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# The Significance of STEM in Effective Teaching-Learning Process at Secondary Schools

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***Abstract***

*In this modern era, the importance of STEM in both instructors' and students' teaching and learning process has a lot of potentials. Like other developing nations throughout the world, Pakistan is in the early phases of incorporating STEM Education into the teaching and learning process at educational institutions. The study's primary focus is on STEM and the elements that influence the teaching-learning process. This was a descriptive research project. The study's sample included secondary school instructors. A questionnaire was used to collect data from 200 secondary school teachers. Data were subsequently analyzed using frequency and basic percentage statistical methods. The study's findings show that secondary teachers have a strong desire to understand the importance of STEM and how it may be integrated into the classroom. According to the results, education stakeholders should provide secondary teachers with the tools they need to maximize the benefits of STEM integrated learning and support secondary school teachers through training delivery. The study may suggest that the ministry of education allocate funding to the education department to promote and develop STEM integrated teaching and learning at the secondary level.*

**Keywords**: STEM Education, Teachers, Stakeholders, Teaching-learning Process and Secondary Schools

## Introduction

STEM education is defined as the study of science, technology, engineering, and mathematics. What does STEM education entail? Whether we call it STEM or STEAM (Scientific, Technology, Engineering, Art, and Mathematics), science education is trending in this direction from the United States to Korea. Connections between activities and resources, relations between disciplines, and measuring and evaluating student learning are all steps toward a more integrated STEM approach, according to the National Research Council (2014). The requirements for student learning in STEM, according to another report, are characterized as engaging in investigations and engineering design projects that are related to core subjects and science, mathematics, and engineering activities (T Roberts, 2018).

Provincial governments have invested in STEM to create and promote teaching-learning environments in government institutions over the last few decades. This technique has piqued the curiosity of the teacher community and students alike. STEM may effectively boost the teaching-learning environment within the classroom in the current technology era. STEM is an essential and unavoidable element of today's world. In reality, it is up to the people and culture to tackle the challenges posed by the explosion of information in this modern age. STEM's emergence has ushered in a technical, social, economic, and political transformation.

Like other developing nations throughout the world, Pakistan is in the early stages of recognizing the importance of STEM and incorporating it into educational institutions' teaching and learning process. There are, without question, several obstacles to incorporating STEM into the teaching and learning process at educational institutions. Various elements impact the importance of STEM in academic institutions to improve the teaching-learning process. STEM is highly significant for both instructors and students since it allows for learning on both ends, i.e. students and instructors. STEM encourages active learning and gives students a sense of ownership over the teaching-learning process both inside and beyond the classroom. In light of his expertise and skills, a teacher may easily

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organize and prepare his classes and develop the technique and materials such as contents, content delivery, and facilitating resource sharing with students.

Researchers in scientific education agree that engaging inquisitive young minds via inquiry in the early grades, particularly at the elementary level, is one of the best ways to address STEM's underrepresentation in the educational system and dispel its unfavourable reputation (King, 2015). STEM is a reimagining of traditional techniques in which these four disciplines are combined into a single meta-discipline (Barker et al., 2015; Nugent et al., 2010b). Unfortunately, most STEM education is business as usual, with little attempt to integrate these subjects or provide better pedagogical alternatives (Thomas Roberts et al., 2018).

Student-centered integrated STEM education has been demonstrated to boost topic recall while also boosting problem-solving and higher-order thinking skills (Duran et al., 2015; Nugent et al., 2010a). Success is feasible, of course, if teachers use the aforementioned pedagogical tactics (Zheng et al., 2020). STEM education aims to provide students with knowledge in science, technology, engineering, and mathematics. It is required to identify challenges, learn new information, apply that information to related problems, and comprehend the particular qualities of STEM in order to use the inside.

STEM is passionate about teaching science and math students to improve the world rather than merely pass tests. "The practice of design is not to arrive at a model as it exists and is conventional," stated Edith Ackerman, "but to conceive all that does not exist in our world and then bring it to existence." (Timms et al., 2018)

STEM is based on problem-solving, in which the learner is given a problem and asked to solve it using his scientific knowledge and mathematical skills, engineering construction, and his use of technology in the research, design, and testing process, as well as presenting his ideas in an environment that combines active and cooperative learning and verbal communication (A. Struyf et al., 2019).

