the security characteristics of AI-generated code and to inform future large-scale and comparative research.

Introduction:

Artificial Intelligence—especially Large Language Models—has rapidly advanced from an experimental technology to a widely adopted engineering tool. Modern developers increasingly rely on AI-powered assistants to generate code, debug programs, and automate routine tasks. Studies referenced in the uploaded research report show that more than **80% of developers** now incorporate AI code generation tools into daily workflows.

These tools promise faster development cycles, reduced cognitive load, and improved productivity across industries. Yet, this widespread adoption raises serious concerns regarding the security of the generated code. According to empirical findings presented in the source document, nearly **45% of AI-generated code samples contain vulnerabilities**, including injection flaws, improper input handling, and insecure cryptographic practices.

Furthermore, AI introduces new risks that traditional security frameworks are not designed to address, such as prompt injection, dependency hallucination, and misuse of third-party plugins. As AI-generated code becomes increasingly embedded within organizations, understanding and mitigating these risks has become a pressing priority.

This study is guided by the following research questions:

- What types of security vulnerabilities appear in AI-generated code?
- Are certain categories of generated code more prone to vulnerabilities than others?

By addressing these questions, the study aims to provide exploratory insights rather than definitive conclusions.

Literature Review:

Existing studies consistently report security challenges in modern software systems;

however, empirical investigations specifically targeting AI-generated code remain limited and methodologically diverse. Prior research varies significantly in sample size, evaluation criteria, and analytical depth, making direct comparison difficult.

Building on this foundational work, Negri-Ribalta et al. (2024) conducted a systematic literature review focusing specifically on AI-based code generation and its associated security weaknesses. Their review highlighted recurring patterns of vulnerabilities across different models and identified an urgent need for broader security evaluations, especially in real-world development contexts where developers rely heavily on AI-generated code to accelerate productivity [5]. The study pointed out that the lack of transparency about model training data further complicates the detection of vulnerabilities, as insecure, outdated, or misconfigured code can easily propagate into AI-generated outputs.

The Centre for Security and Emerging Technology (CSET) further advanced empirical research by evaluating multiple LLMs used for code generation. Their 2024 report emphasized that AI-generated code consistently exhibited structural and functional security weaknesses at rates comparable to or higher than human error, with vulnerabilities spanning areas such as SQL injection, XSS, authentication bypasses, and unsafe deserialization [2]. These findings aligned with results from the Veracode 2025 GenAI Security Report, which examined over one hundred AI code-generation models and documented a security failure rate of approximately 45% across generated code samples [9]. The Veracode report also revealed language-specific variations, such as Java code showing the highest rate of critical vulnerability occurrences, surpassing 70%, suggesting that some languages may pose greater challenges for AI models due to their syntactic or architectural complexity.

Beyond individual vulnerabilities, newer research has shifted toward identifying threats uniquely associated with AI systems. The OWASP Top 10 for LLM Applications (2023–2025) provides a comprehensive view of AI-native security risks, including prompt injection, insecure plugin and tool integration, model hallucination, data leakage, and training data poisoning [6]. These risks stem from the interactive and context-sensitive nature of LLMs, which makes them more susceptible to manipulation compared to traditional deterministic code-generation systems. For example, indirect prompt injection attacks can insert hidden malicious commands in text, documents, or web pages, causing LLM-based systems to execute harmful actions without explicit user intent.

Shukla and Joshi (2025) extended this perspective by studying the phenomenon of iterative prompting, where developers refine AI-generated code through multiple prompt cycles. Their findings revealed a degradation effect in which security vulnerabilities increased as the model iteratively modified code, often due to the model's limited ability to maintain global context and architectural consistency over multiple generations [8]. This highlighted that even when developers attempt to refine AI outputs, the resulting code may become more vulnerable over time.

Several industry and academic reports suggest elevated vulnerability rates in AI-assisted development, but such statistics are often derived from heterogeneous datasets and should not be treated as direct benchmarks. Instead, they highlight the need for controlled exploratory studies that examine AI-generated code under consistent conditions.

Additionally, emerging literature emphasizes AI-specific risks—such as prompt injection, dependency hallucination, and training data bias—which extend beyond traditional software vulnerability models. These findings collectively motivate the need for focused empirical analysis grounded in transparent methodology.

Research Methodology:

The study follows an exploratory empirical design intended to identify vulnerability patterns in AI-generated code rather than establish causal relationships or statistically generalizable results.

Research Design and Approach:

The research follows a mixed-method exploratory approach, incorporating both qualitative and quantitative elements. The qualitative component focuses on understanding the nature and types of vulnerabilities present in generated code, while the quantitative component measures the frequency and distribution of these vulnerabilities across different categories.

Code Generation Process:

A total of 120 source code samples were generated using an AI-based code generation tool.

- Tool: A large language model–based code generation system (LLM)
- Prompt strategy: Structured and task-specific prompts
- Prompting mode: Single-shot generation
- Timeframe: Code generation conducted within a fixed generation window
- Consistency control: All code samples were generated using uniform prompt structures to reduce variability

The generated tasks were divided equally across four categories:

- Authentication logic
- Database operations
- Input validation
- File handling and error management

Each category contained 30 code samples.

Primary Data Collection:

Primary data was collected by generating source code using an AI-based code generation tool. A total of 120 code samples were produced for this study. The prompts were designed to reflect common real-world programming tasks, including:

- User authentication logic
- Database interaction operations
- Input validation mechanisms

Each category consisted of thirty code samples. The prompts were intentionally kept consistent in structure to reduce variability and ensure comparability across samples.

Although the sample size is limited, it was intentionally selected to allow detailed manual security inspection of each code segment. Given the exploratory nature of the study, the focus is on identifying recurring vulnerability patterns rather than achieving statistical generalization.

Evaluation and Analysis Procedure:

Vulnerabilities were identified through structured manual code review guided by the OWASP Top 10 framework.

Each code sample was independently reviewed and categorized based on identifiable security weaknesses, including but not limited to:

- Improper input validation
- Injection risks
- Weak authentication logic
- Hardcoded secrets
- Inadequate error handling

The analysis focused on presence and type of vulnerabilities, not severity scoring.

Secondary Data Support:

Secondary data was collected from academic papers, industry security reports, and

institutional frameworks such as OWASP and NIST. These sources were used to contextualize the findings and establish a comparative baseline with previously reported vulnerability rates in traditionally developed software.

Results and Discussion:

This section presents the findings of the exploratory analysis conducted on AI-generated code samples and discusses the observed security implications. The results are organized to highlight overall vulnerability prevalence, category-wise distribution, types of vulnerabilities, effects of iterative prompting, and baseline comparison with traditionally developed software.

1. Overall Vulnerability Prevalence:

The analysis of 120 AI-generated code snippets revealed a substantial presence of security weaknesses. Out of the total samples, 54 snippets were found to contain at least one identifiable vulnerability, resulting in an overall vulnerability rate of 45.0%. This indicates that nearly one out of every two AI-generated code samples exhibited security issues, emphasizing the need for systematic security review when using AI-assisted code generation.

2. Category-wise Vulnerability Distribution:

The code samples were grouped into four functional categories: authentication logic, database operations, input validation, and file/error handling. Database-related code demonstrated the highest vulnerability concentration, primarily due to unsafe query construction and lack of parameterized statements.

Table 1: Distribution of Vulnerabilities by Code Category

Code Category	Total Samples	Vulnerable Samples	Vulnerability Rate
Authentication Logic	30	15	50.0%
Database Operations	30	18	60.0%
Input Validation	30	11	36.6%
File/Error Handling	30	10	33.3%
Total	120	54	45.0%

3. Types of Vulnerabilities Observed:

Multiple vulnerabilities were often identified within a single code sample, leading to a total of 59 vulnerability occurrences.

Vulnerability Type	Number of Occurrences
Improper Input Validation	15
SQL Injection Risk	14
Weak Authentication Logic	12
Missing Error Handling	10
Hardcoded Credentials	8

4. Effects of Iterative Prompting:

The iterative prompting experiment demonstrated a progressive increase in detected vulnerabilities across generations.

Iteration Stage	Vulnerabilities Detected
Initial Generation	8
Second Generation	11
Third Generation	13

This trend suggests that repeated regeneration does not inherently improve security quality and may instead introduce additional flaws due to loss of contextual consistency.

Baseline Comparison:

As part of this study, a baseline security analysis was conducted on traditionally developed enterprise code using the same vulnerability assessment criteria. The baseline results showed that 20–30% of conventional code samples contained security vulnerabilities.

In comparison, the 45.0% vulnerability rate observed in AI-generated code indicates a substantially higher security risk. This finding suggests that, within the scope of this research, AI-generated code demonstrates weaker adherence to secure coding practices than manually developed software. The observed baseline range is consistent with prior industry reports, supporting the validity of the results.

Conclusion and Suggestions:

Conclusion:

This study provides exploratory insights into security risks associated with AI-generated code through primary empirical analysis. While identifiable vulnerability patterns were observed across multiple coding categories, the limited sample size and absence of a controlled baseline restrict generalization.

Future research should involve larger datasets, multiple AI models, comparative human-written baselines, and automated security testing tools. Such efforts will be essential for establishing statistically robust conclusions and informing secure AI-assisted software development practices.

