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STEM Application in Education: Implication of STEM Computational Paradigm on Employment Prospects

Eboesomi Esther Bunmi[1], Ogheneruona Maria Esegbona-Isikeh[2], Victor Nosakhare Oriakhi[3] , Cynthia Abiemwense Akiotu[4], Daniel Emakporuena[5], Ugochukwu O. Matthew[6]

[1]Management Department, University of Huddersfield, United Kingdom.
[2]Dept of Data Journalism Birmingham City University, United Kingdom.
[3]Robotics and Automation Department, University of Salford, United Kingdom.
[4]Financial Technology, University of Salford, United Kingdom.
[5]Udus Preeminent Global Limited, Nigeria.
[6]Computer Science Department, Federal University of Lavras, Brazil.
Corresponding Email: macdon4ru2003@yahoo.com

Abstract

The rapidly advancing fields of science, technology, engineering, and mathematics (STEM) have contributed to the largely automated diversities in educational technologies. This has impacted several industries and fundamentally changed how academic businesses are conducted. Machine learning and artificial intelligence (AI) have completely changed how services are distributed across the digital ecosystem. Base on the STEM-related technologies, the global digital economy and the educational sector are becoming increasingly computerized. Computers are extensively used as educational pedagogy tools to improve learning quality and student participation. Teachers can use computer-based audio, video, and visual aids to build lesson plans. Using Microsoft Power Point to produce and deliver electronic presentations to audiences is a great example of interactive education. These electronic presentations will be displayed on the screen with multimedia projectors in the classrooms where all students will be engaged in the modern teaching methodology. Video effects make lectures more impactful, and multimedia presentations are entertaining to watch and listen to. The use of computers in classrooms will also have an impact on teaching and learning methodologies and technological breakthroughs. Since computer technology now integrates all forms of media for interactive interaction, it has seen advances in all aspects of human managing responsibility. By employing ChatGPT as a writing coach, students can improve their written communication abilities. With ChatGPT, students can write essays, reports, or creative works by creating outlines, receiving feedback on their drafts, and refining their language and style. For example, when composing a persuasive essay, a student may consult ChatGPT for guidance on how to strengthen their argument or clarify their understandings. This paper provided STEM computational view on the academic business in the ongoing educational technology extreme automation.

Key word: Computer Technology, Educational Technology, Multimedia E-Learning Education, Assistive Technology, STEM, ChatGPT , Artificial Intelligence

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1. Introduction

As the world economy changes and existing jobs are being replaced by automation while new jobs are created daily due to technological advancements, STEM is an approach to education that combines the fields of science, technology, engineering, and mathematics to foster critical thinking in educational automation(Štuikys & Burbait, 2024). As educational technology continues to evolve, so does the way students interact, connect, and study. STEM education gives students the knowledge and skill-set they need to succeed in school and beyond. Businesses and organizations have a high and increased demand for STEM skills and qualifications in order to meet the needs of a dynamic workforce centered on innovation and creativity(Abina et al., 2024). More than 75 percent of jobs in the fastest-growing industries today require STEM-trained workers(Brent, 2019). People that can adapt to a changing environment using STEM computational thinking are needed in the global workforce to be competitive. People with STEM skills are better able to adapt to the constantly changing global workplace and succeed(Achat-Mendes, Anfuso, Johnson, & Shepler, 2020). Computer advancement is leading the way into STEM innovation nowadays, as demonstrated by the rapid educational breakthroughs resulting from the expanding availability of artificial intelligence (AI), machine learning, and contemporary computing platforms and gadgets(Matthew, Kazaure, & Okafor, 2021). Important aspects of computers in the context of information management, or information communication technology (ICT), have come to light as a result of scientific and technological changes. Digital synchronization has allowed computers to impact the lives of numerous students in the most isolated communities in the world. As the number of connected devices has grown, so too has the number of users inside the communication systems, which is consistent with network reliability(Kazaure, Matthew, Okafor, & Okey, 2021),. As current mobile communication technologies (6G, 5G, 4G, and 3G) continue to progress, it is anticipated that mobile communications and device connectivity will become more prevalent in the near future under the sustainable broadband regime(Matthew, Aderinola, et al., 2023),. This device multiplicity will result in high data traffic, which has increased tremendously as a result of online education, video computing, streaming, and Internet of Things (IoT)-connected data communication services for education(Matthew, Kazaure, John, & Haruna, 2021).

