TPCK Investigation of Javanese Language Learning in Indonesian Elementary Schools: Application of Technology and a Pedagogical Approach

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ABSTRACT: This research was conducted to explore the application of pedagogical content technology (TPCK) knowledge and the appropriate strategies used. This research aims to investigate the incorporation of technology and Javanese teaching in academic settings further.

The quantitative research methodology covers Javanese educators and students in elementary schools throughout East Java. Data were collected through Google Forms and evaluated on the use of technology and educational techniques in acquiring Javanese. The research also highlights the beneficial influence of technology on Javanese language teaching.

This research has identified several effective methods to incorporate technology into Javanese language education, such as the development of tailor-made applications and software to facilitate language learning, the use of digital resources such as video, audio, and images related to Javanese culture, and the implementation of collaborative lessons through online platforms.

However, this study also reveals obstacles to implementing TPCK in Javanese language education, including limited technological devices, low-quality internet connections, insufficient guidance and support for teachers in TPCK development, and excess curriculum that hinders the potential of technology to improve language learning.

The use of TPCK in Javanese education has contributed significantly to this research. It is essential to design more effective teaching materials for Javanese language teachers as they integrate technology into their teaching. Furthermore, the results of this research can also be used to develop better systems and policies that support the use of technology in Javanese language education in the Java region and Javanese communities outside the region.

KEYWORDS: TPCK, Javanese language learning, elementary school.

I. INTRODUCTION

Technology has become an essential part of human life. Its presence has brought convenience to various aspects of life, including education. Therefore, an educator needs to focus on developing a technology-based frame of mind (TPCK)(Pollara & Broussard, 2011). TPCK in learning is knowledge about integrating technology and pedagogics in content development in education. This integration between technology and science is expected to bring about changes in the world of education. TPCK consists of the following three components: (a) Technology emphasized in the 21st century, which requires teachers to be proficient in applying technology, (b) Pedagogic, and (c) Knowledge content. These three components cannot be separated from each other. However, technology is expected to enable collaboration with teachers in the academic realm to produce effective learning content for students. This is in line with the concept of education that uses technology in learning (Angeli & Valanides, 2009; Krauskopf & Zahn, 2015; Olphen, 2008).

Koehler and Mishra developed TPCK into seven elements. These elements are commonly referred to as seven domains of knowledge: *Pedagogical knowledge (PK), Content knowledge (CK), Technology knowledge (TK), Pedagogical content knowledge (PCK), Technological content knowledge (TCK), Technological pedagogical knowledge (TPK), and Technological* pedagogical content *knowledge (TPCK)* (Harris et al., 2014; Koehler & Mishra, 2009).

The explanation above provides direction in solving Javanese language learning problems in elementary schools in the implementation of an independent curriculum, including the low qualifications of Javanese language teachers in using information technology, the unapplied use of learning technology by learning demands, and the uneven distribution of network technology support facilities in elementary schools (Murni, 2018) (Dawha et al., 2016).

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The role of teachers in 21st-century learning is as follows: resource *linkers*, building student character, instilling an *entrepreneurial mindset* in students, teaching critical thinking, creating challenges for students, and making learning communities. Teachers must also have the character of *lifelong learners*, diligent throughout life. Teachers must continuously develop their understanding and knowledge, starting from reading, practicing skills, and discussions with other teachers from trusted experts. Teachers must always be open to new insights to be relevant (Subrata et al., 2022).

Teachers are also required to be creative, innovative, and reflective. Build teacher and student engagement to work together or collaboratively. Moreover, it must operate the latest technology to the maximum, especially internet technology. It can also implement blending learning, where learning is combined into one, namely, online, and offline (Hoon et al., 2016; Lahiri, 2016) (Khairurrozikin et al., 2020). Learning must also be *student-centered,* with the teacher being the facilitator. Students will engage in active learning to grow their initiative and creativity. With this model, communication will go both ways (Hartnell-Young, 2003) (Ahmad & Hamda, 2018; Hoon et al., 2016).

