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Evaluation of Teachers' Technological Pedagogical Content Knowledge (TPACK) Understanding Profile

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Abstract

This research aimed to assess teachers' understanding of the Technological Pedagogical Content Knowledge (TPACK) structure and investigate whether TPACK components differ based on gender characteristics. The research method used was a cross-sectional survey, a quantitative approach aimed at examining a condition at a specific point in time and exploring relationships between variables. Respondents were randomly selected from 102 teachers spread across Lombok Island, comprising 48 female teachers and 56 male teachers. The research instrument utilized a TPACK questionnaire measuring CK, PK, TK, TPTCK, and TPCK, adapted from Liang et al., 2013. The analysis results indicated that teachers demonstrated a solid understanding of Content Knowledge (CK) and Pedagogical Knowledge (PK), signifying a strong grasp of the taught material and effective teaching techniques. However, concerning Pedagogical Content Knowledge (PCK), their understanding of how to teach specific content required further attention. Nevertheless, they exhibited a robust understanding of Technological Knowledge (TK), Technological Pedagogical Content Knowledge (TPTCK), and Pedagogical Content Knowledge (TPCK), although the level of understanding in TPCK was slightly higher than TPTCK. Meanwhile, the gender-based analysis showed significant differences in TPACK understanding between the genders in the TK, TPTCK, and TPCK components, but no significant differences were observed in the PK, CK, and PCK components. This highlights the importance of understanding gender differences related to specific aspects of technology, education, and content knowledge. Further research or in-depth analysis is needed to comprehend the underlying factors causing these differences and their implications within the educational context and curriculum development.

Keywords*:* Evaluation; Technological; Pedagogical; Content; Knowledge; Teacher

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INTRODUCTION

Education plays a pivotal role in advancing a country, particularly in the era of Industry 4.0. The quality of education at this juncture heavily relies on the teacher's capacity to incorporate technology, pedagogical knowledge, and content comprehension into the learning process (Ni'mah et al., 2023; Shofani et al., 2022). It's imperative for teachers to acquire technology skills for effective learning (Oke & Fernandes, 2020). The Fourth Industrial Revolution demands significant changes and adaptations in learning approaches and curricula (Ansori & Sari, 2020; Rahmatullah et al., 2022).

This period is marked by substantial progress in digital technology, high levels of connectivity, and transformations across various industries, including education. A primary challenge in the educational realm of the Industry 4.0 era revolves around innovating learning models and methods employed by educators (Wibowo et al., 2023). This involves leveraging continuous technological advancements to enhance the quality of the learning process. A

critical challenge today is preparing teachers to adeptly utilize available technology and optimize their proficiency in employing the latest technological devices (Fatimah & Kurniawan, 2023).

In the 21st century, teachers require comprehensive knowledge and skills in utilizing various technologies, both traditional and modern. Hence, they also need a strong grasp of digital technology literacy (Jalil & Siew, 2023; Mouza, 2016; Supandi et al., 2020). The primary objective remains facilitating learning and improving academic outcomes. However, in the era of Industry 4.0, the role of teachers as educators has become more intricate. They're not only expected to deliver appropriate curriculum-aligned education but also to enhance students' literacy, develop soft skills, and foster high-level thinking abilities, encompassing critical, creative, communicative, and collaborative thinking (Lubis, 2020; Muhali, 2018; Oliver, 2016)

A framework commonly used to measure teachers' abilities in this regard is TPACK (Technological Pedagogical Content Knowledge). TPACK combines three main components: technological knowledge (T), pedagogical knowledge (P), and content knowledge (C) (Gür & Karamete, 2015; Thelespore et al., 2023; Thy et al., 2023). TPACK serves as a specialized framework aidin teachers in effectively conducting the learning process by integrating content, pedagogy, and technology (Chai et al., 2013; Setyowati & Rachmajanti, 2023).