A computer is a technological advancement and innovation that can do a number of human intellectual functions and is controlled by a stored software(Matthew, Kazaure, Kazaure, Nwamouh, & Chinonso, 2022). With its command interface, electronic digital circuitry, storage departments, and tiny semiconductor recording devices, this inventive device enables the logical execution of wired commands or operations in a timely manner. STEM-related innovative technologies have improved student engagement and the deployment of knowledge competencies across industries, while developments in artificial intelligence (AI) and machine learning computing have radically changed how services are distributed throughout the education digital ecosystem(Matthew, Kazaure, et al., 2024). By improving industrial ecosystem operations, research, and service delivery, artificial intelligence has completely transformed the educational system. AI, which emerged from the STEM computational paradigm, is the development of computer systems that are capable of doing activities that frequently call for human intelligence. Advances in AI software and technology, particularly deep learning algorithms, have led to a renewed and quickly growing interest in AI education(Matthew, Oyekunle, et al., 2024). With advances in artificial intelligence, machine learning, natural language processing, cloud computing, big data science, the internet of things, and instructional robots, the twenty-first century is undoubtedly the century of computing(Matthew, Bakare, Ebong, Ndukwu, & Nwanakwaugwu, 2023). Computational Thinking is widely seen as a fundamental skill for both succeeding in STEM fields and being an informed citizen in such a computing-heavy world. However, further research is needed to determine how best to incorporate various teaching modalities like lecture-based learning, project-based learning into university courses. These days, pedagogy robots are frequently utilized as a teaching medium and tool for teacher-student interactions because of their high interactivity, remarkable practicality, and particular operation results.

In the STEM computational paradigm, the 4Cs (Critical Thinking, Communication, Collaboration, and Creativity) are essential skills for students to excel in the twenty-first century education business(Zhong, Guo, Fryer, Chu, & Deng, 2024). According to(Song, Hong, & Oh, 2021), computational thinking is a way of approaching problems that applies fundamental computer science ideas to system design, problem resolution, and human behavior analysis. The author argued that basic language skills should be enhanced by computer programming techniques. Computational abilities should be incorporated into computer science topics in addition to reading and writing(Jeon, Kang, & Kang, 2024). Computer science thinking skills should be a part of everyone's talents and knowledge, not just for computer scientists looking to get inventions. In addition, computational thinking encompasses a range of skills related to problem conceptualization in addition to problem solving(Matthew, Kazaure, Kazaure, & Okafor, 2021). According to (Štuikys & Burbait, 2024) , computational thinking is the fundamental skill needed to become an educated citizen and succeed in STEM-related profession. In a rapidly changing environment, these skills give students the ability to solve issues, be creative, and communicate clearly. Teachers may greatly benefit from tools like ChatGPT as they assist their students in developing these skills as technology becomes more and more integrated into the classroom. The ways that ChatGPT assists teachers in implementing the four Cs in the classroom in the twenty-first century are examined in the remainder of this paper.

2. Research Contribution

The present generation of digital students are both accustomed to and inspired by the usage of STEM resources especially multimedia technology tools. Teachers, lecturers, and educators must thus make the most of their digital potential in order to provide the future generation of classroom engagement with learning opportunities and teaching skills. Multimedia technologies, in their most favorable forms, are a component of students' continuous stimulation, which modifies their brain architecture and influences their thought processes. The research uses an exploratory methodology to examine the potential value of ChatGPT in education. The authors review the available literature on ChatGPT, including peer-reviewed journal articles, preprints, newsletter articles, and social media posts published between December 2022 and September 2024. The authors discussed trends in computational thinking research and highlight opportunities and challenges of connecting critical thinking with STEM disciplines in education. The authors' purpose is not to provide a summary of computational thinking research. Instead, they aim to build on recent discussions about computational thinking in STEM education in three ways.

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i. Identify trends of integrating computational thinking into STEM educational discipline.
ii. Discuss opportunities and challenges to further such educational efforts through needed research and scholarship to support educational practices.
iii. Articulate not only computer science filed such AI , machine learning and natural language processing(NLP) but also other disciplines.

Comparing ChatGPT 4 and ChatGPT 5, the study compares ChatGPT 4 with the anticipated ChatGPT 5, highlighting the new features and improvements expected in the latest model. ChatGPT 5 is designed to have improved context understanding, advanced training methods, multilingual support, multimodal capabilities, and enhanced personalization. These improvements have the potential to further revolutionize the way ChatGPT is used in STEM education. The research recognizes the role of technology in achieving Sustainable Development Goal 4 (SDG 4), which aims to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all(D. O. Oyekunle, Nwaiku, et al., 2025). The authors argue that generative AI, such as ChatGPT, can be a powerful tool to achieve SDG 4 goals by providing students with personalized and innovative STEM learning experiences. The overall aim of the research is to provide insights into the transformative potential of ChatGPT in education, while acknowledging the challenges and ethical considerations associated with its implementation .The study highlights the need for further research to fully explore the capabilities of ChatGPT and its impact on STEM pedagogical practices.