This research investigated the TPCK theoretical framework, which is a development of Pedagogical Content Knowledge (PCK). Pedagogical Content Knowledge (PCK) was first conceived by Shulman in 1986. According to Shulman (1986), a teacher must master pedagogical knowledge (PK) and content knowledge (CK). Combining PK and CK means a teacher must master the content/material and pedagogy to create learning (Krauskopf & Forssell, 2018; Olphen, 2014) (Shulman, 1987).
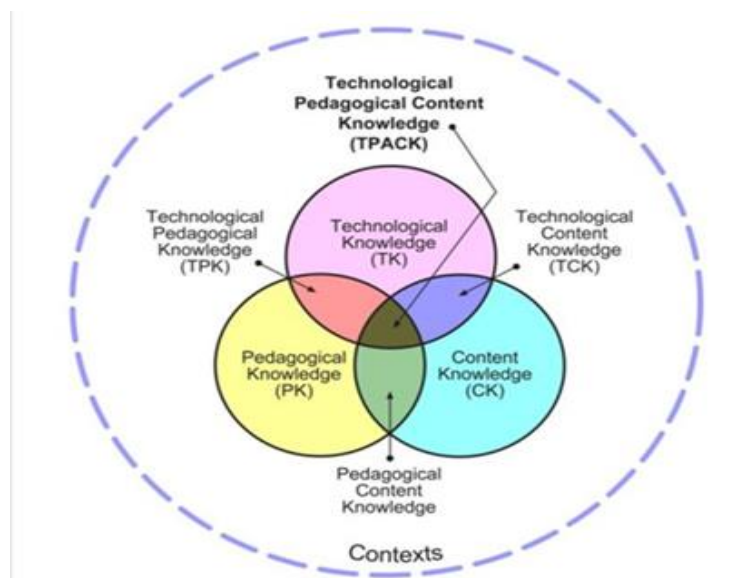

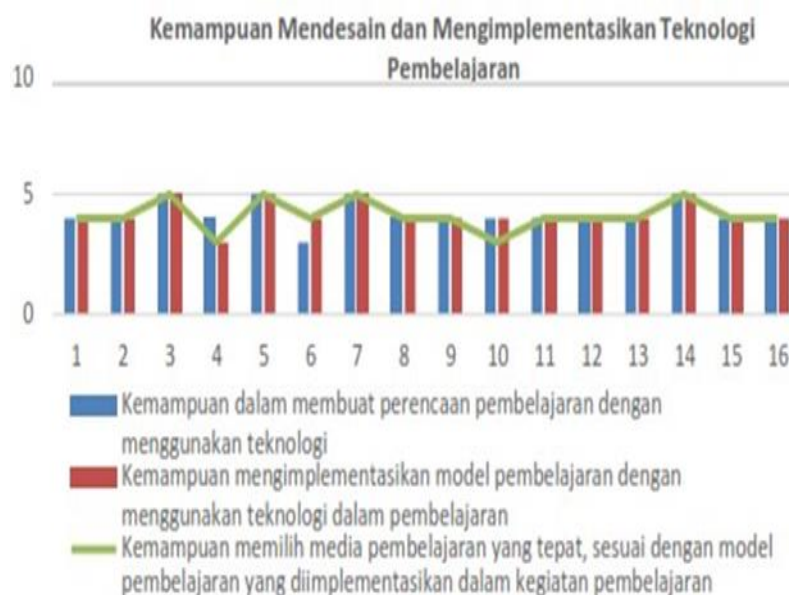**Figure 1. The TPCK framework and its knowledge components (Koehler &Mishra, 2009)**

Figure 2. Ability to Design Learning Technology (Subrata, Zuhdi, Damayanti, et al., 2022)

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Elementary schools in East Java found that technology adoption is still not optimal. Learning media in the environment around students is still effectively used by most Javanese teachers. Students are invited to practice directly with dialogue or dramatization in class, for example, when receiving guests at home, serving dishes, and talking to guests using basic manners. If children in practice still use the wrong or mixed language, the teacher can correct it directly (Subrata, 2022a) (Subrata, 2022c) (Subrata, 2022b; Utami & Zustiyantoro, 2022).

Another finding is that there are still schools, although a small number, that have not used learning media technology. Teachers only use it when necessary, such as in "macapat" song material. Because teachers are not proficient in "nembang", YouTube is a teaching medium (Hoon et al., 2016).
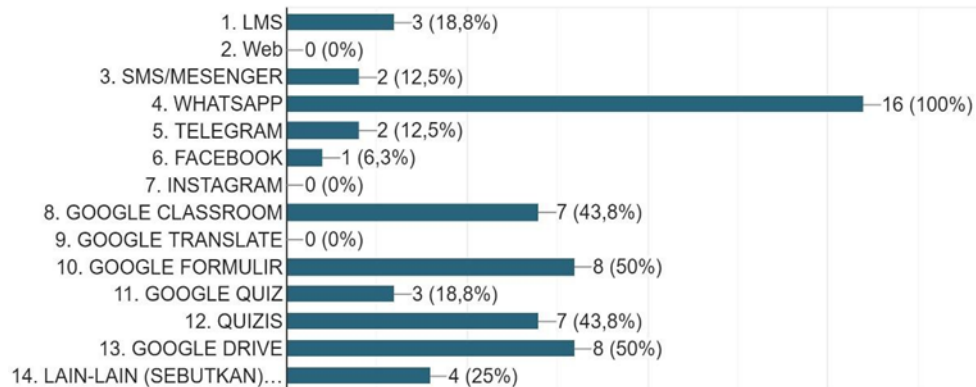

Figure 3. Use of a Digital Platform in Javanese Language Learning in Schools

This study aims to analyze and describe the application of the Technical Pedagogical Content Knowledge) Framework in learning local content of the Javanese language at the elementary school level in East Java. This study's objectives are as follows: First, analyze the TPCK Dimension: Identifying technological knowledge, pedagogy, and content possessed by teachers in the context of Javanese language learning in elementary schools. Second, measuring TPCK integration in Javanese language learning includes technological *knowledge, content* knowledge, pedagogical *knowledge, and TPCK* (technological, pedagogical, content knowledge).

