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Pedagogical Content Knowledge on Primary School Mathematics Teachers Based on Specialization

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Abstract

Quality teaching occur when the knowledge presented is well accepted by pupils. Thus, a teacher's ability to convey knowledge is crucial for the effective teaching and learning process. Pedagogical Content Knowledge (PCK) is the foundation of a teacher's teaching efficacy. Therefore, this study aims to investigate the level of Pedagogical Content Knowledge in primary school mathematics teachers in Kuala Pilah, Negeri Sembilan. This is a quantitative study with a questionnaire as the instrument. The study's findings reveal that the level of Pedagogical Content Knowledge in primary school mathematics teachers in Kuala Pilah is satisfactory. The independent t-test analysis also reveals that there is no significant difference in the level of Pedagogical Content Knowledge among mathematics teachers based on their specialization. This phenomenon could occur due to government resources, lesson study, and mentorship programs that considerably assist mathematics teachers who do not specialize in teaching. This study's findings may assist school administrators to plan and manage issues such as subject distribution as well as the organization of teacher professional development programs.

Keywords: PCK, Pedagogy Content Knowledge, Mathematics, Quality Teaching, and Specialization

Introduction

Effective teaching is heavily reliant on a teacher's ability to convey the curriculum's contents to pupils. As this implies, effective teaching and learning require teachers who competed in both content knowledge as well as proficiency in pedagogical aspects (Nurmelda & Roslinda, 2020). Shulman (1987) defined Pedagogy Content Knowledge (PCK) as integrating these two pieces of knowledge to achieve effective teaching and learning.

PCK is the knowledge that teachers must have to convey lessons based on student appropriateness so pupils may understand them simply and successfully (Shulman, 1987). PCK is frequently used to explain the teacher's thinking to make lessons more understandable and relate to pupils' conceptions and misconceptions (Shulman, 1986).

The efficacy of a teaching and learning process is determined by the quality of the teaching. It is consistent with the content of the Second Wave of The Malaysian Education Quality Standard (SKPMg2), which emphasizes teachers as planners and implementers in a quality teaching and learning process that leads to improve child achievement (Kementerian Pendidikan Malaysia, 2017). However, according to the Trends in International Mathematical and Science Study (TIMSS) Report 2019, Malaysian pupils' math proficiency is just barely sufficient. 50% of pupils were incapable to answer high-level questions (Kementerian Pendidikan Malaysia, 2020). Pupils are more prone to memorize than analytical problem-solving in Mathematics. This has raised the question of whether mathematics teachers' teaching is less effective, which leads to lower TIMSS results.

The TIMSS Report 2019 also stated that there was a difference in average pupils' scores resulting in the issue of specialization (Kementerian Pendidikan Malaysia, 2020). According to the report, pupils instructed by a teacher who specializes in Mathematics education have a higher average score (469) than pupils instructed by a teacher who specializes in another field (459). This phenomenon has raised the issue of whether the specialization of mathematics teachers affects the level of PCK which in turn affects student success in mathematics.

Meanwhile, the quality and effectiveness of mathematics teachers' teaching are being emphasized following the implementation of online learning during the Covid-19 pandemic. Studies on the transformation of learning throughout the COVID-19 pandemic have been carried out and the issue of learning loss, including mathematics subjects, has been addressed (Contini et al., 2021; Patarapichayatham et al., 2021). Pupils claim that they struggle to understand the concepts presented by the teacher during online learning. They prefer face-to-face learning because it allows them to communicate and understand mathematical concepts more easily (Juwairiah & Roslinda, 2021). After the implementation of online learning, pupils face an issue with picking up mathematical concepts. The difficulty in picking up mathematical concepts may cause pupils hard to master mathematics (Er & Roslinda, 2021; Rahmah et al., 2021).

In handling this learning loss, the teacher's ability to convey knowledge effectively is emphasized for pupils picking up on learning that was left behind before. It is closely related to a teacher's PCK. In comparison to teachers who are weak in PCK, teachers who are competent in PCK can boost student attention and achievement (Jacob et al., 2020).