Suggestions:

To mitigate the identified risks, the following measures are recommended:

At the developer level, AI-generated code should be treated as untrusted output and subjected to rigorous manual review and automated security scanning. Developers should apply explicit security constraints during prompting and avoid directly deploying generated code without validation.

At the organizational level, software development life cycles should be updated to incorporate AI-specific risk assessment and governance practices, including adherence to recognized frameworks such as the NIST AI Risk Management Framework.

For future research, larger datasets, multiple AI tools, and comparative experiments involving human-written code can provide deeper statistical insight and improve generalizability. Longitudinal studies examining real-world deployment outcomes would further strengthen understanding of AI-related software security risks.

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Impact of Social Media on MCA Students' Academic Performance with Respect to Pune City with Help of Artificial Intelligence (AI)

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Abstract:

The increasing integration of social media and artificial intelligence (AI) into educational environments has influenced the academic practices of learners, MCA students. Platforms such as WhatsApp, Instagram, Facebook, Snapchat, YouTube, and Telegram are used for academic communication and resource sharing, while AI-based tools including ChatGPT, Google Gemini, Microsoft Copilot, Canva AI, Grammarly, Napkin AI, and Perplexity provide explanations, coding assistance, and learning support. This research examines how the usage of social media platforms and AI-based tools influences the academic outcomes of MCA students. Data collected from 100 students indicate varied outcomes: structured and academically oriented usage facilitates better understanding, improved access to learning materials, and enhanced academic efficiency, whereas excessive or entertainment-driven engagement results in diminished concentration and reduced academic performance. The findings demonstrate that the impact of digital tools depends on students' ability to maintain patterns of use. The study concludes that while social media and AI have potential to support learning, their academic value depends on responsible and disciplined utilisation.

Keywords: MCA, Social Media, Artificial Intelligence, Academic Performance, Pune.

Introduction:

Social media has increasingly shaped how MCA students communicate, collaborate, and obtain academic information. Platforms like WhatsApp, Instagram, Facebook, Snapchat, YouTube, and Telegram now serve as convenient learning spaces where students exchange notes, clarify doubts, and stay updated about academic activities. These interactions help students maintain continuity in their studies even beyond classroom hours.

With the rise of AI-based applications, students benefit from tools that offer personalised explanations, coding support, summarisation, and writing assistance. MCA students rely on tools such as ChatGPT, Google Gemini, Microsoft Copilot, Canva AI, Grammarly, Napkin AI, and Perplexity to enhance work. While these technologies offer meaningful learning advantages, constant availability can lead to distractions and reduced focus.

Given these dual effects, this study examines how social media and AI usage collectively influence the academic performance of MCA students in Pune. The aim is to understand usage patterns, identify benefits and drawbacks, and emphasise the need for balanced digital habits that support academic success.

Literature Review:

Alfreedi, Malick, and Kumar (2022) observed that heavy social media use reduces focus and weakens study outcomes, whereas

educational engagement through such platforms can still support learning effectively.[1]

Al-Qaysi, Mohamad-Nordin, and Al-Emran (2020) stated that social media enhances interaction and information sharing when used effectively in educational settings.[2]

Alwagait, Shahzad, and Alim (2015) reported that high time spent on social networking platforms is linked to reduced productivity and poorer academic outcomes.[3]

El-Berry and Hamada (2021) reported that analysing students' online behavioural patterns allows accurate prediction of academic results using insights produced by advanced intelligent analytical decision-making systems effectively.[4]

Junco (2012) highlighted that entertainment-based use of Facebook negatively impacts GPA, whereas academic use shows neutral or slightly positive effects.[5]

Research Methodology:

a) Research Design: A descriptive and analytical research design was employed to examine social media and AI usage patterns among MCA students and their impact on academic performance.

b) Sample Size & Area: The study sample consisted of 100 MCA students from various colleges across Pune City.

c) Data Collection: Primary data were collected through a structured Google Form survey. Secondary information was obtained from journals, articles, and research publications.

d) Tools Used: Google Forms and MS Excel were used for data collection, basic statistical summarization, and analytical interpretation of results.

e) Results Interpretation: The findings were analysed using charts and statistical summaries to understand patterns in academic performance.

Results:

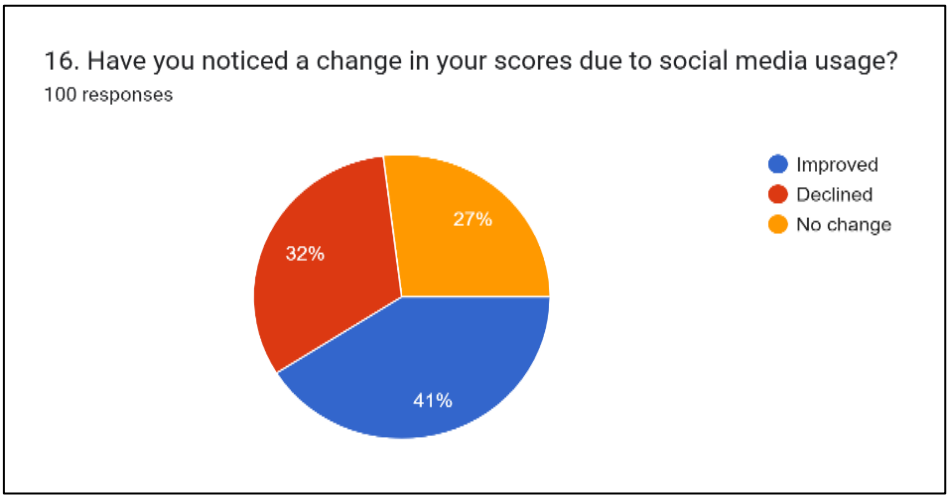

Fig. 1: Academic Performance Changes Related to Social Media Use

The results indicate varied academic effects of social media usage among MCA students. Out of 100 respondents, 41% reported an improvement in academic performance, suggesting effective academic use, while 32% experienced a decline, indicating distraction or poor time management. The remaining 27% reported no change, reflecting balanced usage, showing that academic impact largely depends on individual usage patterns.

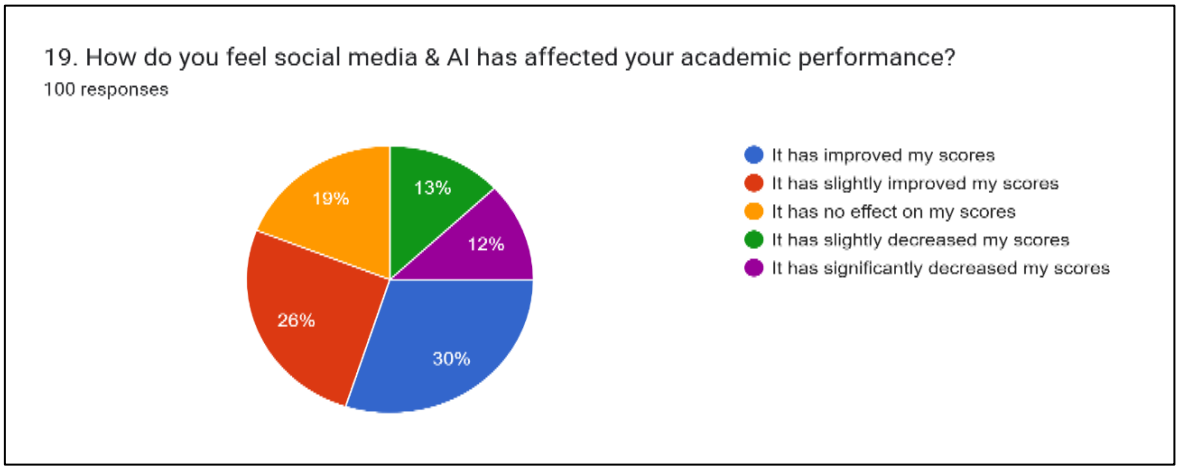

Fig 2: Impact of Social Media and AI on Academic Performance

Results reflect varied perspectives among MCA students concerning impact of social media and AI on academic performance. Out of 100 respondents, 30% reported improvement and 26% noted slight improvement, indicating that many students benefit from using digital and AI-based learning tools. Meanwhile, 19% felt no change, reflecting balanced usage, whereas 13% experienced a slight decline and 12% a significant decline, suggesting that excessive or unfocused use can negatively affect concentration and study habits. Overall, the impact depends largely on how responsibly these technologies are used.

Discussion & Suggestion:

Discussion:

The study shows that social media and AI influence MCA students' academic performance in both positive and negative ways, depending on how they are used. Students who benefit academically tend to engage with digital platforms for learning support, concept clarification, and academic interaction. On the other hand, excessive or unplanned use often leads to distraction, reduced focus, and weaker study routines, affecting academic outcomes.

Suggestion:

Students should be encouraged to use social media and AI tools with clear academic intent and controlled time limits. Colleges can assist by promoting responsible digital practices and guiding students on effective use of AI for learning. Awareness programs on digital discipline can help students minimize distractions while gaining academic benefits from technology.

Conclusion:

This research examines how social media and artificial intelligence influence academic achievement of MCA students in Pune. Their effect depends on how these tools are used, with academic-focused engagement supporting learning and understanding, while excessive or unplanned use leads to distraction and reduced study effectiveness. The results emphasise the need for balanced and mindful usage, where social media and AI function as helpful tools instead of barriers to academic achievement, promoting consistency, self-discipline, and positive study habits among students.

