Journal of Positive School Psychology http://journalppw.com
2023, Vol. 7, No. 4, 11-28

Determining The Science, Technology, Engineering, And Mathematics Teaching Capabilities Of Educators In Karachi, Pakistan

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Abstract

Educators are expected to keep growing and improving all the time. They must be able to change and always get better. In the 21st century, teachers need to know a lot about science, technology, engineering, and math. The goal of this study is to find out how well educators can teach using STEMPCK. In this study, the STEM Pedagogical Content Knowledge Scale was used to measure teachers' STEM knowledge and their ability to grow as professionals to meet the needs and challenges of the 21st century. The STEMPCK Scale was divided into the subcategories: 21st-Century Skills, Pedagogical Content Knowledge, Mathematics, Science, Engineering, and Technology, as well as five demographic questions. To do what it was supposed to do, the study followed a protocol for quantitative research and had participants fill out a questionnaire. Five hundred and thirty-six teachers in Karachi, Pakistan, who worked in public secondary schools were given a survey questionnaire to collect information. SPSS and SMART PLS-SEM were used to analyze the data. Based on the results of analyses, the STEMPCK Scale can be used to test the STEM pedagogical knowledge of teachers. This research comes to a close with a high-quality and valuable discussion of pedagogical concerns for the professional development of teachers. It is suggested that teachers should first improve their STEMPCK skills in core subjects in order to teach STEM subjects to students effectively. Also, more research needs to be done in the diverse contexts.

Keywords: Teacher Learning; STEM; Pedagogical Content Knowledge; 21ST Century Skills.

Introduction

Teacher preparation for learners in the science, technology, engineering, and mathematics fields requires that teachers themselves have strong backgrounds in these areas. However, it is observed and specified that many educators lacked self-assurance when it came to actually influencing their students' enthusiasm for STEM careers in Karachi Pakistan at school levels. There is no denying the importance of teachers in inspiring their students to pursue careers in science, technology, engineering, and math (Margot & Kettler, 2019). Educators who focus on STEM courses strive to strengthen the STEM method at the secondary school level, (Nguyen et al., 2020). Educators should have the confidence to confidently offer lessons and lead workshops after being exposed to STEM-based information (Gardner et al., 2019). In the STEM fields that gets a lot of attention is mathematics. STEM education is essential for student's success. In order to foster learning in other fields, such as science, technology, and engineering, it is essential to first ensure that students have a solid grasp of the mathematical concepts that underpin those fields (English, 2016). He further described that once children grasp mathematics, they are better able to draw conclusions, evaluate evidence, and apply their knowledge to practical situations. The capacity to construct a predicted plan based on data-centered decision making is essential for mathematical literacy. Choices are weighed against ethical considerations and their potential economic and environmental effects. Furthermore, with the rapid development of computer technology within STEM, students can develop expertise in assessing how technology-enhanced STEM education might best serve their learning needs (Wu & Anderson, 2015).

It is undeniable that STEM education has become a focal point of international and national education policy discussions, making its integration into curriculum a major priority (Rahman et al., 2021). And also highlighted additional difficulties associated with integrating mathematics with other related STEM disciplines, including a lack of time for teachers to skill with a new pedagogical approach, difficulties in dividing the assessment, and problems addressing learning outcomes. Hence, many instructors, particularly math teachers, do not have an adequate background in STEM (Margot & Kettler, 2019). In addition, the study's authors argue that many math teachers did not do enough to stress the importance of STEM disciplines in the classroom (English & King, 2019). Educators' computer literacy is vital because of the dramatic changes in ICT since the turn of the century (Penprase, 2020). Teachers may or may not benefit from increased awareness and clarity regarding the need to adopt particular professional developments in teaching skills or pedagogical techniques. Several authors (Baker & Galanti, 2017) agree on this conclusion. Teachers need expertise in both the subject matter and the pedagogical approaches involved in order to successfully integrate STEM courses as part of an interdisciplinary and trans-disciplinary curriculum (Beswick & Fraser, 2019).