This research is expected to benefit various parties involved in education, including teachers and educators, schools and principals, education offices, students, and researchers. Furthermore, this research can be a reference for future research in the field of TPCK and its application in the context of learning local content in Javanese or other fields.

II. METHOD

This study is based on the TPCK framework developed by Mishra and Koehler (2006). This study also used the TPCK-based scoring model that Abbit (2011) proposed. The TPCK framework was introduced in educational research to understand the teacher knowledge required to integrate technology effectively. The framework results from a comprehensive interaction of content, pedagogical, and technological expertise. This includes understanding how concepts are presented through technology. These pedagogical techniques can constructively apply technology to convey content in different ways depending on the learning needs of students, knowledge of what can make or break learning concepts and how technology can help address conceptual challenges, knowledge of previous understanding of content and epistemological assumptions, and knowledge of how technology can be used to build on existing knowledge to develop new epistemologies or reinforce old ones(P. et al., 2006)(Harris et al., 2014). It consists of seven domains: technical knowledge (TK), content knowledge (CK), pedagogic knowledge (PK), pedagogic content knowledge (PCK), technical content knowledge (TCK), pedagogic technical knowledge (TPK), and Technical Pedagogical Content Knowledge (TPCK)(Mouza et al., 2016)(M. Mishra et al., 2022).

This research was conducted in elementary schools (public and private) in the East Java region, consisting of 35 elementary schools—sample selection using the purposive sampling technique. A survey-based questionnaire was used. This research design was used to collect responses from respondents with survey instruments, including Technical Pedagogical Content Knowledge (TPCK in digital platforms used in learning local content of Javanese language in elementary schools.

This survey outlines the aims and objectives of the study, namely the implementation of Technical *Pedagogical Content Knowledge*], including a description of what is needed to learn local Javanese content in elementary schools. The information

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sheet also explains that survey participation is voluntary, and if participants do not agree to participate, they will remain anonymous. Those who decide to participate will remain anonymous.

A. Research Subjects

The research subjects were elementary school teachers in East Java, which included 35 people.

B. Data collection techniques

Data collection is carried out through surveys consisting of two parts. Part A collects information about the participant profiles. Part B gathers information on the use of technology (TPCK) in Javanese language learning. Part C explores the supporting elements of learning Javanese local content using digital platforms.

C. Data analysis techniques

Data analysis techniques in this study, namely quantitative data analysis from survey results, include Technological Pedagogical Content Knowledge TPCK. Pedagogical Content Knowledge (PCK). Pedagogical Knowledge (PK), Content Knowledge (CK), and Combination of PK and CK. The analysis was performed with the help of SPSS software.

III. RESULT

The results of the TPCK questionnaire data analysis of elementary school teachers in East Java were obtained through a closed questionnaire containing statements that teachers must answer regarding whether they agree with the questions (Likert scale). Questions have been adapted to TPCK elements (as limited by Suryawati et al., 2014; Tian et al., 2012; Chai et al., 2011; Schmidt et al., 2009). This category includes pedagogical knowledge (PP), content knowledge (CK), technology knowledge (TK), and technology pedagogical content knowledge (TPCK). All respondents had to answer 30 items in the TPCK questionnaire; of the 85 respondents who answered the questionnaire, 58.

Of the 58 primary school teachers—74.4% of whom taught in public schools and 29.3% in private schools—answered questions. The data are then collected and analyzed according to the data processing needs. Of the 58 educators, 17.2% recorded having more than three years of teaching experience, 15.5% had four to six years of teaching experience, 5.2% had seven to nine years of teaching, 8.6% ten to 12 years of teaching, 13.8% had 13–15 years of teaching, 6.9% had 16–18 years of teaching, 10.3% had 19–21 years of teaching, 8.6% had 22–25 years of teaching, and 15.5% had more than 25 years of teaching.

A. Pedagogical Knowledge (PP)

Knowledge pedagogy (PP) includes understanding various teaching tactics and techniques, including lesson plan creation, classroom management, and learning assessment (Kohler et al., 2014; Schmidt & Mishra, 2009). The results of the analysis of questionnaire data on elements of pedagogical knowledge are presented in Table 1 by selecting Strongly Disagree (1), Disagree (2), Average (3), Agree (4), and Strongly Agree (5).

