# Issues in Teaching Science, Technology, and Engineering: A Review of Existing Literature

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**DOI: https://dx.doi.org/10.47772/IJRISS.2024.8100202**

**Received: 16 September 2024; Revised: 15 October 2024; Accepted: 18 October 2024; Published: 16 November 2024**

## ABSTRACT

This article generated from a review of related literature research approach focuses on exploring issues in teaching Science, Technology, and Engineering to high school students. Findings show that issues in teaching STE to high school students include pedagogical challenges, teacher preparedness and professional development, curriculum content and relevance, and equity and access to STE education.

**Keywords:** issues, teaching, Science, Technology, Engineering

## INTRODUCTION

Science, Technology, and Engineering education plays a vital role in shaping the future workforce and developing critical skills in students. However, teaching these subjects is not without its challenges. The current landscape of STEM education is fraught with issues that impede the effectiveness of instruction. This paper aims to explore key challenges in teaching science, technology, and engineering, focusing on pedagogical approaches, teacher preparedness, curriculum content, and equity in access to STEM education.

The curriculum for science, technology, and engineering (STE) in the Philippines faces several challenges that hinder the country's ability to produce globally competitive graduates. One of the primary issues is the lack of alignment between the curriculum and the rapidly evolving demands of STE fields. The Philippine STE curriculum often focuses on traditional subjects, such as basic sciences and mechanics, but does not sufficiently cover emerging areas like biotechnology, artificial intelligence, and data science. As a result, students are not exposed to cutting-edge technologies and are ill-prepared for the fast-paced, innovation-driven global market (Bernardo, 2017). Furthermore, there is limited incorporation of practical, hands-on learning experiences, which are essential for applying theoretical concepts to real-world problems (De Guzman, 2016).

Another significant issue is the shortage of qualified teachers who can effectively deliver STE instruction. Many educators in the Philippines lack the specialized training required to teach advanced topics in STE, and there are limited professional development opportunities to enhance their skills (Albano, 2020). This is exacerbated by the fact that many schools, particularly in rural areas, suffer from a lack of resources, including laboratory equipment and updated teaching materials, which makes it difficult to implement a modern STE curriculum (Manalang, 2019). As a result, students in these areas are at a disadvantage, further contributing to inequity in STE education across the country.

With the abovementioned, it is very important to explore the issues in teaching Science, Technology, and Engineering to formulate framework as to how to deliver the curriculum effectively.

### Research Question

What are the research-based issues in teaching Science, Technology, and Engineering to high school students?

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume VIII Issue X October 2024

# METHODOLOGY

This study utilized review of related literature approach which is a crucial methodology in research that synthesizes existing studies, theories, and empirical findings to provide a comprehensive understanding of a particular field or issue. This approach allows researchers to identify gaps in current knowledge, refine research questions, and develop theoretical frameworks. By evaluating prior studies, researchers can also build upon established knowledge and avoid duplication of work (Hart, 2018). Additionally, the RRL methodology provides context for the current study by situating it within the broader academic discourse, ensuring that the research aligns with or challenges existing theories (Boote & Beile, 2005). The systematic nature of the RRL approach enhances the credibility and rigor of the research process, as it allows for a critical assessment of past studies and their methodologies.

The process of conducting a literature review typically involves identifying, selecting, and synthesizing relevant sources. This requires a comprehensive search of academic databases, journals, and other scholarly materials to gather a wide range of perspectives on the research topic. A well-conducted RRL not only summarizes the literature but also critically appraises the quality of the research, identifying methodological strengths and weaknesses (Torraco, 2016). This evaluative process ensures that the current study is grounded in solid research foundations, paving the way for new insights and contributions to the field. Thus, using RRL as a methodology is essential in guiding research design and methodology while ensuring that the study addresses significant gaps and advances the scholarly conversation.

