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A Mixed Methods Study to Address the Integration of TPACK in Elementary School Students' Learning Process

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Abstract: The Technological Pedagogical and Content Knowledge (TPACK) framework offers guidance for teachers seeking to address technology integration in classroom learning. This study aims to assess the TPACK proficiency levels among elementary school teachers. This study involved teachers from SDN Sumbersari 03 in Malang City as participants using a mixed-methods approach with a sequential explanatory design. Quantitative data were initially gathered through self-report measures, followed by analysis utilizing descriptive and inferential statistics. Subsequently, qualitative data were collected through interviews and observations, with analysis conducted using the interactive model proposed by Miles and Huberman. The results of this study showed that there was no difference in the TPACK perceptions of primary school teachers based on gender (p-value > 0.05). However, there is an influence between age and tenure on teachers' TPACK ability (p-value < 0.05). Overall, the teachers have a good mastery of TPACK. However, there are some areas that need to be improved, especially in terms of technology mastery (TK, TCK, and TPACK). The highest mean score in the CK and PK domains was 4.875 and the lowest score in the TPACK domain was 4.55. The findings also indicate no significant difference in TPACK perceptions among elementary school teachers based on gender. However, age and tenure were found to influence teachers' TPACK abilities. Overall, teachers demonstrated a good level of mastery in TPACK. Nonetheless, specific areas, particularly technology mastery (TK, TCK, and TPACK), require improvement.

Keywords: Learning process; Mixed methods study; Technology; TPACK.

Introduction

Education serves not only as the primary foundation but also as an irreplaceable pillar in nurturing human potential comprehensively. Within the learning process, teachers assume a vital role in successfully integrating technology into the classroom. This pivotal role stems from optimal learning practices hinge upon teachers' adeptness in pedagogy and content mastery (Niederhauser & Lindstrom, 2018). In alignment with Shulman's (1987) assertion, effective teaching necessitates a fusion of content knowledge and pedagogical expertise encapsulated within Pedagogical Content Knowledge (PCK). Furthermore, contemporary discourse underscores the imperative for teachers also to command technological proficiency alongside pedagogical and content knowledge.

The TPACK model, as proposed by Mishra and Koehler (Mishra & Koehler, 2006), is built upon three interconnected knowledge domains. These include Pedagogical Knowledge (PK), which encompasses understanding teaching methodologies rooted in educational theory; Content Knowledge (CK), which entails a teacher's comprehension of subject matter content and its scope; and Technological Knowledge (TK), which involves familiarity with the application of hardware and software in the classroom learning environment. These three knowledge domains are integrated within three specific domains: Pedagogical Content Knowledge (PCK), which combines

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pedagogical theory with subject matter expertise, Technological Pedagogical Knowledge (TPK), which focuses on employing technology within instructional practices; and Technological Content Knowledge (TCK), which emphasizes the utilization of technology as a tool for clarifying learning materials. When these six domains are seamlessly integrated, they form a comprehensive Technological Pedagogical and Content Knowledge (TPACK) framework.

TPACK is a framework that can provide direction for teachers to solve the problem of technology integration in classroom learning (Mishra & Koehler, 2008). This model continues to be developed to understand the knowledge domains required by teachers to integrate technology successfully and effectively in the learning process (Graham, 2011). The following is an image of the TPACK framework:

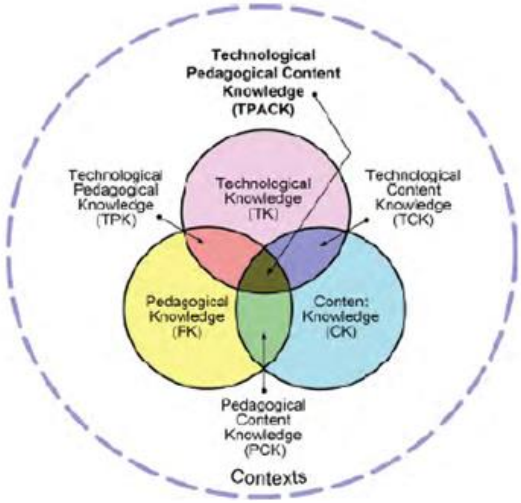

Figure 1. TPACK framework (Mishra & Koehler, 2008)