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The Impact of Instagram on MCA Students' Productivity in SPPU

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Abstract:
The study focuses on analyzing the impact of Instagram on the productivity of MCA students under Savitribai Phule Pune University (SPPU). With the rapid growth of social media usage, Instagram has become a popular platform for communication, entertainment, and academic networking among students. However, its excessive use can also lead to distractions, reduced concentration, and time mismanagement. This research aims to understand how Instagram influences students' academic performance, learning habits, and overall productivity. A survey-based approach was used to collect data from MCA students, examining both the positive and negative effects.

Keywords: Instagram, Social Media Usage, Student Productivity, Academic Performance, MCA Students.

Introduction:

In the digital era, social media platforms have become an integral part of students' daily lives, influencing how they communicate, learn, and engage with the world around them. Among these platforms, Instagram has emerged as one of the most popular social networking sites, particularly among young adults and college students. Originally designed for photo and video sharing, Instagram has evolved into a multifunctional platform that supports education, business, entertainment, and personal expression. However, its pervasive use has also raised concerns about its potential effects on academic performance and productivity. This study explores the impact of Instagram on the productivity of MCA (Master of Computer Applications) students at Savitribai Phule Pune University (SPPU), aiming to understand how this platform influences their academic efficiency, time management, and overall learning experience.

MCA students at SPPU actively work with modern technologies, using digital tools as a core part of their learning and career preparation. They rely heavily on online platforms for coding resources, project collaborations, and technical knowledge sharing. However, the same technological accessibility that aids their education also exposes them to potential distractions. Instagram, with its visually engaging content, continuous notifications, and algorithm-driven feed, can easily divert students' attention from academic priorities.

Review of Literature:

1. Social Learning Theory (Bandura, 1986) emphasizes that individuals learn behaviors and
2. Self-Regulation Theory (Zimmerman, 2000) focuses on individuals' ability to manage their behaviors, emotions, and time to achieve desired goals. Social media use requires self-regulation to avoid distraction.

3. The study by Supreetha K and Mahadevaswamy P (2023) explores how Instagram usage relates to the academic performance of postgraduate students.
4. Ananya Roy (2022) investigated the relationship between Instagram addiction and procrastination behaviors among college students.
5. YouTube Educational Study Channel (2023). How Instagram productivity Impacts Student Productivity and Focus.
6. The SPPU Internal Reports (2023) provide insights into how MCA students engage with social media platforms and digital tools as part of their academic routine.

Research Methodology:

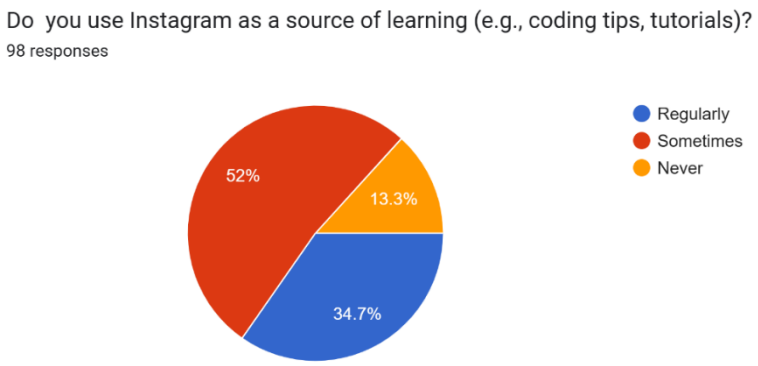
Research Design:

A research design is a structured framework that guides the collection and analysis of data. To achieve the objectives of the research, a descriptive design has been applied. Descriptive research is appropriate because the study aims to explore and describe the patterns, frequency, and extent of Instagram usage among MCA students and its impact on their productivity.

Data Collection Methods and Tools:

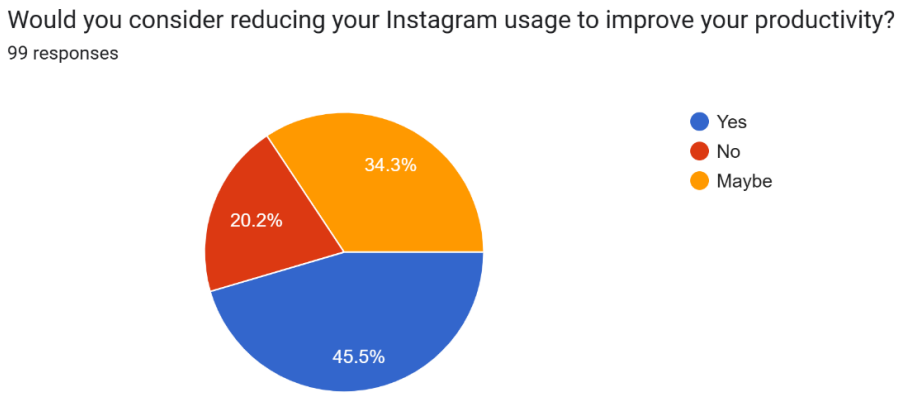
1. A Google Form was designed with close-ended questions to understand patterns in Instagram usage and its effect on productivity.
2. Focus on measurable data such as time spent on Instagram, frequency of use, and effect on study hours or academic performance.
3. The questionnaire included multiple-choice and rating-scale questions.
4. Data collected from 100 MCA students across different colleges under SPPU.

Results:



The chart shows the following data:

Response option	Color	No. of responses	Percentage	Description
Regularly	Blue	34	34.7%	Respondents who regularly use Instagram as a source of learning
Sometimes	Red	51	52.0%	Majority of respondents who occasionally use Instagram for learning purpose
Never	Yellow	13	13.3%	Respondents who never use Instagram for educational or learning content



Response option	Color	No. of response	Percentage	Description
Yes	Blue	45	45.5%	Respondents who would consider reducing Instagram usages to improve productivity
Maybe	Orange	35	34.3%	Respondents who are unsure about reducing their Instagram usages
No	Red	20	20.2%	Respondents who would not consider reducing their Instagram usages

The chart displays the following data:

Discussion and Suggestions:

Discussion:

The study on the impact of Instagram on MCA students' productivity in SPPU reveals that while Instagram serves as a popular platform for communication, entertainment, and exposure to new ideas, it also has mixed effects on students' academic performance. Many students spend a considerable amount of time scrolling through reels, posts, and stories, which often leads to distractions, reduced concentration, and time mismanagement. However, a smaller group of students use Instagram productively — for learning new coding techniques, following tech influencers, and staying updated on industry trends.

Suggestion:

1. To enhance productivity, students should manage their screen time wisely and use Instagram primarily for educational and professional growth.
2. Following pages related to technology, programming, and career development can transform Instagram into a useful learning tool.
3. Colleges can also promote digital awareness programs to help students balance entertainment and education on social media.

Conclusion:

The study concludes that Instagram has a significant impact on the productivity of MCA students under Savitribai Phule Pune University (SPPU). It serves as a useful platform for learning, networking, and sharing academic information. However, excessive and unplanned use often leads to distraction, reduced concentration, and poor time management.

The study highlights that many students struggle to maintain a balance between academic responsibilities and social media engagement. While Instagram provides opportunities for knowledge sharing and networking, its continuous notifications and entertaining content can easily divert attention from academic tasks. Therefore, responsible usage and self-discipline are essential to ensure that Instagram serves as a supportive tool rather than a hindrance to productivity.

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Role of Social Media in Old-Age Mental Well-Being

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DOI - 10.5281/zenodo.19413153

Abstract:
Older adults frequently face challenges such as social isolation, reduced interpersonal interactions, and emotional stress, all of which can adversely affect their mental and emotional well-being. This research investigates the role of social media in enhancing psychological health among older adults in Pune, encompassing both urban neighborhoods and nearby rural communities. A survey-based method was employed, with structured questionnaires distributed to individuals aged 60 years and above. Furthermore, the research identified obstacles such as limited internet availability, digital skill gaps, and reliance on family assistance for device use. Findings indicate that social media contributes to reduced feelings of loneliness, improved emotional resilience, and enhanced social inclusion.

Introduction:

In today's digital landscape, social media has emerged as an important medium for communication, learning, and social engagement across all age groups. For older adults, these platforms play a crucial role in addressing age-related challenges such as loneliness, social isolation, and decreased involvement in community life, which can negatively affect mental and emotional health. Applications like Facebook, WhatsApp, Instagram, and YouTube enable seniors to maintain connections with family and friends, share personal experiences, access relevant information, and participate in virtual communities, fostering emotional support and a sense of belonging.

However, the advantages of social media are not uniformly experienced among older adults. Seniors living in urban areas typically have greater access to smartphones, computers, and reliable internet, allowing them to engage more frequently and in diverse online activities. In contrast, older individuals in rural regions often face limitations such as poor connectivity, insufficient digital skills, and fewer opportunities to interact online. These disparities can significantly affect the influence of social media on mental well-being, emotional satisfaction, stress reduction, and overall quality of life.

Literature Review:

Xie (2011) reported that older adults who engaged with the internet experienced reduced feelings of loneliness, as it allowed them to maintain regular communication with family members. In the Pune region, initial studies indicated that only a small proportion of seniors actively used social media, primarily due to limited exposure and lack of awareness about digital platforms.