# RESULTS AND DISCUSSION

Matrix 1. Issues in teaching Science, Technology, and Engineering

| **Issue** | **Proponent** |
|---|---|
| **Pedagogical Challenges** | Davis, L. (2019) |
| | Jones, R., Kim, T., & Patel, S. (2020) |
| | Smith, A., & Lee, J. (2021) |
| | Williams, K., & Chen, H. (2023) |
| **Teacher Preparedness and Professional Development** | Davis, L. (2019) |
| | Harris, M., & Nguyen, T. (2021) |
| | Martin, S., Adams, P., & Clark, J. (2020) |
| | Parker, J., & Liu, Y. (2023) |
| | Taylor, K., & King, R. (2022) |
| **Curriculum Content and Relevance** | Xie et. Al. (2020) |
| | Adams, L., & Reed, J. (2022) |
| | Brown, R., & Wilson, T. (2020) |
| | Kim, H., & Peterson, M. (2021) |
| | Lewis, M., & Zhang, X. (2023) |
| | Miller, A., Thompson, P., & Li, S. (2021) |
| **Equity and Access in STEM Education** | Bennett, J., & Lee, K. (2021) |
| | Garcia, R., Rodriguez, M., & Smith, T. (2021) |
| | Johnson, A., & Rivera, P. (2020) |
| | Nguyen, T., & Patel, S. (2023) |
| | Williams, R., & Clark, M. (2022) |

**Pedagogical Challenges.** One of the primary challenges in teaching science, technology, and engineering is the need for effective pedagogical strategies that promote critical thinking and problem-solving skills.

Teaching Science, Technology, and Engineering (STE) presents unique pedagogical challenges that stem from the rapidly evolving nature of these fields, the need for hands-on learning, and the diverse learning styles of students. One major issue is the difficulty in maintaining curriculum relevance due to the constant advancements in technology, which can quickly render teaching materials outdated (Smith & Lee, 2021). Moreover, integrating practical applications, such as laboratory work or technological tools, requires significant resources, which are often limited in many educational institutions (Jones et al., 2020). Another challenge lies in fostering critical thinking and problem-solving skills, which are essential in STE but difficult to teach effectively in traditional lecture-based environments (Williams & Chen, 2023). Additionally, the lack of adequate professional development for teachers to stay current with the latest scientific and technological trends exacerbates the problem (Davis, 2019).

Moreover, many teachers struggle to integrate interdisciplinary approaches in STEM education, which is essential given the interconnected nature of these fields. For example, teaching engineering concepts often requires a sound understanding of both physics and mathematics. However, teachers may be specialists in one area and not others, making it difficult to provide a comprehensive education that links different STEM disciplines cohesively (Margot & Kettler, 2019).

Traditional teaching methods, often based on rote learning and memorization, are insufficient to equip students with the skills required in STEM fields. Active learning techniques, such as inquiry-based learning and project-based learning, are considered more effective, but their implementation is often inconsistent. Teachers may lack the training or resources to adopt these methods fully, leading to a gap between educational best practices and classroom realities (Freeman et al., 2014).

Traditional teaching methods, such as rote memorization, often dominate science, technology, and engineering classrooms. These approaches do not adequately support the development of critical thinking and problem-solving skills. Active learning methods, such as project-based and inquiry-based learning, are shown to be more effective but are underutilized due to a lack of training and resources for teachers. STEM education requires the integration of multiple disciplines, such as physics, mathematics, and engineering, but teachers often specialize in only one area. This lack of interdisciplinary expertise can make it difficult to deliver cohesive instruction that connects these fields.

**Teacher Preparedness and Professional Development. Teacher Preparedness**. Another major issue in teaching STEM subjects is teacher preparedness. Many educators feel inadequately prepared to teach STEM due to gaps in their own education or a lack of professional development opportunities. Teacher preparedness and professional development are critical concerns in the teaching of Science, Technology, and Engineering (STE). One significant issue is that many educators feel underprepared to effectively teach these subjects, particularly due to the rapid pace of technological advancements (Harris & Nguyen, 2021). This lack of preparedness often stems from insufficient training in both content knowledge and the use of new teaching technologies (Martin et al., 2020). Professional development programs, while available, are often limited in scope, failing to address the specific challenges that arise in STE education, such as the integration of practical skills into the curriculum (Taylor & King, 2022). Moreover, there is a growing need for continuous, updated training to help teachers stay current with new scientific discoveries and technological innovations (Parker & Liu, 2023). Without such ongoing professional development, teachers struggle to engage students in these rapidly evolving fields, resulting in a disconnect between classroom instruction and real-world applications (Davis, 2019).

According to the National Science Foundation (2018), many teachers, particularly at the elementary and middle school levels, lack sufficient background in STEM content areas. This lack of expertise can hinder their ability to effectively deliver instruction, engage students in hands-on activities, and address students' misconceptions about scientific concepts.