The integration of technology into the learning process in the 21st century is not merely a necessity but also a demand that teachers must meet to enhance learners' 4C skills: creativity, collaboration, critical thinking, and communication (Dewi et al., 2023; Zainulloh et al., 2022). By effectively incorporating technology into instruction, teachers can offer more dynamic, interactive learning experiences tailored to contemporary needs, thereby equipping learners with greater competence and confidence to tackle future challenges (P21, 2007). One approach to integrating technology into instruction involves using various digital media platforms to deliver online and offline materials. For instance, learning materials can be presented using Flipbook applications to captivate student interest and motivation (Yusella et al., 2022). Additionally, teachers can employ a variety of applications such as Google Forms, Quizizz, Kahoot, and Educandy to create quizzes and engage students actively. Consequently, in an educational landscape marked by rapid technological advancements and a demand for innovative learning approaches, teachers' mastery of TPACK is paramount (Kereluik et al., 2013).

Previous Research on TPACK has emerged as a focal point in educational research across various countries worldwide. This underscores the significance of comprehending the role and impact of TPACK in shaping education that is responsive to evolving times and the demands of technological progress. The TPACK framework finds extensive application in the professional development of prospective teachers (Chaipidech et al., 2022; Lachner et al., 2021; Pareto & Willermark, 2019; Schmid et al., 2020; Urban et al., 2018). Furthermore, TPACK is integrated into several academic subjects (Alharbi, 2019; Suryani et al., 2021; Urbina & Polly, 2017).

TPACK research predominantly emphasizes competency development among teachers and prospective educators, along with its application within the school learning environment (Amalia & Radiansyah, 2023; Atmojo et al., 2023; Hikmah & Radiansyah, 2023; Shafira & Minsih, 2022; Yanti & Mawarwati, 2023). However, only a limited number of studies have delved into the TPACK profiles of teachers within school settings. For instance, Hidayati (2019) discovered no discernible differences in TPACK perceptions among SMA/SMK teachers based on gender. Furthermore, Cipta et al. (2024) revealed that music teachers exhibited highly significant and positively correlated perceptions of TPACK integration across each domain. Research by Nuruzzakiah (2022) and Halim (2024) elucidated the TPACK abilities of Physics and Biology teachers, respectively. Hence, there remains a need for further analysis of TPACK among school teachers to assess their skills and comprehensively supplement prior research findings.

This study aims to determine the TPACK profile of elementary school teachers, with a particular focus on assessing TPACK mastery levels among educators at State Elementary School 03 Sumbersari in Malang City. We hope that this research will provide us with a better understanding of how well teachers understand TPACK. Such insights can be extremely useful in improving the use of technology in primary school education and identifying effective techniques to strengthen future educators' technological and pedagogical competencies.

Method

This study used mixed methods research, which combines quantitative and qualitative techniques to

acquire comprehensive, reliable, and objective data (Creswell & Clark, 2011). A sequential explanatory design was specifically used, including qualitative and quantitative research techniques. A phase of the study using qualitative techniques came after a stage using quantitative techniques (Creswell & Clark, 2011). While qualitative data served to support, dive further into, expand upon, contradict, or invalidate the quantitative conclusions, quantitative data were essential in obtaining measurable descriptive, comparative, and associative data (Creswell & Clark, 2011). Please find attached the research flowchart:

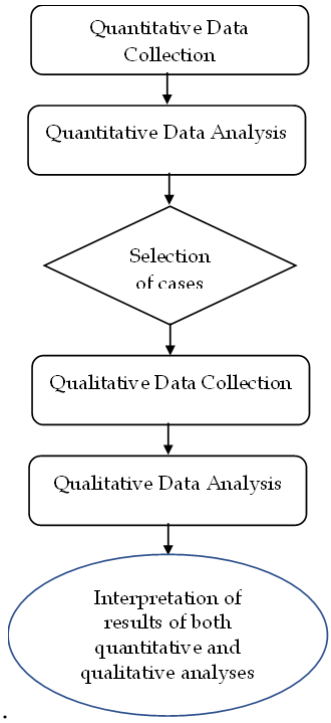

Figure 2. Flowchart for Research

Step 1: Quantitative Method

This study's research sample consisted of teachers from State Elementary School 3 Sumbersari in Malang City. Data collection was simplified by the manual completion of questionnaires provided directly to the teachers. This strategy required teachers to answer questions about their TPACK proficiency, assuring direct participation and complete responses. Since the introduction of the TPACK framework, several measuring methodologies and approaches have been developed to assess teachers' TPACK (Herring et al., 2016). Five of the most commonly used methodologies are self-report measures, open-ended questionnaires, performance assessments, interviews, and observations. In this study, the self-report measurement method was used. This method was chosen based on its applicability to the research environment and is commonly used by researchers to assess TPACK (Chai et al., 2016).

This study used a self-report measure to analyze elementary school teachers' TPACK profiles. Each subdomain has four statements modified from Schmidt, Thompson, Koehler, and Shin (2009), totaling 28 statements spread across 7 TPACK domains (Mishra & Koehler, 2008). The instrument uses a 1-5 Likert scale, with the following ratings: Strongly Agree (SA) = 5, Agree (A) = 4, Undecided (U) = 3, Disagree (D) = 2, and Strongly Disagree (SD) = 1. Pearson Correlation was used to validate the instrument, and statements were considered acceptable if the estimated correlation coefficient (r count) above the significance threshold (r table). All of the statements in the instrument were judged to be genuine. The Cronbach Alpha method was used in Microsoft Excel to measure instrument dependability, resulting in a coefficient of $\alpha = 0.97$, indicating strong internal consistency.

The next step is to analyze the data using descriptive and inferential statistics. Descriptive statistics is an approach used to simplify research data, allowing researchers to better comprehend and evaluate it (Wahyuni, 2020). Using this method, several statistical metrics such as mean, median, and standard deviation will be calculated to provide a full perspective of the distribution and features of the collected data.

Step 2: Qualitative Method

The qualitative data for this study were acquired from ten teachers at State Elementary School 3 Sumbersari in Malang City through observation, interviews, and documentation. The observation allowed for an examination of social interactions, behaviors, and contextual elements relevant to the research (Roberd, 2017), while interviews sought to elicit deeper insights into participants' experiences and viewpoints (Ardiansyah et al., 2023). Documentation, which included written field notes and images, aided the qualitative data collection procedure. Subsequently, qualitative data analysis was carried out using Miles and Huberman's (1994) iterative approach, which included data gathering, reduction, presentation, and conclusion drawing (see Figure 3)

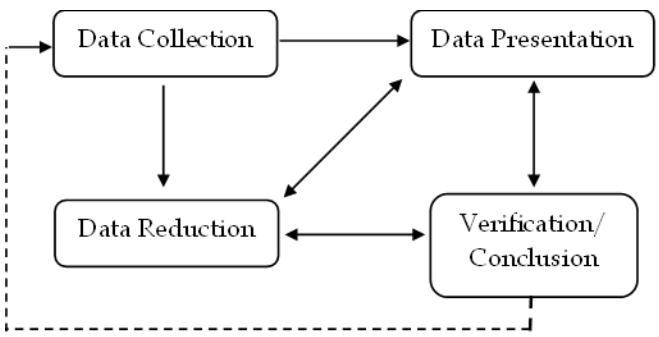

Figure 3. Qualitative Data Analysis Technique (Miles & Huberman, 1994)

Result and Discussion

TPACK of Primary School Teachers

Research on TPACK (Technological Pedagogical Content Knowledge) in primary school teachers has been conducted by various researchers to understand the extent to which teachers integrate technology into their learning process. For example, Schmid et al. (2020, 2021) highlight how technological knowledge can enrich traditional teaching methods by enabling more effective and relevant use of digital tools in the classroom. Schmidt et al. (2009) have developed a framework for measuring TPACK, which includes an understanding of subject content, pedagogy, and technology, as well as the ability to combine the three effectively. Research by Sofyan et al. (2023) also provides important insights into the adaptation and implementation of TPACK in the context of primary schools in Indonesia, showing that mastery of TPACK not only improves teaching effectiveness but also plays a role in motivating students to learn.

During the data analysis phase, mean and standard deviation values were calculated for the seven TPACK domains. This step was conducted to better understand the distribution and variability of each analyzed TPACK domain. Calculating the mean allowed researchers to determine the average value of each TPACK domain, whereas the standard deviation offered information about how far values differed from the average.

