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Challenges Faced by Pre-Service Teachers in Learning STEM Education

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ABSTRACT

Many private and some of government schools have adopted innovative and effective cooperative learning strategies in STEM. These schools in Pakistan take the initiative to provide opportunities to preservice teachers so that they can learn through modern teaching approaches and methods. The purpose of research is to check the teaching of STEM based content in teachers training programs and to check the awareness level of pre-service teachers about emerging trend in education. The researcher targeted the in-service and pre-service teachers of teachers training institutes in Islamabad only. Research design is mixed method design. Researcher used two sampling techniques random sampling technique for quantitative part of research and cluster sampling technique for the qualitative part of research. Researcher collected data through personal visits at first researcher took pre-test and practice modules and after that post-test was taken. Qualitative Data was analysed manually by making themes, codes, and categories and quantitative data was analysed through SPSS. The objectives were to check the content of STEM-Edu in teachers training programs, to know the challenges faced by preservice

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teachers in understanding STEM, to develop and implement the modules. The results showed that the pre-service teachers gained knowledge about STEM-Edu after the teaching of modules. It is recommended that teachers training departments in universities may focus on STEM-Edu to make it a part of teachers training program's curriculum.

Keywords*: teachers training programs, STEM-Edu modules, teachers training.*

1.1 Introduction

The goal of STEM education is to merge four learning components into one new educational system. By employing these four elements, pre service teachers can apply the knowledge they have learned to solve difficulties in their daily lives and in compliance with the needs of the modern workplace. This is consistent with the Expert's view that STEM application in education is essential for today's globe (developing and developed countries).

STEM education has also gained prominence in Pakistan, as the government acknowledges the need of preparing a qualified workforce to prosper in a technologically driven world. The effectiveness of STEM education implementation is dependent on the quality of teacher training programs, which are critical in providing educators with the essential knowledge and abilities. As a result, Therefore, it is crucial to assess how Pakistan's current school system compares to the teacher preparation methods used in STEM education. Promoting STEM education faces a unique set of difficulties in Pakistan. The main barriers to significant STEM provision are the lack of resources, the antiquated curriculum, and inexperienced teachers (Shaikh 2019; Wahab et al., 2020). These difficulties highlight the value of excellent, research-based programs for preparing teachers to teach STEM in an engaging and successful manner (Shaikh, 2019). Every

study that is pertinent to Pakistan may help us identify challenges and opportunities in STEM teacher preparation.

According to Samsudin et al. (2020), STEM education is a teaching approach that blends academic subjects with real-world applications. According to Suratno et al. (2020), pre-service teachers are motivated to learn through STEM education since these subjects enable them to use creativity to address problems. STEM-applying pre-service teachers are better equipped to compete in today's labor market and may recognize links between their employment, education, community, and global enterprise (Hacioglu & Gulhan, 2021; Bruce-Davis et al., 2014).

STEM education aims to give pre-service teachers a wide range of transdisciplinary knowledge and skills (Nguyen et al., 2020). The foundation of integrated STEM education, according to Rohrig et al. (2021), is the notion that solving real-world issues successfully calls for a variety of viewpoints, abilities, and information (Reynante et al., 2020). Science, technology, engineering, and mathematics are to be brought together in a single classroom setting through integrated STEM education, which makes links between the disciplines and the outside world. The efficacy of instruction can rise when STEM and project-based learning are appropriately combined (Jamali et al., 2017).

1.2 Statement of the problem.

STEM education is a important framework for preparing pre_service teachers with the skills and competencies needed for the 21st century. Recognizing the importance of these disciplines in innovation, problem-solving, and economic growth, STEM education has gained global traction. This study aims to assess the awareness level of pre-service teachers towards STEM education, identifying areas of strengths and weaknesses in current teacher training programs. Policymakers

and education stakeholders can develop targeted interventions to enhance the capacity of in service teachers to effectively deliver STEM education in the classroom. By fostering a culture of STEM education within teacher training programs, Pakistan can position itself at the forefront of educational innovation and equip future generations with the skills and awareness needed to prosper in an increasingly complex and inter-connected world.

1.3 Objectives of the Study

1. To highlight the challenges faced by pre-service teachers in learning STEM-Edu.

1.4 Research Questions

1. What are the challenges faced by pre-service teachers in learning STEM-Edu?

Research Hypotheses

H_1: There is no need to practice the STEM education modules to pre service teachers.