Generally, the mastery of PCK by the teacher has an impact on a lesson (Moh'd et al., 2022). Therefore, to enhance the quality of mathematics teaching and ensure Malaysia's educational aspirations to be in the top third of the world's best-educated countries (Kementerian Pendidikan Malaysia, 2016), teacher competency in PCK should be taken seriously and explored deeper. The issue of learning loss in mathematics after the COVID-19 pandemic shall lead to more research into the quality of teacher teaching so that effective teaching can help pupils catch up on learning that has been missed. The aspect of teacher specialization shall also be reviewed due to the existence of differences in pupil achievement as reported in the TIMSS Report 2019.

Research Objective

The purpose of this study is to investigate the level of PCK in primary school mathematics teachers in the Kuala Pilah district based on teacher specialization. The following research questions were asked:

a) What is the level of Pedagogical Content Knowledge (PCK) in primary school mathematics teachers?
b) Is there a significant difference in the level of Pedagogical Content Knowledge (PCK) in mathematics teachers based on specialization?

Literature Review

Pedagogy Content Knowledge (PCK)

PCK refers to a teacher's ability to present a topic in an efficient manner that pupils may easily absorb through a teaching and learning process with the interaction of content knowledge (CK) and pedagogical knowledge (PK) (Shulman, 1986). Additionally, it covers the ability of teachers to select teaching strategies and presentations, and also estimate the level of difficulty of the topic to be taught. A teacher has a high PCK if he or she has enormous content knowledge, can develop problem-solving techniques, a good decision-making ability, and is always sensitive to the pupil's context (Dağlı & Dağlıoğlu, 2021). In general, PCK refers to a teacher's understanding of how to assist pupils in acquiring specific knowledge.

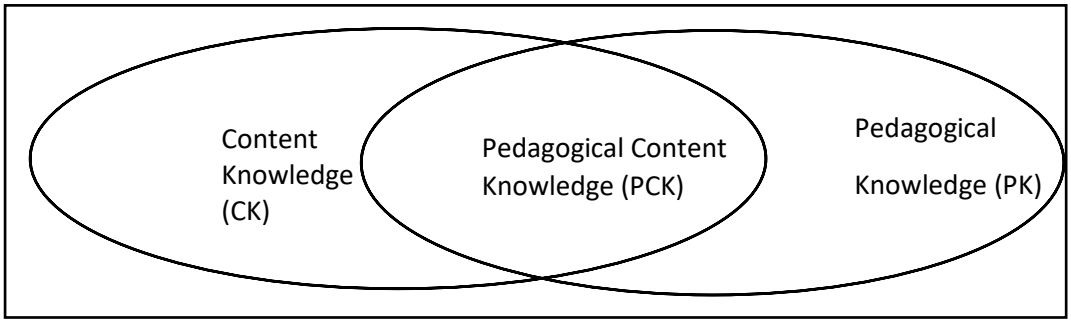

Figure 1: Concept of Pedagogical Content Knowledge (PCK)

The knowledge that is present in a subject is called Content Knowledge (CK) (Shulman, 1986). CK is crucial to the teaching and learning of mathematics because it may contribute to effective teaching (Hafisal & Sukor, 2020). Mathematics teachers can deliver their lessons more effectively when they possess a high CK (Hafisal & Sukor, 2020). On the other hand, teachers who struggle with CK are more likely to face challenges in their lessons (Izzati & Mistima, 2020).

Pedagogical Knowledge (PK) refers to knowledge regarding organizing and managing a classroom (Shulman, 1987). According to Jacob et al. (2020), PK can be defined as knowledge of how to teach. PK consists of the teacher's ability to organize and prepare materials, time management, methods for teaching, questioning, and assessing techniques. Teachers' pedagogical knowledge is critical in the process of delivering knowledge to pupils (Nurmelda & Roslinda, 2020). Therefore, to achieve an effective teaching and learning process, a teacher must not only be familiar with CK but also be competent in PK.

In conclusion, PCK is a knowledge that integrates content knowledge with pedagogical knowledge (Shulman, 1987). PCK is the core component for a teacher in efficiently conveying knowledge that can assist to enhance pupil achievement (Wiliam & Mistima, 2020). Thus, a teacher must be proficient in PCK due to the ability of a teacher to convey content to pupils will affect the efficacy of teaching.