Table 1. Primary School Teachers' TPACK Abilities

Domain	Statement	N	Mean	SD
CK	I have a deep and broad understanding of the subject matter that I teach to students.	28	4.9	0.32
	I know how the theories or principles of the subject have been developed.	28	4.9	0.32
	I study supporting learning materials from sources other than textbooks.	28	4.8	0.42
	I often attend training to improve my skills in the material I teach.	28	4.9	0.32
			4.875	0.343
TK	I have sufficient knowledge about using different technologies (e.g. computer, tablet).	28	4.7	0.48
	I can learn the technology easily.	28	4.7	0.48
	I am updated on learning technology	28	4.6	0.52
	I apply technology in learning	28	4.7	0.48
			4.675	0.491
PK	I am aware of students' possible learning difficulties and misconceptions.	28	4.9	0.32
	I know how to adapt my teaching style to students with individual differences.	28	4.9	0.32
	I prioritise active and collaborative interaction in learning.	28	4.9	0.32
	I actively modify teaching strategies to meet students' individual needs and ensure each student feels valued.	28	4.8	0.42
			4.875	0.343
PCK	I know how to select appropriate and effective teaching strategies for my content area.	28	4.6	0.52
	I know how to prepare comprehensive lesson plans that include engaging activities and differentiated materials.	28	4.6	0.52
	I know that the subject matter is not only informative but also relevant and applicable to students' daily lives.	28	4.9	0.32
	In teaching, I always ensure that the learning process is not only focused on understanding the material, but also on developing students' skills and critical thinking.	28	4.7	0.48
			4.7	0.458
TPK	I know how to use technology to motivate students to learn in class.	28	4.7	0.48
	I know how to use technology to help assess student learning.	28	4.7	0.48
	I can integrate innovative technology tools to design more engaging and relevant learning for students.	28	4.9	0.32
	I design technology-based assignments and projects that stimulate students' creativity, broaden their horizons and help them develop skills relevant in a digital world.	28	4.9	0.32
			4.8	0.4
TCK	I know how to use software applications and subject-specific websites to understand content within my subject area.	28	4.7	0.48
	I know how to use technology to represent content related to my field of study.	28	4.6	0.52
	I strive for technology to not just be an additional tool, but enhance students' understanding and skills in the material.	28	4.7	0.48
	I believe that combining solid material with appropriate technology tools can increase student interest and engagement.	28	4,7	0,48
			4.675	0.491

Domain	Statement	N	Mean	SD
TPACK	I know how to use technology in ways that support exploration and learning in content areas among my students.	28	4.5	0.71
	I know how to select appropriate technologies to enhance student learning on topics that are difficult for students to understand.	28	4.5	0.53
	I know how to creatively use digital tools to explain difficult concepts and provide practical opportunities for knowledge application.	28	4.6	0.52
	Technology allows me to present content in various formats, including videos, simulations, and multimedia presentations.	28	4.6	0.52
			4.55	0.567

The questionnaire findings show the highest values in the CK and PK domains, with a mean of 4.875 and a standard deviation of 0.343. The TPK domain tracks closely, with a mean of 4.8 and a standard deviation of 0.4. The mean for the PCK domain is 4.7 with a standard deviation of 0.458, whereas the mean for TK and TCK is 4.675 with a standard deviation of 0.491. The mean for TPACK is 4.55, with a standard deviation of 0.567.

The elevated levels seen in the CK and PK domains indicate that respondents have great ability to absorb the information and effectively manage the learning process. Good proficiency in the CK domain indicates that teachers have in-depth knowledge of the subject they teach, which enables them to explain concepts clearly and thoroughly. This is very important, as a good command of the material is one of the main prerequisites for delivering quality learning and ensuring that students can achieve a deep understanding of the topics learned (Irvy, 2020).

In addition, high levels in the PK domain indicate that teachers not only understand the teaching materials but also master various pedagogical strategies that enable them to manage the learning process effectively. This includes the ability to adapt teaching methods to students' needs and characteristics, create a classroom environment conducive to learning and apply appropriate evaluation techniques to measure students' learning progress (Gabdulchakov, 2014). Filgona et al. (2020) assert that teachers who have strong content and pedagogical knowledge are able to design and deliver more effective lessons, which in turn can improve student academic achievement. Therefore, investing in the development of teachers' CK and PK should be a priority in efforts to improve education quality.