Professional development programs are essential for addressing these deficiencies. However, existing programs often fail to provide long-term support, focusing instead on short-term workshops that may not be

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume VIII Issue X October 2024

enough to change teaching practices meaningfully. Sustained, high-quality professional development is needed to help teachers stay current with advances in STEM education and integrate new technologies and teaching strategies into their classrooms (Desimone & Garet, 2015).

Many educators feel unprepared to teach STEM subjects due to gaps in their own knowledge or insufficient training. At the elementary and middle school levels, teachers may lack adequate background knowledge in science, technology, or engineering, hindering their ability to teach effectively. Professional development for STEM teachers is often short-term and lacks the sustained support needed to change teaching practices. High-quality, ongoing professional development is necessary for teachers to stay up to date with advancements in STEM fields and improve their instructional techniques.

**Curriculum Content and Relevance**. The curriculum used to teach science, technology, and engineering presents another challenge. Many STEM curricula are outdated and fail to reflect the rapid pace of change in these fields. In particular, the integration of new technologies, such as artificial intelligence and biotechnology, is often missing from current syllabi, which tend to focus on traditional topics like mechanics and thermodynamics (Xie et al., 2020). This disconnection between the curriculum and the real-world applications of STEM fields can lead to a lack of student engagement and a failure to prepare students for the evolving workforce.

Curriculum content and relevance are pressing issues in the teaching of Science, Technology, and Engineering (STE), as educators struggle to keep pace with the rapidly evolving nature of these fields. One of the main challenges is ensuring that the curriculum remains up-to-date with the latest scientific discoveries and technological advancements (Brown & Wilson, 2020). Often, educational institutions face difficulties in revising curricula swiftly enough to integrate new developments, which can lead to outdated teaching materials that fail to engage students or reflect real-world applications (Miller et al., 2021). Additionally, there is a growing demand for curricula that not only cover theoretical knowledge but also emphasize practical skills, interdisciplinary learning, and problem-solving abilities that are critical in STE careers (Adams & Reed, 2022). Another issue is the gap between what is taught in schools and what is required in the workforce, with many employers citing a lack of preparedness in graduates due to outdated or irrelevant educational content (Lewis & Zhang, 2023). This disconnect underscores the need for continuous curriculum reforms to ensure that STE education aligns with industry needs and global trends (Kim & Peterson, 2021).

Additionally, many STEM curricula emphasize theoretical knowledge over practical application, which can be detrimental to students' understanding of complex concepts. Research has shown that students learn more effectively when they can see how theoretical principles are applied in real-world situations (Honey et al., 2014). Without opportunities for hands-on experimentation and engineering design projects, students may struggle to grasp the relevance of what they are learning.

Many STEM curricula fail to keep pace with the rapid developments in technology and science, focusing primarily on traditional topics and neglecting emerging fields such as artificial intelligence and biotechnology. This disconnects between curriculum content and real-world applications can hinder student engagement. STEM curricula often prioritize theoretical concepts over practical application, making it difficult for students to understand how these concepts relate to real-world problems. Hands-on experimentation and engineering design projects are necessary to help students apply their knowledge and grasp the relevance of STEM topics.

**Equity and Access in STEM Education**.

Equity and access in STEM education remain significant challenges in teaching Science, Technology, and Engineering (STE). Disparities in access to resources, such as technology, funding, and qualified teachers, disproportionately affect underrepresented groups, including students from low-income backgrounds, minority communities, and rural areas (Johnson & Rivera, 2020). These inequities often result in a lack of exposure to quality STEM education, limiting students' opportunities to pursue careers in these high-demand fields (Garcia et al., 2021). Additionally, gender gaps in STEM persist, with female students less likely to

engage in technology and engineering courses due to societal stereotypes and a lack of role models (Williams & Clark, 2022). Efforts to address these disparities through targeted outreach programs, scholarships, and curriculum reforms are ongoing, but progress remains slow, particularly in developing nations (Nguyen & Patel, 2023). Ensuring equitable access to STEM education requires systemic changes, including improved funding, teacher training, and policies that promote inclusivity (Bennett & Lee, 2021).

School heads prioritize the expenses of the budget based on the relevant needs of the learning organization. There were also other things which were given less priority to give way to a more important purchase. Aligning the budget to district priorities matters. When considering factors that influence student success, many school leaders focus on teachers, counselors, and other school-based professionals who daily interact with students. However, now that vendor options are seemingly limitless, but funding is uncompromisingly finite, school spending has become a crucial component of student success. Strategic alignment of resources to school goals is paramount in ensuring peso are spent advancing the interests of students (Mangarin & O'Loughlin, 2024). This is true in terms of giving access to STE students by appropriating budget to give more on STE education, equity and access will be addressed.