The success of integrated instruction will be hindered as long as teachers continue to teach STEM subjects separately (Yldrm & Turk, 2018). It was found that pupils' mathematical knowledge might be enhanced through exposure to STEM subjects in the classroom (English & King, 2019). Knowledge, understanding, skill development, values, and attitudes among students are at the heart of STEM education activities, and these outcomes have been proven to be related to teachers' pedagogical knowledge practices. Consequently, it is crucial to conduct this study, as it will provide evidence supporting the efficacy of pedagogical topic knowledge as a tool for implementing the STEM method in the classroom. In order to expose students' talents and, hopefully, one day fulfil the increased demand for a STEM-related workforce, the validated instrument can be used to map a course of action for enhancing instructors' preparedness and confidence in implementing STEM in the classroom.

Literature review

Technological innovation is causing concepts such as STEM (science, technology, engineering, and mathematics) to explode into the educational arena. It was designed to bring in a new era of innovative and compelling teaching and learning approaches. This term has had a greater impact on the teaching and learning processes from the beginning (Hinojo-Lucena et al., 2020). STEM, on the other hand, has flourished in a variety of ways worldwide. STEM began in the United States as "political reactionism to the political disposition of the United States' global hegemony," but STEM was considered as human capital in the United Kingdom (Blackley &

Howell, 2019). Asian countries, on the other hand, with their high-performing education systems and rising economies, have placed a heavy focus on science and technology in their curricula, encompassing both university-based and industry-driven research and development.

The demand for STEM is impacted by the low number of students majoring in or studying related fields in K-12 and higher education (Zaza et al., 2020). When it comes to meeting the secure demand for skilled Labour in the 21st century and achieving the goals of the Industrial Revolution 4.0 the country's greatest asset is its students (Abd Halim & Abd Halim, 2020). STEM education is a sensible strategy for the majority of the world's educational systems (Topcu, 2020). Recently, people have been wondering if and how mathematical concepts and procedures may be applied to other STEM fields in a more tangible way (English, 2015). According to Fitzallen (2015), the STEM fields offer a natural setting in which students can develop their mathematical abilities. Mathematics and computer science are frequently mentioned in conjunction with the CT skills. Students' ability to use computers and technology is influenced by how well they perform in mathematics. Educators are better able to work together when they have access to high-quality STEM education programs that help them effectively integrate the four STEM disciplines into relevant pedagogical methods. Teachers who are well-versed in STEM pedagogy and material (Yldrm & Sahin, 2019) are more likely to be able to engage in adaptive STEM teaching with their students. Because of this, it is important to create a valid and reliable tool for assessing mathematics instructors' STEM-related expertise.

STEM disciplines have typically been studied as separate courses in primary and secondary schools, with little effort spent to non-anecdotal integration, according to (Ortiz-Revilla et al., 2020). One of the most recent interdisciplinary projects is merged STEM education, and school disciplines are beginning to be integrated in educationally useful ways under its umbrella. STEM is gaining popularity as a reenergized approach. According to, people are increasingly requiring STEM knowledge to make informed decisions for themselves, their families, and other communities (Falloon, et al., 2020). Denying someone this education would result in discrimination. It is critical to promote optimal practices for teaching teachers in order to better prepare them for STEM subjects and activities. As a result, STEM instruction will be provided to students. The world will not benefit from enhanced STEM understanding and exposure for all students since increased exposure will result in more engineers, doctors, scientists, and mathematicians.

