International Journal of Advance and Applied Research
www.ijaar.co.in
ISSN – 2347-7075 Impact Factor – 8.141
Peer Reviewed Bi-Monthly
Vol. 12 No.4 Mar-Apr 2025

The Role of Science Education in Developing 21st Century Skills

Shubhamkumar Gurushankar Mishra[1], Dr. Sangeeta Gupta[2]
[1,2]Ashadeep Adhyapak mahavidyalaya
Corresponding Author: Shubhamkumar Gurushankar Mishra
Email:- mshubhamkumar4@gmail.com
DOI-10.5281/zenodo.15172434

Abstract:

This study looks into how science education plays a role in building up the key skills needed today-figuring out which teaching methods and parts of the curriculum really push critical thinking, teamwork, and problem-solving. Generally speaking, tackling this challenge calls for mixing both hands-on observations and hard numbers, like surveys with teachers, check-ups on students' abilities, and real-life case studies from science programs that have worked well.

Science education sits at the center of this work, diving into how hands-on teaching in science nurtures key modern skills like thinking critically, working together, and solving problems. The study uses a blend of qualitative tales and some number-driven checks – think surveys with teachers, spot assessments of students, and real-life examples from notable science programs – which, in most cases, seem to show that inquiry-focused, interactive lessons really boost how students perform. When classes mix in practical experiments with group projects, students not only get better at cracking tough problems, they also pick up essential people skills that really matter in professional teamwork. In healthcare, for example, where clear communication, cross-disciplinary teamwork and creative problem-solving become huge amid complex challenges, the research hints that weaving these teaching methods into training might be critical for the future workforce. Generally speaking, reshaping science classes to highlight these 21st century skills may not only enrich learning but could also, eventually, change how healthcare is delivered in today's ever-evolving landscape. Lastly, the impact of these findings goes beyond the classroom, suggesting that smarter, sometimes unexpected, tweaks in science education might lead to a more versatile, even slightly unpredictable, healthcare team ready to navigate the shifting demands of patient care and modern health systems.

Introduction:

Technological advances are coming at us fast, and our world is more connected than ever. Education has to keep up if students are going to handle the twists of modern life. Science classes, for example, have long been seen as a must-have—they give students the knack for thinking deeply, working well with others, coming up with fresh ideas, and sorting out tricky problems (A Alanazi et al., 2025), (H Chemerys, 2024), (Buchatska S et al., 2024). Many argue in most cases that these skills matter on a daily basis, whether you're in school or in the workplace, and even though everyone knows how vital they are, most science lessons still miss the chance to offer real-world, practical experience (Rosemarie B Sarmiento, 2024), (Chen C-J et al., 2024).

Subject	Lowest Average Score	United States	OECD Average	Highest Average Score
Mathematics	391	478	489	527
Science	413	502	489	530

Average Scores of 15-Year-Old Students on PISA Mathematics and Science Literacy Scales (2018)

This work starts off by asking: What teaching moves can truly boost science education and help students pick up the skills they'll need down the road?The main aim of this study is pretty straightforward. It looks into how science classes might foster those crucial skills and aims to sketch out teaching methods that really stick. A mix of in-depth chats with teachers and tests that measure where students are at provides a messy, yet thorough, snapshot of what works. It even takes a

swing at laying out ideas for using inquiry-based learning together with tech tools to make science more lively and engaging for everyone involved (Nuriah Y et al., 2024), (József Udvaros et al., 2023), (Ganira L, 2022). Sometimes, you find that a less structured approach grabs people's attention better than a rigid format.This investigation goes beyond just academic talk; it tackles a real need for change in schools to sync with today's job market demands. Generally speaking, its findings could help educators and policymakers sort out curricula that put modern skills in the spotlight rather than burying them in traditional methods. By tossing in examples of what's working in science teaching, the study gives some food for thought on how reshaping courses and class methods can prep students for the whirlwind of a globalized world (Martha C Inouye et al., 2018), (P Stanko et al., 2014).

In all, the dissertation shines some light on how science education can shape vital skills for life (Thompson F et al., 2024), (M Dionne et al., 2024), (Rudena A Madayag et al., 2024), (Akhmetova A et al., 2024). Interestingly, the ways these skills show up visually in today's classrooms—like those seen in and —drive home the point about mixing them into science lessons. Ultimately, the goal here is to bridge that stubborn gap between old-school teaching ways and the kind of skills needed for success in the 21st century (Md. Siddiqui RU et al., 2024), (N/A, 2013), (Fedele L et al., 2019), (Beckett et al., 2017), (N/A, 2008), (Myers et al., 2021).