PCK in Mathematics Teaching and Learning Process

The teaching and learning process is an educational interaction between teachers and pupils (Normiati & Said, 2019). Teachers have a vital role in establishing what will be learned, as well as how and when the pupils will be learned (Normiati & Said, 2019). Pedagogical Content Knowledge (PCK) is the foundation of a teacher's teaching and is critical for handling the ever-changing world of education (Nurmelda & Roslinda, 2020).

A teacher with a high level of PCK can develop pupils who excel in mathematics (Normiati & Said, 2019). A study reveals that trainee teachers with a high level of PCK could discover a solution when faced with barriers in the teaching and learning process (Kugra et al., 2021). PCK is also crucial in assisting teachers in predicting or identifying misconceptions among pupils and seeking solutions to their difficulties (Ansah et al., 2020). Therefore, teachers with high PCK can deal with and address difficulties that arise throughout the teaching and learning process.

Mathematics teachers with inadequate PCK will affect lesson preparation (Muhtarom et al., 2019) because teachers are incapable of creating effective lesson plans (Moh'd et al., 2022). Such a tendency will make the teaching and learning process less attractive to pupils. Pupils will unlikely to study mathematics if they believe it is meaningless to them (Jaafar & Maat, 2020). In other words, a good level of PCK in mathematics teachers is a circumstance in the establishment of a teaching plan, that ultimately results in a successful lesson.

Previous research indicates that the level of PCK in mathematics teachers, whether secondary school, pre-service teachers, or mathematics specialized teachers, is rather low (Aksu, 2019; Danisman & Tanisli, 2017; Kugra et al., 2021; Moh'd et al., 2021; Nurmelda & Roslinda, 2020). The findings of the prior study also indicate that the level of PCK on trainee teachers is less sufficient (Aksu, 2019; Fiangga et al., 2021; Kugra et al., 2021; Muhtarom et al., 2019). Furthermore, there is a difference in the level of PCK between female and male trainee teachers. Female teachers had lower PCK than male teachers (Kugra et al., 2021). Trainee teachers perform poorly in understanding the contents of topics, developing goals and objectives, and selecting efficient strategies (Kugra et al., 2021). Trainee teachers are unable to provide relevant and helpful teaching aids because they did not consider PCK when designing a lesson (Fiangga et al., 2021).

PCK is also widely explored in the specific topic of mathematics. According to the findings of research on the topic of fractions, teachers specialized in Mathematics possess a moderate comprehension of the topic (Nurmelda & Roslinda, 2020). There is also research on the topic of the circle, Aksu's study (2019) which shows that the level of pre-service teachers' PCK is not at an adequate level in terms of identifying the context of student mistakes and suggesting a suitable solution. Aside from the previously stated fractions and circles, the PCK research also included the topic of probability. The level of secondary school mathematics

teachers' PCK on the topic of probability is poor (Danisman & Tanisli, 2017). In general, the level of mathematics teachers' PCK on particular mathematics topics remains unsatisfactory.

Based on previous studies, the PCK study focused on pre-service teachers, secondary school mathematics teachers, and particular mathematical topics (Wiliam & Mistima, 2020). However, even though primary school is a critical period for an individual to develop a comprehension of mathematical concepts, it is less often used as a study sample. Pupils who do not understand basic mathematical concepts and skills in primary school will affect their performance in secondary school or higher levels of study. Thus, enhancing the teaching of mathematics in childhood can provide the foundation for pupils' subsequent performance in school (Onoshakpokaiye & ODIRI, 2020).

In conclusion, PCK is critical in the teaching profession (Kugra et al., 2021). The competence of the teacher to deliver lessons and the quality of teaching are two aspects that have a direct impact on the achievement of pupils (Dağlı & Dağlıoğlu, 2021). The level of PCK in a teacher influences his or her ability to manage a class and create effective lessons.

The Influence of Teacher Specialization

The efficacy of the teaching and learning process can be affected by teacher specialization. According to Wong et al (2019), teacher specialization influences teachers' teaching practices, which in turn influences the efficacy of the teaching and learning process. Each qualified teacher will receive training in the content knowledge and pedagogy aspects related to his or her specialization to develop a successful teaching and learning process. Teachers who have never had formal training in areas of knowledge and pedagogy for specific subjects are found unable to successfully manage the teaching and learning process due to difficulties in selecting teaching strategies (Plessis, 2018). On the other hand, teachers who specialize in a subject are more confident while managing a lesson (Plessis, 2018).