Teachers who possess a robust grasp of TPACK generally exhibit greater effectiveness in teaching, enriching comprehension, nurturing student ingenuity, and enhancing the quality of learning (Ambaryati, 2019; Asy'ari et al., 2023; Cekerol & Özen, 2020). Nonetheless, research indicates that numerous educators lack proficiency and competencies in TPACK, thereby encountering obstacles when attempting to integrate it effectively into their teaching methods (Herizal et al., 2022; Nurfidah, 2021; Rahayu, 2022).

This scenario presents considerable hurdles in ensuring that teachers possess sufficient pedagogical, content-related, and technological knowledge to cater to the learning requirements of their students. Assessing teachers' grasp of TPACK holds significant importance due to their pivotal role in the realm of education. While some studies have delved into teachers' understanding of TPACK, further research is necessary to encompass situational elements across diverse educational settings. More comprehensive studies could shed light on how teachers acquire and implement their comprehension of TPACK in varied learning environments.

This study aims to contribute to the existing body of literature by presenting findings regarding the influence of factors like gender on TPACK levels (Technological Pedagogical Content Knowledge). It seeks to evaluate teachers' grasp of the TPACK framework and intends to explore whether TPACK variables differ based on gender characteristics. Ultimately, this research seeks to recommend further educational investigations based on these findings. The study aims to address the following inquiries: 1) What is the extent of teachers' Technological Pedagogical Content Knowledge (TPACK)? and 2) Are there variations in TPACK levels among teachers concerning gender?

METHOD

The research employed a cross-sectional survey technique, recognized as a quantitative methodology (Setia, 2016). This approach seeks to investigate a scenario by gathering data at a single point in time and investigating the connections between various factors (Bariş, 2015).

Respondent

Participants in the election were randomly selected, comprising a total of 102 teachers located throughout Lombok Island. Among these respondents, 46 were female teachers and 56 were male teachers. The information provided by all respondents for the research was gathered via WhatsApp in order to complete a questionnaire on teachers' comprehension of TPACK (Technological Pedagogical Content Knowledge).

Instrument study

An assessment tool was utilized to gauge teachers' grasp of TPACK, employing the TPACK questionnaire adapted from (Liang et al., 2013). Defining the components of TPACK (Abbitt, 2011; Chuang & Ho, 2011; Koehler et al., 2013) involves:

1. Technological Knowledge (TK): Understanding a spectrum of technologies, ranging from traditional and low-tech tools like pencils, paper, and blackboards to digital technologies such as the internet, digital video, interactive whiteboards, and computer software. TK encompasses the comprehension of how computer hardware and software, presentation tools like document projectors, and other technologies are employed within educational contexts.
2. Content knowledge (CK) refers to the understanding of specific subjects and particular content domains such as mathematics and science, which teachers need to be acquainted with and knowledgeable about in order to effectively teach. CK can be defined as the knowledge or specific nature of a discipline or subject matter.
3. Pedagogical knowledge (PK) refers to the general objectives of unique knowledge for teaching purposes. This knowledge involves understanding classroom management, the role of student motivation, lesson planning, and the assessment of learning.
4. Pedagogical content knowledge (PCK) acknowledges that various content aligns with different teaching methods. For instance, this is evident in the teaching of speaking skills, where diverse instructional approaches are utilized.
5. Technological content knowledge (TCK) Knowledge of how technology can create new representations for specific content and influence practices and knowledge within particular disciplines. This indicates that educators understand that by utilizing specific technology in teaching and learning, they can change how learners practice and comprehend concepts within specific content areas.
6. Pedagogical technology knowledge (TPK) refers to the understanding of how technology can be utilized in the teaching process, as well as the awareness that the use of technology has the potential to alter teaching methods for educators. It also involves comprehending the advantages and limitations of various technological tools used within learning contexts.
7. Technological pedagogical content knowledge (TPACK) refers to understanding the intricate interaction among three fundamental knowledge components (CK, PK, TK) possessed by a teacher when delivering content through suitable pedagogical methods and technology. TPACK serves as the foundation for effective teaching with technology.