Respondents in the TPK domain display proficient technical competence, allowing them to use a variety of technological tools and resources to provide innovative and outcome-driven learning experiences. The answers demonstrate commendable PCK proficiency in translating content into understandable representations using integrated educational approaches. This is in line with research from Koehler et al. (2013), which shows that appropriate use of technology can increase student engagement, facilitate understanding of complex concepts, and support the achievement of better learning outcomes. High TPK competence also reflects teachers' ability to translate content knowledge (PCK) into representations that are more easily understood by students. According to studies by Chai et al. (2016) and Hsu et al. (2021), teachers skilled in TPK and PCK can combine their subject-matter knowledge with pedagogical and technological skills, resulting in a holistic and integrated approach to teaching.

However, their TK and TCK talents in exploiting and integrating technology for specific subject matter are rated moderate. The lack of knowledge about integrating technology with specific content is often a major obstacle to optimizing technology-based learning. For example, research by Voogt et al. (2013) revealed that teachers often feel uncertain about how best to use technology in teaching certain subjects, such as math or science. This can result in less than optimal implementation of technology in the classroom, which ultimately affects the effectiveness of student learning. TK knowledge refers to teachers' ability to understand and operate various technologies that can be used in learning, such as software, hardware, and other digital tools. However, despite having basic technological knowledge, teachers may still struggle to relate it directly to specific subject matter, which is the essence of TCK. In the context of modern education, a strong understanding of TK and TCK is key to utilizing technology appropriately, making learning more meaningful and relevant to students (Mishra & Koehler, 2006).

Notably, respondents' TPACK knowledge of technology applications for improving student understanding and learning remained poor. According to research conducted by Harris & Hofer (2011), effective integration of technology in learning requires a deep understanding of how technology can be used to achieve specific pedagogical goals and deepen students' understanding of subject matter. Without this knowledge, efforts to use technology in learning can be less purposeful and have less impact on student learning outcomes.

To overcome this obstacle, professional development programs that focus on improving TCK

and TPACK are needed. These programs should be designed to help teachers identify and apply appropriate technologies to their specific learning contexts, so as to improve student understanding and engagement in the learning process. For example, Niess (2011) recommends a professional development model that focuses on practice-based learning, where teachers can directly apply and reflect on the use of technology in their teaching.

Demographics of Primary School Teachers' TPACK.

The demographics of primary school teachers are important to understand in the context of education, as various demographic characteristics such as age, gender, and length of teaching time can affect the quality of education provided. According to data from the Ministry of Education, Culture, Research and Technology of the Republic of Indonesia, the population of primary school teachers in Indonesia has significant variations in terms of demographics, which affect teaching approaches and student learning outcomes (Kemendikbud, 2022).

The following figure (Figure 4) displays teacher demographic data by gender. This data demonstrates the distribution and variety in technology, pedagogy, and content knowledge skills across male and female teachers.