At the Institute of Teacher Education or University in Malaysia, all educated teachers would be trained to master subject matter knowledge and pedagogical skills. Such training is critical so that future teachers can effectively manage the teaching and learning processes. According to previous research, teachers who specialize in mathematics still possess a poor comprehension of a certain topic. The level of comprehension of mathematics teachers on the topic of fractions is only modest, even though they specialize in mathematics at the Institute of Teacher Education (Nurmelda & Roslinda, 2020). It reveals that teachers who acquire mathematics specialization in teacher training do not necessarily have a high level of understanding or competency in all mathematical topics.

Methodology

This study employed a survey design involving a questionnaire. A survey design is a quantitative approach that can provide information on population trends, attitudes, or views by analyzing a sample (Creswell & Creswell, 2018). This survey design enables the researcher to obtain observations on respondents using statistical analysis to analyze variable trends and compare groups of related variables.

The population of this study focused on mathematics teachers in 47 primary schools located in the Kuala Pilah district. The study sample consists of primary school teachers who teach

mathematics either specializing in mathematics education or not specializing in mathematics education. The sample was chosen by using simple random sampling. This method of sampling is used to ensure that each individual has an equal probability of being chosen (Cohen et al., 2007; Creswell & Creswell, 2018). According to Krejcie & Morgan (1970), sample size determination table with a sampling error of five percent and a reliability level of 95%, a population size of 130 people requires a sample size of 97 people (Krejcie & Morgan, 1970). The researcher chose a sample of 110 people because take into account that there are samples that will be dropped.

Instrument

A questionnaire that does not involve the name of the respondent is more likely to be trusted (Cohen et al., 2007), so this study has used a set of questionnaires as a research instrument. The questionnaire contained four constructs in it. The first construct is made up of 14 questions that focus on teachers' content knowledge. The second construct is made up of 19 questions that focus on general pedagogical knowledge and the third construct focus on specialized pedagogical knowledge with 39 questions. The respondent had to respond to the item in construct one until the third accordingly five-point Likert scale which is *Strongly Agree, Agree, Quite Agree, Disagree, and Strongly Disagree*. A five-point Likert scale is a scale with odd numbers that enables respondents to select unsure replies, barring respondents from being compelled to favour one party over another (Taherdoost, 2019). The last construct is made up of 8 questions that collected the background and demography data of the respondents.

The validity of the instrument was established by a mathematics expert, and the Cronbach Alpha Index was used to assess the research instrument's reliability. In a study, the reliability of an instrument is essential since it allows the researcher to make meaningful interpretations (Creswell, 2014). The value of the Cronbach Alpha coefficient in the pilot study is 0.989, which has exceeded 0.80, indicating that this questionnaire has acquired an acceptable level of reliability (Cohen et al., 2007).

Table 1
Cronbach Alpha Coefficient for each construct in the instrument

Construct	Alpha Value	Number of Items
1	0.945	14
2	0.966	19
3	0.982	39
Overall	**0.989**	**72**

The questionnaire was distributed in the form of a Google form to mathematics teachers in Kuala Pilah District primary schools. At first, the researcher met with School Improvement Specialist Coach (SISC) Mathematics in Kuala Pilah District to ask for support from Kuala Pilah District Education Office in distributing the questionnaire's link to all mathematics committee heads in Kuala Pilah primary schools. Next, the Google form link was distributed to mathematics teachers in Kuala Pilah through the head of the mathematics committee.

Data Analysis

The researcher used the IBM Statistical Package for Social Science (SPSS) 26 software for the data analysis process. The mean and standard deviation of the variables in the research were displayed using descriptive analysis (Creswell & Creswell, 2018). The first research question, which is the level of PCK in primary school mathematics teachers, is answered using descriptive analysis.

Inferential statistical analysis is used to examine the difference between the dependent variable and the independent variable in the study and then make inferences (Creswell & Creswell, 2018). The level of PCK in mathematics teachers is the dependent variable in this study, whereas the teacher's specialization is the independent variable. To address the second research question, an independent t-test will be performed.

