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PERCEPTIONS OF ELEMENTARY TEACHERS ABOUT THE IMPLEMENTATION OF STEM EDUCATION IN DISTRICT BUNER

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Abstract

This study aims to investigate elementary teacher's views on introducing STEM education at elementary level in district Buner. The objective of the study was to explore elementary teachers' perceptions of STEM education. The research question for the study was what will be the perception of elementary teachers regarding implementation of STEM education in Buner? A descriptive survey design was used to assess teachers' opinions on implementation of STEM education. The population of the study was 172 elementary teachers. The sample of the study was 102 elementary teachers who were selected through cluster random sampling. A Questionnaire was used to collect data from the sampled teachers using five points Likert Scale. Descriptive statistics and chi-square were used for data analysis. The findings indicated that teachers had positive opinions regarding STEM's contribution to improving students' capacity for critical thinking and problem-solving. However, issues like no proper training, lack of resources, and challenges in implementing STEM Education in district Buner were observed. The study concluded that proper policy formulation, better infrastructure, and regular teacher training are necessary for STEM to be implemented successfully. It was suggested that proper resources, effective training, and institutional support should be given for proper implementation of STEM education at elementary level in Buner.

Keywords: *STEM Education, Elementary Education, Pedagogy, Teachers' Perceptions, Implementation, Training.*

1. INTRODUCTION

STEM education science, technology, engineering, and mathematics has emerged as a crucial strategy for educating students for the needs of today's workforce. Every nation on the earth has made STEM education a top priority in order to foster the critical thinking, creativity, and problem-solving abilities required for both economic expansion and technical advancement. However, the efficiency of scientific tutors who are crucial for promoting student learning and engagement is a prerequisite for the successful implementation of STEM education (Shernoff et al., 2017).

Educational systems globaly are focusing on preparing students for challenges of the twenty first century. STEM teaching is an incorporated approach to teaching mathematics, science, technology, and engineering. Students are confident to use their knowledge from a diversity of academic fields in realistic settings, which develop their competence for critical thought, creativity, collaboration, and problem-solving. The STEM approach, which was first created in the United States, has been generally embraced by nation's globally to promote innovation and raise academic standards. Early STEM revelation helps children expand basic abilities and motivate them to follow careers in science and technology; according to a study several developed nations have successfully implemented STEM education at the elementary school level to control the promotion of interest in STEM fields from a young age (Schweingruber et al., 2014).

The use of STEM education science, technology, engineering, and mathematics is becoming increasingly widely recognized among educators. Among the nations that place a high priority on implementing STEM education are the US, China, Singapore, and Turkey (Teo & Ke, 2014). This significance stems from the need to prepare their pupils to meet the demands of a global financial system that places a strong emphasis on science and technology. However,

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many nations throughout the world have difficulties when putting STEM education into practice (Margot & Kettler, 2019).

STEM education is steadily becoming more well-known in Pakistan as a crucial strategy for enhancing science and technology education in classrooms. The Pakistani government has started to support STEM education through a range of public sector initiatives and collaborations in recognition of the worldwide trend toward innovation-based economies. With the intention of creating model STEM schools throughout the nation, the Pakistan Science Foundation (PSF) initiated the STEM Schools Initiative in partnership with the Department of Science and Technology, the Office of Federal Education, and competent advisors. Modern labs, digital resources, and a new curriculum that prioritizes inquiry-based and project-based learning are being installed in these schools. Additionally, a number of commercial and non-governmental groups are encouraging STEM through robotics competitions, scientific fairs, and coding workshops, particularly in urban areas (Shaikh & Khoja, 2011).

1.1 Objective of the Study

The objective of the study is follow

i. To investigate how elementary teachers perception about Buner's implementation of STEM

1.2 Research Question

The following are the research question of the study

i. How will elementary teachers perception about the implementation of STEM education in Buner?

2. Review of Literature

The improvement foundation of STEM education is the integration of knowledge from several disciplines into a novel "all-encompassing" rather than a "meta-discipline." It integrates the four subjects into a single, coherent educational program framework using an interdisciplinary approach to education. This combination, now known as STEM, attempts to break down the traditional barriers that have been erected between the four different areas. STEM education is a transdisciplinary teaching approach. It combines challenging academic concepts with real-world learning when students use mathematical concepts, technology, science, and engineering in scenarios that link the classroom, community, business, and global business. As a consequence, students can acquire STEM literacy, which will help them compete in today's economy. STEM education is a meta-discipline based on standards that operates at the school level and in which all instructors, particularly those in STEM subjects, teach a holistic approach to learning and instruction. This method addresses field-specific materials as a single, evolving substance study rather than as distinct subjects (Tsupros et al., 2009).