Science

STEM educators have demonstrated their commitment to the idea of integration through the use of design-based learning (Norton, 2008). For instance, Fortus et al. (2005) looked into whether or not students' efforts to build and transfer new scientific knowledge and problem-solving skills to the solution of a new real-world design problem in a real-world setting were supported by the implementation of a Design-Based Science (DBS) unit. The purpose of this research was to evaluate the usefulness of DBS units in facilitating the development and retention of students' scientific literacy. A total of 149 students participated in the DBS unit, and they were all given the same pre- and post-lesson written assessments to gauge how much they had learned. They concluded that there was a significant increase in the pupils' scientific topic knowledge. In addition, Riskowski et al. (2009) oversaw the implementation of an engineering design project focused on water resources with a group of eighth grade science students. Students were given a choice between a more traditional format (the "control") and an engineering project (the "treatment"), and their understanding of water resource concerns was tested both before and after they had participated. They determined that there was a statistically significant increase in two areas: students' level of thinking while responding to open-ended questions and their understanding of the topic matter. These are just two instances of integrative initiatives in science teaching that benefited students' knowledge acquisition (Becker & Park, 2011).

Technology

Technology education, which focuses on instructing students in the proper use of technology, made available design technology projects through which students may put their knowledge of science, mathematics, and technology to use (Lewis, 2006). Childress (1996) did research to see if tech ed students were more equipped to handle technological difficulties when TSM was incorporated into the curriculum. He examined how students dealt with technology challenges and whether or not their solutions were enhanced when they were part of a quasi-experimental study group. Based on his findings, he concluded that neither the experimental group nor the control group differed significantly from one another. In a traditional educational context predicated on various disciplines, Dawson and Venville (2009) looked into how integrated teaching and learning in science, mathematics, and technology may be described. They looked into how the new method of integrated teaching affected student achievement. They concluded that the technological project known as the Solar Boat gave students a setting in which to apply their knowledge in science, mathematics, and technology, and that this setting boosted the relevance of the students' knowledge. Overall, integrative efforts in technology education demonstrate the feasibility of providing students with constructivist learning and teaching settings through interdisciplinary approaches to STEM disciplines (Becker & Park, 2011).

Engineering

As a result of engineering design, instructors in the engineering industry have been able to integrate numerous STEM subjects (Apedoe et al., 2008). Therefore, it provided first-year engineering students with a solid foundation in mathematics, science, and engineering problem-solving, design, and teamwork. Researchers found that students in the integrated curriculum not only mastered the requisite mathematical and scientific content, but also developed an appreciation for its practical importance. Cantrell et al. (2006) developed the Teachers Integrating Engineering into Science (TIES) curriculum to stimulate the attention of students from a variety of demographics by including engineering design in a wide range of interactive learning activities. Several demographic categories were used to further dissect the assessment results, such as gender, race, special education enrollment, and family income. When children were grouped together based on their racial or ethnic background, the results showed that the pupils who had previously been at the bottom of the achievement curve made much bigger increases than those who had previously been at the top. They reasoned that if they included engineering-related projects in the curriculum, it might assist students from underrepresented groups in science catch up to their peers. Engineering design techniques are applicable to students of various backgrounds and skill levels, as evidenced by ongoing efforts to integrate engineering education (Becker & Park, 2011).

Mathematics

Math educators' past researches shows that interdisciplinary and multidisciplinary methods are key to students' academic performance in mathematics (Elliott et al., 2001). Also, they discussed the results of an interdisciplinary course titled "Algebra for the Sciences" on students' critical thinking, problem solving, and perspective of mathematics. They found no significant difference in problem-solving abilities between the multidisciplinary course and the collegiate algebra course, but the interdisciplinary students did make slightly larger advances in critical thinking and had much more positive attitudes about mathematics. When math is taught alongside science, technology, and engineering, students have the background they need to make real connections between the two disciplines (STE). Since mathematics is already included in STE, integrative approaches could be used to bridge the gap between mathematical abstractions and scientific contexts. To assist teachers in comprehending how to implement STEM ideas in the classroom, especially in mathematics, as stated by Siregar et al. (2019). Educators in the field of mathematics sometimes lack the background and expertise necessary to successfully show children the value of STEM fields (Song, 2019). Instructors have the responsibility of building on students' past knowledge, fostering students' ability to explain their thoughts coherently, and introducing them to new material (Koehler et al., 2015). Student-centered, peer-to-peer interaction with the given activities aids in conceptual clarity and meaningful connection (Priatna et al., 2020). Teachers can encourage higher student participation in mathematics classes by drawing on their own experiences in STEM fields (Koehler et al., 2015). As the backbone of the system responsible for implementing the nations educational curricular, teachers must have a solid understanding of the pedagogical content associated with STEM fields (Maass et al., 2019).