The study employed a questionnaire consisting of six components, as shown in Table 1: CK (4 items), PK (5 items), PCK (8 items), TK (7 items), TPTCK (a fusion of TPK and TCK factors, 8 items), and TPCK (4 items). A Likert scale ranging from 1 to 4 (1 = strongly disagree to 4 = strongly agree) was used for assessment. The reliability of the instrument was assessed across different domains: CK (Cronbach's alpha: 0.87), PK (Cronbach's alpha: 0.88), PCK (Cronbach's alpha: 0.94), TK (Cronbach's alpha: 0.92), TPTCK (Cronbach's alpha: 0.94), TPCK (Cronbach's alpha: 0.91). The overall reliability, indicated by an overall Cronbach's alpha of 0.96, was high. Furthermore, the questionnaire accounted for a significant portion of the variance, explaining 72.56% of it (Liang et al., 2013). The structure of the questionnaire is detailed in Table 1.

Table 1. Adopted TPACK indicators and questionnaires from Liang, 2013

No	Indicator	Subdidicator
1	Content Knowledge	1. I have sufficient knowledge about eye the lessons I teach 2. I can think about fill eye my lesson teach like a expert material lesson 3. I can obtain more understanding deep about fill eye my lesson teach Alone 4. I believe about teach material learning

No	Indicator	Subdidicator
2	Pedagogical Knowledge	1. I can guide student I for apply strategy proper learning 2. I can help student I for monitor learning they Alon 3. I can help student I for reflect strategy Study they 4. I can plan activity group for student I 5. I can guide student I for discuss in a way effective during Work group
3	Pedagogical Content Knowledge	1. Without use technology, me can overcome misunderstanding generally owned student I to eye the lessons I teach 2. Without use technology, me know How choose approach effective teaching for guide student in think and study material lesson. 3. Without use technology, me can help student I for understand content knowledge eye my lesson teach through various method. 4. Without use technology, me can overcome difficulty general learning experienced student I with eye the lessons I teach. 5. Without use technology, me can facilitate discussion meaningful about learned content student in eye the lessons I teach. 6. Without use technology, me can involve student in solve related realworld problems with eye the lessons I teach. 7. Without use technology, me can involve student with activity direct for learn content eye the lessons I teach 8. Without use technology, me can support student for manage content learning they For eye the lessons I teach.
4	Technological Knowledge	1. I have Skills technical for use computer in a way effective 2. I can learn technology with easy. 3. I know How finish problem technical I Alone when use technology. 4. I follow development technology new important thing. 5. I can make web page 6. I can using social media (e.g.blogs, wikis, Facebook). 7. I can use tool communication web -based (IM, MSN MessengICQ, Skype, etc.).
5	Technological Pedagogical, Technological Content Knowledge	1. I can facilitate student I fFor use technology for find more Lots information they Alone. 2. I can facilitate student I for use technology for planning and monitoring learning they Alone 3. I can facilitate student I for use technology for build various form representation knowledge. 4. I can facilitate student I For each other collaborate use technology. 5. I can use device software created _ special for eye lesson I. 6. I know about technology is a must I use for content eye lesson I. 7. I can use appropriate technology, such as source multimedia power or simulation, for describe fill eye my lesson teach. 8. I can use device soft special for submit question about eye lesson I
6	Technological Pedagogical Content Knowledge	1. I can choose technology that can increase What do I teach, how I teaching, and what students learn in class I. 2. I can use combining strategy content, technology, and approach teaching that has been I learn in task lecture in class I

No	Indicator	Subdidicator
		3. I have ability leadership in help others in coordinate use technology content and approach teaching at school 4. I can designing integrated learning content, technology, and pedagogy in a way appropriate For student centered learning

To achieve the objectives of this research, data was analyzed using descriptive statistical methods. The questionnaire used in this research uses a Likert scale which then produces an index percentage with a formula for calculating the total score from the sample divided by the maximum score, then multiplied by 100. The results of this data analysis calculation are then interpreted based on the criteria listed in Table 1 below.

