PROCEEDINGS
OF
LONDON INTERNATINAL CONFERENCES

eISSN 2977-1870

# What is the current state of the Science and Technology perspectives of the STEM field and how do these two perspectives of the STEM field affect the academic pathways of students that are in the STEM field?

Ola Bassel[1]
Mehmet B. Bisen[2]

**Abstract**

This article investigates the current state of the scope of science and technology within the STEM education field. It analyzes how these viewpoints impact the educational pathways of students in the STEM field. The study introduces STEM education, emphasizing its importance in contemporary education and industry, and clarifies the importance of science and technology viewpoints. Then, the article examines the historical backgrounds, present patterns, and the impact of these viewpoints on the education curriculum and teaching. The article thoroughly examines various aspects, highlighting distinctions, similarities, and interdisciplinary methods. It provides valuable insights and suggestions for improving the STEM education curriculum. The study provides insights for effectively incorporating these viewpoints into STEM education to affect students' academic and career trajectories.

**Keywords**: STEM, education, science, technology, curriculum, development, methods, teaching patterns, trajectories, educational viewpoints, curriculum improvement

https://doi.org/10.31039/plic.2024.11.250

[1] HS of Endeavor at Austin, USA, ola.basil2007@gmail.com
[2] University of Texas, Austin, USA

# 1. Introduction

## 1.1 - History of STEM

The stem field has existed for decades, providing an academic pathway for everyone to learn in various ways. Curiosity is what helps humanity evolve, and being in a constant state of learning is the key to helping us answer that curiosity and make more room for new explorations and innovations. Socrates, the founder of Western philosophy, once said, “Wonder is the beginning of wisdom.” Due to that wisdom, STEM can keep students, teachers, and anyone partaking in STEM consistently learning, interested in the things they have learned, and providing them a desire to work towards endless opportunities. Dr. Josh Brown, PhD graduate from the University of Maryland and CEO of New York City-based Ritholtz Wealth Management, states, “Science, technology, engineering, and math (STEM) education research is a field of wide variety and unclear parameters” (Brown, 2012).

## 1.2 - Opportunities in STEM

STEM provides people with enhanced problem-solving skills, numerous career opportunities, economic benefits, and the ability to drive innovation and technological advancements that improve quality of life and societal progress. STEM allows anyone to enter the fields of science, technology, engineering, or math and gives those already in the field room for growth.

STEM, for those utilizing it to enter an academic field, offers hands-on programs and activities beyond teaching science or mathematics concepts. It helps you discover real-world applications, sparking creativity and developing crucial life skills such as media and technology literacy, productivity, social skills, communication, flexibility, and initiative. The practical nature of STEM education is a key factor in its importance, as it allows for applying theoretical knowledge to real-world situations.

## 1.3- Mission of the Article

Throughout this article, we will be taking a closer look at the science and technology perspectives of STEM to focus on the interdisciplinary connections of the science and technology of STEM and the influence of these two fields on students.

# 2. Literature Review

## 2.1 Science in Stem

### 2.1.1 - An Overview

According to the University of California, Berkeley, science is the current knowledge of the world and the process through which that knowledge is built. There isn’t one specific definition of science, but it can be described with multiple characteristics. More specifically, science in STEM aims to ensure that students can not only understand scientific books and ideas but also use what they have learned to make decisions and solve problems in their daily lives. Inquiry-based learning methods, which include active problem-solving and experimental research, are the best way to improve scientific knowledge. These methods help students understand scientific concepts better by involving them directly in the scientific

process. This makes them more interested in the material, which leads to better academic results.

Previously, science in STEM was less strong than it is now, specifically in the United States. According to Abbey Thomas, during the 1950s, science education in STEM wasn't as significant compared to other nations, such as the Soviet Union, when they created the "Sputnik 1", the first artificial Earth satellite. The U.S. realized it was falling behind and that the science education system needed to be prioritized. In 1958, the National Defense Education Act was passed by Congress, prioritizing defense education and training, introducing new audio and visual technology into American classrooms, and providing a budget of one billion dollars for science education.

Many advancements have been made in STEM, more specifically in science education. In biology, chemistry, and environmental science, the recent use of big data analytics and data science is changing research methods by making it possible to handle and analyze datasets to find new scientific discoveries. Similarly, the fields of genomics and biotechnology are transforming areas like medicine and agriculture through tools such as CRISPR, a technological tool that research scientists use to modify the DNA of living organisms, and genome sequencing, where both are increasingly being incorporated into STEM education. Synthetic biology is becoming a prominent field of research, combining the principles of biology with engineering and computer science to construct new biological systems that have applications in various fields, such as healthcare. Overall, it is recognizable that incorporating technology and engineering into science has been a recent trend that elevates education and research in STEM.