1.5 Literature Review

The acronym STEM represents the disciplines of science, technology, engineering, and mathematics. While widely utilized, there is currently no common definition of STEM among educators. It serves as a general term for activities, policies, programs, or initiatives related to these fields (Reeve, 2013). The term widely embraced by governments, educators, businesses,

communities, and industry leaders emphasizes the critical importance of educating preservice teachers for success in college and the workforce. However, there is a lack of clarity on its specific implications beyond a general sense, with interpretations varying between different sectors and regions. For instance, in the U.S., it is often associated more with science and math than with technology or engineering (Bybee, 2010). In Thailand, STEM education, as defined by the IPST, integrates science, engineering, technology, and mathematics to address real-world challenges and enhance human life and work (IPST, 2013).

Teachers and educators need to take a proactive approach because of the rapid and intricate changes in society. The needs of the people who live in the global society are completely different from those of earlier or even more recent times. Science teacher trainers must enhance science instruction strategies to better meet the requirements of both local and global communities as well as individual preservice teachers in order to raise the standard of science instruction and ultimately accomplish higher goals (Khan, 2015).

If teachers and teacher educators have the ability to influence how scientific education is taught in the future, STEM education could be a viable way to implement reforms in the classroom (Zajda, 2018; Zajda & Rust, 2016). As deliberate endeavors, education and training support undefined aims as well as societal and individual objectives both directly and indirectly (Ben-Peretz, 2001).

According to Du and Wong (2019), Chinese pre service teachers also expressed comparatively low career expectations in science. Many elements have been found to be significant predictors of pre service teachers' career aspirations, including learning experiences, views of STEM

professionals, motivational beliefs, gender, or parental educational and occupational backgrounds (Ketenci et al., 2020). For example, pre service teachers who lacked strong ideas about their abilities to do science, or who did not strongly believe that science was important to them, were less likely to want to work in STEM fields (Aschbacher et al., 2014).

Pre-service teachers' attitudes towards scientists and engineers may have a substantial impact on how their ambitions of working in STEM disciplines are created and realised (So et al., 2020).

1.6 Research Methodology

The research methodology is based on mixed method.

1.6.1 Qualitative research.

In this research in qualitative research methodology, observations were taken, the researcher personally visited the institute and observe regular classes of in-service teachers to check the teaching of STEM-EDU and the observations were noted done by researcher according to checklist which contains 10 areas.

1.6.2 Quantitative research

In this research in quantitative research data was collected from pre service teachers of B.S.Ed (Hons) with different science backgrounds, through pre-test and post-test questionnaire, contained 30 questions which were divided into 07 areas. after getting validation of questionnaire from research experts. The researcher first took pre-test then practice STEM-EDU three modules for two months and after completing the teaching of STEM-EDU modules post-test was taken.

1.7 Population of the Study.

For the quantitative part of research population was, All the teachers training institutes of Islamabad those who offered under graduate teachers training programs were part of this study.

The targeted population was the pre-service teachers of FEDERAL COLLEGE OF EDUCATION, H-9 Islamabad which are total 201 pre-service teachers enrolled currently.

Sr. no	**Teacher's training programs**	**Total no. of pre service teachers**
1	B.S Education (5-8)	35
2	B.S.Ed. (HONS)	120
3	B.Ed. (HONS) Elementary	46
	TOTAL	201

For qualitative part of research, population was all the lecturer education currently working in FEDERAL COLLEGE OF EDUCATION, H-9. IBD. There were total 38 teachers, currently working in FCE from which 15 were taken as a sample of this study.

Sr. no	**TOTAL NUMBER OF TEACHERS**	**TEACHERS OBSERVED**
01.	37	15

1.8 Sample.

The researchers choose a cluster sampling technique to perform the Experiment and for collection of data. And random sampling technique for observations. The sample was pre service teachers of BS.ED (Hons), because they have educational background of sciences. The researcher took 30 pre service teachers of BS.Ed (Hons) for the collection of quantitative data.

For qualitative data, the 15 in-service teachers were taken as sample and observations were recorded during the lectures of STEM-Edu.