Table 2. Interpretation Categories

Percentage of Respondents (%)	Interpretation
1-19,9	Very Lacking
20-39,9	Less
40-59,9	Fair
60-79,9	Good
80-100	Excellent

(Sugiyono, 2022)

After being analyzed using descriptive statistical methods, the next step involves the use of JASP Software 0.17.3.0. In analyzing the collected data in this study, correlation tests are used to explore the relationships among TPACK components. Additionally, analysis of variance (ANOVA) is also conducted to compare teachers' perceptions of TPACK based on gender.

RESULTS AND DISCUSSION

Result

The research analysis results are categorized into three sections: descriptive analysis concerning teachers' understanding of TPACK analyzed based on subfactors, subsequent correlational analysis among TPACK subfactors to determine relationships between them, and a third analysis to observe the relationships among TPACK subfactors based on gender differences. The findings are presented as follows:

1. Findings Concerning Teachers' Technology Pedagogical Content Knowledge

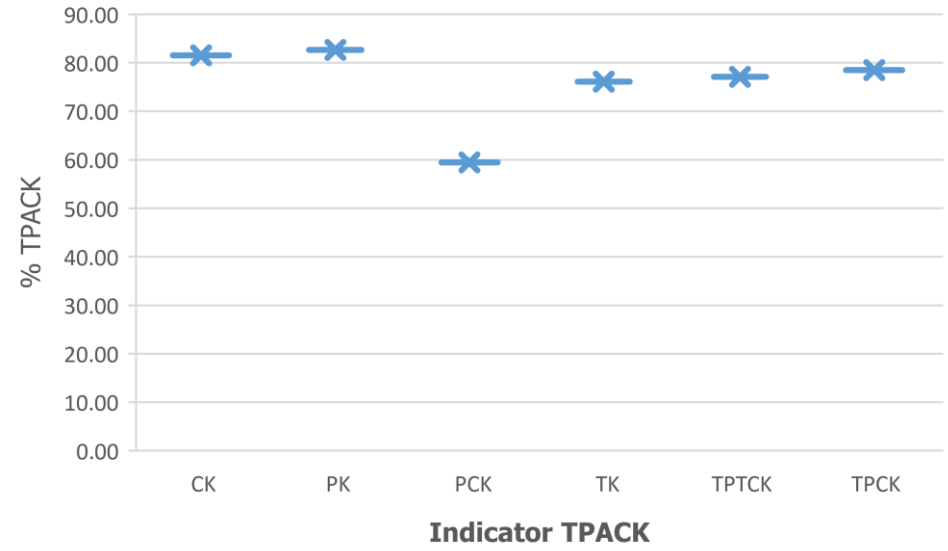

Figure 2 Displays Teacher TPACK capabilities.

The chart above represents the results of an analysis of teachers' Technological Pedagogical Content Knowledge (TPACK), with values indicated in percentages and categorized into categories based on different TPACK indicators. Here is the interpretation of the given values:

1. CK (Content Knowledge): Teachers demonstrate excellent understanding in content knowledge, scoring 81.50%. The "Excellent" category indicates their very strong grasp of the material they teach.
2. PK (Pedagogical Knowledge): Scoring 82.65% in Pedagogical Knowledge indicates that teachers have a very strong understanding of teaching methods. They possess good teaching skills and strategies.
3. PCK (Pedagogical Content Knowledge): In this category, the score of 59.44% places teachers in the "Fair" category. While not as strong as CK and PK, their understanding of how to teach specific content can still be considered fairly good, but it might require further attention or development.
4. TK (Technological Knowledge): Teachers display good understanding (76.12%) in technological knowledge. They have a solid understanding of technology relevant to their teaching content.
5. TPTCK (Technological Pedagogical Content Knowledge): In this category, with a score of 77.11%, teachers show a good understanding of integrating technology, teaching approaches, and content understanding.
6. TPCK (Technological Pedagogical Content Knowledge): A score of 78.49% indicates that teachers also have a good understanding of integrating technology, teaching approaches, and content understanding, although it might be slightly higher than TPTCK.