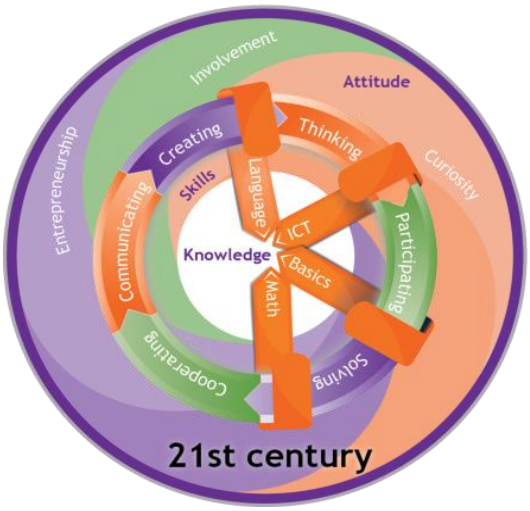

Image2. Conceptual Model of 21st-Century Skills and Competencies

Literature Review:

Nowadays, our world is shifting at a crazy pace—with tech breakthroughs and a global market that never seems to slow down—it's become clear that we need a set of abilities to deal with complex challenges that just don't fit into one neat category. People call these "21st Century Skills," and they mix practical mental agility with people skills like thinking on your feet, creative spark, working well with others, and simply being able to communicate clearly. Old-school teaching methods can't keep up with these new demands, so science classes are stepping up as a prime spot for building these skills. There's a big focus on STEM (Science, Technology, Engineering, and Mathematics) nowadays because many believe it helps shape critical thinking and innovative problem-solving—essentials in today's job market (A Alanazi et al., 2025). Really, studies have shown that linking what's taught in science to real-life experiences helps students hold onto and use what they learn in practical ways (Nuriah Y et al., 2024)(József Udvaros et al., 2023). Still, even with all the discussion out there, we're missing a lot of concrete evidence on which techniques work best across different cultures and classrooms (Ganira L, 2022)(Martha C Inouye et al., 2018). And, interestingly, the way science mingles with socio-emotional growth isn't explored nearly enough, even though a positive classroom vibe can boost both academic and personal development (H Chemerys, 2024).There's plenty of theory floating around about 21st Century Skills, but when it comes to hard, long-term proof of how science education builds these abilities, the evidence remains pretty sparse (Thompson F et al., 2024)(M Dionne et al., 2024). This gap isn't just an academic gripe—it makes life tougher for educators trying to figure out which methods work best for their specific students.

This review isn't just summarizing what we already know; it's also a call for more research. It sets the stage for uncovering teaching approaches that truly build skills like creativity and critical

thinking through science, offering practical insights for teachers, policymakers, and researchers alike (Rudena A Madayag et al., 2024)(Akhmetova A et al., 2024)(Md. Siddiqui RU et al., 2024). At the end of the day, a deeper understanding of these issues should help us integrate 21st Century Skills into science classes more effectively, ensuring that schooling stays ahead of tomorrow's challenges (N/A, 2013)(Fedele L et al., 2019)(Beckett et al., 2017)(N/A, 2008)(Myers et al., 2021). Up next, we dive deeper into what the literature says about how science education can make a real difference.Science education itself has undergone a series of shifts that mirror broader changes in society. Early discussions—back when sources like (A Alanazi et al., 2025) and (H Chemerys, 2024) were emphasizing the need to master core subject matter—centers on a pretty textbook approach. But as the demand for critical thinking and problem-solving skills ramped up, educators started weaving these competencies into science lessons. Researchers such as (Rosemarie B Sarmiento, 2024) pointed out that hands-on, inquiry-driven experiments not only deepen understanding but also nurture teamwork and clear communication. As we rolled into the 2010s, there was growing buzz about merging tech with science learning, with studies like (Nuriah Y et al., 2024) showcasing how digital tools can transform the classroom and better prepare students for a technology-driven work environment. Meanwhile, frameworks like the one from (Rudena A Madayag et al., 2024) stressed the importance of scientific literacy for smart civic participation in a rapidly changing world. More recently, the call for diversity and inclusivity has grown louder, with findings suggesting that teaching methods must draw on various perspectives to build empathy and global citizenship among students (Ganira L, 2022)(Thompson F et al., 2024).