Findings

Data analysis was done on 108 primary school mathematics teachers in Kuala Pilah, Negeri Sembilan. The findings of this study are divided into three parts that are the demographics of the respondents, the level of PCK on mathematics teachers, and the level of PCK on mathematics teachers based on specialization.

Demographics of Respondents

The majority of respondents are female teachers that are 82 people (75.9%), while male respondents comprise 26 people (24.1%). In terms of age distribution, only 7 (6.5%) teachers are under the age of 25, 10 (9.3%) teachers are between the ages of 26 to 30, and 22 (20.4%) teachers are between the ages of 31 to 35 years old. 29 people (26.9%) are between the ages of 36 to 40 years old, while the group over 40 is represented by 40 people (37.0%). In terms of specialization, 29 people (26.9%) have mathematics as their main specialty, 31 people (28.7%) have mathematics as their second specialty and the majority of mathematics teachers do not specialize in mathematics.

Table 2
The background of the respondents

Demographics Background	Item	Frequency	Percentage (%)
Gender	Male	26	24.1
	Female	82	75.9
Age	Below 25 age	7	6.5
	26 - 30 age	10	9.3
	31 - 35 age	22	20.4
	36 - 40 age	29	26.9
	More than 40 age	40	37.0
Specialization (Major)	Mathematics	29	26.9
	Other than mathematics	79	73.1
Specialization (Minor)	Mathematics	31	28.7
	Other than mathematics	77	71.3

Level of PCK on Mathematics Teachers in Kuala Pilah

The study's findings indicate that respondents had high content knowledge (mean=4.16, sd=0.38), followed by specialized pedagogical knowledge (mean=4.13, sd=0.36), and finally general pedagogical knowledge (mean=4.02, sd= 0.41). In general, the level of respondents in these three components are high.

In terms of PCK, respondents had a high level with a mean score of 4.10 and sd = 0.35. As a result, the level of primary school mathematics teachers' PCK in Kuala Pilah is satisfactory. Mathematics teachers can convey lesson content according to student appropriateness and deliver teaching understandably and effectively. Table 3 and figure 1 provides a descriptive analysis of the level of PCK among mathematics teachers in the Kuala Pilah district according to each component.

Table 3
Level of components in PCK among mathematics teachers

Component of PCK	**Mean**	**Standard Deviation**	**Score Interpretation**
Content Knowledge	4.16	0.38	High
General Pedagogical Knowledge	4.02	0.41	High
Specialized Pedagogical Knowledge	4.13	0.36	High
PCK	**4.10**	**0.35**	**High**