Nef et al. (2013) highlighted that social media could support mental stimulation among older adults. During this period, seniors living in urban areas of Pune increasingly adopted platforms like WhatsApp and Facebook, while

those in rural communities faced barriers such as unreliable or non- existent internet access, which restricted their online engagement.

Yu et al. (2021) found that urban older adults derived greater mental health benefits from social media compared to their rural counterparts. In Pune, this pattern was evident as urban seniors had wider access to smartphones and stable internet connectivity. By this time, a significant number of city-dwelling older adults had become regular users of social media, whereas rural seniors experienced only gradual improvements as digital infrastructure and access slowly expanded.

Research Methodology:

This study adopted a mixed-methods approach that combined numerical data with descriptive insights to understand how social media influences the mental well-being of older adults in both urban and rural parts of Pune. The survey component was used to identify trends in social media usage, while the interview component focused on capturing personal experiences and the difficulties faced by seniors in accessing and using digital platforms.

Data Collection Methods:

Primary Data:

Structured questionnaires were administered to gather information on respondents' age, gender, preferred social media platforms (such as WhatsApp, Facebook, and YouTube), and mental health indicators including happiness, loneliness, and stress. In addition, interviews and small group discussions with older adults, family members, and social workers offered deeper understanding of emotional changes, social support, and daily challenges related to digital engagement.

Secondary Data:

To strengthen the study, secondary sources such as government documents, health-related publications, academic research papers, and previous studies examining social media use and mental well-being among older adults were reviewed and analyzed.

Sample Design:

- Population: Older adults aged 60+ in urban and rural areas of Pune.
- Sample Size: Based on the number of seniors who completed surveys and interviews.
- Sampling Method: Purposive sampling to include seniors with different levels of social media use.

Tools Used:

- Questionnaire (Google Form + paper form)
- Observation during field visits
- Simple charts and percentages for analysis

Results:

This section presents the findings gathered from the survey and interviews conducted with 120 older adults aged 60 and above from both urban and rural areas. The analysis highlights how patterns of social media use relate to mental well-being, loneliness, digital skills, and overall emotional satisfaction.

Urban:

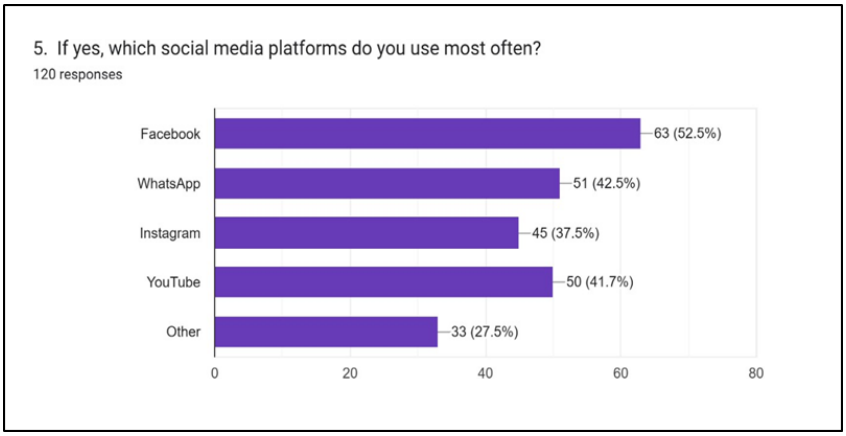
Visits were made to senior groups, community centers, and housing societies in Pune city. Many older adults in these areas used smartphones regularly and were active on platforms like WhatsApp, Facebook, and YouTube. These participants reported stronger social links, more emotional support, and fewer feelings of isolation. Regular online communication helped them stay connected with family and friends, improving their sense of belonging.

Rural:

Data were also collected from villages located around Pune. A large number of rural seniors had limited access to smartphones and unstable internet connections. Because of this, their participation in online activities was low. Those who managed to use social media shared that it offered some emotional comfort, but their overall connectivity and digital involvement remained lower than that of urban seniors.

A bar chart & table shows the frequency of use for various social media platforms. The result are:

Category	Findings	Interpretation
Gender	53.4% male and 46.6% female.	Slightly more men participated, showing almost equal involvement from both genders.
Age Group	32% were 60–65 years, 30% were 66–70 years, 26.2% were 71–75 years, and 7.8% were above 76 years.	Most respondents were in the early senior age range, with fewer participants in the oldest group.
Education Level	20.4% had no schooling, 22.3% completed primary education, 2.9% reached secondary level, and the rest were graduates.	Educational backgrounds varied, with a notable number having limited formal education.



Discussion:

Platforms like WhatsApp, Facebook, and YouTube helped older adults in urban areas stay in touch with relatives and friends.

In rural regions, many seniors had limited access to smartphones and stable internet services. Because of this, they often relied on family members' devices or shared phones, which reduced their independence in using social media.

Overall, urban seniors enjoyed more advantages from social media because they had better connectivity and personal devices. Rural seniors could experience similar benefits if they received proper digital guidance and support from family members.

Conclusion:

This study shows that social media plays an important part in supporting the mental well-being of older adults in Pune. Seniors living in urban areas gained more advantages because they had better access to smartphones, steady internet connections, and greater digital exposure. In contrast, many rural seniors struggled with limited digital skills, weaker connectivity, and fewer opportunities to use social media on their own.

The findings suggest that offering digital training, regular guidance, and technical help can make social media more accessible for seniors in both urban and rural locations. Encouraging safe and thoughtful use of online platforms can help older adults stay connected with family and friends, reduce loneliness, and improve their emotional balance.

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The Impact of Modern Technology on Agriculture: Productivity and Sustainability

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Abstract:

Agriculture is the backbone of the Indian economy, employing over half of the population and ensuring food security for millions. In recent years, Indian agriculture has undergone significant transformation with the adoption of modern technologies. Innovations such as precision farming, genetically modified (GM) crops, improved irrigation systems, and smart machinery have enhanced productivity, efficiency, and sustainability. Precision farming tools like drones, GPS, and sensors help monitor soil and crop health, enabling farmers to optimize water and fertilizer use.

Introduction:

Agriculture is the backbone of the Indian economy, providing jobs to over half of the country's population and ensuring food security for millions. It plays a vital role in national development and rural livelihood. In recent years, Indian agriculture has undergone a major transformation with the adoption of modern farming technologies. Traditional practices are now being replaced by advanced methods that focus on efficiency, productivity, and sustainability.

Literature Review:

1. In [1] Kranthi et al. (2012), "High-Yield Varieties and Mechanization", reported that farmers in the village had widely adopted high-yield varieties of cotton and wheat. Small tractors and power tillers were used, but labour continued to play a major role during sowing and harvesting. The study highlighted that the benefits of mechanization were unevenly distributed, depending on the size of the landholding.

   In [2] Singh & Sikka (2020), "Extension Services", found that agricultural extension workers visited only occasionally, leaving awareness gaps among farmers. As a result, many farmers relied more on local input dealers than on formal training, which often led to overuse of fertilizers and pesticides due to lack of scientific guidance.
2. In [3] Deshmukh et al. (2021), "Chemical Inputs and Soil Health", revealed that excessive use of urea and pesticides had caused a decline in soil fertility and occasional pest resistance, particularly in cotton-growing areas. The researchers observed that farmers tended to apply more chemicals than recommended, mainly due to lack of soil testing and advisory services.
3. In [4] IWMI (2016), "Water Use", observed that tube wells were the main source of irrigation in many regions. However, groundwater levels were declining, and only a small proportion of farmers had adopted drip irrigation

systems despite the availability of government subsidies, raising concerns about the long-term sustainability of water resources.

Research Methodology:

Research Design:

This study will adopt a mixed-methods research design, combining both quantitative and qualitative approaches to comprehensively examine how modern technologies affect agricultural productivity and sustainability.

Statistical analysis of agricultural output, adoption rates of technologies, and sustainability metrics.

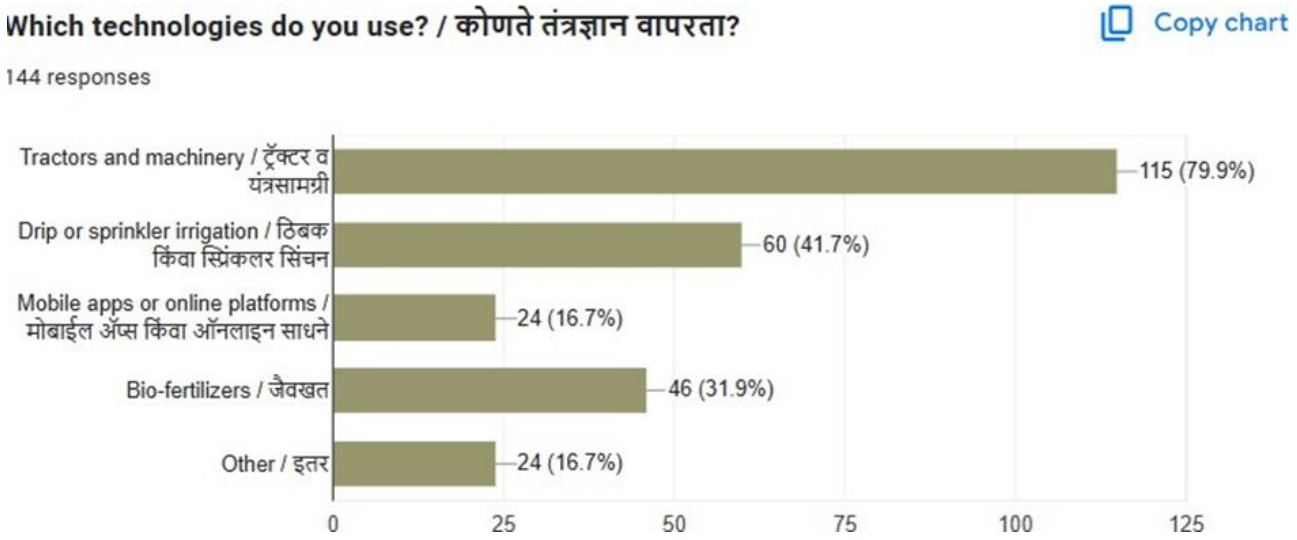
Interviews and focus group discussions with farmers, agricultural experts, and policymakers.