3. Theoretical Framework

Developing critical thinking ability, computational power , awareness, and action is the goal of STEM education for sustainable development(Matthew & Kazaure, 2020). Science, technology, engineering, and mathematics are commonly referred to as STEM, which also refers to an educational method that uses knowledge from multiple subjects to solve real-world problems(Suh & Han, 2019). The fact that STEM fields impact national competitiveness is the primary factor behind STEM's rise to prominence in education. There is a shortage of workers in STEM disciplines as a result of college students in many developed and developing nations choosing not to major in STEM subject matters and its curriculum, despite the field's importance. In an effort to boost students' interest in STEM disciplines, educators and researchers have sought to persuade students to choose STEM majors. The fact is that the upcoming generations will face significant challenges in the twenty-first century if action are not taken towards environmental ecosystem sustainability and employment generation(Ugochukwu Okwudili Matthew, Ado Saleh Kazaure, et al., 2022). Therefore, we must ensure that they have the information and skillset necessary to address climate change-related concerns like water scarcity , food security and employment opportunities. STEM for Sustainability must be incorporated into our curricula as extensively as English and Mathematics, and this must happen in all of the nation's schools(Akudugu & Abagale, 2024). Students thus comprehend how the knowledge they have acquired in the classroom through STEM education aids in resolving issues in everyday life, and they also help to solve sustainable development goals by learning about new technologies and employment opportunities.

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With the goal of bridging the gender and digital divide in STEM education, UNESCO Member States are receiving crucial assistance in rethinking and revitalizing the STEM learning model for future generations(Sarma & Bagiati, 2021). Investing in and coordinating efforts to develop innovative educational solutions and enhance institutional and professional capabilities are crucial to achieving the 2030 Agenda, especially SDGs 4 and 9(Carpentier & Braun, 2020). The world is at the nexus of innovation and education today, and it is our shared responsibility to make sure that the upcoming generation of digital citizens is equipped with the skills necessary to succeed in this ever-changing environment. The STEM computational endeavors are the key to opening up a world of opportunities where knowledge and creativity come together to mold the brains of future manufacturers, captains of industries, leaders, and innovators. The fact that STEM education may enhance children's imaginative thinking, interdisciplinary analytical skills, and sustainable development, all of which are vital qualities they will require in the future is another reason why it should be prioritized. An interdisciplinary curriculum that integrates a variety of courses into each class is a component of STEM education(Yoon et al., 2024), (Matthew, Kazaure, & Haruna, 2020),(Ugochukwu Okwudili Matthew, Jazuli Sanusi Kazaure, et al., 2022). For instance, a teacher can use an interdisciplinary curriculum in the field of mathematics by asking students to use mathematical techniques for big data analysis to solve real-world problems like eliminating pollution and poverty.

Students employ a variety of information from subjects outside of mathematics classes, such as technology, engineering, physics, social studies, and even the arts, in this kind of project. To guarantee accessible and culturally sensitive learning that equips students for the demands of the contemporary workforce, a strong, contextually relevant STEM education system must be established. Improving teacher preparation programs, providing schools with necessary instructional materials, and closing the digital gap are important tactics(Matthew, Kazaure, Kazaure, Onyedibe, & Okafor, 2022),(Okwudili & Kazaure, 2020). These steps are essential for developing a workforce that is knowledgeable, flexible, and able to propel technological advancement and sustainable development across the continent. In order to shape Africa's STEM future and realize its full potential, innovation, entrepreneurship, and engineering are essential cornerstones. The continent can enable its fast growing youth population to achieve revolutionary digital and economic progress by cultivating a culture based on STEM-driven innovation. Partnerships with global institutions and the African diaspora may foster innovation, reduce brain drain, and retain local talent. Through the alignment of resources from governments, corporations, and international organizations, public-private partnerships can finance research, educational initiatives, and technological advancement(D. Oyekunle, Claude, Waliu, Adekunle, & Matthew, 2024),(Waliu et al., 2025). Africa can become a major participant in STEM, address regional issues, and develop capacity by bolstering science diplomacy and collaborations.

4. The Significance of Promoting Sustainability in STEM Education

Teachers must receive extra consideration in school-based initiatives to foster students' critical thinking (CT), since they must be equipped and encouraged to meet the task. It is not unexpected to learn that pre-college teachers frequently lack adequate CT knowledge and skills because CT is still relatively new in pre-college and undergraduate education(Li et al., 2020). There are numerous approaches to assist in-service teachers in learning and executing CT

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integrated curricula, depending on the subject area being integrated. Using CT concepts and techniques to improve professional development courses was the focus of one study on learning in professional development. They observed a shift in instructors' understanding of CT from general to more intricate ideas after a year-long professional development program that concentrated on applying CT principles and procedures to generate solutions. The results presented the prospect of helping teachers learn more about CT and its integration into elementary science. It is also crucial to note that, in our opinion, STEM including computer science education is particularly positioned to foster students' modes of thinking, and that CT, with its expanded conceptualization, offers a model of thinking that is significant for all students. Integrating CT into STEM disciplinary education is a relatively new issue, but it is crucial to teaching a new generation of students for the twenty-first century(D. Oyekunle, Ugochukwu, Rosa, Rodriguez, & Fatai, 2024). Like disciplinary studies, teacher education research on CT education and teacher preparation and training is still in its early stages. Researchers will need to invest time, energy, dedication, and teamwork to get enough knowledge about the particular difficulties teachers encounter and potential solutions.

