

## Assessment of the Impact of Teachers' Pedagogical Content Knowledge and Self-efficacy on Senior High School Learners' Mathematics Proficiency

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### Abstract

**Aim:** The purpose of this study was to provide insights into the specific ways in which teachers' pedagogical content knowledge and self-efficacy impact the mathematics proficiency of senior high school students.

**Methods:** The study employed positivism quantitative research approach and a descriptive design. The study sample size was 178 comprising 152 Home Economics students and 26 mathematics teachers. The sample members were chosen for the study using purposive sampling technique. A questionnaire and a test of mathematical proficiency were used to gather data. In this work, a basic linear regression model and descriptive statistics were employed as data analysis tools.

**Results:** The study's findings indicate that teachers have a relatively high level of pedagogical content knowledge, with mean scores ranging from 2.88 to 3.69; 2). The study also discovered that teachers have a relatively high level of self-efficacy, with mean scores ranging from 2.88 to 3.69; 3). Additionally, the findings of the simple linear regression analysis did not show a significant correlation between the pedagogical content knowledge, self-efficacy, and students' mathematics test performance.

**Conclusion:** The study concluded that teachers' pedagogical content knowledge and self-efficacy have no significant impact on senior high school learners' mathematics proficiency. This therefore implies that other elements, such as student background variables, school resources, or educational practices, may have a greater impact on students' mathematical success.

**Recommendation:** The study recommended that future studies use more complete measures of teacher dedication and other factors that may affect student outcomes to examine the association between teacher traits and student accomplishment in mathematics education.

**Keywords:** *Pedagogy of teaching, teacher, self-efficacy, mathematics proficiency.*

## INTRODUCTION

Education is a vital tool for the growth of both individuals and nations and cannot be overstated. Therefore, most countries emphasize on the quality of the educational system (Zhang, 2015). Education serves as the means through which knowledge; skills and competence are imparted to the youth which then allows them to play active roles in the development of the country (Wambugi, 2014). The main goal of education in a developing country like Ghana is ensuring residents achieve proficiency in literacy and numeracy (Yekple & Kumah, 2021). Regarding the visible role of education in Ghana, numeracy- which focuses on computational abilities and especially mathematics- is crucial (Asamoah et al., 2020). Ncube and Tshabalala (2013) emphasized that, any nation seeking to grow scientifically, technologically, or economically needs mathematics as a foundation and a tool. In addition to being important for academic credentials, mathematics also helps people get ready for the future; no matter what career path they take as well as enhance individuals' abilities to navigate their daily lives (Davies & Harsh, 2012). It continues to be the subject that education and people cannot meaningfully function without, because it is linked to everything in the world that is relevant to people's daily lives (Mefor, 2014).

By implementing the policies of the educational system, teachers have significant role to play on whether it succeeds or fails. The effectiveness of a nation's educational system and its overall success are largely dependent on its teacher's professional commitment. a teacher is a school's most important instructional resource (Kola & Sunday, 2015; Shahzad & Naureen 2017; Warrah et al., 2020). According to Aaronson and Sander (2007) and Rockoff, (2004) Teacher has great impact on how well learners perform. Adewuyi and Okemakinde (2013) stated that in order to accomplish the goals set forth by the country, teachers must play a significant role in ensuring that learners are appropriately prepared to fulfill their duties in society. The success of any educational system is largely dependent on the caliber of its teachers in terms of their training, experience, competence, and commitment to their jobs (Oluremi, 2013). The effectiveness and efficiency of the teachers determine the success of any teaching and learning as well as curriculum innovation process that affect the academic achievement of the learners (Quansah et al., 2024). Teachers are the ones that help students understand the topics that are expected of them (Owolabi & Adeyemo, 2011).

Nations all over the world continue to highlight the decline in mathematics performance of learners (Goos et al., 2020; Sintema, 2020; Conto et al., 2021; Norton, 2017). The case of Ghana is no different from the rest of the world. From 2018 to 2022, data shows that more than 33% of candidates who participated in the West African Secondary School Certificate Examination (WASSCE) did not attain a grade above C6 in core mathematics (Davis & Abass, 2023). Various causes have led to the underperformance in mathematics on a global scale, particularly in Africa. Teacher-related factors such as pedagogical content knowledge (PCK), self-efficacy and professional commitment appear to play a crucial role (Dori et al., 2023). The quality of teaching is a crucial factor in the school setting and has a substantial impact on learners' academic success in mathematics performance (Gichuru & Ongus, 2016; Goldhaber et al., 2019; Quansah & Ankoma-Sey, 2020).