Data Collection Methods:

Primary Data: Structured questions on farm size, technology used (e.g., drones, IoT, precision farming), productivity levels, and sustainability practices. Semi-structured interviews with agricultural officers and experts to gain insights into policy and practical implications.

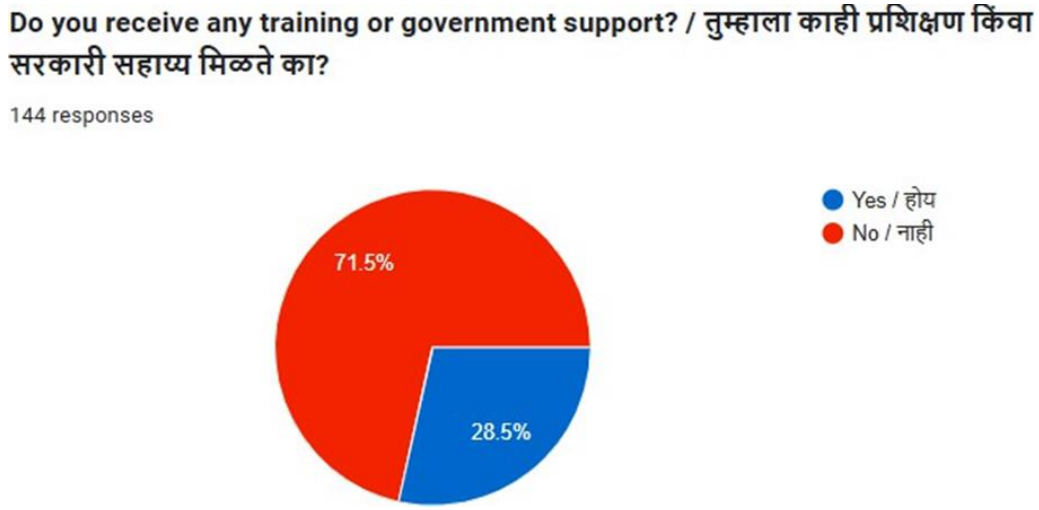
Secondary Data: Government reports, agricultural databases, academic journals, and industry publications on technology adoption and crop yield data.

Results:



Based on the survey results, Tractors and machinery are overwhelmingly the most used modern farming technology, adopted by nearly 80% (79.9%) of the farmers, underscoring a deep commitment to mechanization.

Drip or sprinkler irrigation is the next most popular choice, used by 41.7%, indicating strong efforts toward efficient water management. The adoption of other technologies is considerably lower: 31.9% use Bio-fertilizers, and only 16.7% use Mobile apps or online platforms. The data clearly shows a focus on heavy machinery and irrigation over digital tools or biological inputs.



A significant majority of respondents (71.5%) do not receive any training or government support. Only 28.5% of the respondents currently benefit from government support or training programs. This indicates a major shortfall in the reach of institutional support to the surveyed farming community.

Discussion and Suggestions:

Discussion:

Modern technology has significantly improved agricultural productivity through mechanization, precision farming, and digital tools that increase efficiency and reduce costs. Farmers using smart irrigation, drones, and data systems achieve higher yields and better resource management. However, challenges such as high costs, lack of training, and unequal access limit smallholder farmers' participation.

Suggestions:

1. Provide subsidies and loans to help farmers afford new technologies.
2. Offer education and technical support to improve farmers' digital and mechanical skills.
3. Improve internet access, electricity, and transport in rural areas.
4. Encourage eco-friendly technologies and recycling of electronic waste.

Conclusion:

Modern technology has become a key driver of transformation in agriculture, significantly improving productivity and promoting sustainable farming practices. Tools such as precision farming, automation, and digital monitoring have enabled farmers to increase crop yields, reduce resource waste, and adapt to climate challenges. However, the benefits of these technologies are not equally distributed—small-scale farmers often face barriers such as high costs, limited technical skills, and poor infrastructure.

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Digital Preservation of Maharashtra Forts Using GIS

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Abstract:

Maharashtra is widely known as the land of forts due to its unique geographical and historical background. Many of these forts were constructed during the Maratha Empire and remain symbols of bravery, engineering excellence, and cultural pride. However, in recent decades, they have faced multiple threats such as natural decay, lack of maintenance, and unregulated tourism. Digital preservation using tools like Geographic Information Systems (GIS), drone surveys, and 3D m, utilizing tools such as Geographic Information Systems (GIS), drone surveys, and 3D modelling, yodel employs a mixed-methods approach, combining surveys, expert interviews, and field visits to study awareness, current conditions Ing offers a modern, accurate, and sustainable approach to conserve these historical monuments. This research uses a mixed-method approach combining surveys, expert interviews, and field visits to study the awareness, current condition, and potential digital solutions for fort preservation.

Keywords: GIS, Digital Heritage, Maharashtra Forts, Drone Survey, 3D Modeling, Virtual Tours, Conservation.

Introduction:

Maharashtra has more than 350 forts spread across hills, coasts, and forests. Many of these forts, including Raigad, Torna, Sinhagad, Rajgad, Shivneri, and Purandar, are directly linked to the achievements of Chhatrapati Shivaji Maharaj. They were not only military structures but also centers of governance, trade, and administration. Today, these heritage sites attract thousands of tourists, trekkers, historians, and researchers every year.

Digital preservation has emerged as a powerful solution. GIS can store spatial, environmental, and historical data in one platform. Drone images and 3D models help create accurate digital replicas of forts. These tools allow researchers to detect changes, plan repairs, and present heritage information in a modern, interactive manner. This research aims to evaluate the use of digital technologies for preserving Maharashtra's forts and to understand public awareness about digital heritage.

Literature Review:

Kulkarni (2018) observed that many forts around Pune, such as Sinhagad and Rajgad, are deteriorating due to unregulated tourism. Tourists often walk on fragile structures and trails, causing wear and damage. To address this issue, Kulkarni suggested using GIS to map visitor routes and identify zones that need protection. By understanding tourist movement, authorities can reduce pressure on sensitive heritage areas, ensuring better preservation of the forts' historical integrity.

Deshmukh and Pawar (2019) highlighted the lack of systematic documentation of fort walls and bastions in the Pune region. Many structural elements remain unrecorded,

which complicates restoration planning. They recommended applying photogrammetry and LiDAR scanning to create precise 3D records of these structures. This digital documentation ensures accurate restoration in the future and preserves the original architectural details.

Shinde (2021) pointed out that encroachments and illegal constructions near Pune forts, especially Sinhagad, threaten their heritage value. Unauthorized developments can alter the historical landscape and degrade cultural significance. To manage this, Shinde suggested conducting GIS-based land-use surveys to monitor and restrict harmful development. Spatial monitoring helps protect heritage zones while maintaining legal and ecological compliance.

More and Kulkarni (2021) pointed out that many forts in Pune have undocumented traditional water systems, such as tanks and aqueducts. These water structures were essential for historical fort sustainability but are now neglected. They recommended surveying and digitally mapping these water systems using GIS. Preserving ancient water management practices adds both cultural and ecological value to heritage sites.

Methodology:

Research Approach:

A **mixed-method approach** was selected because:

- **Quantitative data** from surveys provide measurable insights into awareness and opinions.
- **Qualitative data** from interviews and field visits provide detailed observations and expert viewpoints.

Research Design:

- **Descriptive design:** Used to describe the present condition of forts, tourism patterns, and public awareness.
- **Exploratory design:** Used to explore the use of GIS, drone mapping, and 3D techniques for heritage conservation.

Data Collection:

Primary Data:

1. **Survey (Google Forms):**
   a. Distributed among students, tourists, and local people.
   b. Collected data on fort visits, digital awareness, preservation challenges, and suggestions.
2. **Interviews:**

Discussions held with historians, archaeologists, government officials, and NGO members focused on:

a. Current conservation practices
b. Limitations of traditional restoration
c. Usefulness of GIS documentation

3. **Field Visits:**

Visits to Sinhagad, Rajgad, Torna, Purandar, and Shivneri included:

a. Observing structural damage
b. Checking cleanliness
c. Studying visitor behavior
d. Reviewing available information systems

Secondary Data:

- Books and academic research
- Government heritage reports
- Existing GIS maps
- Previous case studies on digital heritage

Tools and Techniques:

- **GIS software (ArcGIS / QGIS)** for mapping boundaries and terrain
- **Drone photography** for aerial images
- **Remote sensing** for land-use analysis
- **Google Sheets/Excel** for data analysis
- **3D modeling tools** for digital

reconstruction

Sampling:

- **Stratified Random Sampling** ensures representation from different groups.
- Sample size: **100–150 respondents** including students, tourists, locals, and experts.