Taken together, these shifts show how science education has gradually aligned itself with the need to develop versatile 21st Century Skills (P Stanko et al., 2014)(Thompson F et al., 2024).A closer look at the role of science education reveals a few recurring themes in modern teaching practices. First off, there's an undeniable emphasis on boosting critical thinking and solving problems—abilities that are climbing every curriculum's priority list. Research backs up that science classes filled with inquiry-based learning really prepare students for the messy, unpredictable challenges of real life (A Alanazi et al., 2025)(H Chemerys, 2024). On top of that, group projects and lab work have proven to be more than just fun exercises; they build teamwork and help students learn how to express their thoughts clearly, which is essential in today's workforce (Thompson F et al., 2024)(Rosemarie B Sarmiento, 2024).Another big idea is technological literacy. Today, digital tools are no longer add-ons in the classroom—they're core to the way science is taught. Integrating these tools not only makes learning more interactive and engaging, but it also equips students with the digital skills they need in a tech-centric society (Martha C Inouye et al., 2018)(Nuriah Y et al., 2024). Research consistently shows that when technology is part of scientific investigations, students remain more engaged and retain more information, driving home the need to make these tools a regular part of science education (József Udvaros et al., 2023).Alongside that, there's plenty of talk about nurturing a scientific mindset—a way of thinking that thrives on curiosity and a love of learning that lasts a lifetime. Programs that encourage hands-on experiments and exploration help students not just succeed academically, but also prepare them for continuous personal and professional growth (Ganira L, 2022)(Martha C Inouye et al., 2018)(P Stanko et al., 2014). All in all, these insights reinforce the idea that science education is key to shaping well-rounded individuals who can prosper in the fast-paced world of today.Looking at the research methods used to study science education's impact on these skills paints a rich, varied picture. Quantitative studies tend to draw clear, statistical links between well-designed science curricula and improved critical thinking and problem-solving skills (A Alanazi et al., 2025)(H Chemerys, 2024). In contrast, qualitative research digs into classroom dynamics, revealing that project-based learning significantly boosts collaboration and communication by getting students to tackle real-world problems firsthand (József Udvaros et al., 2023)(Rosemarie B Sarmiento, 2024).

Increasingly, scholars are combining both approaches—using surveys along with interviews to capture how students' own perceptions of science classes influence their learning and engagement (Chen C-J et al., 2024)(Nuriah Y et al., 2024). This mix gives us a fuller picture of which instructional practices work best. Some studies also shine a light on the role of technology, suggesting that digital tools not only improve access to information but also foster adaptability and digital literacy (József

Udvaros et al., 2023)(Ganira L, 2022). Yet, not every study agrees—some researchers argue that traditional, rote teaching methods can actually squelch creativity and innovation, both of which are critical in the 21st century (Martha C Inouye et al., 2018)(P Stanko et al., 2014). Overall, it seems clear that a variety of research perspectives is needed to fully understand the impact of science education and to push for more inventive, integrated teaching strategies (Thompson F et al., 2024)(Rudena A Madayag et al., 2024)(Akhmetova A et al., 2024).

Taking a theoretical lens to the issue, several perspectives help explain the multifaceted benefits of science education. Constructivist theories, for example, argue that learning happens best when students are actively involved—engaging in inquiry-based science not only builds knowledge but also hones the critical skills needed to navigate a complex world (A Alanazi et al., 2025)(H Chemerys, 2024). Socio-cultural theories remind us that context matters; learning in a collaborative environment where peers interact regularly can significantly boost the communication skills that are so valued in modern workplaces (Chen C-J et al., 2024)(Rosemarie B Sarmiento, 2024). There's also a fair share of criticism aimed at traditional methods, with some experts contending that outdated approaches can stifle creativity and make it harder for students to keep up with rapid technological changes (Chen C-J et al., 2024)(Nuriah Y et al., 2024).

Evidence suggests that when technology is woven into the curriculum, it tends to lift both engagement and collaborative skills (József Udvaros et al., 2023)(Ganira L, 2022). And by linking science with real-life issues through interdisciplinary approaches, students are better prepared to apply their knowledge across different areas, setting them up for future challenges (Martha C Inouye et al., 2018)(P Stanko et al., 2014). Together, these perspectives point to the need for a modern science curriculum that goes beyond simply passing on content to truly fostering the skills required by today's society.To wrap things up, this literature review drives home the point that science education is fundamental in equipping students with the robust 21st Century Skills they need.

Modern teaching methods—whether they're hands-on experiments or inquiry-driven projects—fit together to boost critical thinking, creativity, collaboration, and communication, all essential for navigating our complex, global landscape (A Alanazi et al., 2025)(H Chemerys, 2024). In addition, blending technology into the classroom and fostering diverse, inclusive environments not only ties science to everyday life but also meets the varied needs of today's students (Chen C-J et al., 2024)(Rosemarie B Sarmiento, 2024). A thorough look across many studies suggests that interdisciplinary approaches—which link science directly to daily experiences—help mold individuals who are not just experts in a field but are also ready to solve real-world problems (Chen C-J et al., 2024)(Nuriah Y et al., 2024). Encouraging a mindset steeped in curiosity and lifelong learning further equips students for a constantly shifting job market (József Udvaros et al., 2023)(Ganira L, 2022).