1.9 Sampling Frame

For quantitative part

S.NO.	INSTITUTION	NO. OF PRE SERVICE TEACHERS
01.	FEDERAL COLLEGE OF EDUCATION, H-9/1. ISLAMABAD.	30

For qualitative part

S.NO	TOTAL TEACHERS	SAMPLE
01.	38	15

1.10 Sampling Method and Sampling Technique

- For the quantitative part of research, the sampling method was cluster sampling. This sampling technique was chosen, because this was the most suitable technique for quantitative part of study. The institute and the pre-service teachers of 5th semester of

BS.ED (HONS) both were chosen as a cluster. Sample of 30 pre-service teachers were taken for experimentation and collection of quantitative data.

- For qualitative part of research, the sampling method chosen by researcher was simple random sampling technique. The fifteen 15 in-service teachers were taken for observation of STEM-EDU teaching.

1.11 Data Collection.

The data was collected by the researcher through personal visit at Federal College of Education, H-9. ISLAMABAD.

In quantitative part:

The researcher first took pre-test and then practiced the teachers training modules of STEM-EDUCATION for the duration of 02 months and after completing the teaching of three STEM-EDU modules to pre-service teachers, the researcher took post-tests.

In qualitative part:

The researcher did 15 class observations of the in-service/ permanent teachers of Federal college of Education to check the teaching of STEM-EDU content or approaches.

1.12 Data Analysis.

The quantitative data was analyzed by applying statistical test, one sample T-test through SPSS. While the qualitative data was analyzed manually by making themes, codes and categories.

(A) Qualitative Analysis

Qualitative analysis of observation data was done manually by researcher by making themes, codes and categories.

THEMES	CODES	CATEGORIES
A. Teachers knowledge ***SUB THEMES.*** ▪ Basic knowledge about STEM-EDUCATION. ▪ Knowledge about teaching methods of STEM-EDU	• 5 out of 10 teachers have basic knowledge of stem education. • Some teachers have full knowledge about stem education and it is teaching methods	• Only 50% of the permanent teachers have basic knowledge of STEM Education. • Very less number of teachers know about STEM Education, i.e. only 10% of the teachers but they were also not fully aware of STEM Edu, for example the teaching methods of STEM Edu, assessment in STEM etc.
B. Teaching strategies	• Practice Concepts Teaching through STEM-EDUCATION.	• None of the teachers teaches any concepts through STEM
C. Technology	• Practice of technology	• There's no use of

integrations	to boost STEM-learning	technology to boost stem learning
D. Pre service teachers engagement	• Teacher encourage pre service teachers to participate in STEM classes	• No encouragement is provided to pre service teachers to participate in stem education or stem courses
E. Teacher preservice teachers interaction	• How much teacher facilitate or guide pre service teachers in conceptual learning	• Teacher preservice teachers interaction in conceptual teaching learning is very low
F. Assessment and feedback	• How frequently teachers provide feedback to pre service teachers	• None of the teacher provides STEM feedback. • None of the teacher takes STEM assessment and provide it feedback
G. Collaborative learning	• Teachers encourage collaborative learning among pre service teachers	• Teachers do not encourage collaborative learning only traditional lecture methods are

		used.
H. Teamwork	• Collaboration of pre service teachers with each other to solve problems	• Preservice teachers sometimes collaborate with each other by their own to solve problems.
I. Time management	• How effectively teacher manages time	• Teachers are not punctual in taking classes. • Teachers do not take classes on time. • Teachers leave classes before time.
J. Challenges and innovation	• How effectively teachers manage time and bring innovation	• Some teachers try to manage challenges But very rarely bring innovation in teaching

The above mentioned table of themes, code, and categories is qualitative analysis of observation, that whether the permanent teachers/in service teachers of Federal college education H-9, where the experiment was conducted and observations of in-service teachers were taken, uses STEM EDU approaches or teach STEM EDU content while teaching different subjects, manage classes and are punctual in taking classes or not.