Since there is little study in this field, CT has recently been seen as a trans-disciplinary thinking method with potential computational perspective, such as:

i. **Natural language processing (NLP)**: Natural language processing is the process of computationally deriving meaning from natural language, which can be displayed as spoken words, written text in a document, or visual information(Matthew, Onumaku, et al., 2024). It is possible to convert this data between languages. Named entity recognition from text and word tag recognition, such as identifying verbs or adjectives, are two examples of applications for natural language processing. It can be applied to translate documents into different languages or to transform medical data into formats that are easier to understand. To fulfill growing needs in the healthcare industry, NLP has been applied to electronic health records (EHR) to enhance genetic counselors' capabilities(Onyebuchi et al., 2024),(Onyebuchi et al., 2022).
ii. **Computer vision:** AI algorithms are used in computer vision, an interdisciplinary field that processes and analyzes images, to simulate the human visual system(Ugochukwu O Matthew, Jazuli S Kazaure, Amaonwu Onyebuchi, et al., 2021). The US Food and Drug Administration (FDA) has approved computer vision for use in certain picture recognition tasks, demonstrating the application of these AI algorithms in healthcare(Mashar et al., 2023). The automated analysis of medical imaging data from sources such as positron emission tomography (PET) scans and magnetic resonance imaging (MRI) is one of the main uses of computer vision. Algorithms can, for instance, analyze MRI cardiograms to determine how blood flows through the heart, measure and identify blood vessel blockages from coronary computed tomography angiography pictures, detect breast densities from mammography, and assist in diabetic retinopathy screening.
iii. **Virtual Reality Environment (VRE), Virtual and Augmented Reality**: Simulation has been shown to benefit nursing and medical student's at all instructional levels when it is fully integrated into the curriculum. Today's nursing educators have many

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possibilities for incorporating simulation-based learning methods into their courses(D. Oyekunle, Matthew, Waliu, & Fatai, 2024). Using computer technology, an immersive digital ecosystem of augmented reality (AR) and virtual reality (VR) is used to enhance teaching and learning in nursing education by creating a three-dimensional (3D) interactive environment that gives users a sense of spatial presence. By embracing the technological pedagogical content knowledge (TPCK) model in its core discussion and implementation, cost-effective clinical simulation laboratory for clinical students, nurses, midwives, and practicing healthcare professionals in a way that guarantees ongoing learning and occupational efficiency(Matthew, 2019),. In nursing and clinical education, the TPCK model has shown how to identify the distinctions between educational structures and technology elements, as well as how they are related while generating facts.

iv. **ChatGPT helping Teachers to implement STEM Education and infuse Critical Thinking:** Critical thinking is necessary for STEM education in order to assess evidence, examine data, and reach well-reasoned conclusions. It is a fundamental ability that supports all subject areas. ChatGPT can help educators promote inquiry-based learning, in which students are urged to pose queries, consider hypotheses, and look for answers on the relevant research areas such as nutritional assessment and health topics(D. O. Oyekunle, Esseme, et al., 2025). For instance, a teacher could use ChatGPT to come up with interesting questions about a particular subject. ChatGPT could produce questions such as "What are the most significant causes of climate change?" or "How can different countries collaborate to reduce carbon emissions?" if the class is studying climate change. Students are prompted to consider the problem critically and investigate it from several angles by these questions.

v. **Problem-Based Creativity**: ChatGPT can provide story ideas, twist in the narrative suggestions, and character development assistance for creative writing activities. This assistance broadens pupils' creative horizons by encouraging them to try out various genres and styles. ChatGPT can push students to use their imaginations to solve challenging issues. In a science class, for example, ChatGPT might suggest a task like creating a community's sustainable energy solution. Following that, students can apply their ideas and knowledge to create creative solutions.

vi. **Enhancing Peer Review and Global Collaboration:** ChatGPT can be used by teachers to facilitate peer review procedures, in which students critique one another's work. Constructive feedback prompts like "What strengths do you see in this work?" and "What areas could be improved?" can be generated with the use of ChatGPT. By using a methodical approach to peer review, students are encouraged to work together to improve each other's work and create a cooperative learning environment(Jibril et al., 2022). By removing language barriers and fostering intercultural communication, students can work on collaborative projects with classmates from around the globe by using ChatGPT's linguistic capabilities(D. O. T. Oyekunle, Okwudili Matthew, Preston, & Boohene, 2024). This global perspective increases students' awareness of various cultures and points of view while also enhancing the collaborative experience.

vii. **Facilitating Effective Communication, Writing Skills and Support for Verbal Communication:** In order to collaborate with people, share ideas, and effectively and

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clearly transmit information, communication is an essential ability(Ebong et al., 2024). ChatGPT can help students become better writers by acting as a writing coach. Students can use ChatGPT to create outlines, get comments on their drafts, and improve their language and style when they are writing essays, reports, or creative pieces. For instance, a student preparing a persuasive essay might ask ChatGPT for advice on how to make their ideas more clear or bolster their argument. By outlining important points, organizing arguments, and offering advice on successful speaking strategies, ChatGPT can assist students in getting ready for speeches, presentations, and debates. Instructors can use ChatGPT to mimic discussions or arguments, giving students a safe space to hone their verbal communication abilities.