While STEM may appear to be a relatively recent concept globally, the acronym really came from the United States in the 1990s (English 2016). However, STEM education has become a major priority in recent years due to global educational and legislative objectives. It is regarded as essential to the economy, global competitiveness, and eventually future progress on both a national and personal level. Since it is crucial to ensuring economic progress, governments everywhere place a high value on it (Bell 2016, Brown 2011). Future forecasts and the challenges of a changing global economy have made STEM a popular topic of discussion worldwide (Bell, 2016).

Despite the fact that the term "STEM" is being used more and more, its true meaning is still unclear. Usually, it is utilized to teach math and science without considering how much engineering and technology have affected our day-to-day existence. A methodical approach to STEM education improves students' ability to recognize and value how things work as well as how they may utilize technology to make their life easier (Gonzalez & Kuenzi, 2012).

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One of the most crucial indicators of a country's degree of development is its advancement in science and technology. The fact that many of the problems we face in an increasingly worldwide society necessitate the integration of disciplines like STEM is a natural reflection of this reality. The countries, especially the developed ones, have always worked to raise the bar for science and technology education. Phoenix, Brok, and Taconis state that outreach activities in secondary STEM education require students to conduct experiments, record their qualitative and quantitative work, record their observations at the end of these experiments, and evaluate their graphic creation or reading skills. Students have the creativity, invention, design, and critical thinking skills to tackle the difficulties they have faced as a direct result of 21st-century technical breakthroughs and the rising need for these talents to use this technology. In the twenty-first century, STEM education is seen as a way to attain similar anticipated outcomes (Parakh et al., 2017).

Teachers are crucial to the success of STEM education. But many individuals are unsure about their ability to teach a range of STEM courses. This is especially true in fields like technology and engineering, which are frequently the least understood. Because they are more comfortable with science or math, primary school teachers may be reluctant to include the less well-known components of STEM, according to studies. Low teacher self-efficacy reduces risk-taking and originality in class design and delivery (Nadelson et al. 2013).

2.1 Theoretical Framework of the study

The combination of science, technology, engineering, and mathematics to foster meaningful learning via practical problem solving is the foundation of the STEM educational conceptual framework. A number of crucial elements, including as curricular integration, support from the institution, teacher competency, and the availability of instructional tools, are necessary for effective STEM education. While effective teaching procedure like inquiry based and problem based learning develop classroom procedures, teachers' capability and professional training are essential to the implementation of multidisciplinary STEM methods. The effective implementation of STEM education is additional strengthened by sufficient resources and encouraging school policies (Bybee, 2013).

This paradigm makes the assumption that when these STEM-related inputs are successfully used, they will have a favorable impact on the general caliber of STEM education and mold instructors' attitudes toward its application. The practicality, efficacy, and difficulties of STEM education in actual classroom settings are reflected in teachers' opinions, which are regarded as an essential consequence. Higher teaching strategies, more student engagement, and higher learning results are all likely to result from positive impressions. As a result, knowing teachers' perspectives provide important information on the advantages and disadvantages of implementing STEM education (Kelley & Knowles, 2016).

3. Methodology

The research design used in this study was quantitative. Creswell (2013) defines a quantitative study as one in which the researcher examines the variables using statistical techniques for data collection and analysis and observes the relationship between the various variables.

3.1 Research Design

Survey design was used in this study to accomplish its goals. Because the goal was to describe elementary teachers' perceptions of the anticipated difficulties in implementing STEM education, a survey approach was used.

3.2 Sample

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Using the cluster random sampling approach, a sample of 102 certified teachers was chosen. 17 teachers were chosen from each of the six tehsils that make up the district Buner: Daggar, Gadezai, Gagra, Chagharzi, Mandnr, and Khudokhail. The Yamane formula (for finite population size) was used to get the sample size.