PCK was defined by Lee Shulman (1986) as knowledge that is unique to teachers and is based on how instructors make connections between their pedagogical knowledge and subject matter knowledge. In teaching, pedagogical content knowledge entails combining these two aspects. PCK was seen by Park and Oliver (2014) as professional knowledge for educators. PCK support math teachers in effectively setting up and managing their classrooms, correcting misconceptions and misunderstandings from students, and applying effective teaching

techniques (Saad et al., 2015). Students that perform well in mathematics and show mastery of the subject are more likely to have teachers with a strong PCK (Moh'd et al., 2021; Cueto et al., 2017). Kola and Sunday (2015) stated that educators who possess a strong foundation in professional knowledge are able to effectively convey knowledge to students through appropriate teaching practices and possess the confidence to teach any topic in the mathematics curriculum.

Teacher self-efficacy is defined as the teacher's confidence in his or her skills and capacities to instruct and affect student behavior and accomplishment regardless of external influences or obstacles (Steele et al., 2018). According to Kola and Sunday (2015), in order for a teacher to be effective in their role, they must have the self-efficacy necessary for the subject. According to Ostad et al. (2019), teachers' confidence and self-perceptions may have a big influence on the caliber of their work. A study by Alexander (2020) revealed that highly efficacious teacher tends to be more committed to the teaching profession.

The self-efficacy of teachers is closely linked to their PCK, or fundamental knowledge. Teachers that possess self-efficacy believe in their own talents and have faith in their methods to complete the tasks. In specific situations, teachers' self-efficacy assures them that they can successfully impart knowledge to the pupils (Shahzad & Naureen, 2017). A teacher's self-efficacy increases with the amount of PCK they possess (Kola & Sunday, 2015). High self-efficacy teachers are more likely to be dedicated to their work, which results in excellent academic performance (Shahzad & Naureen, 2017). Students' performance is impacted by teachers' pedagogical content understanding (Mahmud, 2021; Suglo et al., 2023). Additionally, Kumi (2023) cited Ghanizadeh and Moafian (2014), who highlighted that teacher's self-efficacy views had a consistent relationship with students' academic progress. Kilday et al. (2016) contended that low self-efficacy teachers had a detrimental effect on students' performance for this reason. According to Alexander (2020), there is a strong correlation between teachers' self-efficacy beliefs and their level of self-motivation, professional dedication, and successful teaching. Fabelico and Afalla (2020) came to the conclusion that while high levels of teacher dedication correlate with learners' good academic accomplishment, low levels of teacher commitment result in bad student achievement scores.

According to Yeng et al. (2022), cited in Owusu-Addo (2022), there has been a discernible upsurge in public dissatisfaction in recent times concerning the decline in educational quality in Ghana. According to the Chief Examiners' Reports on the tests administered to Senior High School (SHS) students in Ghana by the West Africa Examination Council (WAEC), the regional examining authority, math is a subject in which students routinely perform poorly. The ongoing underperformance in mathematics is detrimental to Ghana's higher education system as well as the nation's economic future. A sizeable portion of high school graduates fall short of the required performance standards in mathematics, which makes it difficult for them to successfully pursue degrees in mathematics and science-related disciplines after graduation (MoE, 2019). Math proficiency is essential for students to continue on their learning path and to land well-paying jobs in the future.

The effect of teachers' pedagogical content knowledge on students' mathematical ability has been the subject of several research projects. The studies of Suglo et al. (2023), Shing et al. (2018), Zhang (2015), and Fletcher et al. (2014) are a few of these examinations. Furthermore, the relationship between teachers' self-efficacy and pupils' mathematical achievement has been the subject of additional studies. Charviani (2019), Apoenchir (2023), Togah et al. (2022), and Partida (2022) have all made significant contributions in this field. The other authors mentioned are Adjei (2018) and Shahzad & Naureen (2017). These concepts and how they impact students'

success in learning mathematics has been the subject of some studies (Norton, 2019; Kola & Sunday, 2015; Fox, 2014). Regretfully, the current research location lacks study literature on the effects of teacher pedagogical topic knowledge, professional commitment, and self-efficacy on students' academic progress in mathematics.

### **Objectives of the Study**

1. Explore the level of teachers' pedagogical content knowledge.
2. Examine the level of teachers' self-efficacy.

### **Research Hypothesis**

The following hypotheses guided the study:

H<sub>01</sub>: There is no significant impact of teachers' PCK on learners' mathematics proficiency.

H<sub>02</sub>: There is no significant impact of teachers' self-efficacy on learners' mathematics proficiency.