Effective teaching practices, which have long been a source of disquiet for some educators, are required for successful STEM education (L. Struyf, 2019). According to (Solanki et al., 2019), practical instruction that actively engages students in science, mathematics, and engineering practices throughout their schooling and broadens their awareness of STEM careers is the key to better student preparation. Few teachers are prepared to operationalize STEM education. Students eventually get a better understanding of basic STEM ideas that stimulate STEM involvement include interest and engagement (Gupta et al., 2020), competence and reasoning, attitude and behavior, career knowledge and acquisition, and topic knowledge (Morrissey et al., 2020).

**Objectives of the Study**

1. To identify the importance of STEM education in teaching
2. To find out the factors affecting STEM education

**Review of Related Literature**

STEM's usefulness in the teaching and learning process and the classroom is a relatively new trend in emerging nations. Teachers and administrators alike have difficulties in making appropriate use of this space at the school. The goal of the Olivarez research (2012) was to look at the role of science, technology, engineering, and mathematics (STEM) on academic success. STEM instructors employed project-based learning, collaborative learning, and experiential learning, which positively influenced students' ability in mathematics, science, and reading. As a consequence, the STEM-based academic group outperformed the STEM-based educational group on all outcome measures.

The Wang research (2012) attempts to uncover teachers' opinions on STEM integration and how to incorporate STEM mindsets into their teaching methods. The study concluded that STEM integration is achieved not via the quantity of integrated curriculum in the classroom, but rather via students' capacity to combine engineering design with what they already know from science or mathematics to discover the most number of solutions to issues.

The Carter research (2013) goal was to reach a consensus on the qualities of an integrated STEM strategy. A panel of experts was chosen based on their understanding of the integrated STEM approach. In the STEM-oriented literature, the study found contradictions between the aims and the results, both in the present literature and in the business curriculum of private firms and institutions. The features of STEM's integrated curricular approach were discovered in this study.

The combination of sociocultural theory dialogism and the capabilities approach in STEM education results in transformational learning. It enables a meaningful production of the world relevant to the participants by cultivating critical consciousness (Rahm, 2019). Furthermore, this form of learning serves as a tool for reducing marginalization, allowing communities to gain both financially and socially by regulating their measurement of well-being and quality of life through other approaches such as the capacity approach (de Roock & Baildon, 2019). Rather than being a content-based strategy, STEM education is an integrated curricular approach (Yelland & Waghorn, 2020) that may promote the development of talents and lifetime learning skills (Nugent et al., 2015).

Educational institutions are often responsible for training, preparing, and teaching students in the broadest sense, i.e., providing them with the tools necessary to cope with society's and businesses' ever-changing conditions (Sierra-Gómez, 2013). The present competencies required for the twenty-first century have caused educational systems to evolve. However, specific educational models are still outdated, and teachers' roles as information transmitters must be re-evaluated to become learning facilitators (Khan, 2017) following constructivist ideas (Nugent et al., 2015).

STEM programs are defined by the design of challenges in which STEM must be integrated and employed productively to solve issues. Students are exposed to a variety of scientific and engineering activities due to the range of possible challenges to be handled utilizing a STEM approach. As a result, learning is both experienced and contextualized in the context of resolving problems that are important to students and society. This is an effective strategy for preparing the next generation of STEM experts, such as scientists, engineers, architects, and technology experts, to ensure our society's competitiveness (Gupta et al., 2019). Additionally, the STEM viewpoint provides beneficial experiences for instructors by allowing for group work and problem solving of science-related topics.

Creating a methodology for teaching STEM topics is increasingly influenced by transformational learning and discourse (LópezLeiva et al., 2016). The significance of museums and other non-formal venues in educating teachers on STEM topics has become increasingly acknowledged.

Undoubtedly, it is critical for the country's future that not everyone is steered to STEM professions, but those interested in these disciplines are driven to STEM fields. A systemic approach to professional development will be required to prepare future STEM teachers and support teachers who find themselves in STEM schools (A. Struyf et al., 2019).

## Research Methodology

This research study was descriptive in nature, and quantitative data analysis was employed. The study's participants were all secondary school teachers in Southern Punjab. The study's target populations were drawn from the districts of Bahawalpur, Multan, and Dera Ghazi Khan. The study's sample was drawn from the target demographic. The study's participants were 200 secondary school teachers. The researcher came in person and gave the respondents instructions on how to fill out the questionnaire. The frequency and percentage of analyzed data were calculated using the SPSS software.