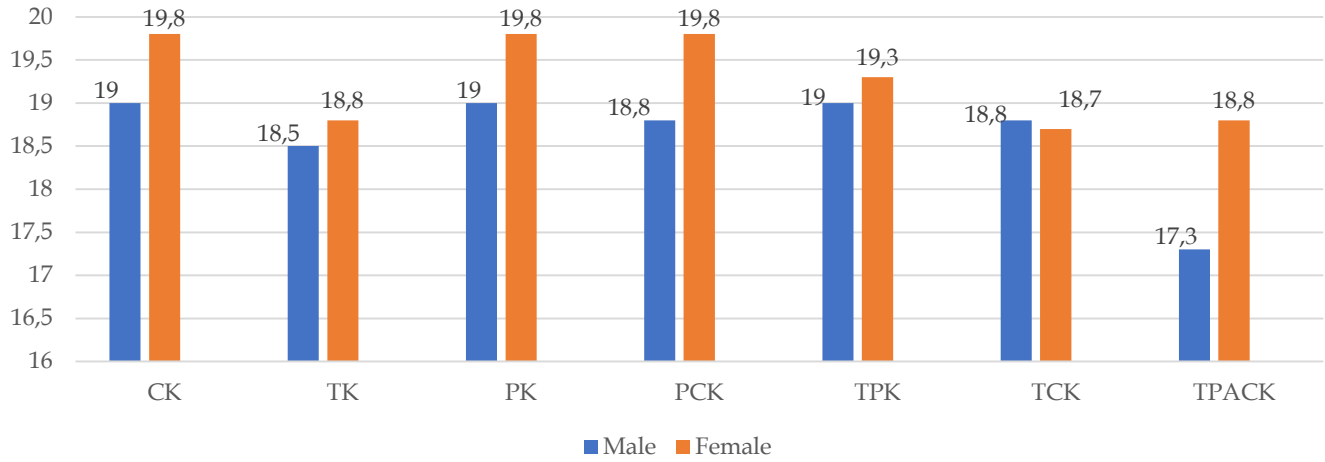

Figure 4. TPACK Demographics by Gender

Based on the data presented, female teachers exhibit slightly higher TPACK scores compared to male teachers. However, the difference in averages is not particularly significant, as evidenced by the ANOVA test results in Table 2.

Table 2. ANOVA test results on Gender Demographic

Source of Variation	SS	df	MS	F	p-value	F crit
Between Groups	1.096	1	1.096	3.4089	0.0896	4.7472
Within Groups	3.857	12	0.321			
Total	4.943	13				

The data in Table 2 reveals a p-value > α (α = 0,05), indicating that H0 is accepted (no effect). This suggests that elementary school teachers' perceptions of TPACK in the learning process are unaffected by gender. Hidayati (2019) published a similar study, stating that gender did not influence TPACK perceptions among Soshum teachers in Malang city high schools.

According to UNESCO (2021), gender demographics play an important role, as the majority of primary school teachers are women. This reflects a global trend, where teaching at the primary level is often perceived as a female-dominated profession. The study emphasizes the importance of supporting gender equality in the teaching profession and ensuring that both men and women have equal opportunities to progress in an education career.

Figure 5 also shows a comparison of demographics based on age and work experience. The figure shows an average disparity between the age and tenure categories. This demonstrates how modernization and technology improvements influence teachers' perspectives of TPACK integration in the learning process.

Teachers' age is often related to their level of experience and pedagogical approach. Younger teachers may be more inclined to adopt technology in their teaching, while older teachers may be more experienced in traditional teaching methods. This is relevant to research conducted by Hazizah & Rigianti (2021), which suggests that there are significant differences in technology use by the teacher age group, with younger teachers being more adaptive to technology than their older counterparts