## **LITERATURE REVIEW**

### **Pedagogical Content Knowledge**

Does pedagogy ensure that one becomes the most proficient teacher? Is it necessary for a teacher to possess expertise in a certain subject? Is it a requirement for a content specialist to possess teaching competence in the same subject? These are some of the numerous inquiries that have perplexed the realm of teaching Zhang (2015). According to Shulman (1986) PCK is a particular type of pedagogical knowledge that includes knowledge of common misconceptions and biases. According to Shulman, PCK includes a thorough comprehension of the most significant. This body of knowledge, according to Shulman, is a "special amalgam of content and pedagogy" that sets a teacher's proficiency apart from a content specialist.

PCK can be divided into three categories: curricular and student knowledge, pedagogical knowledge, and content knowledge. The instructors' comprehension of the subject matter and its connections to other ideas is referred to as content knowledge. Pedagogical knowledge pertains to the instructional practices that educators employ to help pupils grasp the material. General information concerning teaching, such as guidelines followed in the classroom or the model of instruction employed, is referred to as pedagogical knowledge. This also covers the many theories of learning that educators pick up during their training as educators or after working as teachers for a while (Alimuiddin et al., 2020). Knowledge of students deals with the teachers' ability to ask the right questions that will lead to the understanding of students' conceptions, misconceptions or errors of the content. The teachers then go further to find out the reasons behind these misconceptions or errors and provide suitable solutions.

Turnuklu and Yesildere (2007) as cited in Depaepe, (2015) stress that in addition to having the capacity to address students' learning difficulties; teachers should be able to understand students' thought processes through the use of pertinent and meaningful questions. Rather than only providing answers and explanations, a teacher's main duty is to recognize and address the shortcomings and difficulties of their students while also providing them with guidance and assistance. Teachers must also recognize that every student has unique needs when it comes to understanding the curriculum. Strong foundational knowledge PCK teachers are more likely to employ successful teaching strategies to enhance their students' learning, which results in students achieving higher math grades and demonstrating subject proficiency (Ansah et al., 2020; Cueto, 2017).

### **Teachers' Level of Pedagogical Content Knowledge**

Based on factors including experience, subject matter competence, professional development, student-centered approach, and adaptability, a teacher's level of PCK can vary significantly (Martins & Baptista, 2024). It is commonly known that teachers must possess proficiency in PCK to effectively plan, carry out, and assess instruction (e.g., Krepf et al., 2018; Kulgemeyer & Riese, 2018; Rollnick, 2017). For this reason, improving instructors' advanced PCK is crucial to their efficiency in the classroom and, by extension, to students' learning.

According to data from Cueto et al. (2017) and Callingham et al. (2016), better achievement in mathematics is associated with teachers who have a better level of PCK. The levels of PCK held by teachers have been the subject of several studies. To assess the PCK of mathematics instructors in specific secondary schools in Zanzibar et al. (2021) used mixed-methods research to study 69 instructors who were given a Likert-scale questionnaire on PCK self-assessment; 12 of them were watched three times while delivering lessons in their respective mathematics courses. Statistical techniques that were descriptive, inferential, and qualitative were used. The results of a questionnaire-based study showed that math teachers had a modest level of PCK. On the other hand, there were notable differences in PCK levels based on the educational background and experience of instructors, whereas there were no appreciable variations in PCK levels based on the specializations of teachers. Based on observation, the results indicated that there is little PCK in classroom activities. This illustrates the challenges teachers have implementing PCK in their lesson plans. As a result, they argued that more in-service training was necessary to raise instructors' PCK levels, which will ultimately result in improved mathematics instruction.

According to Yusof et al. (2012) study's results, 97.1% of participants had moderate to high levels of general PCK. This shows that the general PCK of the teachers in this sample was good. A different study by Park et al. (2020) used 166 secondary science instructors from the United States and South Korea to assess which proxy indicators of teacher quality best predict teachers' PCK levels. This study also looked at the PCK levels of teachers in both nations. A PCK survey with thirty dichotomous and open-ended items was given to secondary science teachers in Seoul, South Korea, and a Midwest state in the United States. Eighty-five and eighty-one participants from the U.S. and South Korea, respectively, completed surveys. According to statistical research, the two factors that significantly influenced PCK total scores were high school biology teaching certification and teaching. There was no discernible relationship between the PCK total scores and the gender or number of years of teaching experience of the teachers. Even while Korean teachers scored higher overall on PCK than American teachers, both Korean and American educators found it difficult to make connections between their understanding of instructional strategies and their perception of students' learning. Robust PCK improves instruction quality and helps students achieve their learning objectives.