## Analysis and Interpretation of Data

The importance of STEM education in the teaching-learning process and factors affecting on STEM teaching-learning process at secondary schools were presented in the following table:

**Table 1. Opinion regarding teacher factors influencing on STEM education in teaching-learning process at secondary schools**

| Sr. No | Statement | SA | A | U | D | SD |
|---|---|---|---|---|---|---|
| 1 | Teachers having more education are likely to use STEM education resources in the teaching-learning process more efficiently. | 44 | 120 | - | 30 | 6 |
| | | 22% | 60% | - | 15% | 3% |
| 2 | Teachers who have easy access to STEM education resources are likely to integrate into the teaching-learning process. | 62 | 100 | 10 | 12 | 16 |
| | | 31% | 50% | 5% | 6% | 8% |
| 3 | Teachers' STEM knowledge has a more significant outcome in the teaching-learning process. | 70 | 74 | 10 | 30 | 16 |
| | | 35% | 37% | 5% | 15% | 8% |

| | | | | | | |
|---|---|---|---|---|---|---|
| 4 | Gender differences of teachers influence usage of STEM education in teaching. | 64 | 34 | 42 | 46 | 14 |
| | | 32% | 17% | 21% | 23% | 7% |
| 5 | Department of school education should replace the old teaching methods with new STEM education tools to improve the teaching-learning process. | 64 | 106 | 4 | 16 | 14 |
| | | 32% | 53% | 2% | 8% | 7% |
| 6 | The attitude of teachers influences the successful integration of STEM education into teaching. | 60 | 94 | 14 | 24 | 8 |
| | | 30% | 47% | 7% | 12% | 4% |
| 7 | Government has a decent policy to improve the present condition of STEM education in secondary schools. | 70 | 94 | 10 | 10 | 16 |
| | | 35% | 47% | 5% | 5% | 8% |
| 8 | The leadership of headteachers is strongly related to Teachers' practice of STEM education in teaching. | 40 | 130 | 10 | 16 | 4 |
| | | 20% | 65% | 5% | 8% | 2% |
| 9 | Department of school education should support the teachers in STEM education training. | - | - | 10 | 30 | 160 |
| | | - | - | 5% | 15% | 80% |

According to the data mentioned above, most respondents (82%) believe that instructors with more outstanding education apply STEM education well in teaching-learning processes. According to 81 percent of respondents, STEM education can be integrated into the teaching and learning process. According to 72 percent of respondents, secondary school teachers' STEM expertise significantly impacts the teaching-learning process. According to respondents, the use of STEM education in the teaching-learning process is influenced by gender differences in instructors. Eighty-five percent of respondents believe that traditional teaching techniques should be replaced with innovative STEM education technologies to improve the teaching-learning process. According to 77 percent of respondents, teachers' attitudes have an impact on the successful integration of STEM education into the classroom. The majority of respondents (82%) thought that the government had an excellent policy to enhance the current state of STEM education in secondary schools. The assertion that the Department of School Education supports teachers in STEM education training sessions was met with 95% disapproval.

**Conclusion and Discussion**

The relevance of STEM education in many sectors is causing numerous changes in 21st-century cultures. It also impacts the importance and integration of STEM by instructors in the classroom. The findings of this study reveal that secondary school instructors are concerned about the importance of STEM education and its integration into the classroom environment. On the other hand, secondary school instructors encounter several challenges and roadblocks when it comes to incorporating STEM education into the classroom. To establish STEM education in the classroom, the government will need to spend a significant amount of money (Li et al., 2021). According to the findings, the instructors have a better level of education and are more engaged in STEM teaching. They will be able to make more effective use of STEM instruction. It is also found that differences in teacher gender significantly impact the value of STEM education in the classroom. According to the conclusions of the study, the government should replace outdated teaching techniques with new technologies in order to improve student learning and those technical approaches that are useful in secondary school teaching. It has also been noticed that the school education department should assist teachers who work in STEM education and should help instructors by conducting STEM education pieces of training.

**Recommendations**

It is strongly advised that the government play an active role in implementing STEM education in secondary school classrooms. The ministry of education plays a critical role in providing money to the education department to promote STEM education in secondary schools. It is also suggested that principals have the vision to play a vital role as a leader in providing STEM education materials using school finances.

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