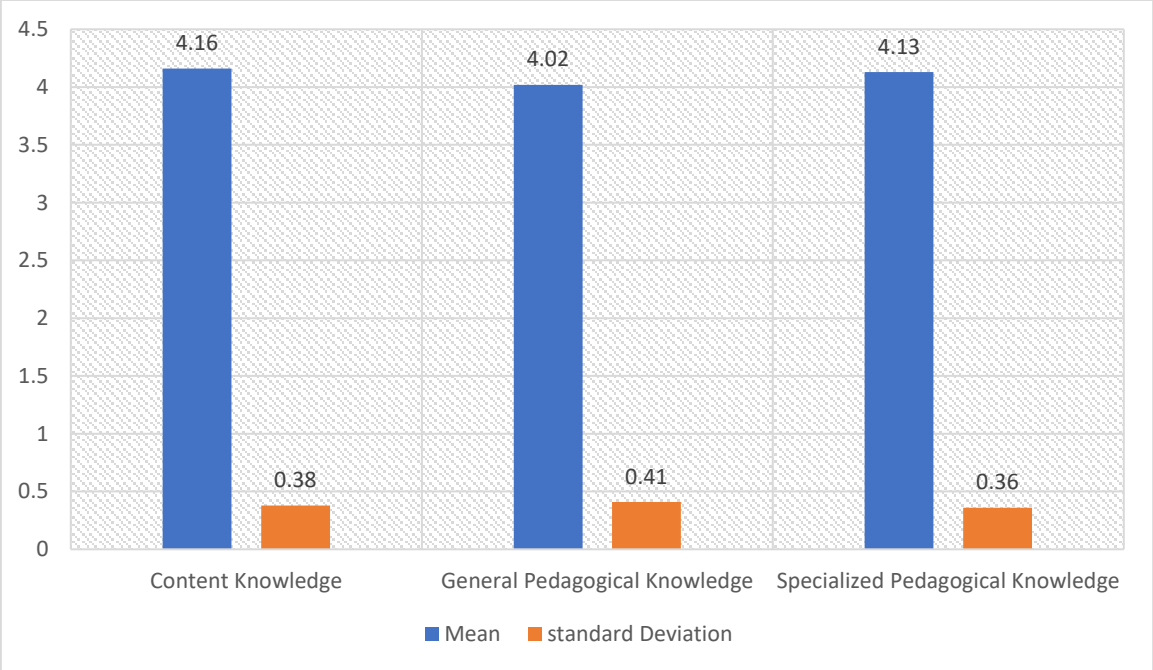

Figure 1: Level of component in PCK among mathematics teachers

Level of Mathematics Teachers' PCK Based on Teachers' Specialization

In this study, specialization just corresponds to the main specialization (major). Teachers with mathematics as a secondary specialization (minor) will not be included in this study. The

normality test is performed initially to define the kind of test to be performed (Kim, 2014; Sang & Park, 2019). The Kolmogorov-Smirnov test findings reveal that the p-value is 0.00, which is $p < 0.05$.

Table 4
Kolmogorov-Smirnov Normality Test

	Kolmogorov-Smirnov			**Shapiro-Wilk**		
	Statistic	df	Sig.	Statistic	df	Sig.
PCK	.150	108	.000	.0941	108	.000

The Kolmogorov-Smirnov test findings demonstrate that the data is not normal, hence the skewness value was analyzed as a feasible alternative. The skewness value for this data set is 0.66 (SE=0.233) which is within the range accepted as normal data (George & Mallery, 2020; Kim, 2014).

Table 5
Skewness Normality Test

	Skewness		*Kurtosis*	
	Statistic	*Std. Error*	*Statistic*	*Std. Error*
PCK	0.660	.233	-.273	.461

According to the findings of Levene's test, the value of sig. is 0.421, indicating that $p > 0.05$. This finding demonstrated that the variance for both groups is equal and independent. This study's data meets the t-test requirements, which are normal and homogenous variance, thus the independent t-test can be performed.

Table 6
Levene's Test

	F	**Sig.**
Levene's Test	0.654	0.421

*Significant at the 0.05 (2-tailed)

After the t-test assumptions are fulfilled, the mean score of mathematics teachers' PCK by specialization is investigated. Table 7 and Figure 2 reveals that the mean score for mathematics specialization teachers is 4.14 (sd=0.32), which is higher than the mean score for non-mathematics specialization teachers, which is 4.09 (sd=0.36).

Table 7
Descriptive analysis of PCK based on specialization

	N	**Mean**	**Standard Deviation**
Mathematics Specialization	29	4.1445	0.31981
Non- Mathematics Specialization	79	4.0857	0.36417