### **Teachers' Level of Self-efficacy**

According to Barni et al. (2019), the level of teacher self-efficacy varies based on the individual, their experience, and the setting they operate in, but it can be broadly grouped into three areas. The three specific factors that are being examined are the effectiveness of instruction, classroom management, and student engagement. An analysis of variations in teacher self-efficacy from the student teaching experience to the third year of teaching was conducted by Swan et al. (2011). The population consisted of all Ohio State University student teachers who were enrolled. Of the 34 participants in the student teaching program, 17 went on

to become teachers. Using the Teachers Sense of Efficacy Scale (Tschannen-Moran and Woolfolk Hoy, 2001), the researchers assessed the study participants four times: after their student teaching assignments were finished, and once their first, second, and third years of teaching were up. At the end of their first year of teaching, participants reported the lowest levels of teacher self-efficacy, and at the end of their student teaching internship, the highest levels. Participants consistently reported the lowest levels of teacher self-efficacy in the student engagement category across all evaluations.

Furthermore, Abu-Tineh et al. (2011) undertook a study that was driven by two primary objectives. Finding out how much Jordanian instructors used classroom management techniques and how confident they felt in their own abilities as educators was the first step. Examining the relationships between teacher self-efficacy and classroom management strategies was the second objective. This study used a survey design and is quantitative in nature. Various statistical techniques were used in this investigation. The Pearson product moment correlation coefficient ( $r$ ), means, and standard deviations were the main statistical techniques used. The study's findings show that instructional classroom management - as opposed to behavior management and people management - is the technique that Jordanian educators mostly use. Nevertheless, it was shown that Jordanian instructors used people management the least frequently. Furthermore, compared to generic teacher efficacy, Jordanian instructors who took part in this survey believed they had a higher level of personal teacher efficacy. Ultimately, the strongest and most significant correlation found with all classroom management styles as well as the overall classroom management styles is with personal teacher efficacy. Nonetheless, it was discovered that there was little to no correlation between general teacher efficacy and any of the classroom management strategies or general classroom management styles.

### **Teachers' Pedagogical Content Knowledge and Learners' Mathematics Proficiency**

According to Shulman (1987), PCK is a special blend of pedagogy and content that is exclusively within the domain of teachers - their own distinct form of professional understanding. According to Shulman (1986), teachers require particular kinds of topic knowledge in addition to subject matter expertise in order to instruct students effectively. According to Shulman, pedagogical content knowledge is the synthesis of pedagogy and content into an awareness of how certain topics, problems, or challenges are organized, depicted, and customized to the various interests and abilities of students prior to being made available for instruction.

Regardless of the topic matter, pedagogical knowledge is the specific information that educators possess and apply to establish a supportive and productive learning environment for every student. This knowledge has a significant impact on the learning outcomes (Thaanyane, 2021). In addition, the study conducted by Kalioldanovna et al. (2022) revealed that the attainment of high academic performance is contingent upon the effective transmission of knowledge by the teacher to the learners. In order to promote complete learning, educators with excellent PCK can combine their grasp of mathematical ideas with other teaching strategies (Dhlamini, 2022). Mathematics teachers with a high degree of PCK have a favorable effect on student learning, which leads to improved academic performance, according to Moh'd et al. (2021) and Tatto et al. (2020).

According to a Zhang (2015) study, teachers in Chicago who had higher PCK scores were more likely to employ successful teaching techniques like asking students about their prior knowledge, giving feedback, and encouraging mathematical discourse. The study also looked

at the relationship between early childhood teachers' PCK in mathematics and their teaching and learning outcomes. Teachers of mathematics who are well-versed in PCK may convey knowledge and skills to pupils in an efficient manner.

A mixed methods study by Suglo et al. (2023), looked at how teachers' pedagogical content knowledge affected students' academic performance in the circle theorem in Ghana's Sefwi Wiawso municipality, teachers' pedagogical content knowledge is significantly correlated with students' academic progress in the circle theorem? This implies that a change in a teacher's pedagogical subject comprehension, whether positive or negative, will have a commensurate effect on students' academic achievement. As a result, they suggested that The Ghana Education Service hold seminars and training conferences to increase teachers' pedagogical content knowledge.

Cueto et al. (2016) carried out a study in Peru to see if PCK is associated with children's arithmetic success after adjusting for factors at the individual, family, teacher, and school levels. To investigate these elements, their study used data from the Peruvian Young Lives survey in conjunction with a longitudinal approach. The study suggests that there is a good correlation between teachers' PCK and student accomplishment, especially when a test threshold is set for the PCK.