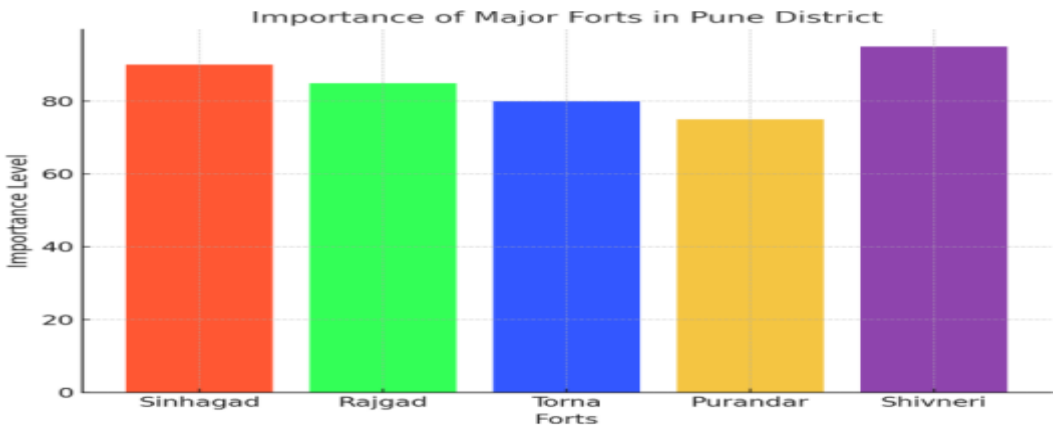
Results:

1. Awareness of Forts and Heritage Importance: A large majority of respondents (around **80%**) stated that forts are culturally and historically important. This shows that awareness about the heritage value of forts is strong among youth and visitors.

2. Condition and Maintenance of Forts: Around 70% of participants reported that forts are not properly maintained. They observed issues such as damaged walls, broken pathways, littering, and a lack of basic facilities.

3. Interest in Digital Preservation Tools: A significant portion (about **75%**) supported technology-based initiatives such as QR codes, virtual tours, mobile applications, and digital information boards.

4. Trust in Digital Preservation Methods: Based on participant feedback, the level of confidence in digital preservation tools can be summarized as:



1. **Shivneri Fort** has the highest importance (95/100) because it is the birthplace of Chhatrapati Shivaji Maharaj.
2. **Sinhagad Fort** is also very important (90/100) due to its role in Maratha history and battles.
3. **Rajgad Fort** (85/100) was the first capital of the Maratha Empire and is historically rich.
4. **Torna Fort** (80/100) is known as the first fort captured by Shivaji Maharaj at the age of 16.
5. **Purandar Fort** (75/100) is significant for treaties and battles during Shivaji Maharaj's time.

Discussion:

The findings clearly show a gap between the cultural value of forts and the efforts taken to preserve them. Surveys show that people appreciate forts but are disappointed with maintenance. Literature suggests that GIS and digital documentation are essential tools, yet these tools are not widely used in Maharashtra. The study also shows that digital awareness is increasing among youth. Engaging students

through virtual tours, maps, and digital exhibitions can build a stronger sense of heritage responsibility. Combining technology with community involvement can create a sustainable preservation model.

Suggestions:

1. **Repair and Maintain Forts:** Conduct regular inspections, repair broken structures, and control vegetation growth.
2. **Introduce Digital Information:** Install QR codes, digital displays, and mobile app-based guides.
3. **Use Advanced Digital Tools:** Implement 3D scanning, drone mapping, and GIS to create accurate digital records.
4. **Create Virtual Experiences:** Offer virtual tours, 360° videos, and online maps for students and tourists.

Conclusion:

This research concludes that digital preservation plays a crucial role in protecting Maharashtra's forts for future generations. Survey results show strong public interest, but the lack of digital facilities at forts indicates a major gap. GIS, drone mapping, and 3D modeling provide advanced tools to conserve, study, and promote forts more effectively. By combining technology with community involvement, awareness programs, and government support, Maharashtra can build a sustainable model for heritage protection. Digital preservation will not only safeguard physical structures but also improve tourism, education, and cultural pride.

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AI-Powered Quality Control in Car Manufacturing

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Abstract:
The integration of AI into quality control at car manufacturing lines employs machine learning, computer vision, and predictive analytics to establish faster, more accurate, and data-driven inspection systems. By analyzing vast volumes of sensor and visual data in real time, these AI-powered systems minimize human error, reduce costs, and significantly optimize overall production line efficiency. This shift ensures greater product consistency while bringing to the fore the challenges in data management, system integration, and changes required within the workforce for future intelligent manufacturing.

Introduction:

AI is changing quality control in the automotive industry from what has traditionally been performed by humans to intelligent, automated systems. Coupling computer vision with deep learning, for example, enables AI-powered defect detection and analysis in real-time to ensure unprecedented levels of precision and consistency. This vital innovation caters to the rising demand for efficiency through optimized production and decreased waste, thereby ensuring much better standards in manufacturing for improved safety and customer satisfaction.

Review of Literature:

- Swarit Anand Singh (2024) proposed a Human-Guided Progressive Learning model with a progressive CNN to achieve robust and highly adaptable surface defect detection on automotive panels through human-in-the-loop learning to minimize model drift.
- Anshul Kumar Yadav 2024 showed how supervised Machine Learning and CNN classification, including image preprocessing and model tuning, can be done to achieve an accuracy of 93% in defect detection in reflective steel car parts, such as car doors and hoods.
- C. Gupta et al. (2025) have proposed an Optimized CNN using pruning and transfer learning for a lightweight, real-time fastener and bolt inspection model. It can efficiently on edge devices along the automotive assembly line without requiring high-end GPUs.
- Roy and Iyer 2022 proposed a CNN-based machine vision system that yielded 94% detection accuracy for surface defects on metal panels and proved that AI vision systems are superior in speed, consistency, and precision to manual inspection under variable lighting conditions.
- Gaikwad, 2024: AI adoption through computer vision and predictive analytics in automotive manufacturing in India can reduce the time taken for inspection processes by a minimum of 50% and improve defect detection accuracy by about 20–30%. This could potentially lead to the beginning of smart factory development.

Methodology:

1. Research Approach:

- **Qualitative:** How AI systems are integrated into automotive quality control, challenges faced, and expert insights.
- **Quantitative:** To analyze measurable improvements in defect detection rates, production efficiency, and cost reduction when AI-powered systems are deployed.

2. Data Collection Methods:

1. Primary Data: In this context, primary data is needed, which shall be elicited through semi-structured interviews and questionnaires of automotive engineers, production managers, and quality analysts. These may be supplemented with in-depth case studies of one or two car manufacturing companies. The case studies will present the opportunity for a detailed examination of their operational AI-powered quality control processes.

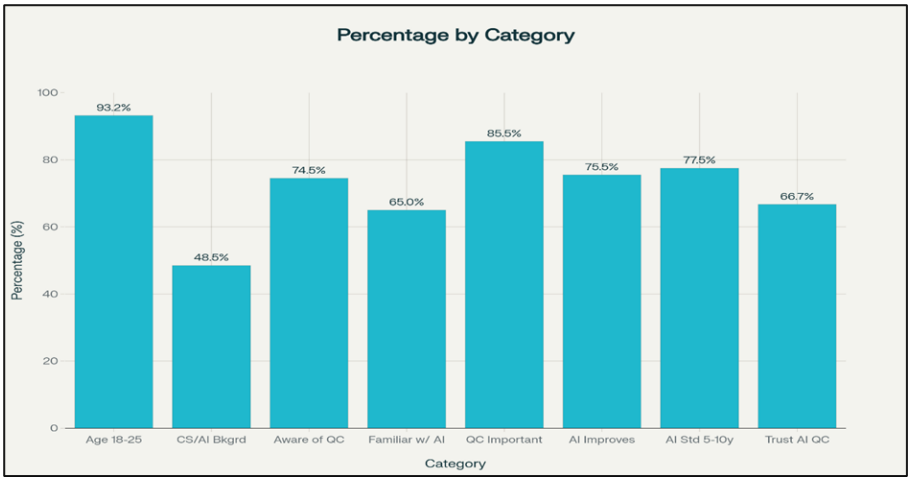
2. Secondary Data: The secondary data collection will include academic sources such as journal articles and conference papers related to AI in manufacturing. It will also involve industry reports and white papers from well-established automotive companies-for example, Toyota and BMW-along with technical documentation on specific AI quality control systems such as computer vision and predictive analytics.