5. Research Methodology

The author concentrated on STEM education and career prospect in the study methodology, which covers all kinds of engineering positions, information technology (IT) employment, and scientific research prospects. It also classifies some health, education, and social science courses as STEM, including veterinary medicine, psychology, EdTech, and environmental health. STEM workers can pursue a variety of careers. STEM occupations need the application of math, science, technology, and/or engineering. Mechanical engineers, math teachers, biologists, and computer programmers are a few examples of STEM occupations. As a collection of academic disciplines, STEM seeks to develop critical thinking, problem-solving, and computing abilities, among other hard and soft talents. A new analysis recently released on career performances found that 67% of U.S. jobs and 69% of the nation's gross domestic product (GDP) are supported by science, technology, engineering and mathematics professions(Carnevale, Smith, Van Der Werf, & Quinn, 2023),(Arcelus et al., 2024). According to the analysis, which was carried out by Forensics Technologies International (FTI) Consulting on behalf of ten prominent scientific, engineering, and business associations in the United States, including IEEE-USA, STEM contributes significantly to the country's economy and generates $2.3 trillion in federal tax revenue each year(Joseph, Arar, Karaburk, & Elbedour, 2023). By including qualified Americans with a range of academic backgrounds, this analysis demonstrates that STEM workers in the US represent more than just the software engineers or rocket scientists typically associated with science-driven occupations. As a result, it captures STEM professionals operating across all sectors of our economy. The analysis also highlights the importance of every institutions in supporting the STEM workforce, the advantages of sustained strong federal funding for scientific and engineering research, and how inclusive the STEM boom is in America, where 819 employments as defined by the Bureau of Labor Statistics were examined in the analysis. Of the 195.8 million jobs identified across 819 occupations, 64 million or 33% were direct high-skilled STEM professions. However, 59% of direct U.S. STEM professionals do not hold a bachelor's degree(Burke, Okrent, Hale, & Gough, 2022). The United States economy depends heavily on the STEM sectors, which account for 69% of the GDP, 67% of all jobs, and $2.3 trillion in federal tax income annually(Walters-Williams, 2023). Engineers, computer scientists, and data scientists were considered the main STEM forces behind economic growth(Vargas et al., 2023). It was discovered that a mere 1.1 percentage point increase in the proportion of engineers and computer scientists in the workforce could result in a 1.6 percentage point increase in the state's GDP in just 15 years.

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6. Data Analysis

The highest-paying STEM occupations, according to 2023 Bureau of Labor Statistics(BLS) statistics, are petroleum engineer ($135,6900), computer scientist ($145,080), and physicist (median income of $155,680)(Carnevale et al., 2023). The median yearly salary for many STEM occupations is in the six figures, making them generally profitable career choices. The National Center for Education Statistics reports that engineering and biological sciences are the most sought-after STEM majors(Sovansophal, 2020). Majors in engineering and biological sciences made up 13% of all bachelor's degrees granted in 2022(Yu, Kuncel, & Sackett, 2020). A list of all the subjects that the US Department of Homeland Security deems to be STEM is kept up to date. These encompass all things pertaining to mathematics, engineering, computers and technology, and the natural and physical sciences.

Table 1: Science Careers

Job Class	Mini Degree Required	Median Annual Salary as at May 2023	Job Growth Rate (2022-2023)
Agricultural and Food Scientist	Bachelor’s Degree	$76,400	6%
Astronomer	Doctoral Degree	$127,930	50%
Atmospheric Scientist	Bachelor’s Degree	$92,860	4%
Chemical Technician	Associate Degree	$56,750	3%
Environmental Scientist	Bachelor’s Degree	$78,980	6%
Epidemiologist	Master Degree	$81,390	27%
Medical Scientist	Doctoral Degree	$100,890	10%
Nuclear Technician	Associate Degree	$101,740	-1%
Physicist	Doctoral Degree	$155,680	%5
Zoologist and Wildlife Biologist	Bachelor’s Degree	$70,600	3%

Source: Bureau of Labor Statistics (BLS) statistics, 2023.