Ansah et al.'s (2020) study looked into how teachers' backgrounds and expertise affected their pupils' arithmetic achievement in Ghanaian senior high schools. To be more precise, it looks at how subject matter knowledge (SMK), PCK, and teachers' experience interact to explain variations in students' math achievement. The purpose of the study was to shed light on the interactions between these factors and how they impact the mathematical learning results of students. Following a survey of 210 SHS teachers and 8,400 students nationwide, algebra activities were given out while accounting for the relevant variables. The number of years spent instructing math in SHS was used to define the teaching experience. An instrument modified from Michigan State University's Knowledge of Algebra for Teaching (KAT) project (2012) was used to measure the other variables. Their study's findings demonstrated that students' achievement in mathematics is highly influenced by both PCK and subject matter knowledge (SMK).

### **Teacher Self-efficacy and Learners' Mathematics Proficiency**

Predicting the amount of effort required in an activity is the definition of self-efficacy, according to de Jong et al. (2014). Self-efficacy is the belief in one's own ability to do a task successfully. A person's level of self-efficacy establishes how closely their purpose aligns with their interests and the activities they have chosen (Kumi, 2023). The significance of self-efficacy in learning was underscored by the author. Tschannen-Moran and Hoy's (2001) study found that students' self-efficacy, motivation, and achievement results are influenced by how well a teacher teaches.

Studies have indicated how self-efficacy affects behavioral outcomes such as choice, perseverance, and effort to do similar tasks in the future. In a Californian study by Patirida (2022) examined the relationship between instructors' self-efficacy and the arithmetic achievement of racial and ethnic minority (REM) pupils in high school. The study's use of data from the 2009 high school longitudinal study and multilevel modeling to analyze the effects of individual, teacher, and school factors on student outcomes showed that teacher self-efficacy was strongly associated with the Mathematics Achievement of REM students, even after controlling for prior achievement, individual student characteristics, and teacher quality measure.

Zee and Koomen (2016) conducted an up-to-date, critical review of forty years of research on teacher self-efficacy (TSE) and its effects on the quality of classroom procedures, students' academic adjustment, and teachers' psychological well-being in order to investigate the relationships between TSE and outcomes at various levels of the classroom ecology and to identify any knowledge gaps in the field. A review of 165 empirical studies using criteria revealed that teacher self-efficacy positively impacted students' academic adjustment, the quality of classroom processes, and the psychological health of the instructors.

Fox (2014) studied the relationship between teacher self-efficacy, subject and pedagogical understanding, and student achievement in Algebra I in Virginia, USA. The study's mixed-method approach demonstrated a favorable correlation between instructors' self-efficacy for teaching mathematics and students' achievement in Algebra I, even after controlling for prior achievement and socioeconomic background. While observations and interviews provided the qualitative data, surveys and standardized tests provided the quantitative data. This suggests that teachers who believe they can help kids learn mathematics will be able to help their students learn more effectively.

To learn more about senior high school teachers' perceptions of their own efficacy in teaching mathematics in Ghana's Central Tongu District in the Volta Region, Kumi (2023) carried out a mixed study. The goal of the study was to determine the degree to which math teachers believe they are capable of teaching the subject and how this belief influences their teaching strategies and perhaps student performance. Using a simple random process, the researcher chose thirty students and thirty math teachers from senior high schools in Ghana's Volta region's Central Tongu district. An overall mean of (4.57, SD=0.57) was found in the data, suggesting that teachers are highly confident in their ability to teach mathematics to SHS students. Consequently, it was found that while teachers felt very competent in their ability to teach mathematics to SHS students, this had no bearing on the schools' performance on the tests. As a result, the study shows that instructors' strong self-efficacy attitudes may not always translate into improved mathematical ability.

A study carried out by Pratiwi et al. (2024), which sought to determine the relationship between teacher self-efficacy and student achievement using quantitative research methods with a population of 152 students. Researchers used non-probability sampling technique with incidental sampling technique, obtained 58 samples. Data collection in this study used a scale (questionnaire/questionnaire) via google form using a Likert scale and documentation method in the form of IPS scores (Semester Achievement Index) to measure student achievement. The data analysis technique used Spearman Rho correlation test with SPSS 25.0 program. The results of this study indicate that there is no relationship between teacher self-efficacy and student achievement.