Empirical studies and STEM

Nguyen et al. (2020) agree that 21st-century instructors must be good learners. STEM education requires teachers to know these subjects and how to teach them. Pre-service teachers say STEM instruction requires STEM expertise, pedagogy knowledge, interdisciplinary correlations, incorporation knowledge, real-life connections, and enthusiasm. They also mentioned that teachers must be productive, up-to-date, open to new ideas, know 21st-century life sciences, and have general knowledge and skills (Yıldırım & Sidekli, 2018). According to Ostler (2012), instructors need pedagogical abilities to understand STEM approaches and apply STEM education in their classrooms. Weber et al. (2013) advised teachers to combine STEM subjects for STEM applications. The outcome suggests that STEM education's performance depends on teachers' methods, which largely resemble their training. Briggs (2017) suggests that teachers learn STEM subjects by doing. Thus, STEM education must be included. Teacher-centered activities and teacher-directed knowledge acquisition help teachers develop a good questioning approach (Kommers, 2019).

Teachers must understand the concept, think differently, and act differently to implement a new educational strategy (Chanthala et al., 2018). Effective STEM teaching approaches have long confused educators. Thus, teachers' capabilities enable STEM instruction (Rifandi & Rahmi, 2019). Effective STEM teachers must comprehend STEM pedagogical subject and have productive skills. Instructional leadership practices affect teaching strategies and effectiveness (Ali, Ahmad, & Sewani, 2022; Ahmad, Thomas, & Hamid, 2020: Ahmad, & Hamid, 2021; Ahmad, Sewani, & Ali, 2021; Ahmad, Ali, & Sewani, 2021). In-service teachers will have a solid foundation in integrated STEM and develop a passion in teaching from it. This improves STEM education and society. STEM education is crucial, and teachers with subject awareness and domain pedagogical content understanding increase STEM education instruction (Voronkova et al., 2018). STEM activities assist teachers grasp each domain and identify STEM learning outcomes. STEM teacher professional development can assess the impact on STEM students. STEM education makes students more employable and ready to meet emerging labour demands (Blackburn, 2017).

Methodology

The researchers used a quantitative research design (Creswell, 2014), and conducted our research using a survey technique that relied on questionnaires. The STEMPCK Scale, which was originally developed by Yildirim and Sahin (2019), was adapted with prior permission so that it could be used to evaluate teachers' STEM-related knowledge. The participants were chosen through a process known as purposive sampling. The STEMPCK survey was divided into three primary sections: pedagogical knowledge (12 items), STEM integration knowledge (8 items each for science, technology, engineering, and mathematics), and 21st-century learning (12 items). On a Likert scale with a maximum of five points, the items are scored from 1 for strongly disagreeing to 5 for strongly agreeing.

Data Analysis and Results

Demographics

Table 1 provides demographic details of the participants in the study. The table indicates that 50.9 percent of males and 49.1 percent female teachers participated in this study and almost half of the teachers (48.5%) were having the age of 31-40 years. A reasonable percentage of teachers (32.1%) were holding 11-15 years teaching experience where majority of them (58.8%) having the qualification of graduation. Amongst the total valid sample cases (n = 536), 54.3 percent have the professional qualification of M.Ed. and 45.7% have the B.Ed. in the current study.