Table 2: Technology Careers

Job Class	Mini Degree Required	Median Annual Salary as at May 2023	Job Growth Rate (2022-2023)
Computer and Information Scientist	Master’s Degree	$145,080	23%
Computer Network Architect	Bachelor’s Degree	$129,840	4%
Computer Programmer	Bachelor’s Degree	$99,700	-11%
Computer Support Specialist	High School Diploma or Associate Degree	$60,810	5%
Computer Systems Analyst	Bachelor’s Degree	$103,800	10%
Database Administrator	Bachelor’s Degree	$101,510	7%
Database Architect	Bachelor’s Degree	$134,700	10%
Information Security Analyst	Bachelor’s Degree	$120,360	32%
Software Developer	Bachelor’s Degree	$132,270	26%
Web Developer	Bachelor’s Degree	$84,960	17%

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Source: Bureau of Labor Statistics (BLS) statistics , 2023.

Table 3: Engineering Careers

Job Class	Mini Degree Required	Median Annual Salary as at May 2023	Job Growth Rate (2022-2023)
Aerospace Engineer	Bachelor's Degree	$130,720	6%
Chemical Engineer	Bachelor's Degree	$112,100	8%
Civil Engineer	Bachelor's Degree	$95,890	5%
Electrical Engineer	Bachelor's Degree	$106,950	4%
Environmental Engineer	Bachelor's Degree	$100,090	6%
Industrial Engineer	Bachelor's Degree	$99,380	12%
Marine Engineers and Naval Architect	Bachelor's Degree	$100,270	1%
Mechanical Engineer	Bachelor's Degree	$99,510	10%
Nuclear Engineer	Bachelor's Degree	$125,460	1%
Petroleum Engineer	Bachelor's Degree	$135,690	2%

Source: Bureau of Labor Statistics (BLS) statistics , 2023.

Table 4: Math Careers

Job Class	Mini Degree Required	Median Annual Salary as at May 2023	Job Growth Rate (2022-2023)
Actuary	Bachelor's Degree	$120,000	23%
Data Scientist	Bachelor's Degree	$108,020	35%
High School Math Teacher	Bachelor's Degree	$65,220	1%
Math Professor	Doctoral Degree	$81,020	3%
Mathematician	Master's Degree	$116,440	2%
Operation Research Analyst	Bachelor's Degree	$83,640	23%
Statistician	Master's Degree	$104,110	32%

Source: Bureau of Labor Statistics (BLS) statistics, 2023.

7. Discussion of Research Findings

In order to investigate the occupations of STEM graduates, the authors of this study examined several data sources, refer to **Table 1-Table 4**. For comparative purposes, we also examined data on non-STEM graduates, even though our primary focus was STEM career. In the STEM labor market, we looked at historical trends, longer-term career trajectories, and professional destinations soon after graduation. While there is no direct way to quantify the demand for STEM personnel, such as by looking at open positions, we have periodically used trends in the STEM labor market and the paths taken by STEM workers and graduates to draw conclusions about demand. Using the finest available data, this study aimed to comprehend the general trends in long-term engagement in STEM sector occupations. We are constrained by the

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caliber and extent of the data at our disposal, as is the case with every inquiry of this kind. The total percentage of STEM and non-STEM graduates starting graduate-level positions soon after graduating from college showed little variation.

Historically, the yearly unemployment rate for STEM workers has been lower than that of the labor force as a whole(Sargent Jr, 2017). The BLS indicates that while unemployment rates were very high for all groups after the Great Recession (2007–2009), STEM workers' unemployment rates were consistently lower than those of the general and non-STEM labor sectors(Noonan, 2017). From **Figure 1,** unemployment rates decreased by 2019 for all broadly defined occupational groupings, but they were lowest for workers with a bachelor's degree or more (2.3%) and those in the STEM field (2.2%)(Steinberg, 2024). The highest unemployment rates were found among non-STEM workers (3.6%) and workers in the overall labor force (3.7%).