3.3 Data Collection Tool

Data from sample teachers was gathered using a questionnaire as a research tool. A five-point Likert scale served as the basis for the questionnaire. The researcher personally distributed the questionnaires to the participants. Out of the 102 teachers that received the questionnaire, 102 teachers were responded. The questionnaires were delivered, and every sample teachers responded.

3.4 Data Analysis

The collected data was analyzed through descriptive statistics and Chi-Square.

4. Findings

The Chi-Square test was performed to analyze and interpret the quantitative data that was collected.

Table 4.1 Show that the perceptions of elementary teachers about the implementation of STEM education

S.N	Statement	NO	SD	D	N	A	SA	x^2
1	STEM education enhances students' critical and analytical skills.	102	3	4	11	54	30	**92.2**
			2.9 %	3.9 %	10.7%	52.9%	29.4%	
2	STEM education connects classroom learning to real-life situations.	102	4	5	**7**	49	37	**87.2**
			3.9 %	4.9 %	6.8 %	48.0%	36.**%**	
3	Students problem-solving skills are develop through STEM education.	102	2	7	13	41	39	**65.8**
			1.9 %	6.8 %	12.7%	40.1%	38.2%	
4	Implementing STEM will help students develop interpersonal skills.	102	01	05	21	46	29	**65.8**
			0.9 %	4.9 %	20.5%	45.0%	28.4%	

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5	STEM teaching helps students to become independent learners.	102	02	08	11	51	30	**84.5**
			1.96%	7.84%	10.7%	50.0%	29.41%	
6	STEM education meets the global needs and requirements of the new digital era.	102	01	08	08	41	44	**81.6**
			0.9%	7.8%	7.8%	40.1%	43.1%	
7	Through the implementation of STEM education it is easy to shift from teacher-centered approach to student-centered approach.	102	6	5	18	47	26	**58.3**
			5.8%	4.9%	17.6 %	46.0%	25.4%	
8	Teachers lack expertise for integration all STEM subjects.	102	21	28	13	19	21	**5.6**
			20.5%	27.4%	12.7%	18.6%	20.5%	
9	Interdisciplinary teaching will be challenging in STEM classrooms.	102	31	20	17	14	20	**8.1**
			30.3%	19.6%	16.6%	13.7%	19.6%	
10	Teachers are familiar with modern STEM teaching	102	8	10	13	50	21	

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	tools and technologies in STEM.		7.8%	9.8%	12.7%	49.0%	20.5%	**58.5**
11	I have not received any formal training focused on STEM education so far.	102	7	26	18	41	10	**36.7**
			6.8 %	25.4 %	17.6%	40.1%	9.8%	
12	I need hands-on, activity-based training sessions for learning STEM teaching methods.	102	7	1	13	54	27	**87.4**
			6.8 %	0.9 %	12.7%	52.9%	26.4%	
13	Professional development is necessary for effective implementation of STEM curriculum.	102	8	2	8	41	43	**77.5**
			7.8 %	1.9 %	7.8 %	40.1%	42.1%	
			1.9 %	2.9 %	11.7%	38.2%	45.0%	
14	There is capacity for establishing STEM resource room at your school.	**102**	15	14	14	49	10	**50.8**

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			14.7 %	13.7%	13.7%	48.0%	9.8%	
15	Reliable electricity and internet connectivity to support the use of digital STEM tools and platforms are available at your institution.	102	28	23	14	17	20	**5.7**
			27.4 %	22.5%	13.7%	16.6%	19.6%	

Degree of Freedom=4, Significance level =0.05, Table Value = 9.488

The majority of statements revealed statistically significant variations in teachers' responses regarding STEM education, according to the chi-square analysis (df = 4, χ^2tab = 9.488, $p < 0.05$). More than 70% of respondents agreed or strongly agreed with statements about the advantages of STEM education, such as improving critical and analytical skills ($\chi^2 = 92.2$), connecting classroom learning with real-life situations ($\chi^2 = 87.2$), developing problem-solving skills ($\chi^2 = 65.8$), encouraging independent learning ($\chi^2 = 84.5$), and meeting global digital-era needs ($\chi^2 = 81.6$). These statements had high chi-square values. The change to student-centered learning ($\chi^2 = 58.3$) and instructors' acquaintance with contemporary STEM technologies ($\chi^2 = 58.5$) both showed significant results. Conversely, nearly half of the teachers disagreed with statements about the availability of electricity and internet facilities ($\chi^2 = 5.7$), the difficulties of interdisciplinary teaching ($\chi^2 = 8.1$), and the lack of teacher expertise ($\chi^2 = 5.6$). These statements did not reach the critical value. Additionally, there is a strong need for capacity building to guarantee the successful implementation of STEM education at the elementary level, as evidenced by the significant chi-square values for lack of formal training ($\chi^2 = 36.7$), need for hands-on training ($\chi^2 = 87.4$), and importance of professional development ($\chi^2 = 77.5$), with over 80% agreement.