Table 1 Demographic Information

		Frequency	**Percent**	**Cumulative Percent**
Gender	Male	273	50.9	50.9
	Female	263	49.1	49.1
	Total	536	100	100
Age Range	20-30 years	23	4.3	4.3
	31-40 years	260	48.5	48.5
	41-50 years	234	43.7	43.7
	Above 50 years	19	3.5	3.5
	Total	536	100	100
Experience	1-5 years	103	19.2	19.2
	6-10 years	156	29.1	29.1
	11-15 years	172	32.1	32.1
	16-20 years	105	19.6	19.6
	Total	536	100	100
Academic Qualification	Graduate	315	58.8	58.8
	Masters	202	37.7	37.7
	MS/M.Phil.	17	3.2	3.2
	PhD	2	0.3	0.3
	Total	536	100	100

Professional Qualification	B.Ed.	245	45.7	45.7
	M.Ed.	291	54.3	54.3
	Total	536	100	100

Measurement model

Table 2 Construct Reliability and Validity

Constructs	Cronbach'Alpha	rho_A	Composite Reliability	(AVE)
ENGI	**0.822**	0.861	**0.892**	**0.734**
MATH	**0.827**	0.876	**0.883**	**0.654**
PK	**0.838**	0.857	**0.891**	**0.671**
SCI	**0.728**	0.731	**0.845**	**0.644**
TEC	**0.769**	0.771	**0.867**	**0.684**
T1stCSK	**0.802**	0.810	**0.870**	**0.626**

In the PLS-SEM, researchers have used Cronbach's alpha and composite reliability with thresholds of 0.70 and 0.80, respectively. A further application of AVE is the estimation of the degree of convergence between markers of a latent component (Hair et al., 2013; Sarstedt et al., 2014). All latent constructs in this investigation have achieved a high level of reliability as determined by Cronbach's alpha and composite reliability, and their AVE coefficients were found to be greater than the indicated requirements. The findings from the studies construct reliability and validity tests demonstrate its convergent validity.

Table 3 Outer Loadings

Constructs	ENGI	MATH	PK	SCI	T1stCSK	TEC
ENGI1	**0.895**					
ENGI2	**0.885**					
ENGI3	**0.787**					
MATH4		**0.815**				
MATH5		**0.758**				
MATH6		**0.889**				
MATH7		**0.766**				
PK2			**0.759**			
PK3			**0.878**			
PK5			**0.839**			
PK6			**0.796**			
SCI2				**0.787**		
SCI4				**0.839**		
SCI8				**0.781**		
T1st_CSK10					**0.742**	
T1st_CSK6					**0.779**	
T1st_CSK7					**0.824**	
T1st_CSK9					**0.817**	

TEC5	**0.823**
TEC6	**0.833**
TEC7	**0.824**

For the most reliable results, Hair et al. (2016) recommend keeping only indicators with a reliability of at least 0.70 and discarding those with loadings of less than 0.40. Indicator reliability between 0.40 and 0.70 should be maintained due to their significant convergence. Indicators with reliabilities above 0.70 are all kept in the final model. For this reason, strong factor loadings are found for all markers of latent constructs (Hair et al., 2011), demonstrating construct validity.

Table 4 Discriminant validity

Construct	ENGI	MATH	PK	SCI	T1stCSK	TEC
ENGI	**0.857**					
MATH	0.384	**0.809**				
PK	0.791	0.352	**0.819**			
SCI	0.419	0.693	0.453	**0.803**		
T1stCSK	0.830	0.405	0.820	0.446	**0.791**	
TEC	0.697	0.409	0.790	0.467	0.950	**0.827**

Fornell and Larcker (1981) stipulate that the square-root of AVE for latent constructs must be bigger than correlation coefficients of other latent constructs (Hair et al., 2011). In this table, the values in bold across the diagonal represent the square-rooted AVE coefficients, whereas the values in regular font represent the correlations between latent constructs. As a result, discriminant validity according to the Fornell and Larcker (1981) criterion has been established, as all latent constructs were shown to be statistically distinct from one another in the measurement model.