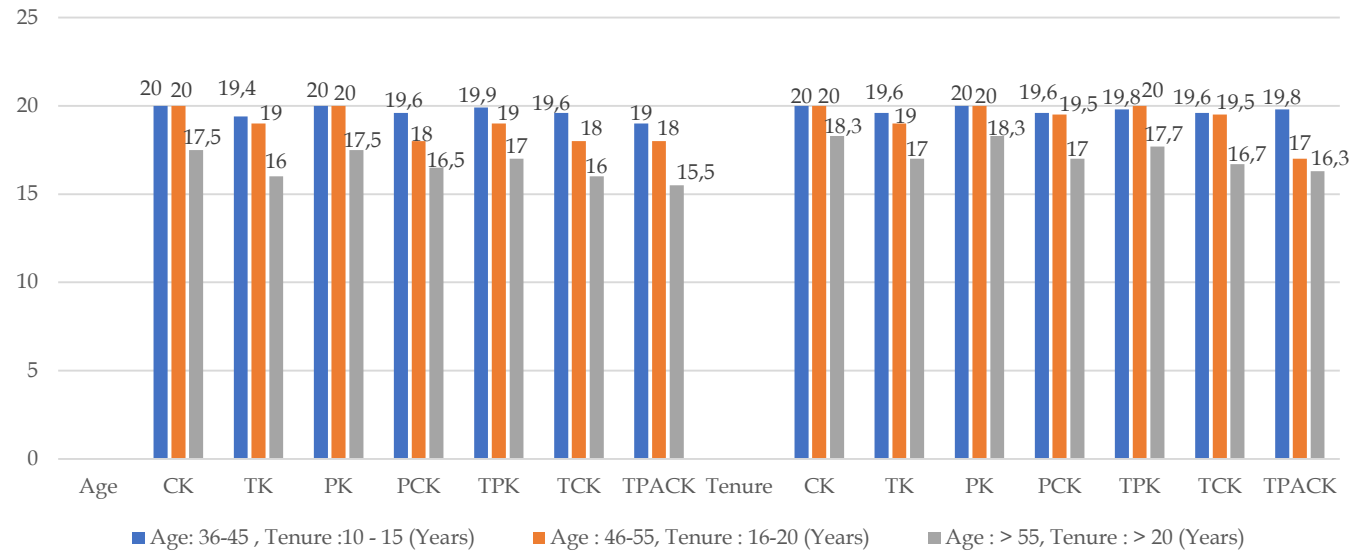

Figure 5. TPACK Demographics by Age and Tenure

Pedagogical and Content Knowledge (PCK) Ability

The Pedagogical Content Knowledge (PCK) ability of primary school teachers is one of the important aspects in the success of the learning process. PCK refers to the knowledge possessed by teachers on how to teach specific subject content using effective pedagogical approaches. In primary schools, teachers' PCK skills are crucial as students at this level are in the early stages of developing fundamental concepts that will form the basis of their future learning.

Qualitatively, the majority of respondents in the study have a thorough comprehension of the learning materials they offer and are skilled at structuring the learning process in their classrooms. Interview findings highlight three critical considerations for effective learning: first, teachers' readiness to deliver comprehensive lesson plans; second, the importance of selecting appropriate learning strategies aligned with the material being taught; and third, the emphasis on developing students' critical thinking skills through a contextual learning approach. These findings support the independent curriculum paradigm, which emphasizes learning that is relevant to students' real-life experiences.

Referring to the book written by Hume (2019) revealed that teachers with good PCK skills are able to adapt their teaching strategies to better suit students' level of understanding and needs. This includes the use of analogies, concrete examples, and visualization to explain abstract concepts that are difficult for students to understand. Teachers also demonstrate the ability to identify and address students' misconceptions, which are often a barrier to learning.

In addition, good PCK skills enable teachers to develop teaching materials that are more relevant and interesting to students. Research by König et al. (2020)shows that primary school teachers who have a good understanding of the subject matter as well as how to pedagogically deliver the material are better able to design learning activities that motivate and engage students. This not only increases students' active participation in learning, but also deepens their understanding of the material being taught.

Another study on teachers' PCK skills also found that they play an important role in the effective use of educational technology in the classroom. Research by Sukaesi et al. (2017) found that teachers with good PCK are more likely to integrate technology in learning in meaningful ways. They not only use technology as a teaching aid, but also as a means to deepen students' understanding of the lesson content. For example, the use of simulations or interactive software that allows students to visualize complex concepts.

High PCK quality among primary school teachers not only improves students' understanding of the subject matter but also helps students to develop broader learning skills, such as critical thinking, creativity, and collaboration. As an implication, training and professional development for teachers should continue to focus on improving their PCK, whether through self-directed learning, school-based training, or participation in teacher communities of practice.

Integration of Technology in Material Development (TCK)

Technological Content Knowledge (TCK) is one of the important components of the Technological Pedagogical Content Knowledge (TPACK) framework that emphasizes the integration of technology with learning content. In the context of primary school education, TCK refers to a teacher's ability to understand

how technology can be used effectively to teach specific subject matter. This includes not only an understanding of the technological tools themselves but also how they can enhance the way content is delivered and understood by students.

Some respondents used technology to improve their knowledge of learning materials. However, some other respondents claimed that they rarely utilize technology to expand their expertise. According to the interview results, the age factor is a barrier for respondents to integrating technology. Respondents over the age of 55 report difficulty using hardware and software. They prefer to read books that are related to the subject. The challenges these senior teachers face are often related to factors such as limited adaptation to new technologies, lack of experience with digital tools, and a tendency to stick to traditional teaching methods.