5. Discussion

As indicated by statistically significant chi-square values for the majority of benefit-related claims, the results of this study show that primary school teachers have a generally favorable opinion on the implementation of STEM education. There are more than 70% of respondents agreed or strongly agreed that STEM education improves students' capacity for critical and analytical thought, problem solving, and self-directed learning. These findings are reliable with earlier research that highlights how STEM integrated education fosters higher order thinking abilities and helps students is relevant their knowledge to real world situations (Bybee, 2013; Kelley & Knowles, 2016). There is wide-ranging agreement about the educational usefulness of STEM at the elementary level, as seen by the significant correlation between teachers' replies and its advantages.

Furthermore, a high chi-square value and significant agreement percentages show that teachers believe STEM education is pertinent to the global digital world. The idea that STEM education gives students 21st century skills like creativity, collaboration, and technological literacy all

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crucial in a knowledge based economy that is changing quickly is supported by this research (National Research Council, 2012). In line with constructivist learning theories, the noteworthy findings on the transition from teacher-centered to student-centered learning also imply that STEM pedagogy promotes inquiry, active learning, and teamwork (Capraro & Slough, 2013). Notwithstanding these favorable opinions, the investigation clearly highlights important difficulties. Diverse answers and contextual limitations are shown by non significant chi-square values for statements about teachers' expertise, interdisciplinary teachings, and the availability of electricity and internet connectivity. These outcome imply that even when educators realize the value of STEM, poor infrastructure and a be short of of interdisciplinary knowledge may make implementation difficult. Similar difficulties have been accepted in emerging educational systems, where the implementation of creative teaching methods is hindered by a lack of institutional support and resources (Marginson et al., 2013; UNESCO, 2017).

Additionally, there is a significant demand for capacity building among teachers, as evidenced by the significant chi-square values for clarification pertaining to the absence of formal training, the need for realistic professional development, and the significance of ongoing training. For STEM implementation to be successful, over 80% of respondents stressed the importance of professional development. This is in line with researches that demonstrate teacher preparation is a essential factor in successful STEM integration, especially in elementary education (Darling-Hammond et al., 2017; Thibaut et al., 2018). Despite having constructive temperament, teachers may find it hard to integrate STEM principles without organized and ongoing professional development.

Overall, the discussion illustrate that institutional support in the structure of professional training and infrastructure are necessary, even despite the fact that elementary teachers show good attentiveness and positive attitudes toward STEM teaching. In order to successfully incorporate STEM education in elementary schools, particularly in the location of Khyber Pakhtunkhwa, policymakers and education administrators must tackle numerous matters.

6. Conclusion

According to the study's findings, elementary school teachers generally have a favorable opinion of STEM education. For the majority of assertions about the academic, cognitive, and pedagogical advantages of STEM education, the chi-square analysis produced statistically significant findings. The vast majority of educators concurred that STEM education improves students' critical and analytical thinking, problem-solving skills, autonomous learning, and ability to relate what they learn in the classroom to real-world scenarios. Additionally, teachers said that STEM education supported the transition from teacher-centered to student-centered instructional approaches and was in line with the demands of the global digital era, demonstrating their willingness to embrace cutting-edge teaching methods. Despite these positive opinions, the study also finds that practical difficulties limit the successful use of STEM education. Gaps in ability and infrastructure at the elementary level are suggested by varied and non-significant replies about teachers' expertise, interdisciplinary teaching, and the availability of electricity and internet connectivity. Teachers' positive views only are insufficient for successful implementation, as support by the broad consensus regarding the lack of formal STEM training and the stated need for realistic professional development. The study's generally conclusion is that, despite teachers' strong support for STEM education, organized professional development programs and improved infrastructure support are necessary to convert favorable attitudes into productive teaching methods.

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