Teachers focus on conceptual understanding of preservice teachers, bring innovation in teaching style, facilitate preservice teachers and encourage collaborative learning, learning by doing or not.

a. The observations taken by researcher shows that some of the in service teachers do not know about STEM-EDU. Only 50% of the in-service teachers have basic knowledge of STEM Education, very less number of in-service teachers know about STEM Education, i.e. only 10% of the in-service teachers but they were also not fully aware of STEM Edu. for example, the teaching methods of STEM Edu, assessment in STEM Edu etc.
b. There was less or no use of technology to enhance STEM-EDU learning, in service teachers provide no encouragements to pre service teachers towards STEM-EDU as it is the need of time and latest emerging trend. Also it was observed that teacher preservice teachers' interaction overall and specially in conceptual understanding was very low, pre service teachers do not ask much questions also teachers do not encourage them to ask questions.
c. STEM assessments were never taken by teachers and practice of taking feedbacks from preservice teachers was also very less, also feedback was not provided to pre service teachers. moreover, teachers do not encourage collaborative learning among pre service teachers. most of the pre service teachers interact with each other by their own if they have any query.
d. In service Teachers were not punctual, do not take classes on time, came in class after the class was started and left the class before time.

e. Teachers do not bring any innovation in teaching the difficult concepts and very few teachers were able to overcome the hurdles and challenges.

4.3. (B) Descriptive Analysis, Quantitative Analysis

Descriptive statistics, one sample T-test was used to explain the features of data and comparing the area wise means of pre –test and post –test.

Area wise data analysis

Area 1: Teachers' knowledge

Test	N	Mean	S.D	t-value	Df
Pre-test	30	15.3667	2.9981	27.966	29
Post-test	30	19.1009	2.1229	49.149	29

The knowledge of teachers in Area 1 is assessed using at T-test, both before and after the teaching of modules. The test appears to have good reliability.

The mean scores on the pre-test (M = 15.3667, SD = 2.9981) and post-test (M = 19.1009, SD = 2.1229) indicate an increase in knowledge and understanding from pre-test to post-test. Whereas pre-test results show the teaching of their permanent teachers and post-test results show the result of experiment of STEM-EDU modules taught by researcher.

The mean and t-value of post-test shows that pre-service teachers gained knowledge about STEM-EDU after the teaching of modules done by researcher. moreover, their permanent teachers do not teach them through STEM and training programs for teachers to enhance their STEM knowledge were barely arranged by institute.

Table . **Area 2: STEM-Practice**

Test	N	Mean	S.D	t-value	Df
Pre-test	30	17.9668	3.438	28.536	29
Post-test	30	22.333	1.80676	67.552	29

In area 2, STEM practice is assessed using a t-test, both before and after the teaching of modules. The mean scores on the pre-test (M = 17.9668, SD = 3.438) and post-test (M 22.333, SD = 1.80676) indicate an increase in STEM practice from pre-test to post-test.

The increase in t-values, from pre-test to post-test also shows that pre service teachers very rarely performed STEM-activities (only 3D models making hardly in a year) and almost never had a STEM-EDU lecture before the teaching of STEM-EDU modules done by researcher. Moreover, hands-on practice in STEM OR STEAM is done by very few pre service teachers.

The results showed that teachers do not gave them STEM-EDU projects and whole class never participated in STEM or STEAM while researcher encouraged whole class to participate in STEM-EDU projects which were given by the researcher at the end of teaching of modules, projects were given in the form by groups.

Table 4.5 **Area 3: STEM EDU part of curriculum**

Test	N	Mean	S.D	t-value	Df
Pre-test	30	8.7667	1.92414	24.813	29
Post-test	30	9.9000	1.47040	35.799	29

In area 3, STEM Edu as a part of curriculum component is assessed using a t-test, both before and after the implementation of modules. The mean scores on the pre-test (M = 8.7667, SD =

1.92414) and post-test (M = 9.9000, SD = 1.47040) indicate an increase in preservice teacher's performance in the STEM curriculum component from pre-test to post-test. The results and data collected by research showed pre-service teachers never knew about STEM-EDU initiatives done by government of Pakistan before the teaching of modules. Pre-service teachers came to knew about STEM-EDU initiatives done by government of Pakistan after the teaching pf modules. Also, pre-service teachers agreed that they never studied about STEM/STEAM EDUCATION in their curriculum or outlines and there is no dedicated STEM curriculum or framework in their institute that guides teachers in integrating STEM across subjects.