The data interpretation indicates that teachers have a very good understanding of Content Knowledge (CK) and Pedagogical Knowledge (PK), which is a positive aspect in the context of teaching. However, there are indications that there is room for improvement in integrating technology into teaching and learning. Content Knowledge (CK), as proposed by (Mishra & Koehler, 2008, 2006), refers to the understanding teachers have of concepts, theories, ideas, and methods related to the subjects they teach. This involves a deep understanding of core information, crucial concepts, relevant theories, and relevant steps within the scope of the subjects they teach. Furthermore, CK also encompasses an understanding of frameworks that explain and link various concepts within that subject. (Shulman, 1986) This also includes an understanding of validity criteria and evidence supporting the subject matter.

Pedagogical Knowledge (PK) is the deep understanding held by teachers regarding various strategies, models, methods, techniques, and processes used to deliver learning materials to students (Kanuka, 2006; Nasar & Daud, 2020). PK encompasses an understanding of educational objectives, classroom management, curriculum analysis, lesson planning, and assessment of students' cognitive, affective, and psychomotor development.

The improvement of PCK (Pedagogical Content Knowledge) indicates that teachers need to pay attention to the best ways to integrate learning materials into effective teaching strategies. Similarly, TK (Technological Knowledge) signifies that teachers need to enhance their understanding of using technology relevant to the learning content. In the context of modern education, appropriate technological integration can enhance teaching effectiveness and facilitate more interactive and comprehensive learning. Therefore, teachers can enrich students' learning experiences by deepening their understanding of using technology specifically within the learning context. Enhancing the understanding of technology relevant to the subject matter will assist teachers in designing and implementing more innovative teaching strategies, ultimately supporting better learning outcomes for students (Akram et al., 2022). Their research explains:

1. Positive perspectives on technology use: Teachers hold the belief that integrating technology into teaching can enhance their teaching effectiveness. They view technology as a tool that can reinforce how they deliver the subject matter.
2. Improved quality of learning: This positive belief indicates that technology integration is seen as a factor in improving the quality of learning. Teachers believe that technology can help make the learning process more engaging, interactive, and relevant to students.
3. Sustaining student motivation: Teachers also believe that using technology in education can maintain student motivation. With technological aid, they can create a more dynamic and engaging learning environment, ultimately boosting students' motivation to learn.

Additional training, professional development, or expanded resources on technology use in education can assist teachers in enhancing their understanding and skills in this field. Furthermore, moderate values of TPTCK (Technological Pedagogical Content Knowledge) and TPCK (Technological Pedagogical Content Knowledge) indicate that there is room for further development in how technology, teaching strategies, and content understanding can be better integrated. Therefore, it is crucial for teachers to consider additional training or development in utilizing technology within the learning context. This could involve training in using tools or technology applications relevant to the taught material, as well as developing teaching strategies that incorporate technology to enhance learning effectiveness in the classroom. Thus, teachers can better harness the potential of technology to support student learning.