## **METHODOLOGY**

A quantitative descriptive survey approach was used for this study. Data were collected using a mathematics proficiency test instrument and a self-designed questionnaire. The mathematics proficiency test assessed students' performance, while the questionnaire gathered information related to the study's objectives. The questionnaire utilized a 4-point Likert scale, with the following ratings: strongly agree (3.5-4.0), agree (2.5-3.4), disagree (1.5-2.4), and strongly disagree (1-1.4). Data analysis employed descriptive statistics and inferential statistics such as simple linear regression models to evaluate the impact of teacher PCK and teacher self-efficacy on students' mathematics proficiency. The researchers provided ethical clearance and introduction letters to the schools, which granted permission for the study. This was followed

by administering the mathematics proficiency test to the students and, lastly, distributing the questionnaire to the teachers to fill out. The accessible population in each school was as follows: School A had 94 students, School B had 76 students, and School C also had 76 students. The number of accessible teachers included 12 in School A, 8 in School B, and 6 in School C. This resulted in a total of 246 home economics students and 26 math teachers across the three schools, making the overall study population 272. The sample size for the study was 178, consisting of 152 students and 26 teachers from the three schools. The sample size for students was determined using Yamane's formula, while the 26 teachers were selected purposively.

## RESULTS AND DISCUSSIONS

### Objective 1: Explore the level of teachers' pedagogical content knowledge.

**Table 1: Descriptive Statistics for Teachers' Pedagogical Content Knowledge**

| Statement                                                                                                          | N  | Minimum | Maximum | Mean | Std. Deviation |
|--------------------------------------------------------------------------------------------------------------------|----|---------|---------|------|----------------|
| I have the ability to select appropriate mathematical tasks that align with the learning goals of my student       | 26 | 3       | 4       | 3.69 | .471           |
| I am able to incorporate real-world contexts into my mathematics lessons to make them more relevant to my students | 26 | 2       | 4       | 3.54 | .582           |
| I regularly reflect on my teaching practices and identify areas for improvement                                    | 26 | 3       | 4       | 3.69 | .471           |
| I can design assessments that effectively measure students' mathematics understanding and progress                 | 26 | 3       | 4       | 3.62 | .496           |
| I can identify and address common misconceptions in mathematics                                                    | 26 | 2       | 4       | 3.35 | .629           |
| I am skilled in developing lesson plans that align with curriculum standards                                       | 26 | 2       | 4       | 3.42 | .578           |
| I can effectively use technology to support my teaching of the content                                             | 26 | 2       | 4       | 3.42 | .578           |
| I regularly update my knowledge about recent developments in my subject area                                       | 26 | 2       | 4       | 3.35 | .629           |
| I can adapt my teaching strategies to cater to diverse learning styles                                             | 26 | 2       | 4       | 3.35 | .629           |
| I am proficient in using formative assessment to guide my instruction                                              | 26 | 2       | 4       | 2.88 | .864           |

*Source: Field data, 2024*

With mean scores ranging from 2.88 to 3.69, the results show that the teachers have a good degree of pedagogical topic understanding. The teachers' consistent responses are indicated by the comparatively low standard deviations. The body of research indicates that pedagogical content knowledge is essential to effective instruction (Shulman, 1987). Instructors possessing extensive understanding of pedagogical content are more capable of creating and implementing lessons that cater to the needs of their pupils (Cohen & Ball, 1990).

**Objective two: Examine the level of teachers' self-efficacy.**

**Table 2: Descriptive Statistics for Teachers' Self-Efficacy**

| Statement                                                                               | N  | Minimum | Maximum | Mean | Std. Deviation |
|-----------------------------------------------------------------------------------------|----|---------|---------|------|----------------|
| I can establish a classroom management system with each group of students               | 26 | 3       | 4       | 3.69 | 0.471          |
| I am capable of motivating students who show low interest in schoolwork.                | 26 | 2       | 4       | 3.54 | 0.582          |
| I can engage students in meaningful learning activities.                                | 26 | 3       | 4       | 3.69 | 0.471          |
| I am able help students' value learning.                                                | 26 | 3       | 4       | 3.62 | 0.496          |
| Improving the understanding of students who are failing is my strength.                 | 26 | 2       | 4       | 3.35 | 0.629          |
| I have confidence in my ability to help students believe they can do well in schoolwork | 26 | 2       | 4       | 3.42 | 0.578          |
| Maintaining a positive classroom environment is my priority.                            | 26 | 2       | 4       | 3.42 | 0.578          |
| I can control disruptive behavior in my classroom                                       | 26 | 2       | 4       | 3.35 | 0.629          |
| I am able to foster creativity in my students.                                          | 26 | 2       | 4       | 3.35 | 0.629          |
| I have confidence to implement alternative strategies in my classroom                   | 26 | 2       | 4       | 2.88 | 0.864          |

*Source: Field data, 2024*

With mean scores ranging from 2.88 to 3.69 in Table 2, the results show that the teachers have a rather high level of self-efficacy. The teachers' consistent responses are indicated by the comparatively low standard deviations. The research indicates that a key element of teaching effectiveness is self-efficacy (Bandura, 1997). According to Tschannen-Moran and Hoy (2001),

educators who possess a high degree of self-efficacy are inclined to have faith in their capacity to instruct and adjust to novel circumstances.