Table 4.6 **Area 4: Teaching methods**

Test	N	Mean	S.D	t-value	Df
Pre-test	30	16.7333	10.037	9.104	29
Post-test	30	22.5667	8.73551	13.993	29

In area 4, teaching methods of STEM Edu was assessed using a T-test, both before and after the implementation of various teaching methods of STEM-Edu. The consistency of scores within each group (standard deviation) suggests that the measurement instrument is reliable. The mean scores on the pre-test (M = 16.7333, SD = 10.037) and post-test (M = 22.5667, SD = 8.73551) indicate an increase in preservice teacher's performance from pre-test to post-test.

The t-tests conducted reveal extremely significant differences among pre-test and post-test scores, with t-values of 9.104 and 13.993 respectively, suggests that the observed increase in pre-service teacher's knowledge about teaching methods of STEM-EDU. Increase in t-value from pre-test to post-test shows and pre-service teachers also strongly agreed that they never learnt

about STEM-EDU teaching methods before the teaching of modules done by the researcher. Also their regular teachers do not use STEM-EDU approaches in regular classes. Moreover, their teachers have never taught them through the project based STEM approach, inquiry based STEM approach and problem based learning related to STEM, these approaches were new for them during the teaching of modules. Collaborative learning and learning by doing and researching was not taught to pre-service teachers by their regular teachers.

Table 4.7 **Area 5: Teacher and preservice teacher's interaction**

Test	N	Mean	S.D	t-value	Df
Pre-test	30	11.4667	7.064	8.851	29
Post-test	30	12.1333	1.13664	58.227	29

In area 5, Teacher-preservice teacher's interaction is assessed using a T-test, both before and after the teaching of modules. The consistency of scores within each group (standard deviation) suggests that the measurement instrument is reliable. The mean scores on the pre-test (M = 11.4667, SD = 7.064) and post-test (M = 12.1333, SD = 1.13664) indicate a slight increase in teacher preservice teacher's interaction from pre-test to post-test. The huge difference in values of t-test from pre-test to post-test shows regular teachers do not help pre-service teachers in STEM activities, if rarely any activity happens, the teachers do not facilitate pre service teachers during STEM related discussions and projects. Also, do not guide pre-service teachers effectively in their STEM explorations.

Table 4.8 **Area 6: Use of technology**

Test	N	Mean	S.D	t-value	Df

Pre-test	30	7.2333	1.56873	25.081	29
Post-test	30	8.0667	0.907	48.401	29

In area 6, The use of technology is assessed using a T-test, both before and after teaching STEM modules. The consistency of scores within each group (standard deviation) suggests that the measurement instrument is reliable. The mean scores on the pre-test (M = 7.2333, SD = 1.56873) and post-test (M = 8.0667, SD = 0.907) indicate an increase in the use of technology from pre-test to post-test. The difference in t value from pre-test to post-test shows that the pre-service teachers agreed that the regular teachers do not use technology to enhance STEM education learning while researcher tried maximum to use technology to enhance their STEM EDU learning.

Moreover, the pre service teachers agreed that technology can be better utilized to support STEM education learning in classroom and overall.

Table 4.9 **Area 7: Pre service teachers' knowledge/ Engagement**

Test	N	Mean	S.D	t-value	Df
Pre-test	30	18.4000	2.97808	33.749	29
Post-test	30	22.5667	2.223	55.468	29

In area 7, Pre service teachers' knowledge and engagement towards STEM Edu are assessed using a test, both before and after teaching the STEM modules. The consistency of scores within each group (standard deviation) suggests that the measurement instrument is reliable. The mean scores on the pre-test (M = 18.4000, SD = 2.97808) and post-test (M = 22.5667, SD = 2.223)

indicate an increase in both pre service teachers' knowledge and engagement from pre-test to post-test.

The difference in t- value from pre-test to post-test show that pre service teachers do not know about principles of STEM education before the teaching of STEM education modules done by researcher moreover, very few like 3 to 4 pre service teachers have worked on STEM or STEAM related projects outside their institute.

The pre- service teachers agreed that incorporating real-world application and examples in STEM lesson enhance their engagement and understanding they also agreed that extra STEM/STEAM activities should be organized by their institute for their better conceptual understanding and learning towards real world problems. Moreover, the preservice teachers showed interest and enthusiasm for subject related to STEM as compared to the traditional subjects and traditional teaching.