### 2.1.2 - A Deeper Analysis

According to Grand Canyon University, the science sector in STEM refers to formal sciences and natural sciences. It includes subjects such as biology, chemistry, and environmental science, and formal sciences include statistics and mathematics. The key characteristics that define science in STEM are critical thinking, problem-solving, and research. Each characteristic is crucial in the STEM education system and ensures learners' understanding and development. Critical thinking helps students make informed decisions, analyze data, and evaluate hypotheses.

In contrast, problem-solving can help students generate innovative solutions and apply theoretical knowledge to real-world situations. Research is one of STEM's most important science factors because it is an opportunity for development and discoveries. Research skills are fundamental for conducting experiments, reviewing literature, and effectively communicating findings, which are vital for advancing scientific knowledge.

The influence of science in STEM has evolved, with a significant shift in science education away from standard memorization and towards inquiry-based learning. This shift, where students take an active role in the scientific method, is an exciting development. It fosters critical thinking, problem-solving, and the application of scientific ideas to real-world issues and enhances students' understanding and interest in science.

In STEM education, academic pathways that focus on science give students a structured way to learn the skills and information they need for jobs in science areas. At the University of

Colorado Boulder, a program called "NSF's Creating Academic Pathways in STEM" (CAPS) helps community college students and teachers by giving them research opportunities and putting these experiences into a bigger picture of career and educational development. The program ensures students can easily move from two-year to four-year colleges to be ready for further education and careers in STEM.

## 2.2 Technology in STEM

### 2.2.1 - An Overview

The use of technology and technological advancements in education has shown unimaginable growth in the last century. At first, the focus was on the fundamentals of scientific principles and everyday usage. And as time passed by, technology had many breakthroughs such as the internet, computers, smartphones, etc., two fields of technology that were mainly affected by these technological breakthroughs were computing and electronics. After undergoing years of growth, technology was making its way into the education system, and the inclusion of technology introduced many new opportunities in the education field, especially STEM.

Technology has shaped who we are. Dr. Akgun, a graduate of the Institute of Educational Sciences, Ankara University, states, “Technology, driven by human genius and creativity, aims to make the lives of people easier by solving problems, and offers a more efficient and productive life” (Akgun, 2013). As humans, we use technology daily, and most of us use it more than we don’t, but it wasn’t always like that. The more you go back in time, the less technology we have. We humans created the current rapidly growing technology that we have. It was designed to make our lives easier and help us develop greater communities.

The STEM field is currently distinguished by many technological advancements and cutting-edge technology, and some examples of these are robotics, virtual reality, and technological equipment (phones, laptops, etc.). Robotics, artificial intelligence, and data science are some technological fields that are becoming important elements in STEM. Organizations such as EdTech have utilized this technology and transformed classroom settings by introducing resources such as virtual labs, coding platforms, and interactive simulations. These technological investments have also been increasing emphasis on practical use cases such as developing problem-solving abilities and using project-based learning methods to equip students with the necessary skills for the requirements of the contemporary labor market.

### 2.2.2 - A Deeper Analysis

Technology in STEM refers to the tools, platforms, and methodologies to enhance learning and teaching processes. Key characteristics of technology in education include Interactivity, Flexibility, and Accessibility. These key characteristics are illustrated through computer softwares, artificial intelligence platforms, robotics and coding, and digital simulations. Let's take a closer look at what these key characteristics really are:

a. Interactivity

    i. The primary aim of technology in STEM is to captivate students by utilizing interactive tools. This covers activities from basic instructional games to complex virtual reality (VR) environments. Having interactive activities enriches the learning experience by allowing

students to constantly be active in their education instead of passively absorbing information.

b. Flexibility

i. Technology in STEM aims to cater to each student's learning pace, a goal facilitated by artificial intelligence (AI). AI-powered platforms can assess a student's performance in real-time and adjust the difficulty of assignments or recommend resources based on the student's specific needs. This adaptability ensures that every student can progress, regardless of their initial skill level. Accessibility

c. Accessibility

i. Accessibility is another major aim of technology in STEM. Ensure that all students have access to learning, no matter their challenges or the location where they are trying to learn. Online platforms, digital textbooks, and virtual classrooms make education easier for everyone by letting anyone get good knowledge anytime and anywhere. Promoting educational equality is crucial because it makes sure that all students have the possibility of growth and room for improvement.