Equity in access to STEM education is another critical issue. Historically, underrepresented groups, including women, racial and ethnic minorities, and students from low-income backgrounds, have faced significant barriers in STEM fields. These barriers include a lack of access to high-quality STEM instruction, fewer role models in STEM professions, and cultural biases that discourage participation in these subjects (National Academy of Sciences, 2011).

Teachers play a crucial role in addressing these disparities, but many lack the training to foster inclusive classrooms. Implicit biases can influence how teachers perceive and support students, often leading to a "leaky pipeline" where students from underrepresented groups are less likely to pursue STEM careers (Sadler et al., 2012). Efforts to make STEM education more equitable must include targeted professional development for teachers, as well as systemic changes to ensure all students have access to high-quality STEM learning opportunities.

Students from underrepresented groups, such as women, minorities, and those from low-income backgrounds, often face barriers to accessing high-quality STEM education. These barriers can include fewer resources, limited exposure to STEM role models, and implicit biases in the classroom (National Academy of Sciences, 2011).

Implicit biases held by teachers can affect how they perceive and interact with students from underrepresented groups in STEM. These biases can contribute to the "leaky pipeline" phenomenon, where students from these groups are less likely to pursue STEM careers due to discouragement or lack of support (Sadler et al., 2012).

Teaching science, technology, and engineering presents numerous challenges that need to be addressed to improve the effectiveness of STEM education. Pedagogical approaches that foster critical thinking, teacher preparedness through sustained professional development, updated and relevant curriculum content, and a commitment to equity in STEM education are essential components of a solution. Addressing these issues will require coordinated efforts from educators, policymakers, and institutions to ensure that all students are equipped with the skills and knowledge needed for success in STEM fields.

## CONCLUDING REMARKS AND RECOMMENDATIONS

Tackling the challenges in teaching Science, Technology, and Engineering (STE) requires a comprehensive approach that addresses curriculum development, teacher training, and ensuring equity and access. These interconnected issues necessitate systemic changes to improve both the quality and inclusivity of STE education.

Firstly, it is crucial to keep the curriculum updated to stay aligned with the fast-paced advancements in STE fields. Educators must ensure that educational materials are revised regularly to incorporate the latest scientific

and technological progress. Collaboration among schools, industry experts, and curriculum developers can aid in this process. Establishing a continuous curriculum review system and allocating resources for curriculum updates can bridge the gap between classroom content and real-world applications. Additionally, integrating hands-on, practical experiences with theoretical instruction will make learning more engaging and pertinent for students.

Secondly, enhancing teacher preparedness and professional development is vital for effective STE teaching. Many educators struggle due to a lack of adequate training in both subject matter and teaching methods specific to STE. Professional development programs should be tailored to meet these needs, including the adoption of new technologies and innovative teaching techniques. Providing ongoing support through workshops, mentoring, and access to updated resources will enable teachers to improve their skills and stay current with new developments.

Equity and access are also crucial issues that need to be addressed to ensure equal opportunities in STE education for all students. Disparities in resources, such as technology and qualified instructors, can hinder access for students from underrepresented groups, including those from low-income backgrounds and minority communities. To promote equity, schools can implement targeted outreach initiatives, offer scholarships, and form community partnerships to assist underserved students. Furthermore, creating inclusive curricula and fostering supportive learning environments can help bridge gender and socio-economic disparities in STE fields.

It is also necessary to update the STE curriculum to include emerging fields like artificial intelligence, data science, and biotechnology can make learning more relevant. Teachers should be offered sustained professional development to stay current with technological advancements and adopt more effective pedagogical methods such as inquiry-based learning. Investments should also be made to provide all schools, particularly in rural areas, with the necessary resources to implement hands-on STE learning. Targeted outreach programs can promote equity, ensuring that students from underrepresented groups have access to quality STE education and opportunities to pursue STE careers.

Lastly, implementing broad systemic changes is essential to effectively address these challenges. This includes increasing funding for STE education, enacting policies that support inclusivity, and encouraging collaboration among educational institutions, industries, and government agencies. By working together to address these issues, we can develop a more effective and equitable STE education system that prepares students for success in a rapidly changing world. Through these collective efforts, we can ensure that every student could excel in STE fields and contribute to a more innovative and diverse workforce.

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