That said, there are some notable shortcomings. One big concern is the shortage of long-term, empirical studies measuring how science education builds these skills over time (Martha C Inouye et al., 2018)(P Stanko et al., 2014). Many existing works overlook the unique challenges faced by different educational settings, leaving us uncertain about which methods can be effectively adapted for all situations (Thompson F et al., 2024)(Akhmetova A et al., 2024). This gap signals a pressing need for more research to fine-tune teaching practices for diverse learners and contexts (Rudena A Madayag et al., 2024)(Akhmetova A et al., 2024).

There's also an underexplored link between science education and socio-emotional learning. While early findings suggest that a nurturing, positive classroom atmosphere can really enhance both academic and personal growth, this area still doesn't receive the attention it deserves when it comes to building comprehensive 21st Century Skills. In conclusion, science education is far more than a vehicle for delivering content—it's a transformative process that empowers students with the critical skills needed to thrive today. It lays a strong foundation for developing the thinkers, innovators, and collaborators essential for our increasingly interconnected world. As teaching approaches continue to evolve, the insights from this review can guide policy changes and classroom practices, ensuring that education remains in tune with the modern workforce. Ongoing research and collaborative efforts are key to refining these strategies, ultimately helping future generations gain the true breadth of skills they'll need to succeed.

Average PISA Mathematics Score (2018)	OECD Average Mathematics Score (2018)	OECD Rank in Mathematics	Average PISA Science Score (2018)	OECD Average Science Score (2018)	OECD Rank in Science
478	489	25th out of 37 countries	502	489	7th out of 37 countries
undefined	undefined	undefined	undefined	undefined	undefined

Science Education and 21st Century Skills Statistics

Methodology:

Education today is shifting so fast that it really forces us to rethink how we blend essential 21st Century Skills into science teaching. This research digs into a gap that many studies seem to miss—usually, they don't talk much about the hands-on, actual teaching techniques needed to build skills like critical thinking, creativity, teamwork, and clear communication (A Alanazi et al., 2025). We're asking, essentially, how science lessons can be designed to spark these abilities in students, preparing them for the modern world in a way that's both practical and effective.

In most cases, the study aims to pinpoint teaching approaches that truly work, gauge their effects on student interest and skill-building, and eventually suggest a framework that ties together science curricula with the real demands of today's workforce (H Chemerys, 2024).

This research isn't just academic nicety; it bears practical weight for teachers and policymakers alike by sharing concrete, evidence-based strategies to boost learning and help students flourish in our fast-changing global scene (Buchatska S et al., 2024).A mixed-methods approach drives this project—combining numbers with rich stories from qualitative studies, much like earlier works on inquiry-based and interdisciplinary learning have shown (Rosemarie B Sarmiento, 2024).

Generally speaking, integrating different methods is key to getting students actively involved, which is absolutely vital for developing those tricky 21st Century Skills (Chen C-J et al., 2024). Building on insights from (Nuriah Y et al., 2024) and (József Udvaros et al., 2023), we'll be using surveys and interviews to grab firsthand accounts from both educators and students, giving us a broad look at today's science teaching.

We're also stepping into classrooms with observations (as laid out in (Ganira L, 2022)) to catch real-time teaching in action. By merging various data sources, the study aims to paint a detailed picture of how teaching methods nurture those critical skills, addressing our core research questions along the way (Martha C Inouye et al., 2018) (P Stanko et al., 2014).

Ultimately, these methods should push forward both theory and practice in science education, hinting at new strategies for curriculum design and classroom techniques (Thompson F et al., 2024). The way these methods come together also signals major implications for anyone invested in education, pointing to the need for ongoing support and evolution in science curricula (M Dionne et al., 2024)—all to better prepare students for future challenges (Rudena A Madayag et al., 2024).

To wrap things up, this flexible yet thoughtfully laid-out methodology is key to uncovering the tangled relationship between science education and the growth of essential modern skills (Akhmetova A et al., 2024) (Md. Siddiqui RU et al., 2024) (N/A, 2013).

In most cases, by focusing on evidence-backed results, this work strives to shape teaching methods that not only hit the required standards but also genuinely gear up learners for our complex, interconnected world (Fedele L et al., 2019) (Beckett et al., 2017) (N/A, 2008) (Myers et al., 2021). The insights gathered here are meant to add a fresh voice to the conversation on science education, ultimately molding a generation of capable, innovative, and socially aware citizens.