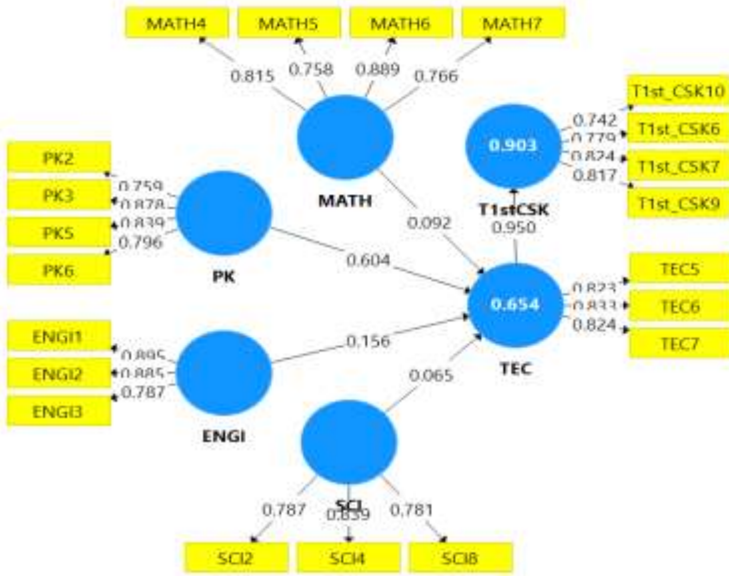


Table 5 Collinearity Statistics (VIF)

Outer VIF Values

Constructs with Items	VIF
ENGI1	**1.944**
ENGI2	**2.056**
ENGI3	**1.667**
MATH4	**1.777**
MATH5	**1.758**
MATH6	**2.105**
MATH7	**1.760**
PK2	**1.403**
PK3	**2.262**
PK5	**2.518**
PK6	**2.085**
SCI2	**1.721**
SCI4	**1.911**
SCI8	**1.247**
T1st_CSK10	**1.866**
T1st_CSK6	**1.551**
T1st_CSK7	**1.821**
T1st_CSK9	**2.223**
TEC5	**1.631**
TEC6	**1.613**
TEC7	**1.494**

Table 6 R Square

Constructs	R Square	R Square Adjusted
21st CSK	**0.903**	**0.903**
TEC	**0.654**	**0.652**

Exogenous constructs such as technology impact (TEC) and uncertainty have been identified in the model as shown in the table above (21st CSK). According to Hair et al. (2011), a structural model with an R-squared value of less than 25%, 50%, or 75% is regarded to have weak predictability, moderate predictability, or strong predictability, respectively. The model predictability for TEC is 0.64, while that for 21st century CSK is 0.903%; this means that while TEC's exogenous structures have some predictive potential, it is on the lower end of the spectrum.

Structural Model

Table 7 Hypothesis Testing

Constructs Hypothesis	Original Sample	Sample Mean	Standard Deviation	T Statistics	P Values	Decision
ENGI -> TEC	0.156	0.152	0.059	**2.650**	**0.008**	**Supported**
MATH -> TEC	0.092	0.090	0.041	**2.253**	**0.025**	**Supported**
PK -> TEC	0.604	0.610	0.063	**9.619**	**0.000**	**Supported**
SCI -> TEC	0.065	0.067	0.046	**1.406**	**0.160**	**Not Supported**
TEC -> T1stCSK	0.950	0.951	0.004	**239.491**	**0.000**	**Supported**

The results of the above table revealed that **(H_1)** Engineering has a positive significant impact on Technology, (t=**2.650**, p=**0.008**), **(H_2)** Mathematics has a positive significant impact on Technology (t=**2.253**,p=**0.025**), **(H_3)** Pedagogical Knowledge has a positive significant impact on Technology(t=**9.619**,p=**0.000**), **(H_4)** Science has an insignificant impact on Technology(t=,**1.406**p=**0.160**) and **(H_5)**Technology has a positive significant impact on 21st century skills of the educators(t=**239.491**,p=**0.000**).