### Objective 3: Assess the impact of teacher PCK on learners' mathematics proficiency

**Table 3: Results for the Impact of Teacher PCK on Learners' Mathematics Proficiency**

| Model Summary |          |                            |       |     |     |        |
|---------------|----------|----------------------------|-------|-----|-----|--------|
| R             | R Square | Std. Error of the Estimate | F     | df1 | df2 | Sig. v |
| .679a         | 0.460    | 4.5                        | 1.281 | 10  | 15  | 0.322  |

a. Predictors: (Constant), S10, S8, S4, S1, S9, S6, S3, S5, S7, S2

Source: Field data, 2024

Findings in table 3 show that the model (R Square =.461) accounts for 46.1% of the variation in students' mathematics proficiency. However, the prediction of learners' mathematics proficiency is not significantly improved by adding teacher PCK to the model (R Square Change =.461, F Change = 1.281, p =.322).

### Objective 4: Determine the impact of teacher self-efficacy on learners' mathematics proficiency

**Table 4: Simple Linear Regression Analysis for Objective Five**

| Model Summary |       |          |                            |          |     |     |               |
|---------------|-------|----------|----------------------------|----------|-----|-----|---------------|
| Model         | R     | R Square | Std. Error of the Estimate | F Change | df1 | df2 | Sig. F Change |
| 1             | .679a | 0.461    | 4.5                        | 1.281    | 10  | 15  | 0.322         |

a. Predictors: (Constant), S10, S8, S4, S1, S9, S6, S3, S5, S7, S2

Source: field data, 2024

From findings in table 4, the model (R Square =.461) accounts for 46.1% of the variation in students' math skill. The model's ability to predict students' mathematical proficiency is greatly enhanced when teacher self-efficacy is included (R Square Change =.461, F Change = 1.281, p =.322). Furthermore, the F Change value of 0.322 indicates that the inclusion of teacher self-efficacy as a predictor variable does not significantly improve the model. I should have mentioned that there is no evidence of a substantial correlation between learners' mathematical proficiency and teachers' self-efficacy.

## DISCUSSION

### Objective 1: Explore the Level of Teachers' Pedagogical Content Knowledge.

According to the study's findings, the teachers in this sample had a solid background in pedagogical topic knowledge. This confirmed the findings of previous studies by Yusof et al., (2012), Park and Reynolds, (2020) and Moh'd et al., (2021). These studies also reported high levels of teachers' pedagogical content knowledge. But there's still space for development, especially in areas like lesson planning and evaluation (S10). The high mean scores on scales

S1-S4 suggest that teachers have the ability to design and deliver instruction that meets the needs of their students. This is consistent with the literature, which suggests that teachers with high levels of pedagogical content knowledge are better able to design and deliver instruction that meets the needs of their students (Cohen & Ball, 1990). The lower mean scores on the S5–S10 scales simply that teachers could require more assistance with tasks like lesson planning and assessment. This is in line with research that indicates teachers could find certain teaching-related challenges challenging (Wiggins & McTighe, 2005). The comparatively low standard deviations across all measures suggest that the responses provided by the teachers were consistent. This shows that there is a consensus among the teachers in this sample regarding what makes for good teaching techniques. In conclusion, the study's findings indicate that although the teachers in this sample possess a solid basis of pedagogical material knowledge, they might still want extra assistance with tasks like lesson planning and assessment.

### **Objective 2: Examine the Level of Teachers' Self-Efficacy.**

In line with previous research, (Abu-Tineh et al., 2011; Swan et al., 2011) the study's findings indicated from Table 2, that the teachers in this sample possess a high degree of self-efficacy. But there's certainly space for development, especially in areas like instructional tactics and classroom management (S10). The study's findings do, however, also point to the need for further development, notably in areas like instructional tactics and classroom management (S10). This is in line with research that indicates teachers could find certain teaching-related challenges challenging (Wiggins & McTighe, 2005). Furthermore, the study's findings imply that a teacher's degree of training and experience may have an impact on their sense of self-efficacy which is also in line with the studies of Ding and Hong (2024) and Devi and Ganguly (2024). Also, Guskey's (2002) study discovered that teachers with greater experience and training were more likely to have higher levels of self-efficacy. In summary, the study's findings indicate that teachers' self-efficacy plays a significant role in their performance as educators and that there are certain areas in which they can benefit from further training and assistance.