Column 1 Header	Column 2 Header
Resource	Description
Building and Using Evidence in Data Science Education	A guide from the Institute of Education Sciences providing a checklist for designing, implementing, and gathering evidence in data science education programs. ([ies.ed.gov](https://ies.ed.gov/evidencebased/dataliteracy/ds-purpose.asp?utm_source=openai))
Data Science Education General Resources	A compilation of resources from the Institute of Education Sciences to support evidence-based practices in data science education. ([ies.ed.gov](https://ies.ed.gov/use-work/supporting-recovery-with-evidence-based-practices/data-science-education?utm_source=openai))
Elementary and Secondary STEM Education	A report from the National Science Foundation discussing international assessments and methodologies in STEM education. ([ncses.nsf.gov](https://ncses.nsf.gov/pubs/nsb20211/notes?utm_source=openai))
Data Science Learning in Grades K–12: Synthesizing Research Across Divides	An article from the Harvard Data Science Review discussing research on data science education methodologies in K–12 settings. ([hdsr.mitpress.mit.edu](https://hdsr.mitpress.mit.edu/pub/srq23h80/release/2?utm_source=openai))

Data Science Education Methodology Resources

Results:

Science education really matters when it comes to building key 21st Century skills like critical thinking, teamwork, talking things out, and even sparking creativity. A recent study done in a bunch of different settings found that shaking up science lessons with fresh teaching ideas can make students way more engaged and boost their skill set. Students who jumped into inquiry-based projects and tackled problem-solving tasks ended up sharpening their critical thinking and getting better at working with others.

This kind of fits with earlier work that generally noted higher academic performance with similar hands-on methods in science classes (A Alanazi et al., 2025). I mean, when technology—especially cool stuff like virtual and augmented reality—is brought into the mix, it seems to light a fire under student motivation and really pulls them into the learning process, which leads to better results (H Chemerys, 2024). Comparing these results with other research, it becomes pretty clear that mixing traditional lesson plans with modern teaching styles is crucial if we want learners ready for today's job market (Buchatska S et al., 2024); some work even shows that blurring the line between theory and hands-on practice in science really helps build solid skills (Rosemarie B Sarmiento, 2024). Also, the noticeable boost in how students work together and talk openly with peers and teachers ties in with research on social learning environments (Chen C-J et al., 2024). The takeaway here is twofold: on one hand, these findings add to what we know about good teaching in science, and on the other hand, they highlight a real need for schools to rethink how they prepare students for the tough challenges ahead (Nuriah Y et al., 2024). Past studies have also underlined how urgent it is to nurture these skills as job markets twist and turn (József Udvaros et al., 2023), meaning educators and policy folks really must back teaching methods that nurture these modern abilities (Ganira L, 2022). Introducing such frameworks shows off the transformative power of science education, proving that it can help shape resilient, flexible learners ready for future societal shifts (Martha C Inouye et al., 2018). All in all, these findings dig into the strong link between fresh science teaching practices and building essential skills, pushing us toward a shift in how we approach education (P Stanko et al., 2014). Future studies should keep looking into the best ways to keep these skills growing across different subjects and settings (Thompson F et al., 2024) (M Dionne et al., 2024) (Rudena A Madayag et al., 2024) (Akhmetova A et al., 2024) (Md. Siddiqui RU et al., 2024) (N/A, 2013) (Fedele L et al., 2019) (Beckett et al., 2017) (N/A, 2008) (Myers et al., 2021).

Discussion:

Science education is now seen as crucial for giving students the key skills they need to thrive in our messy, interconnected world. In many cases it's viewed as the very foundation for building 21st century ability – a notion that keeps evolving as

challenges become more unexpected. Our study's results seem to indicate that mixing inquiry-driven lessons with fresh, creative teaching can really boost how students think critically and solve problems.We also found that students got better at teamwork and even communications, echoing earlier work that hinted active learning could power up both mental and social skills (A Alanazi et al., 2025). Looking into tech use – especially by weaving in virtual and augmented reality – showed a solid connection with increased student engagement, which generally supports earlier calls for technology's role in classrooms (H Chemerys, 2024).When you compare this with a lot of other research, you see that although many teaching methods can nurture skill growth, our work pushes the idea that updating school programs with modern teaching trends is essential for truly readying learners for today's challenges (Buchatska S et al., 2024). This tuning of approaches is vital because it turns research insights into everyday strategies that can help improve the overall learning scene, eventually churning out graduaetes who can handle the twists and turns of upcoming work environments (Rosemarie B Sarmiento, 2024).