2. Findings correlation between TPACK subfactors

Tabel 3. Pearson Correlations

		CK	PK	PCK	TK	TPTCK	TPCK
CK	Pearson Correlation	1	.079	-.117	-.064	-.078	.204*
	Sig. (2-tailed)		.428	.243	.523	.436	.040
	N	102	102	102	102	102	102
PK	Pearson Correlation	.079	1	.302**	.640**	.699**	.494**
	Sig. (2-tailed)	.428		.002	.000	.000	.000
	N	102	102	102	102	102	102
PCK	Pearson Correlation	-.117	.302**	1	.429**	.320**	.225*
	Sig. (2-tailed)	.243	.002		.000	.001	.023
	N	102	102	102	102	102	102
TK	Pearson Correlation	-.064	.640**	.429**	1	.748**	.479**
	Sig. (2-tailed)	.523	.000	.000		.000	.000
	N	102	102	102	102	102	102
TPTCK	Pearson Correlation	-.078	.699**	.320**	.748**	1	.528**
	Sig. (2-tailed)	.436	.000	.001	.000		.000
	N	102	102	102	102	102	102
TPCK	Pearson Correlation	.204*	.494**	.225*	.479**	.528**	1
	Sig. (2-tailed)	.040	.000	.023	.000	.000	
	N	102	102	102	102	102	102

Table 3 shows the results of the correlation matrix analysis which shows the Pearson correlation coefficient between different variables (CK, PK, PCK, TK, TPTCK, TPCK) along with their respective significance levels based on a two-sided test. The table displays the strength and direction of the linear relationship between these variables. Following are the details of the correlation matrix:

a. CK correlated positively (but weakly) with TPCK (r = 0.204*) and negatively (but weakly) with PCK (r = -0.117). Only its correlation with TPCK was statistically significant at the 0.05 level.

b. PK showed moderate to strong positive correlations with TK (r = 0.640**), TPTCK (r = 0.699**), and TPCK (r = 0.494**). All of these correlations are highly statistically significant at the 0.01 level.
c. PCK is moderately correlated with PK (r = 0.302**) and TK (r = 0.429**), and weakly with TPCK (r = 0.225*). All of these correlations are statistically significant at the 0.01 level except the correlation with TPCK which is significant at the 0.05 level.
d. TK has a strong positive correlation with PK (r = 0.640**), TPTCK (r = 0.748**), and TPCK (r = 0.479**), all of which are highly statistically significant at the 0.01 level.
e. TPTCK is positively and strongly correlated with PK (r = 0.699**), TK (r = 0.748**), and TPCK (r = 0.528**), all of which are highly statistically significant at the 0.01 level.
f. TPCK showed moderate positive correlations with PK (r = 0.494**), TK (r = 0.479**), and TPTCK (r = 0.528**), all of which were highly statistically significant at the 0.01 level.

Correlation values closer to 1 or -1 indicate a stronger linear relationship, while values closer to 0 indicate a weaker relationship. This correlation reflects a linear relationship and does not imply a causal relationship between variables.

The correlation analysis in the table identifies the relationship between various variables such as CK, PK, PCK, TK, TPTCK, and TPCK, which play a role in understanding TPACK (Technological Pedagogical Content Knowledge). The use of Pearson correlation coefficients aims to measure the level of linear relationship among these variables. The primary findings from this analysis reveal diverse levels of correlation among the investigated variables. It's essential to note that correlation does not interpret the cause-and-effect relationship between these variables. Significant correlations only indicate a stronger linear relationship between the variables. Therefore, these results provide an overview of how much these variables are linearly related in the context of understanding TPACK but do not uncover causal relationships among TPACK indicators.

The correlation analysis of the variables associated with TPACK demonstrates varying levels of relationships among them. Higher correlation levels reflect a closer association between variables, while lower correlation levels indicate weaker associations. These findings offer insight into how these variables are interrelated in a linear sense concerning the understanding of TPACK but do not draw conclusions about cause-and-effect relationships among these variables. Further studies are necessary to comprehend the dynamics of these variable relationships and their implications in educational contexts and curriculum development.

3. The results of the ANOVA analysis were to compare teachers' understanding of TPACK in terms of gender.

Table 4. Results of Anova analysis

Component	SS	df	MS	F	P
PK	0.533	1	0.533	2.699	0.104
CK	0.192	1	0.192	0.911	0.342
PCK	1.198	1	1.198	2.667	0.106
TK	1.406	1	1.406	7.188	0.009
TPTCK	0.896	1	0.896	4.351	0.040
TPCK	1.276	1	1.276	7.120	0.009

The analysis results indicate a significant difference in the understanding of TPACK between genders in the components TK, TPTCK, and TPCK. However, there is no significant difference in the understanding of TPACK between genders in the components PK, CK, and PCK. This highlights that in certain aspects of understanding technology, pedagogy, and

content knowledge, gender-based differences appear significant, while in other aspects, such differences are not significantly observed among gender groups.