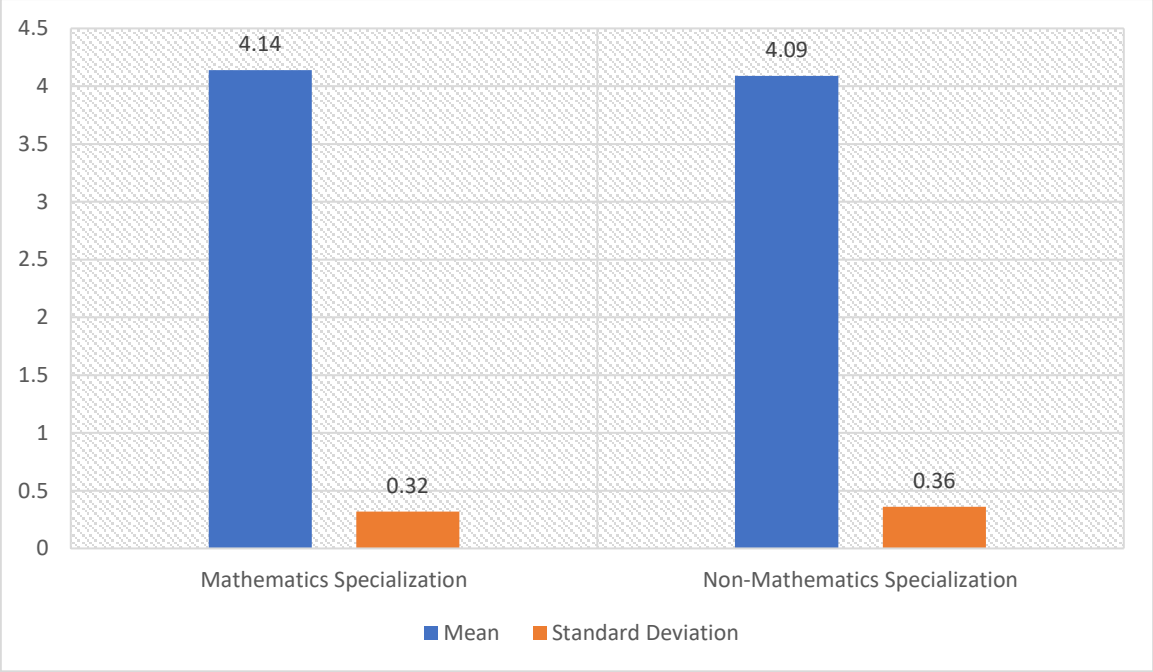

Figure 2: Descriptive analysis of PCK based on specialization

The independent t-test p-value (significance 2-tailed) is 0.45, df=106, indicating that $p > 0.05$. As a result, there is no statistically significant difference in the PCK competency level of teachers for mathematics specialization (mean = 4.14, sd = 0.32) and non-mathematics specialization (mean = 4.09, sd = 0.36); t (106)= 0.77, p=0.45. The level of PCK for teachers who specialize in mathematics and teachers who do not specialize in mathematics is the same, and there is no substantial difference between these two groups. As a result, the researcher may infer that the level of PCK among mathematics teachers in Kuala Pilah is good and not affected by the teacher's specialization.

Table 8
Independent T-test

	Levene's Test for Equality of Variances		**t-test for Equality of Means**		
	F	Sig.	t	df	Sig. (2-tailed)
Equal Variances Assumed	0.654	0.421	0.767	106	0.445
Equal Variances Not Assumed			0.815	56.411	0.419

Discussion

Level of Pedagogical Content Knowledge on Mathematics Teachers

The findings indicate that primary school mathematics teachers in Kuala Pilah have a high level of PCK. However, this finding is contrary to the research findings of Aksu (2019); Danisman and Tanisli (2017); Mahendran et al (2021); Moh'd et al (2021), Nurmelda and

Roslinda (2020) that were discovered that the PCK of secondary school mathematics teachers, pre-service teachers, or teachers specializing in mathematics is still below satisfactory.

Mathematics teachers with good PCK can create effective lessons. Teachers with high levels of PCK are quality teachers because they may stimulate pupils' interests and enhance their achievement compared to teachers who lack PCK understanding (Jacob et al., 2020). A high level of PCK enables mathematics teachers to recognize pupils' mathematics misconceptions. Mathematical concepts are extremely essential in the field of mathematics. Misconceptions in mathematics will impose restrictions on pupils' ability to learn mathematics (Rahmah et al., 2021). Mathematics teachers who are not proficient in PCK are unable to recognize their pupils' misconceptions (Kugra et al., 2021; Rahmah et al., 2021). Teachers' failure to identify misconceptions among pupils will affect their mathematics learning at a higher level.

The primary school mathematics teachers in Kuala Pilah who have a high level of PCK may be due to the school's support, which constantly provides chances for teachers to improve their knowledge and skills. The Professional Learning Community (PLC) in school assists mathematics teachers in improving their subject matter and pedagogical knowledge. PLC is a practice used by teachers all across the world, including in Malaysia (Hajar & Mistima, 2021), and it is a strategy that may increase teacher competency in the creation of mathematical concepts among pupils (Aini & Zanaton, 2018). The PLC's activities included Peer Coaching and Teacher Sharing Sessions. These activities encompassing discussion and advice have assisted mathematics teachers in equipping themselves with the knowledge and confidence to teach mathematics, including the creation of mathematical concepts among pupils.