4.3.2. Over-All Analysis of Pre-Test and Post-Test

Table 4.10

	T- VALUE OF PRE-TEST	***T-VALUE OF POST-TEST***
Area 1	27.9	*49.1*
Area 2	*28.5*	*67.5*
Area 3	*24.8*	*35.7*
Area 4	*9.10*	*13.9*
Area 5	*8.85*	*58.2*

Area 6	*25.0*	*48.4*
Area 7	*33.7*	*55.4*

- The increase in t-test values of all areas from pre- test to post- test shows that pre-service teachers gained knowledge about STEM-EDU after the teaching of STEM Edu modules done by researcher moreover, their permanent teachers do not teach them through STEM and training programs for teachers to enhance their STEM knowledge were barely arranged by institute.
- The increase in t-values, from pre-test to post-test also shows that pre service teachers very rarely performed STEM-activities (only 3D model making hardly in a year) and almost never had a STEM-EDU lecture before the teaching of STEM-EDU modules done by researcher. Moreover, hands-on practice in STEM OR STEAM is done hardly by very few pre service teachers that was also external project other than their curriculum.
- In service teachers do not gave them STEM-EDU project and whole class never participated in STEM or STEAM while researcher encouraged whole class to participate in STEM-EDU projects which were given by the researcher at the end of teaching of modules, projects were given in the form by groups. pre-service teachers never knew about STEM-EDU initiatives done by government of Pakistan before the teaching of modules. Pre-service teachers came to knew about STEM-EDU initiatives done by government of Pakistan after the teaching of modules. Also, pre-service teachers agreed that they never studied about STEM/STEAM EDUCATION in their curriculum or

outlines and there is no dedicated STEM curriculum or framework in their institute that guides teachers in integrating STEM across subjects.

- The t-tests values of area 04, 9.104 and 13.993 respectively, suggests that the observed increase in pre-service teacher's knowledge about teaching methods of STEM-EDU. pre-service teachers also strongly agreed that they never learnt about STEM-EDU teaching methods before the teaching of modules done by the researcher. Also their regular teachers do not use STEM-EDU approaches in regular classes. Moreover, their teachers have never taught them through the project based STEM approach, inquiry based STEM approach and problem based learning related to STEM, these approaches were new for them during the teaching of modules.
- Collaborative learning and learning by doing and researching was not taught to pre-service teachers by their regular teachers.
- T-test values from pre-test to post-test shows regular teachers do not help pre-service teachers in STEM activities, if rarely any activity is going to happen, the teachers do not facilitate pre service teachers during STEM related discussions and projects. teachers do not guide pre-service teachers effectively in their STEM explorations.
- The pre-service teachers agreed that the regular teachers do not use technology to enhance STEM education learning while researcher tried maximum to use technology to enhance their STEM EDU learning. Moreover, the pre service teachers agreed that technology can be better utilized to support STEM education learning in classroom and overall.

- The difference in t- value from pre-test to post-test show that pre service teachers do not know about principles of STEM education before the teaching of STEM education modules done by researcher moreover, very few like 3 to 4 pre service teachers have worked on STEM or STEAM related projects that was not part of their curriculum but arranged by any other institution.
- The pre- service teachers agreed that incorporating real-world application and examples in STEM lesson enhance their engagement and understanding they also agreed that extra STEM/STEAM activities should be organized by their institute for their better conceptual understanding and learning towards real world problems, the pre service teachers showed interest and enthusiasm for subject related to STEM as compared to the traditional subjects and traditional teaching.

Qualitative Part findings:

The result of qualitative data shows that

- Most of the teachers do not know about stem education and its approaches very few know about stem education from which also some teachers do not fully know about it teaching methods.
- Teachers also do not use technology to enhance STEM education learning and also do not provide encouragement to preservice teachers towards stem education as it is the latest trend.
- preservice teachers' interaction is very low specially teachers do not focus on conceptual understanding of pre-service teachers.

- Teachers never took STEM assessment and feedback is never given to pre service teachers as teachers are not fully aware of STEM education and they do not use STEM approaches in class. Moreover, teachers do not encourage collaborative learning among pre service teachers, pre service teachers interact with each other by their own if they have any query.
- Teachers are not punctual in taking classes they do not start classes on time and also teachers leave the classes before time. Moreover, teachers do not bring any innovation in teaching methods, it is also observed that difficult concepts were taught in a traditional way. And if any hurdle or challenge occurs very few teachers are able to overcome the challenges rest of the teachers leave it as it is.