In the components of TK, TPTCK, and TPCK, significant gender differences reflect tendencies or specific preferences in the use of technology, pedagogical approaches, or content knowledge within the context of learning. Conversely, in the components of PK, CK, and PCK that do not show significant gender differences, it may suggest that the understanding of technological aspects, pedagogy, and content knowledge is not significantly influenced by gender factors in the analyzed sample (Nindiasari et al., 2021). Both gender and years of teaching experience do not show a significant influence on the understanding of mathematics education lecturers regarding the seven components of TPACK. This research result aligns with a study conducted by (Wang, 2022) where TPACK among English as a foreign language teachers is not strongly associated with gender, and there are no gender differences in their perception of TPACK.

It is important to note that these findings only pertain to specific samples analyzed in the research. Gender differences in understanding TPACK may vary depending on context, culture, or individual experiences. Further research or in-depth analysis is necessary to comprehend the underlying factors of these differences and their implications in the educational context and curriculum development.

Evaluating TPACK skills requires educators to understand the technology knowledge applied in the learning process. Various aspects of TPACK are interconnected, offering interdisciplinary abilities that complement each other in an educational context. Enhancing teachers' TPACK skills remains crucial as it combines pedagogical expertise related to content with significant technology integration (Sahin et al., 2013). TPACK is described as an extensive process of integration and restructuring. This dual integration signifies the merging of content, teaching methods, and essential technological tools for educators to deliver material and facilitate substantial learning experiences (Holland & Piper, 2016) (Holland & Piper, 2016). Understanding TPACK in the learning process is crucial, prompting teachers to continuously motivate themselves to delve deeper into TPACK concepts. (Suyanto & Wibowo, 2018) emphasize that improving teachers' competencies in TPACK remains a necessity. Mastery of TPACK by a teacher is crucial for several reasons:

a. Effective Integration of Technology in Learning: Teachers who understand TPACK can integrate technology more effectively in the learning process. They can plan the use of appropriate technological tools and resources to deliver learning material in an engaging and relevant manner for students.
b. Meaningful Learning Experiences: Teachers who grasp the content, teaching methods, and technology application can present learning material with greater depth. They can combine learning content with relevant technology, making learning more dynamic and enabling students to understand the material better. This brings about more responsive and interactive learning. (Sintawati & Indriani, 2019) The high confidence of teachers in pedagogical principles is reflected in how they incorporate technology with educational value (Hill & Uribe-Florez, 2020)
c. Adapting to Student Diversity of Needs: By applying the TPACK concept, teachers can create a learning environment responsive to various learning styles and individual student needs. They have the ability to use technology carefully to support the learning process for students with diverse needs. This principle is closely related to differentiated learning, where teachers ensure that every student with different characteristics and needs receives appropriate attention in the classroom. Differentiated learning is also a significant characteristic in the Mardeka Belajar curriculum. It facilitates grouping students based on their abilities, learning styles, and needs (Indrajit;, 2022). This approach provides an opportunity for every student, including those with special needs or outstanding potential, to receive a learning approach tailored to their individual characteristics (Salassa' et al., 2023).

d. Increased Student Engagement and Motivation: The appropriate use of technology in the learning process can enhance student engagement and motivate them to learn. Utilizing interesting and interactive technological tools can make learning more appealing to students.
e. Preparing Students for the Digital World: In an increasingly digital era, mastery of TPACK helps students acquire the necessary skills to face challenges in this ever-evolving world. Teachers who understand TPACK can assist students in becoming better prepared to face a more technologically interconnected world.