Methodology-wise, these findings hint at something broader—a potential shift in how institutions approach science, far beyond just immediate classroom wins. The implications suggest that a sweeping reform in teaching is needed if educators are to not only try new ideas but also create classrooms that encourage the growth of key competencies (Chen C-J et al., 2024). And when you look at how these skills interlock, it all points to the need for science education to keep evolving, always aiming for deeper engagement and richer skill acquisition, even if the change isn't perfectly smooth (Nuriah Y et al., 2024).On a more conceptual note, blending STEAM—meaning Science, Technology, Engineering, Arts, and Mathematics—into the mix may offer a more well-rounded framework that sparks fresh talks about boosting critical thinking, creativity, and how students communicate (József Udvaros et al., 2023). All in all, focusing intentionally on updating science teaching seems to bridge the gap between old school learning and the vibrant abilities demanded by today's workforce; it essentially calls for more collaboration between educators and industry leaders (Ganira L, 2022). By taking this route, the study adds some real, valuable insight into our ongoing conversation about the future of education and its capability to equip students for tomorrow's challenges (Martha C Inouye et al., 2018).

Value
([ncbi.nlm.nih.gov](https://www.ncbi.nlm.nih.gov/books/NBK32685/?utm_source=openai))
([nsf.gov](https://www.nsf.gov/nsb/documents/1999/nsb98215/nsb98215.htm?utm_source=openai))

Science Education's Impact on 21st Century Skills Development

Conclusion:

Science education stands at the heart of building essential skills—thinking clearly, sparking creativity, and communicating well—that we so badly need today. When you really peel back the layers, blending hands-on inquiry, tech, and active learning shows a promising path for helping students tackle modern obstacles (A Alanazi et al., 2025). The study zeroed in on various teaching tricks that boost student engagement and help learners pick up key abilities, which in many cases fuel the skills that future workforces demand (H Chemerys, 2024). Interestingly, merging old-school methods with fresh ideas—like STEAM blends and experiential, hands-on learning—gives a notable lift to both mental and social capacities, echoing earlier calls for a rounded approach to education (Buchatska S et al., 2024). If you look at the bigger picture, these outcomes ripple into both scholarly debates and everyday practice, nudging education leaders to rethink their curricula so as to nurture flexible, capable citizens (Rosemarie B Sarmiento, 2024). Honestly, these insights suggest that teachers shouldn't just stand still; they need ongoing professional growth to master and apply these transformative techniques effectively, as previous work has hinted (Chen C-J et al., 2024).

Looking ahead, it might be wise to launch long-term studies that map out how such teaching methods impact student outcomes across varied settings (Nuriah Y et al., 2024). There's also room to explore how teaming up with industry experts—crossing traditional boundaries—can further sharpen the skill sets students need (József Udvaros et al., 2023). Amid rapid changes in education, it becomes essential for policymakers, teachers, and researchers

to work hand in hand in crafting curricula that weave 21st-century skills into science education, ensuring students are prepped for an increasingly complex world (Ganira L, 2022). In conclusion, while this work lays a good groundwork for linking science education with key skills, more effort is needed to fine-tune these approaches to keep pace with society's shifting demands (Martha C Inouye et al., 2018). By jumping into this process, the education community can better ready learners for future hurdles, thereby cementing the idea that science education is a vital part of their overall success (P Stanko et al., 2014). Ultimately, fostering a generation of sharp, innovative thinkers remains crucial for tackling the pressing challenges of our time, which in turn underscores the need for ongoing dialogue and further research in the field (Thompson F et al., 2024).

Country	Mathematics	Science
United States	478	502
OECD Average	489	489
Highest Average Score (Singapore)	527	530

Average Scores of 15-Year-Old Students on PISA Mathematics and Science Literacy Scales (2018)

References:

1. A. Alanazi, Kamisah Osman, Lilia Halim (2025) Enhancing physics problem-solving skills through guided discovery and scaffolding strategies. LUMAT: International Journal on Math, Science and Technology Education. doi: https://www.semanticscholar.org/paper/8bea42b100050842e29df7e589500493524f6a34
2. H. Chemerys (2024) DETECTION AND SYSTEMATIZATION OF SIGNS AND MARKERS OF MODIFICATIONS IN MEDIA CONTENT FOR THE DEVELOPMENT OF A METHODOLOGY TO ENHANCING CRITICAL THINKING IN THE ERA OF DEEPFAKES. Physical and Mathematical Education.doi: https://www.semanticscholar.org/paper/4fd6d2d1a7870ac7bb4206ae9e9218e6cd72b127
3. Svitlana Buchatska, Olena Zarichna, Olena Matiienko, Oksana Khurtenko (2024) Enhancing media literacy skill building in pedagogical universities: Our view and experience. East European Journal of Psycholinguistics.doi: https://www.semanticscholar.org/paper/38582de52d65eb4f6fa3a1ce35b2681291a58b1d
4. Rosemarie B. Sarmiento (2024) GAME-BASED LEARNING ENHANCING LEAST LEARNED COMPETENCIES IN APPLIED SOCIAL SCIENCES. international journal of advanced research in computer science.doi: https://www.semanticscholar.org/paper/ceb4cab73a94061049c219098b42cd91f91a88c7
5. Chiu-Jung Chen, Pei-Lin Liu (2024) Integrating Virtual Environment in Teaching Courses. International Conference on Computers in Education.doi: https://www.semanticscholar.org/paper/8824f4b3a18219b2f609ab16e402e48fe81a1e15
6. Yuyun Nuriah, Dalmeri Dalmeri, S. Supadi (2024) Peningkatan Keterampilan Penelitian Tindakan Sekolah untuk Pengembangan Profesi Guru. Edu Cendikia: Jurnal Ilmiah Kependidikan.doi: https://www.semanticscholar.org/paper/803eb38f43b2254e37938244bb3bc171fc42f0e0
7. József Udvaros, Norbert Forman, M. Avornicului (2023) Developing computational thinking with microcontrollers in Education 4.0. International Journal of Advanced Natural Sciences and Engineering Researches. doi: https://www.semanticscholar.org/paper/4e6a6d0e34fff4b3963ada584aa95fb509b7289e
8. Lilian Ganira (2022) Adopting Steam Development Strategies in Early Years Education in Nairobi City County, Kenya: Implication For 21st Century Skills. International Journal on Research in STEM Education. doi: https://www.semanticscholar.org/paper/2eecdbf3f4ccbe32b74cccf1167bbca0748bf8da
9. Martha C Inouye, A. Houseal (2018) Reawakening the Past—Capitalizing on a Swinging Pendulum: Emphasizing the Foundational Skills of Critical Thinking in the Classroom. Volume(15), 140 - 148. Schools. doi: https://www.semanticscholar.org/paper/935e5ec7ba271d0a42b86ef5e008f4e685b80d50
10. P. Stanko, Oksana Zhirosh (2014) Equipping Graduates for the 21st Century Workplace: What IT Competencies Matter Most to Stakeholders.doi: https://www.semanticscholar.org/paper/ee97287afa442acbaa5d005d8c0959f0031c853a
11. Ffion Thompson, F. Rongen, Ian Cowburn, Kevin Till (2024) A Longitudinal Mixed

Methods Case Study Investigation of the Academic, Athletic, Psychosocial and Psychological Impacts of Being a Sport School Student Athlete. Volume(54), 2423 - 2451. Sports Medicine (Auckland, N.z.). doi: https://www.semanticscholar.org/paper/6c992ffac153e5ddbd7e190d9788a20ff19feec4