In conclusion, the primary school mathematics teachers' PCK in Kuala Pilah is satisfactory. Primary school mathematics teachers in Kuala Pilah can modify lesson content based on student appropriateness and deliver teaching understandably and effectively. This phenomenon may be due to school support, which provides numerous possibilities for mathematics teachers to develop their skills in terms of content and pedagogy frequently.

The Level of Mathematics Teachers' PCK Based on Specialization

The study's findings reveal that the level of primary school mathematics teachers' PCK in the Kuala Pilah district is not affected by the teacher's specialization. It might be related to the resources provided by the Ministry of Education. The resources are extremely beneficial to mathematics teachers, particularly for those who teach mathematics but do not specialize in it. Textbooks provided by the Malaysian government are commonly utilized as a reference by teachers while preparing lesson plans. Textbooks have provided an abundance of methods to assist teachers with conveying mathematical topics in a manner that pupils can easily understand (Julie & Mistima, 2021; Moh'd et al., 2021). Mathematics teachers rely primarily on textbooks when developing lesson plans (Julie & Mistima, 2021). It is obvious that mathematics teachers extensively use the resources that are given, and these resources greatly assist teachers in efficiently conveying and teaching mathematical concepts, particularly those who do not specialize in mathematics.

Furthermore, the PLC's activities also included Lesson Study aside from Peer Coaching and Teacher Sharing Sessions. Lesson study assists teachers who do not specialize in mathematics in effectively implementing the teaching and learning process (Aini & Zanaton, 2018).

Teachers who participated in Lesson Study are more competent in dealing with student concerns and enriching learning strategies and approaches because they will discuss and contribute suggestions to create a successful daily lesson plan during the Lesson Study. Lesson Study is also particularly helpful in assisting teachers who do not specialize in mathematics to enhance pupils' concept-building skills (Aini & Zanaton, 2018). Therefore, organized lesson study in school may raise the level of content and pedagogical knowledge through collaborative preparation for teaching and further increase the level of PCK in mathematics teachers.

The mentoring programs in the school additionally contribute to an essential part in increasing the quality of teaching for teachers who do not specialize in mathematics. Teacher mentoring is a program that is carried out to support and assist teachers in overcoming challenges encountered throughout the teaching and learning process (Wexler, 2020). Mentors will share teaching resources and provide advice to mentored teachers (Wexler, 2020). Mentoring can be done in face or online. According to a particular study, e-mentoring programs are also beneficial in building teacher confidence and strengthening teacher pedagogical skills (Nelly et al., 2022). Since online mentoring may benefit the mentored teachers, not to mention face-to-face mentoring. Thus, the PCK of non-specialization mathematics teachers is high, which may be due to the school's mentoring programs that assist those teachers in carrying out the teaching and learning process effectively.

In conclusion, the resources provided accessible to teachers, such as textbooks, Lesson Study, and mentoring programs in schools, are extremely beneficial for developing quality teachers and increasing the level of mathematics teachers' PCK, particularly for mathematics teachers who do not specialize in the field of mathematics.

Conclusion

PCK is the core of a lesson's efficacy. This study revealed that primary school mathematics teachers' PCK in Kuala Pilah is good, which may be due to school support that provides numerous possibilities for mathematics teachers to develop their content and pedagogical knowledge. Teacher specialization does not affect the level of PCK in mathematics teachers. This phenomenon may be due to the materials provided accessible to teachers, such as textbooks, school programs such as Lesson Study, and mentoring programs for mathematics teachers, particularly those who do not specialize in mathematics. Mathematics teachers with a high PCK can guarantee that both the preparation and delivery of mathematical subjects are carried out efficiently. As a result, mathematics teachers must possess a high level of PCK to guarantee that the teaching and learning process performs smoothly.

The findings of this study are expected to offer administrators a clear direction in the subject distribution as well as the organization of teacher professional development programs. Future research should be conducted to broaden the study sample because this study was limited to mathematics teachers from one district implying that it is unable to represent mathematics teachers throughout the state of Negeri Sembilan. Furthermore, qualitative research including interviews is highly recommended to acquire further information from respondents as well as explore the topic of PCK deeper.

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