Therefore, a teacher's mastery of TPACK is crucial in delivering effective, meaningful, and student centered learning within the context of an evolving education landscape. Several research findings have reported that teachers' skills in integrating TPACK into instruction have a positive impact on the learning process. This is evident in studies such as the one conducted by (Wang, 2022), where EFL (English as a Foreign Language) teachers exhibiting outstanding performance tend to have high levels of confidence in their TPACK skills. This indicates their confidence and ability to effectively integrate TPACK while teaching English to students. This level of confidence is often closely associated with a teacher's ability to creatively and relevantly utilize technology within the context of English language learning as a second or foreign language, thus facilitating a better learning experience for students.

CONCLUSION

Based on the findings of this research, it can be concluded that teachers demonstrate a solid understanding in Content Knowledge (CK) and Pedagogical Knowledge (PK), showing a strong grasp of the taught material and effective teaching techniques. However, concerning Pedagogical Content Knowledge (PCK), their understanding of how to teach specific material requires further attention. Nonetheless, they have a fairly good understanding of Technological Knowledge (TK), Technological Pedagogical Content Knowledge (TPCK), and Pedagogical Content Knowledge in Technology (TPTCK), although TPCK is slightly higher than TPTCK. Correlation analysis indicates diverse patterns of relationships among variables, with positive and negative correlations varying from weak to strong. There is a significant relationship between CK and TPCK, PK and TK, TPTCK, and TPCK, as well as between TK and PK, TPTCK, and TPCK. Significant differences have been identified in TPACK understanding based on gender in the TK, TPTCK, and TPCK components, but not in the PK, CK, and PCK components. In conclusion, the research findings suggest the need for improvement in PCK understanding and recognition of differences in TPACK understanding based on gender, while other variables show a good understanding with varied correlation levels.

RECOMMENDATION

Based on the findings of this research, it can be concluded that teachers demonstrate a solid understanding in Content Knowledge (CK) and Pedagogical Knowledge (PK), showing a strong grasp of the taught material and effective teaching techniques. However, concerning Pedagogical Content Knowledge (PCK), their understanding of how to teach specific material requires further attention. Nonetheless, they have a fairly good understanding of Technological Knowledge (TK), Technological Pedagogical Content Knowledge (TPCK), and Pedagogical Content Knowledge in Technology (TPTCK), although TPCK is slightly higher than TPTCK. Correlation analysis indicates diverse patterns of relationships among variables, with positive and negative correlations varying from weak to strong. There is a significant relationship between CK and TPCK, PK and TK, TPTCK, and TPCK, as well as between TK and PK, TPTCK, and TPCK. Significant differences have been identified in TPACK understanding based on gender in the TK, TPTCK, and TPCK components, but not in the PK, CK, and PCK components. In conclusion, the research findings suggest the need for improvement in PCK understanding and recognition of differences in TPACK understanding based on gender, while other variables show a good understanding with varied correlation levels. Therefore, further

research can focus on teacher training programs to enhance PCK understanding and gain a deeper understanding of the factors influencing gender-based differences in TPACK understanding.

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RESEARCH CONTRIBUTIONS

This research makes significant contributions by revealing differences in TPACK understanding based on gender characteristics, highlighting the importance of understanding gender implications in the education context. Using an adapted TPACK questionnaire, the study also measures teachers' understanding of CK, PK, TK, TPTCK, and TPCK, providing a valuable tool for evaluating teachers' understanding of the significance of content knowledge, pedagogical knowledge, and technological knowledge in their teaching . Furthermore, the research identifies strengths and weaknesses in TPACK understanding, showing a strong grasp of CK and PK but a need for further attention to PCK. These findings offer valuable insights for schools and educational institutions in identifying areas that require additional training or support. The research also lays the groundwork for further investigation by highlighting gender differences in TK, TPTCK, and TPCK components, emphasizing the importance of further research to understand the underlying factors behind these differences and their implications in the context of education and curriculum development.

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