In the modern-day STEM field, specialized pathways focus on technology, such as Computer Science and Engineering, Robotics and automation, data science and analytics, cybersecurity, and bioinformatics. These pathways concentrate on programming, engineering systems, writing code, understanding the ideas and methods used to build, put together, and run robots and automated systems, understanding the concept behind collecting data, protecting themselves from harmful cyber threats, and more. These pathways prepare students for jobs in the technology field, providing them with the necessary knowledge, experience, and opportunities to work with professionals in their pathway.

## 3. Limitations

This study has potential limitations. The first limitation is that the data and the analysis are mainly focused on the Western education systems of the world, primarily the USA, which may only partially capture the global diversity of STEM. The second limitation is the skyrocketing growth of STEM. The STEM field evolves at such a pace that it is difficult to keep the educational data used to analyze up to date, affecting the study's relevance over time. Future research should include a more holistic approach by gathering global data on STEM and analyzing that scale.

## 4. Conclusions

In conclusion, science and technology are critical in the STEM field and a student’s academic pathway. By taking a close look at the historical growth, trends, educational practices, and opportunities provided by STEM, we can confidently conclude that the science and technology perspectives of STEM are root materials that give the STEM program the ability

to drive students' innovation, enhance their critical thinking abilities, and provide various and diverse opportunities. Integrating technology in STEM improves the interactiveness and flexibility of STEM and student learning and is the main source behind the opportunities STEM can provide with advanced technological equipment. Additionally, science in STEM emphasizes inquiry-based learning and increases student engagement and performance. The variety of new studies the science perspective provides helps students narrow down their interests and use technology to reach new heights. To maximize these enhancements, the STEM curriculum constantly evolves to incorporate the newer findings, ensuring students are well-prepared for future challenges and opportunities.

## References

Akgun, O. E. (2013). Technology in STEM Project-Based learning. In *SensePublishers eBooks* (pp. 65–75). https://doi.org/10.1007/978-94-6209-143-6_8

Brown, J. (2012, October 29). *The current status of STEM education research*. https://www.jstem.org/jstem/index.php/JSTEM/article/view/1652

Gcu. (2019, November 21). What are STEM degrees? *GCU*. https://www.gcu.edu/blog/engineering-technology/what-are-stem-degrees

*Janet Yowell*. (2019, May 2). Creating Academic Pathways in STEM (CAPS). https://www.colorado.edu/stempathways/janet-yowell

Jia, F., Sun, D., & Looi, C. (2023). Artificial Intelligence in Science Education (2013–2023): Research trends in ten years. *Journal of Science Education and Technology*, *33*(1), 94–117. https://doi.org/10.1007/s10956-023-10077-6

Kennedy, T. J., & Odell, M. R. L. (n.d.). *Engaging students in STEM education.* https://eric.ed.gov/?id=EJ1044508

Margot, K. C., & Kettler, T. (2019). Teachers' perception of STEM integration and education: a systematic literature review. *International Journal of STEM Education*, *6*(1). https://doi.org/10.1186/s40594-018-0151-2

Oschepkov, A. A., Kidinov, A. V., Babieva, N. S., Vrublevskiy, A. S., Egorova, E. V., & Zhdanov, S. P. (2022). STEM technology-based model helps create an educational environment for developing students' technical and creative thinking. *Eurasia Journal of Mathematics Science and Technology Education*, *18*(5), em2110. https://doi.org/10.29333/ejmste/12033

Roque, T. (2022, April 20). *science - Understanding Science*. Understanding Science - How Science REALLY Works. . . https://undsci.berkeley.edu/glossary/science/Yager, R. (2015, January 5). *STEM: a focus for current science education reforms*. Learning & Technology Library (LearnTechLib). https://www.learntechlib.org/p/209585/

Thomas, A. (2022, November 15). *The evolution of science education in the United States*. Ohio Energy Project. https://ohioenergy.org/the-evolution-of-science-education-in-the-united-states/

Valladares, L. (2021). Scientific literacy and social transformation. *Science & Education*, *30*(3), 557–587. https://doi.org/10.1007/s11191-021-00205-2

*What is STEM education and why is it important?* (n.d.). https://www.utep.edu/extendeduniversity/utepconnect/blog/december-2021/what-is-stem-education-and-why-is-it-important.html