This is in line with research conducted by Ottenbreit-Leftwich et al. (2018), older age can be a barrier to TCK mastery due to discomfort and lack of confidence in using new technologies. Older teachers may feel left behind due to the rapid development of technology and changes in teaching methods that require the use of digital tools.

In addition, a study by Tondeur et al. (2017) also found that older teachers tend to have more negative attitudes towards the use of technology in the classroom compared to younger teachers. This attitude is often due to a lack of adequate training and technical support in using technology devices and applications. This results in senior teachers feeling more isolated and reluctant to try new approaches involving technology.

In another study, Ertmer et al. (2014) emphasizes that senior teachers often face structural and personal barriers to adopting technology. These barriers include limited time to learn new technologies, fear of failure, and uncertainty about how technology can improve their teaching effectiveness.

Research by Farjon et al. (2019) highlighted the importance of ongoing support and professional development programs tailored to the needs of older teachers. They suggest that technology training that focuses on practical applications in teaching and is supported with hands-on mentorship can help reduce the gap between senior teachers' abilities and the demands of using technology in the classroom. By providing a supportive environment and relevant training, senior teachers can more easily adapt to technological changes and feel more confident in using TCK to enhance students' learning experiences.

Integration of Technology in the Learning Process (TPK)

Technological Pedagogical Knowledge (TPK) of primary school teachers is an important aspect in effectively integrating technology into the learning process. TPK refers to the knowledge and skills possessed by teachers to combine technology with pedagogy so as to create more innovative and effective learning experiences. As the use of technology in education increases, teachers' GTC skills become increasingly crucial to create a dynamic and relevant learning environment for students.

Respondents used technology as a learning tool in school, especially LCDs. This technology may project instructional materials, photos, or videos directly to the entire classroom, allowing pupils to better understand the concepts being taught. Respondents can use LCD projectors to give a more visual and engaging learning experience for students while also expanding access to relevant digital educational resources. Furthermore, the use of this technology promotes engagement in learning, allowing students to participate more actively in conversations, problem solving, and study of newly offered concepts.

Research by Chai et al. (2013) showed that primary school teachers' TPK skills are directly related to their effectiveness in integrating technology into teaching practices. Teachers who have good TPK tend to be more adept at selecting and using technology tools that suit learning objectives as well as students' needs. They are also better able to adapt their teaching strategies to the latest technological developments, thereby increasing student participation and understanding.

The factors that influence primary school teachers' TPK skills are diverse and include both internal and external factors. According to a study by Koh et al. (2017), internal factors such as confidence in using technology, a positive attitude towards technology, and a desire to continue learning and developing are important determinants of teachers' TPK skills. Teachers who have high confidence in using technology tend to be more proactive in finding innovative ways to integrate technology into their teaching.

In addition to internal factors, external factors such as support from educational institutions, professional training, and the availability of technological resources also play an important role. Research conducted by Salehi et al. (2021) found that teachers who received support from the school, including access to adequate technological devices and the opportunity to take part in technology training, showed a significant improvement in their TPK ability. This support not only improved their technical skills but also gave them new ideas on how to utilize technology to improve learning.

Overall, primary school teachers' TPK skills are influenced by various factors, both from the teachers themselves and from their surrounding environment. Improving their TPK skills can be achieved through continuous training, adequate support, and the creation of a school culture that supports the creative use of

technology in learning. Thus, teachers can be more effective in creating meaningful and developmentally appropriate learning experiences for their students.

Conclusion

This study provides important information about the TPACK profile of elementary school teachers. Quantitative and qualitative data gathering and analysis can highlight teachers' challenges when integrating TPACK into the learning process. Overall, instructors at State Elementary School 3 Sumbersari Malang City demonstrate a decent understanding of TPACK. However, several areas require improvement, particularly in terms of mastering TK, TCK, and TPACK, so that teachers can integrate technology more effectively into the learning process. To help strengthen these skills, the school enrolled certain responders in ICT training activities, workshops, and seminars. This study was conducted in a single primary school. As a result, additional study in diverse primary schools is required to obtain a more complete picture of teachers' comprehension of TPACK at the primary level.

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Author Contributions

Conceptualization, methodology, formal analysis, investigation and writing-original draft preparation, S.N.F; validation and visualization, R.S.I.D and R.S.K; writing—review, editing and supervision, E.S. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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