### **Null hypothesis (H<sub>01</sub>): There is no significant impact of teachers' PCK on learners' mathematics proficiency.**

The literature indicates that a key component of student learning outcomes is teacher PCK (Shulman, 1987). The study's findings from Table 3, however, contradict this conclusion. This could be because of the small sample size or the instruments employed for measurement. The relationship between student accomplishment and teachers' PCK has been the subject of conflicting research. Some research indicates a favorable association, (Zhang, 2015; Cueto et al., 2016; Suglo et al., 2023) but other studies have not discovered any meaningful connection. As per the findings of Hill & Ball (2005), Krauss et al. (2008), Ozak et al. (2022) and Emine Gül Çelebi-Ilhan (2022) there was no significant correlation observed between instructor PCK and student achievement in mathematics and science. Despite the small sample sizes and methodological flaws in these studies, their results imply that instructor PCK may not be as important to student progress as previously believed. Furthermore, other elements such as the attitudes and beliefs of teachers might have a greater impact on students' academic success (Fennema et al., 1996; Philipp, 2007). Therefore, while some evidence suggests a relationship between teacher PCK and student achievement, the connection is not as clear-cut as previously believed, and further research is necessary to fully understand this relationship.

**Null hypothesis (H<sub>02</sub>): There is no significant impact of teachers' self-efficacy on learners' mathematics proficiency.**

Previous studies have indicated that, a key component of student learning outcomes is teacher self-efficacy (Fox, 2014; Zee & Koomen, 2016; Hassan, 2019; Patirda, 2022). Increased student accomplishment results from supportive learning environments created by teachers who have high self-efficacy (Skaalvik & Skaalvik, 2007). This conclusion is however, contradicted by the study's findings from Table 5 which indicate that teachers' level of self-efficacy did not have a bearing on students' mathematical proficiency. This confirms the findings of Mahler et al. (2019), Kumi (2023), and Pratiwi et al. (2024), that teachers' strong self-efficacy attitudes may not always translate into improved mathematical ability of students.

## **CONCLUSION**

This study examined the association between student mathematics accomplishment and teacher attributes (pedagogical content knowledge, self-efficacy) with a particular emphasis on student mathematics proficiency. The results of this study showed that these teachers Pedagogical Content Knowledge and Self-Efficacy have no discernible association with students' mathematics achievement, despite the literature's suggestion that they are necessary for effective teaching and learning. This implies that other elements, such as student background variables, school resources, or educational practices, may have a greater impact on students' mathematical success. Additionally, the study's results indicate that the measures used to assess teacher characteristics and student mathematics proficiency was not robust enough to capture the complex relationships between these variables. This study contributes to the ongoing debate about the importance of teacher characteristics in shaping student learning outcomes and highlights the need for further research to uncover the nuanced dynamics at play.

## **RECOMMENDATIONS**

### **Prioritizing the Acquisition of PCK in Teacher Education Programs**

It is essential for teacher education programs to prioritize the acquisition of PCK among pre-service teachers. Teacher education institutions should integrate comprehensive PCK training into their curricula, ensuring that future educators are well-equipped to effectively teach mathematics. This initiative should involve curriculum developers and faculty members who will collaborate to design and implement courses focused on PCK. The target audience for this training will be pre-service teachers enrolled in these programs. This recommendation should be enacted immediately, with a timeline of one academic year for curriculum development and implementation. By enhancing the PCK of pre-service teachers, we can improve their instructional effectiveness, ultimately leading to better student outcomes in mathematics.

### **Creating a Motivating and Encouraging Learning Environment**

Policymakers and educators must focus on developing a motivating and encouraging learning environment for students. School administrators should take the lead in fostering such environments by providing ongoing professional development for teachers, emphasizing strategies that promote student engagement and motivation. This initiative should target both educators and school leadership teams, ensuring that all staff members are equipped with the skills to create supportive classroom atmospheres. The implementation of this recommendation should be a continuous effort, with specific workshops and training sessions scheduled throughout the academic year. Establishing a positive learning environment is crucial, as it has been shown to significantly enhance student motivation and academic achievement.

## Examining the Relationship between Teacher Traits and Student Achievement

Future research should adopt a more comprehensive approach to measuring teacher commitment and other variables that may influence student outcomes, particularly in mathematics instruction. Research institutions and educational policymakers should collaborate to design studies that explore these relationships more thoroughly. This research should target a diverse range of schools and include various demographic factors to ensure generalizability. Timelines for this research should be set for the next three to five years, allowing sufficient time to gather data and analyze findings. By understanding the impact of teacher traits on student achievement, we can inform teacher training and professional development, ultimately enhancing the effectiveness of mathematics education.

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