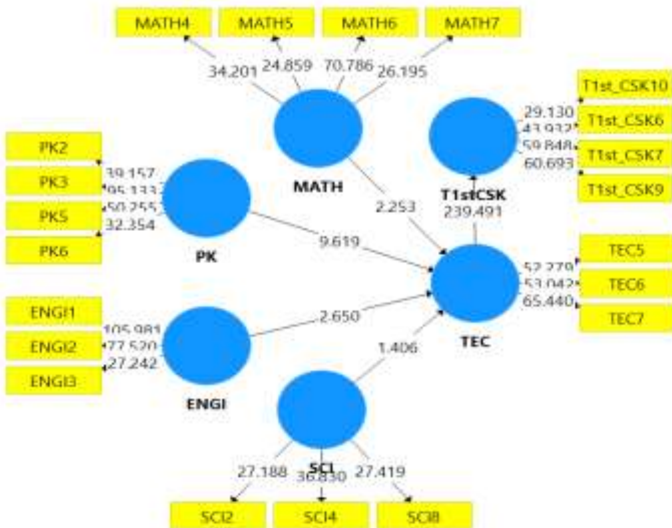
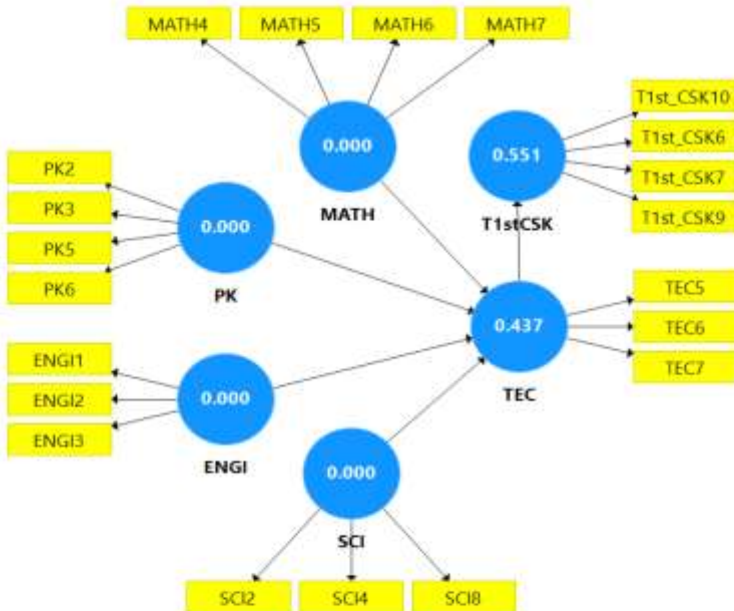


Table 8 Construct Cross validated Redundancy

Constructs	Q^2	Decision
21st CSK	**0.551**	Strong Predictive Relevance
TEC	**0.437**	Strong Predictive Relevance

The predictive relevance of exogenous constructs was assessed using a cross-validation and redundancy approach similar to that developed by Geisser (1975) and Stone (1975). With respect to this, Hair et al. (2013) suggested that Q2 should be more than zero, with poor predictive relevance falling in the range of 0.02–0.15, and moderate predictive relevance falling between 0.15 and 0.35. The following table shown that the effects on 21st century CSK have a 0.551 and the effects on TEC have a 0.43 strong predictive significance.



Discussion and Conclusion

The objective of this study was to determine the level of expertise that educators have in the subject areas of science, technology, engineering, and mathematics, as well as how they evaluate their capacity to incorporate technology into their lessons and the impact that this has on their ability to instruct students in the 21st century. There were 50.9 percent of male teachers and 49.1 percent female teachers who took part in this study, as indicated by the findings of the demographic characteristics of the participants. Also, at the time of the survey, nearly half of the teachers (48.5% of the total) were in the age range of 31 to 40 years old. A sizeable percentage of educators, 32%, had 11-15 years of experience teaching, and the majority of them, 58.8%, held a bachelor's degree or higher in education. There are a total of 536 real sample cases in the current research, of which 54.3% have the professional qualification of M.Ed. and 45.7% have the B.Ed. The researchers also utilized smart PLS to test the hypothesis, and the findings revealed that (H_1) Engineering has a positive significant impact on Technology, (t=2.650, p=0.008), (H_2) Mathematics has a positive significant impact on Technology (t=2.253,p=0.025), (H_3) Pedagogical Knowledge has a positive significant impact on Technology(t=9.619,p=0.000), (H_4) Science has an insignificant impact on Technology(t=,1.406p=0.1), and (H_5) Technology has a positive significant impact on 21st century skills of the educators(t=239.491,p=0.000).