. Quantitative part findings:

teachers do not teach pre-service through STEM and training programs for IN-SERVICE teachers to enhance their STEM knowledge were Rarely arranged by institute and those trainings are also not for whole staff.

- Pre-service teachers OF BS.Ed agreed that they never studied about STEM/STEAM EDUCATION in their curriculum or outlines and there is no dedicated STEM curriculum or framework in their institute that guides teachers in integrating STEM across subjects.
- IN-SERVICE teachers do not use STEM-EDU approaches in regular classes. Moreover, their teachers have never taught them through you project based STEM approach, inquiry based STEM approach and problem based learning related to STEM, these approaches were new for them during the teaching of STEM modules.

- The regular teachers do not help pre-service teachers in STEM activities, if rarely any activity happens, the teachers do not facilitate pre service teachers during STEM related discussions and projects. Also, teachers do not guide pre-service teachers effectively in their STEM explorations and researches.
- The pre-service teachers agreed that the regular teachers do not use technology to enhance STEM education learning. Moreover, the pre service teachers also agreed that technology can be better utilized to support STEM education learning in classroom and overall.
- It was checked that there's no content related to STEM EDU was present in outlines of BS.Ed (Hons), Bachelors of science education and class observations also showed this.

Conclusion

1. Lack of STEM Education Integration: The study reveals a significant absence of STEM education content within the undergraduate teachers training programs. Observation of course outlines and pre-test from pre service teachers confirms this deficiency.
2. Need for STEM Education Understanding: There was an increase in comprehension among pre-service teachers after the teaching of STEM-Edu modules. however, the initial lack of awareness of STEM education indicates that there is an urgent need for better education and training in this area to teachers.
3. Practice and sensitization are required. The study rejects the null hypothesis, which suggests that no practice or sensitization is required in

STEM education. It emphasizes the importance of practical experience and improving awareness among pre-service teachers.

4. Insufficient Teacher Preparation: Qualitative studies indicate that in-service teachers are unfamiliar with STEM education concepts and approaches. This includes insufficient use of technology and little encouragement for preservice teacher's participation in STEM disciplines.
5. Limited Participation in STEM Activities: pre-service teachers reported little participation and exposure to STEM education projects and activities prior to the implementation of STEM modules but those activities were not part of curriculum.
6. Lack of Formal STEM Curriculum and Training: Pre-service teachers reported a lack of structured STEM curriculum at their institutions.
7. Potential for Technology Integration and Real-World Application: Pre-service teachers stated a desire for increased use of technology in STEM teaching, emphasizing the relevance of real-world examples and applications to improve learner engagement and comprehension.
8. Motivation and enthusiasm in STEM: Despite present shortcomings, preservice teachers expressed interest and excitement for STEM subjects, showing a readiness to engage with in depth teaching approaches.

In conclusion, current research highlights the critical need for teacher training initiatives for STEM Edu, curriculum reforms and institutional support to successfully integrate STEM education into teacher training programs. Addressing these gaps is essential for preparing both

in-service and pre service teachers equipped to foster preservice teachers' interest, understanding, and proficiency in STEM fields and to prepare their preservice teachers for future, real world challenges.

5.5. Recommendations

Recommendations may include:

1. Higher education commission (HEC) for teacher education may provide support to develop curriculum for STEM education and arrange trainings for pre service and in service teachers.
2. In universities, Teacher training departments may consider integrating STEM education content into their teachers training program's curriculum. Course outlines may need to be revised as part of this integration.
3. Teacher's training departments of universities may offer workshops and trainings on STEM/STEAM education to increase awareness and understanding of pre-service and in-service teachers. These initiatives may help bridge the gap identified in the study.
4. Teacher training departments may focus on refresher courses for in-service teachers, this will improve their familiarity with STEM education new trends, concepts and approaches.
5. Teacher's training departments may promote participation of in-service and pre-service teachers in STEM education projects and activities. An organized STEM curriculum, assistance from STEM experts, and the planning of training initiatives, that enhance STEM proficiency could all be part of this.
6. Teacher training departments may work together with educational experts to reform the curriculum and integrate structured STEM content. such collaborative efforts might

involve consulting with STEM professionals and educational researchers to ensure that the curriculum meets current and future demands.