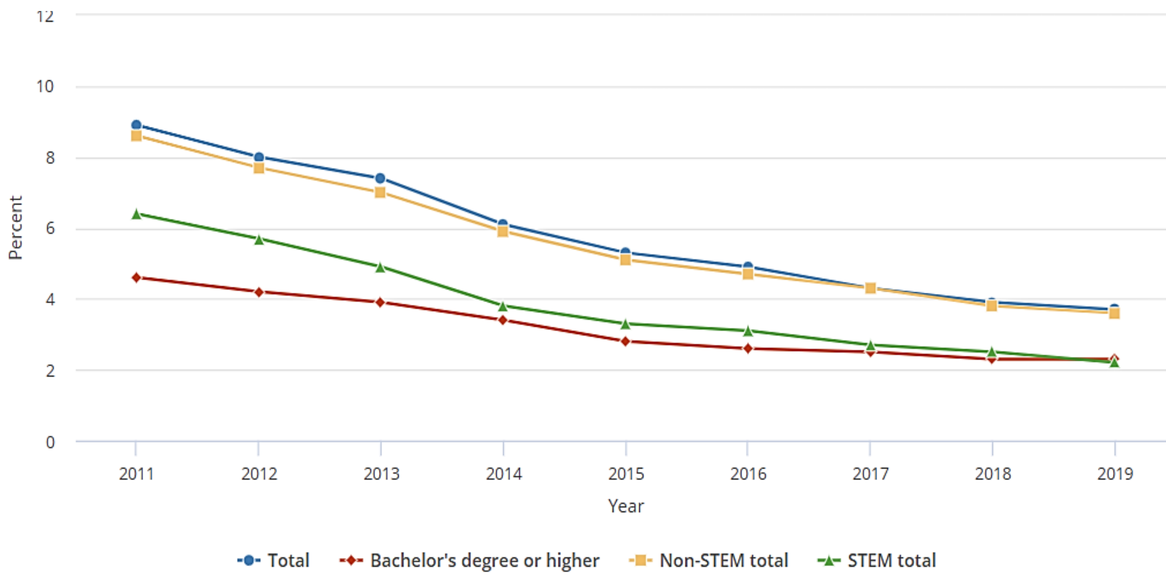

Figure 1, STEM Labor Force of Today-Scientists, Engineers, and Skilled Technical Workers: Unemployment rate in each workforce: 2011–2019(Okrent & Burke, 2021).

Across all educational levels, the STEM workforce generally had lower unemployment rates than their non-STEM counterparts(Smith & White, 2019). Over the course of the decade, the rates for STEM workers with a bachelor's degree or above were lower than those for non-STEM workers with a bachelor's degree. The National Survey of College Graduates (NSCG) also shows that unemployment rates for workers with a bachelor's degree or more differed by degree level and among main occupational categories. For instance, people who had a doctorate or professional degree as their highest degree were typically less likely to be unemployed than people who had only a bachelor's degree. In comparison to their non-STEM peers, the STEM workforce with no bachelor's degree had lower rates. Jobs requiring technological skills and expertise were quite strong, as seen by the fact that 2.8% of STEM workers without a bachelor's degree, were unemployed in 2019 compared to 4.3% of non-STEM workers without a bachelor's degree in Figure 2.

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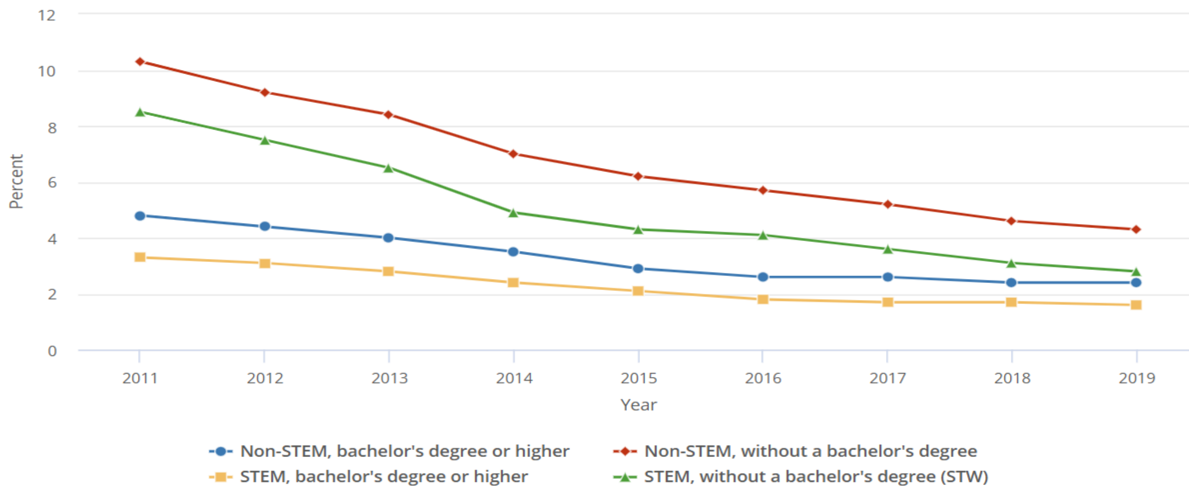

Figure 2, Unemployment rate in each workforce, by degree attainment: 2011–2019(Smith & White, 2019),(Okrent & Burke, 2021).

Occupational earnings enable people to maintain themselves and their families and contribute to the economy sustainability. As shown in Figure 3, the median salary for STEM professionals is higher than that of their non-STEM colleagues ($55,000 against $33,000). The median wage for STEM workers with a bachelor's degree or above is 47% more than that of STEM workers without a bachelor's degree. Compared to non-STEM workers without a bachelor's degree makes 60% more at the median.