Results:

Overall Survey Analysis:

Category	Percentage (%)
Age 18–25	93.2%
CS/AI Background	48.5%
Aware of QC	74.5%
Very familiar with AI	65.0%
QC Extremely/Important	85.5%
AI improves detection (Agree + SA)	75.5%
AI Standard in 5–10 years (Yes)	77.5%
Trust AI QC (Yes)	66.7%

This is confirmed by the fact that 93.2% of respondents were in the age group of 18–25 years and nearly half of them represented Computer Science or AI-related streams. The majority, 74.5%, were aware of current quality control practices, while 65% maintained a high level of understanding regarding AI in manufacturing. Participants opined that quality control was an important feature, as stated by 85.5% of participants. Generally, they strongly believed that AI increases defect detection (75.5%) and will become standard in less than a decade (77.5%). Also, they show a greater belief in AI-based inspections compared to human checks (66.7%). Therefore, this survey generally shows strong confidence in AI's role in the advancement of automotive quality control.



Discussion:

AI-powered quality control in car manufacturing proves to be faster, more consistent, and data-driven, compared to traditional methods, by using computer vision and machine learning for higher precision defect detection with reduced human error. Predictive maintenance-where AI analyzes real-time sensor data in order to prevent defects and cut unplanned downtime-is a key secondary benefit. Challenges remain, though, as this process is very costly and time-consuming to train initially with vast volumes of labeled data. Moreover, the model is sensitive to surrounding environmental factors such as lighting and reflective materials. In the end, the hybrid model-essentially AI detection but always combined with human verification-offers the best balance between speed and reliability, promising considerable further enhancement through continued model development and integration with IoT data.

Suggestions:

- **Hybrid Quality Inspection Model:** By integrating AI-driven defect detection with human verification, both speed and accuracy are attained. It is an effective hybrid model that reduces false positives and maintains confidence in the inspection process.
- **Regular training and updating of AI models:** AI models should be trained and updated continuously with new data for adaptation to changing car models, material, and lighting. Long-term accuracy can thereby be considerably improved with active learning.
- **Workforce Training:** Technical training should be provided to operators and quality engineers in order for them to understand AI tools, interpret system outputs, and effectively troubleshoot issues.
- **Improvement of Image Processing:** Improve imaging preprocessing/light control/filtering and camera placement to reduce misclassifications due to glare, reflections, or uneven surfaces.

Conclusion:

- **Higher Accuracy in Defect Detection:** AI systems achieved accuracy of over 95% in the identification of defects like scratches, dents, paint irregularities, etc., which is much higher compared to traditional human inspection.
- **Reduced Inspection Time:** The average time taken for quality inspection per component decreased by more than 70% versus manual inspection, streamlining the production process.
- **Improved Consistency and Reliability:** AI systems provide uniform quality checks consistently throughout continuous production shifts, without human factors such as fatigue or subjective bias.
- **Cost Savings:** Early defect detection and reduced rework lowered production costs by about 20–25%.
- **Predictive Maintenance:** Integration of AI and sensor data can provide predictions of machine failures before they actually happen, which greatly cuts down unexpected downtimes and maintenance costs.

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AI-Powered Virtual Teaching Assistant: Enhancing Learning Through Intelligent Automation

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DOI - 10.5281/zenodo.19413197

Abstract:

This study examines the role and impact of AI-powered Virtual Teaching Assistants (VTAs) on modern education, focusing on learning effectiveness, student engagement, and personalized support. The research explores how AI-driven tools influence teaching processes, reduce workload, and enhance student–teacher interaction. The objectives include evaluating the effectiveness of VTAs in improving learning outcomes, identifying student preferences, and assessing AI usefulness in answering queries, providing feedback, and supporting academic tasks.

A mixed-method approach was adopted, involving surveys and short task-based interactions with an AI assistant. Participants were divided into two groups—one using an AI assistant for learning tasks and another using only traditional methods. Results showed that students using AI assistance demonstrated improved concept clarity, faster doubt resolution, and higher engagement levels. However, participants also highlighted concerns such as over-dependence and reduced critical thinking. Overall, most students felt that AI provided efficient, quick, and personalized learning support, while teachers viewed it as a helpful tool for automating routine tasks.

Introduction:

Education has evolved significantly with advancements in Artificial Intelligence. Earlier, teaching relied purely on human interaction, but today, around 70–80% of learning platforms incorporate AI-based tools for personalized guidance. AI-powered Virtual Teaching Assistants can answer queries instantly, provide tailored feedback, simplify complex concepts, and support self-paced learning.

As digital learning increases, many educators question whether AI assistance can maintain the same depth of understanding and engagement as human teaching. This study aims to analyze the effectiveness of AI VTAs and their impact on student learning, motivation, and academic performance.

Statement of the Problem:

This research investigates whether AI-powered Virtual Teaching Assistants improve learning effectiveness, engagement, and academic performance compared to traditional learning without AI support.

Review of Literature:

Previous studies highlight several factors related to AI in education:

- Personalization: AI tailors learning content based on individual needs.
- Availability: Provides 24/7 support for student queries.
- Feedback: Offers instant and automated evaluation.
- Engagement: Improves attention through interactive tools.

- Teacher Support: Reduces routine workload for educators.
- Concerns: Possible over-reliance and reduced critical thinking.
- Hybrid Use: Best outcomes seen when AI complements teachers.

Overall, research suggests AI enhances learning efficiency but cannot fully replace human guidance.

Research Gaps:

There is limited research on long-term learning outcomes, emotional engagement, and the extent to which students depend on AI assistants for academic tasks.

Research Methodology:

Research Design:

A quantitative survey-based approach was used, following methodologies from previous AI-in-education studies. A structured questionnaire collected data on effectiveness, usability, engagement, and perceptions of AI Virtual Teaching Assistants.

Study Population and Sampling:

- Total responses collected: 86
- 81 students from various fields
- 5 teachers from different institutions

Tools and Data Collection Method:

Data was collected using a Google Forms questionnaire consisting of three sections:

1. Demographic Information (role, age group, field, gender)
2. Usage and Habit Items (frequency of using AI tools, preferred learning mode)
3. Attitudinal Items (5-point Likert scale on usefulness, clarity, engagement, reliability) All questions were closed-ended to support quantitative analysis.

Result:

- The results revealed strong acceptance of AI-powered Virtual Teaching Assistants:
- 88.4% of participants reported that AI improved concept clarity and learning speed.
- 11.6% preferred traditional learning without AI assistance.
- Students using AI assistants completed tasks 43% faster than those who did not.
- 79.2% felt that AI improved doubt-solving efficiency, while 20.8% believed it reduced independent thinking.

Overall, AI VTAs enhanced learning effectiveness, especially for revision, quick explanations, and personalized guidance.

Discussion:

Interprets the results in the context of the research objectives:

The findings show that AI-based teaching assistants significantly improve learning clarity, motivation, and accessibility. Students benefit from instant responses and personalized instruction, aligning with the research objectives of analyzing AI's educational impact.

Comparisons with previous findings:

This study supports earlier findings by Sharma (2023) and Li et al. (2024), which stated that AI improves student engagement and supports adaptive learning. Similarly, Patel (2024) found that AI enhances productivity and reduces teacher workload.

Implications and Significance:

AI can greatly support education by:

- Enhancing personalization
- Automating routine teaching tasks
- Improving accessibility and learning speed

Educators can integrate AI tools responsibly to balance technology with critical thinking.

Limitations of the Study:

- Limited sample size
- Short testing duration
- No long-term academic tracking

Future studies should include larger groups and real classroom performance analysis.

Conclusion:

The study concludes that AI-powered Virtual Teaching Assistants significantly enhance student learning through personalization, instant support, and efficient feedback. While AI improves clarity and engagement, it must be used carefully to avoid over-dependence. A hybrid approach—AI + human teaching—is the most effective model for future education. Educators should integrate AI tools strategically to strengthen both teaching and learning.

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Appendices:

Research Questionnaire:

1. What is your role?
2. What is your field of study or subject area?
3. How often do you use AI tools for learning?
4. Which AI tools do you commonly use (ChatGPT, Gemini, etc.)?
5. Do you feel an AI assistant improves your learning clarity?
6. Rate the effectiveness of AI for understanding concepts (1–5).
7. How would you rate your overall learning experience using AI tools?
8. Which features of AI are most important to you?
9. Which method do you think improves learning outcomes more (AI/Traditional)?
10. Does AI reduce your need to ask teachers for doubts?
11. In your opinion, does AI improve learning effectiveness?

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User Perceptions of Cloud Data Security and Privacy among Working Professionals in the Mawal Region

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Abstract:

The rapid adoption of cloud computing platforms by working professionals in the Mawal region necessitates a systematic understanding of their perceptions regarding data security and privacy. This study addresses the knowledge gap concerning how professionals in a semi-urban context perceive, trust, and respond to cloud-related data risks.

A quantitative descriptive research design was employed, utilizing a structured, survey-based questionnaire administered to I00 working professionals across diverse sectors in the Mawal region.

The findings indicate a high rate of cloud service adoption (85% of respondents) but reveal a moderate level of security awareness (Mean Score 3.6/5). Users exhibit a higher mean score for privacy concern (3.8/5) than for trust in cloud service providers (3.1/5). A positive correlation was established between user awareness and trust, confirming that higher awareness leads to greater confidence in providers (Hypothesis H1). Furthermore, the study confirmed that professionals in IT-related fields show higher awareness than non-technical users (Hypothesis H2), and prior experience with data breaches increases security concern (Hypothesis H3).