7. To help in-service and pre-service teachers improve their knowledge and abilities in STEM education, teacher training departments may provide continuous professional development opportunities. Such opportunities could be lectures, workshops, or exhibitions, pedagogies and teaching practices in STEM education.

STEM education can be effectively integrated into teacher preparation programs by incorporating recommendations to equip instructors with the necessary skills to foster preservice teachers' curiosity, comprehension, and mastery of STEM subjects.

References

Aschbacher, P. R., Li, E., & Roth, E. J. (2014). Is science important to you? Predictors of students' career aspirations in STEM fields. *Journal of Research in Science Teaching*, 51(7), 1043-1080.

Ben-Peretz, M. (2001). The complex nature of teacher education: Shaping societal and individual goals. *Journal of Teacher Education*, 52(1), 48-56.

Bruce-Davis, M. N., Gubbins, E. J., Gilson, C. M., Villanueva, M., Foreman, J. L., & Rubenstein, L. D. (2014). The outcomes of STEM-focused high school programs on diverse student populations. *Journal of Advanced Academics*, 25(3), 187-216.

Bybee, R. W. (2010). Advancing STEM education: A 2020 vision. *Technology and Engineering Teacher*, 70(1), 30-35.

Du, X., & Wong, S. (2019). Chinese pre-service teachers' career aspirations and science-related expectations. *Asian Journal of Teacher Education*, 14(2), 78-90.

Hacioglu, Y., & Gulhan, G. (2021). STEM education and its impact on pre-service teachers' preparedness for the global labor market. *Journal of Global Educational Trends*, 29(4), 99- 112.

Institute for the Promotion of Teaching Science and Technology (IPST). (2013). STEM education in Thailand: Integrating science, technology, engineering, and mathematics to solve real- world problems. *IPST Educational Review*, 9(2), 56-64.

Jamali, M., Rehman, Z., & Ahmed, T. (2017). The impact of integrating STEM education with project-based learning in classroom settings. *International Journal of STEM Education*, 15(2), 112-125.

Ketenci, T., Anderson, J., & Hughes, L. (2020). Predictors of pre-service teachers' STEM career aspirations: A multi-dimensional analysis. *International Journal of STEM Education*, 7(1), 56-72.

Khan, A. (2015). Enhancing science instruction strategies for pre-service teachers: Addressing local and global community needs. *Journal of Science Teacher Education*, 18(2), 112-125.

Nguyen, T., Suratno, S., & Samsudin, A. (2020). Transdisciplinary skills and knowledge in STEM education: Preparing pre-service teachers. *Asia-Pacific Journal of Teacher Education*, 48(1), 44-58.

Reeve, E. M. (2013). Clarifying the meaning of STEM education: A review of policy, practice, and research. *Journal of STEM Education Research and Innovation*, 5(1), 12-25.

Rohrig, M., Reynante, R., & Gulhan, G. (2021). The foundation of integrated STEM education: Perspectives, skills, and knowledge for solving real-world problems. *Journal of Educational Research and Innovation*, 35(1), 56-70.

Samsudin, A., Suratno, S., & Hacioglu, Y. (2020). STEM education: Integrating academic subjects with real-world applications. *International Journal of STEM Education Research*, 12(3), 134-145.

Shaikh, S. (2019). Challenges of STEM education in Pakistan: A review of current practices and potential strategies for improvement. *Journal of Educational Research and Development*, 10(2), 45-58.

So, H. J., Kim, M. S., & Wong, S. (2020). Attitudes towards scientists and engineers: Impacts on pre-service teachers' STEM career aspirations. *Journal of STEM Teacher Education*, 25(3), 100-114.

Suratno, S., Nguyen, T., & Bruce-Davis, M. (2020). The role of STEM education in motivating pre-service teachers through creative problem solving. *Journal of Teacher Education and Training*, 18(2), 67-79.

Wahab, S., Anwar, M., & Khan, N. (2020). Barriers to effective STEM education in Pakistan: A focus on resource allocation and teacher training. *International Journal of Science and Technology Education Research*, 11(1), 25-34

Zajda, J. (2018). The future of science education reform: The role of STEM education. *International Journal of Educational Reform*, 27(1), 45-58.

Zajda, J., & Rust, V. (2016). STEM education and classroom reforms: Teacher educators' influence. *Journal of Global Education and Research*, 15(3), 221-234.