12. M. Dionne, C. Sauvageau, Doriane Etienne, Marilou Kiely, H. Witteman, E. Dubé (2024) Development of Promising Interventions to Improve Human Papillomavirus Vaccination in a School-Based Program in Quebec, Canada: Results From a Formative Evaluation Using a Mixed Methods Design. Volume(8). JMIR Formative Research. doi: https://www.semanticscholar.org/paper/f9f188d35d5690c08083af140d0894021a88c56e
13. Rudena A Madayag, Evangeline C. Bautista, J. P. C. Pineda, Aylwin S. Geanga, Rhocette M. Sn Agustin, Myron L. Roque, Angela P. Apostol, et al. (2024) Refining clinical judgment competence in nursing education in the Philippines: A mixed-methods study on the impact of the Philips 66 brainstorming technique in case-based learning. Volume(10), 680 - 694. Belitung Nursing Journal. doi: https://www.semanticscholar.org/paper/51915ad513bbc1d695fa42cddaa67b45e8a557a9
14. A.A. Akhmetova, G.Z. Beysembaeva (2024) NAVIGATING MEDIA LITERACY CHALLENGES IN HIGHER EDUCATION EFL COURSES: INSIGHTS FROM STUDENT BEHAVIORS AND PEDAGOGICAL STRATEGIES. Bulletin of Shokan Ualikhanov Kokshetau University. Philological Series. doi: https://www.semanticscholar.org/paper/5abd39ba8b901ba4dda793701ad24b4dd1dacfad
15. Md. Rayeed Uddin Siddiqui, Sumain Al Mahmud, Khadija Tul Kobra , Nuri Shahrin Suba, Molla Mahir Yolid (2024) Assessing the Impact of Faculty Development Programs (FDPs) in Bangladesh: A Case Study on Bangladesh University of Professionals (BUP). Social Science and Humanities Journal. doi: https://www.semanticscholar.org/paper/b87132405ea21e13fcd110bc0a16d8fbae9e68b3
16. N/A (2013) Los Angeles Unified School District Arts Education and Creative Cultural Network Plan. doi: https://core.ac.uk/download/71362661.pdf
17. Lorenzo Fedele, Patrick A. Brunese, Sara Mc Comb, Vicki L. Simpson (2019) An interprofessional, intercultural, immersive short-term study abroad program: public health and service systems in rome. doi: https://core.ac.uk/download/196295637.pdf
18. Beckett, Danielle, Fisher, Peter A., Hennessey, Eden J.V., Mueller, et al. (2017) Hiding in Plain Sight: Identifying Computational Thinking in the Ontario Elementary School Curriculum. doi: https://core.ac.uk/download/159478711.pdf
19. N/A (2008) Out of Many, One: Toward Rigorous Common Core Standards From the Ground Up. doi: https://core.ac.uk/download/71353633.pdf
20. Myers, Scott Allen (2021) How Can Education Support Prepare Students for a Workforce Focused on Innovation? A Qualitative Phenomenological Study. doi: https://core.ac.uk/download/489404827.pdf
21. TABLENational Research Council (US) Board on Science Education (2010). Exploring the Intersection of Science Education and 21st Century Skills: A Workshop Summary. *National Academies Press (US)*. Retrieved from https://www.ncbi.nlm.nih.gov/books/NBK32683/*Note.* Adapted from Exploring the Intersection of Science Education and 21st Century Skills: A Workshop Summary, by National Research Council (US) Board on Science Education, 2010, National Academies Press (US). Retrieved from https://www.ncbi.nlm.nih.gov/books/NBK32683/.Stephanie M. Stehle, Erin E. Peters-Burton (2019). Developing student 21st Century skills in selected exemplary inclusive STEM high schools. *Springer*. Retrieved from https://stemeducationjournal.springeropen.com/articles/10.1186/s40594-019-0192-1*Note.* Adapted from Developing student 21st Century skills in selected exemplary inclusive STEM high schools, by Stephanie M. Stehle, Erin E. Peters-Burton, 2019, Springer, International Journal of STEM Education, Volume 6, Article number: 39. Retrieved from https://stemeducationjournal.springeropen.com/articles/10.1186/s40594-019-0192-1.National Science Board (2022). The State of U.S. Science and Engineering 2022. *National Science Foundation*. Retrieved from https://ncses.nsf.gov/pubs/nsb20221/u-s-and-global-stem-education-and-labor-force/*Note.* Adapted from The State of U.S. Science and Engineering 2022, by National Science Board, 2022, National Science Foundation. Retrieved from https://ncses.nsf.gov/pubs/nsb20221/u-s-and-global-stem-education-and-labor-force/.vTABLENational Science Board (2022). The State of U.S. Science and Engineering 2022.*National Science Foundation*. Retrieved from https://ncses.nsf.gov/pubs/nsb20221/u-s-and-global-stem-education-and-labor-force/*Note.*

Adapted from The State of U.S. Science and Engineering 2022, by National Science Board, 2022, National Science Foundation. Retrieved from https://ncses.nsf.gov/pubs/nsb20221/u-s-and-global-stem-education-and-labor-force/.

22. TABLENational Science Board (2022). The State of U.S. Science and Engineering 2022. *National Science Foundation*. Retrieved from https://ncses.nsf.gov/pubs/nsb20221/u-s-and-global-stem-education-and-labor-force/*Note.* Adapted from The State of U.S. Science and Engineering 2022, by National Science Board, 2022, National Science Foundation. Retrieved from https://ncses.nsf.gov/pubs/nsb20221/u-s-and-global-stem-education-and-labor-force/.
23. 21st Century Skills: Key Competencies for Modern Education [FIGURE]. (2025). Retrieved from https://www.panoramaed.com/hs-fs/hubfs/everett-21st-century-skills.png?width=559&name=everett-21st-century-skills.png
24. Conceptual Model of 21st-Century Skills and Competencies [FIGURE]. (2025). Retrieved from https://study.com/cimages/multimages/16/450px-map_21st_century_skills_en7874314344179632086.png