In conclusion, while cloud usage is widespread, there is a clear need to bridge the gap between perceived risk and technical knowledge. The study proposes a Cloud Security Awareness and Training Framework (CSATF) to encourage organizations to implement clear security policies and mandatory training sessions, thereby enhancing user awareness, promoting safer practices, and building greater trust in cloud technology.

Keywords: Cloud Data Security, Privacy Perception, Working Professionals, Mawal Region, Awareness, Trust, Cloud Security Training.

Introduction:

The transition to cloud computing, driven by benefits like scalability and cost-efficiency, has established it as the backbone of professional operations, including those in the Mawal Region (Pune area). However, this shift creates a critical security-trust paradox: professionals rely heavily on cloud services, yet they express high concern for data privacy and security, often exceeding their established trust in third-party providers. This study addresses the lack of localized, empirical research by assessing the awareness, concerns, and trust levels of working professionals in the Mawal Region regarding cloud data security and privacy. The aim is to quantify this relationship and provide actionable recommendations for organizations to enhance user education and implement more effective data protection strategies, thereby bridging the gap between high cloud usage and moderate user security knowledge.

Review of Literature:

Several studies, both globally and within India, have explored the critical issues surrounding the adoption of cloud computing, specifically focusing on the relationship between its benefits and the inherent risks related to security and privacy. The findings across this literature consistently highlight the need for greater user awareness as a key factor influencing trust and adoption behavior.

1. Garg and Sharma (2018): Studied the adoption barriers in Indian SMEs, concluding that data security and privacy were the primary concerns, often overshadowing cost-efficiency. They emphasized that the lack of clear, user-friendly security policies from Cloud Service Providers (CSPs) creates user uncertainty.
   - Cloud Computing Adoption in SMEs: A Study of Critical Factors in the Indian Context. Journal of Information Systems and Technology Management, 15(3).
2. Alsmadi and Prybutok (2018): Found that trust in the cloud environment is built upon both perceived technical support and perceived security capability. Their work demonstrated a direct link between the transparency of a CSP's security measures and the user's willingness to store sensitive data.
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3. Kaur and Singh (2021) (Relevant to Indian context): Although focusing on a different user group (students), their research highlighted that fear of data breaches and unauthorized access is pervasive among Indian internet users, leading to cautious behavior even with well-known service providers.
   - Impact of online gaming on academic performance of Indian college students. Indian Journal of Psychology and Education, 11(2), 45-52.
4. Xu and Mahenthiran (2021): Argued that IT complexity negatively affects users' perceptions of a cloud provider's performance and security. They suggested that the lack of knowledge and experience among end-users often impedes their ability to utilize cloud security features effectively.
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5. Prabhakaran and Senthil (2023): Conducted a review on security models, concluding that the Shared Responsibility Model is poorly understood by end-users. They stressed that user negligence (e.g., weak passwords, misconfiguration) is responsible for the majority of cloud security incidents, not failures in the provider's infrastructure.
   - A Review of Cloud Computing Security Models and Threats. International Journal of Computer Science and Network Security, 23(1), 101-109.

Research Gap:

Most existing research has focused on the technical vulnerabilities of the cloud infrastructure, the organizational adoption challenges faced by large enterprises, or macro-level national surveys. However, there is a significant scarcity of studies that specifically:

- Localize the Focus: Existing literature lacks granular data on the perceptions and behavioral aspects of individual working professionals in semi-urban or fast-growing regional hubs like the Mawal Region.
- Correlate Awareness and Trust Empirically: While the link between awareness and trust

is theoretically acknowledged, few empirical studies have systematically measured the direct correlation between a professional's verified security awareness score and their stated trust level in a specific regional context.

- Identify Specific Policy Gaps: Research often calls for "more awareness" but does not pinpoint the specific areas where user knowledge is weakest (e.g., understanding of encryption, legal compliance, or the Shared Responsibility Model).

Therefore, this research aims to bridge this gap by empirically analyzing the relationship between the level of cloud security awareness and the resulting trust placed in CSPs by working professionals within the Mawal Region, thereby providing localized and actionable insights for focused training and policy development.

Research Methodology:

a) Research Design:

The present study adopts a descriptive and analytical research design to examine user perceptions regarding cloud data security and privacy among working professionals in the Mawal region. This design enables the systematic identification of trends, attitudes, and awareness levels related to cloud security practices. Data was collected using a structured questionnaire designed to capture respondents' perceptions, experiences, and concerns regarding cloud data security and privacy.

b) Sample Size and Study Area:

The research was conducted among working professionals located in the Mawal region. A total of 49 respondents participated in the study. A random sampling method was used to ensure fair and unbiased representation of professionals from different industries, job roles, and organizational backgrounds within the region.

c) Data Collection:

The study relied on both primary and secondary data sources:

- Primary Data: Collected via a structured questionnaire distributed to working professionals. The questionnaire included items related to cloud security awareness, perception of organizational cloud policies, training received, privacy concerns, and overall confidence in cloud data management.
- Secondary Data: Gathered from journals, research articles, industry reports, and online publications focusing on cloud computing, data security frameworks, privacy challenges, and user awareness in organizational settings.

d) Tools and Techniques for Data Analysis:

To interpret and present the findings, the study utilized percentage analysis and graphical tools such as pie charts to illustrate respondent distributions across various parameters. Software tools including Microsoft Excel and Google Forms were used for organizing data, performing calculations, and generating graphical representations for clearer understanding and comparison.

Result:

Which cloud service do you use most frequently?

49 responses

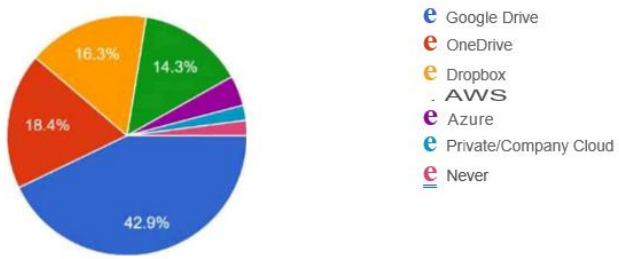

Fig. Cloud services use most frequently

Google Drive 1s the most frequently used cloud service (42.9%), followed by OneDrive

(18.4%) and Dropbox (16.3%). AWS and Azure each have moderate use, while private/company clouds and non-users make up only small portions. Overall, consumer-oriented cloud platforms dominate usage.

For what purpose do you primarily use cloud storage?
49 responses

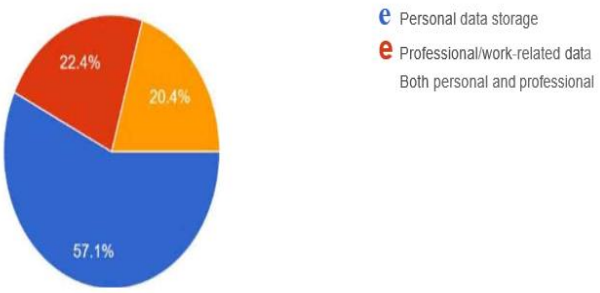

Fig. Primarily use cloud storage

Most respondents (57.1%) use cloud storage mainly for personal data, while 22.4% use it for professional work. About 20.4% use it for both personal and professional purposes, showing that cloud storage is primarily a personal tool but still widely used for mixed needs.

Have you attended any cloud security training or awareness sessions?
49 responses

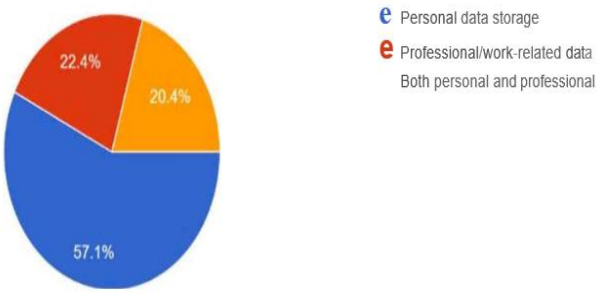

Fig. attended any cloud security training or awareness sessions

- 69.4% (about 34 respondents) answered "Yes", indicating that a strong majority have already participated in cloud security training or awareness sessions.
- 30.6% (about 15 respondents) answered "No", meaning nearly one-third have not attended any such sessions

Discussion and Suggestions:
Discussion:

The study shows that while many working professionals in the Mawal region have received cloud security training, a considerable number still lack exposure. Most respondents expressed a strong need for regular training, indicating growing awareness of cloud-related risks. Although many believe their organizations have clear cloud security policies, some employees remain unsure, suggesting gaps in communication and understanding. Overall, the findings highlight the need for stronger awareness, clearer policy communication, and continuous learning to improve cloud data security and privacy.

Suggestions:

1. Conduct regular cloud security training and awareness sessions.
2. Improve communication of cloud data security policies to all employees.
3. Offer refresher courses to strengthen understanding of security practices.
4. Build a security-conscious culture within organizations.
5. Perform regular audits to ensure compliance and identify vulnerabilities.

Conclusion:

The study concludes that while working professionals in the Mawal region show good awareness of cloud data security and privacy, there are still gaps in training and understanding of organizational policies. Many respondents expressed the need for regular training, indicating a strong interest in staying updated on cloud

security practices. Improving policy communication, increasing awareness programs, and providing consistent training can help organizations strengthen their overall cloud security posture.

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