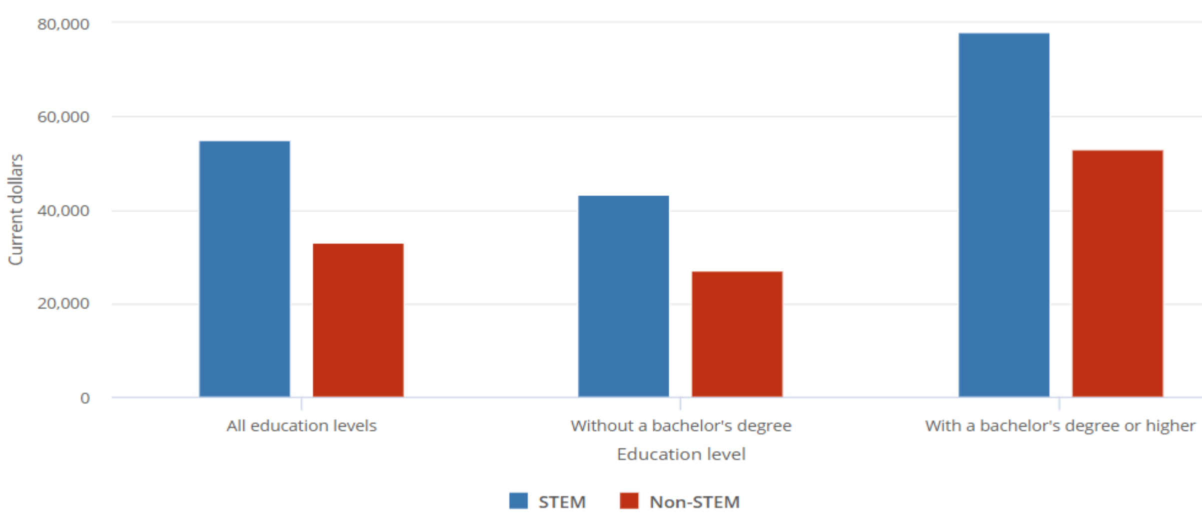

Figure 3, Median salaries, by workforce and education level – 2019(Okrent & Burke, 2021).

The Sustainable Development Goals (SDGs), especially SDG 9 (Industry, Innovation, and Infrastructure), SDG 4 (Quality Education), SDG 3 (Good Health and Well-Being), and SDG 13 (Climate Action), are largely dependent on technology with emphasis on STEM education(Leal Filho et al., 2022). Through boosting economic development, decreasing inequality, improving access to essential services, and advancing sustainability, technology's revolutionary potential can

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hasten the achievement of all the SDGs(Ugochukwu O Matthew, Jazuli S Kazaure, Ado Saleh Kazaure, et al., 2021). Technology, especially information and communication technology (ICT), is a major facilitator of infrastructural development and industrial innovation under SDG 9(Matthew et al., 2020). Through increasing productivity, generating employment, and encouraging entrepreneurship, ICT has the potential to propel economic growth(Gumel, Abdullahi, & O, 2019). Additionally, by supporting the shift to smart manufacturing and circular economy models, it can help make industries more sustainable. Technology can significantly improve access to high-quality education in relation to SDG 4. Geographical distance, socioeconomic class, and physical limitations are only a few of the obstacles to education that can be overcome by digital technology, such as e-learning platforms. By facilitating individualized, student-centered learning experiences, they can also improve the educational process. Regarding SDG 3, health outcomes are significantly impacted by technology. Healthcare delivery has been transformed by medical technologies, ranging from basic tools to digital health technology that can improve patient outcomes, lower healthcare costs, and increase access to health services(Ugochukwu O Matthew, Jazuli S Kazaure, Onyebuchi Amaonwu, et al., 2021).
Regarding SDG 13, technology provides effective instruments for climate change adaptation and mitigation. But the advantages of technology are not always immediate, and there are many obstacles to overcome, such as the STEM digital divide, cybersecurity risks, and moral dilemmas pertaining to data ownership and privacy. Therefore, to guarantee that technology promotes sustainable development and does not worsen inequality, legislative interventions and multi-stakeholder partnerships are required.

8. Conclusion

As demonstrated in the last section, technology is clearly important in all facets of life, but it is especially important in professions that involve direct interaction with STEM. Future work learning is significantly impacted by the technology skills that are taught in the classroom. After mastering these skills, people are impressed by the ability to think critically and thoroughly about workplace issues and their particular roles in creating corporate cultures while adding value to the products or services a company provides to the community or the world. In the context of global sustainable education, technology is never neutral in terms of ideology. It illustrates and emphasizes particular worldviews and signifies particular ways of knowing and thinking. This holds true for new generative AI tools and models as well. With each iteration of AI models, generative AI is expanding the range of what educational technology and robots can accomplish at a rate never seen before. New industries are often born as a result of technology midwifed by STEM computational paradigm. The emergence of the internet, for example, not only transformed already-existing industries but also gave rise to brand-new ones like social media, e-commerce, and cybersecurity. In consequence, these sectors create a variety of previously unattainable job opportunities. Technological developments have continuously raised living standards and stimulated economic expansion by creating more employment than they have destroyed. Society can fully utilize technology to build a prosperous and inclusive future for all workers by establishing a culture of lifelong learning and implementing policies that promote STEM education.

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