As a result of the fact that hypothesis number four out of the five received support, which suggested that educators have a broad knowledge of the STEM teaching skills, the findings of this quantitative analysis revealed that educators have a profound comprehension of STEMPCK and its constituent parts. This was the case because hypothesis number four out of the five suggested that educators have broad knowledge of the STEM teaching skills. In addition, they do not possess the necessary understanding to educate students about scientific concepts through the application of various technologies. Teachers are bound to fully embrace and implement the skills into their lessons since STEM education entails combining STEM concepts and approaches to solve real-world problems. This means that instructors are required to fully embrace and incorporate the skills. Because science, technology, engineering, and mathematics require particular pedagogical competencies, teachers will need to develop new skills in order to increase the state of technological and scientific knowledge.

Recommendation

An essential aspect of this line of inquiry is the investigation of the ways in which it influences the formation of curricular programs. In-service teachers need access to professional development opportunities that will allow them to acquire a more in-depth understanding of STEM subjects so that they can improve their chances of being successful in the classroom. Students who are enrolled in education programs at universities and colleges should be required to take training courses that are focused on STEM (science, technology, engineering, and mathematics) as part of their academic requirements. In order to successfully carry out the teaching session, it is necessary to acquire a STEM enhanced digital understanding. New tactics improve learning effectiveness. Traditional and stem education are not identical. So for the beneficial expansion of the education system and to overcome problems and meet modern needs, instructors should consider the importance of stem/steam education as mentioned and illustrated in the present study to produce a favorable impact of modern practices on society. There is plenty of evidence that society prefers traditional teaching methods to new ones. Thus, institutes must examine, investigate, and implement effective methods to improve teacher skills. Educators must supply enough knowledge throughout educational levels. Institutes should also develop creative strategies to end ineffective teaching practices. To comprehend society's views on e-learning, which has hindered educators' efforts to reform the education system, surveys should be conducted. Institutes should guarantee teachers have a positive perspective by communicating and implementing effective plans. Finally, the institute must create a diverse learning management system to help students grasp new concepts. This would remove all barriers preventing educators from improving society.

To encourage 21st-century educational practices, teachers should participate in professional development programs. To boost teacher growth, the system should include a wide range of teacher philosophies. Teachers should also use different instructional tactics to motivate pupils to study and increase their ability to understand new concepts that answer modern problems. Teachers can also encourage pupils to use internet resources to expand their knowledge and problem-solve. In addition, institutes should improve their pedagogical framework to help teachers build critical thinking abilities and reduce paradoxical difficulties in subjects like science and technology, which involves specialized teacher training. For better planning and contemplation of instructional processes in the institute, teachers should develop their pedagogical skills. Additionally, teachers and students should communicate more to adopt effective tactics that help students succeed in their careers. Cultural variety should be fostered to create a peaceful and diverse campus environment. STEM education should also be fostered in teacher education institutes. Active learning promotes extrinsic behavioral changes and prepares pupils for future chances. For student success and social productivity, STEM education should be integrated. As technology alters society and is widely used, institutes should encourage its use. Technology will help pupils adjust and improve their learning habits. Teachers can also use teaching tactics that motivate students and produce lucrative, in-demand careers. In addition, classroom teachings should be well-oriented and include critical and creative thinking abilities to help students achieve their goals and satisfy 21st-century workforce standards. Teachers' capacity to educate in an applied manner can also encourage curricular change and education quality. Finally, teachers should encourage multidisciplinary knowledge exposure to foster students' vested desire in learning for academic and career success.

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