Table 1. Results of the Pedagogical Knowledge (PP) questionnaire

No	Item	SCORE	%
1	I have a good understanding of the purpose of learning Javanese	4.1	76
2	I recognize the common difficulties and misconceptions experienced by students while learning Javanese	4.2	82
3	I can choose and develop Javanese learning materials that suit the needs of students.	4.2	55
4	I can explain Javanese concepts clearly and efficiently to students	4.1	66
5	I know how to present Javanese learning materials in an exciting and relevant manner	4.1	62
6	I could identify students' progress in learning Javanese and provide appropriate feedback	4.1	60
7	I use different learning strategies to overcome students' learning difficulties in Javanese.	4.0	66
8	I can adapt the Javanese learning method to the student's learning style	4.0	65
9	I continuously develop my teaching methods and learn Javanese	4.1	76

To the first question, which asked whether teachers understood Javanese learning objectives well, 4.1% of teachers answered in the affirmative. This shows that teachers have good knowledge of Javanese learning outcomes. This is also related to other question items, including having a good understanding of Javanese learning objectives, recognizing common difficulties and misunderstandings experienced by students when learning Javanese, and the ability to choose and develop Javanese learning

materials that suit student needs. Overall, as many as 76% of the respondents agreed. Furthermore, for the ability to explain Javanese concepts and how to present Javanese learning materials, a percentage of 82 was obtained using a score of 4.1. It is also about the ability to identify student progress in learning Javanese and provide appropriate feedback, strategies, and student learning difficulties in Javanese, as well as adjusting Javanese learning methods to student learning styles, also obtained a percentage of 65% with a score of 4.

Regarding continuous efforts to develop themselves in Javanese teaching and learning methods, 76% received a score of 4.1, which means that respondents agree with this statement. The results showed that teachers' pedagogical knowledge of Javanese learning in East Java was included in the excellent category. A teacher who does not thoroughly understand the material risks creating misunderstandings and falsifying facts (Mishra & Koehler, 2008).

B. Content Knowledge (CK)

Content Knowledge (PK): Knowledge of specific content related to subject matter expertise that educators must possess (Kohler et al., 2014; Schmidt & Mishra, 2009), which in this study refers to Javanese language material or content. Understanding the subject means understanding various concepts, theories, terminology, and frameworks (Shulman, 1986). The results of questionnaire data analysis for aspects of content knowledge are presented in Table 2 by selecting Strongly Disagree (1), Disagree (2), Average (3), Agree(4), and Strongly Agree(5).

Table 2. Results of the Content Knowledge (PK) questionnaire
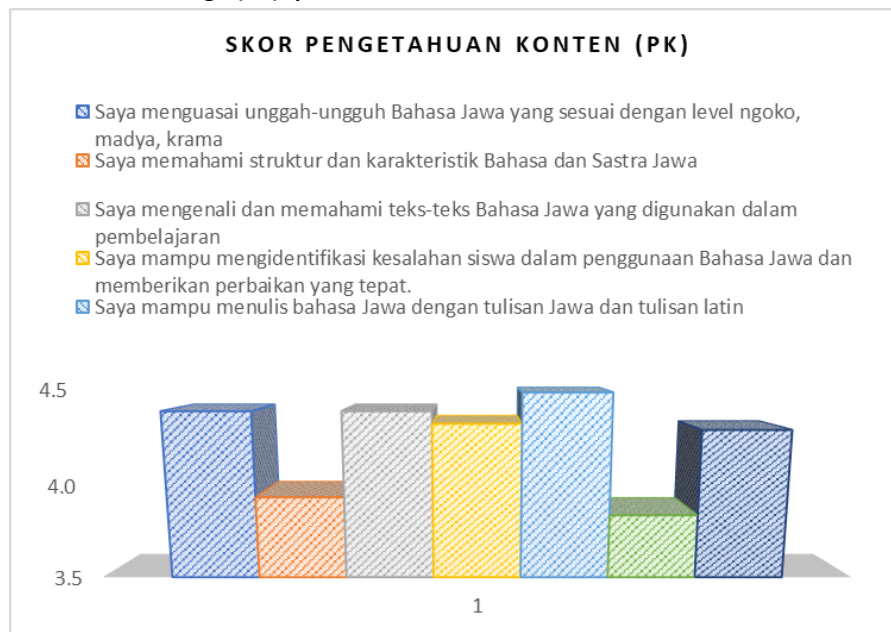
Overall, mastery of Javanese uploads by the level of ngoko, madya, krama, mastery of Javanese uploads by the level of ngoko, madya, krama, understanding of Javanese texts used in learning, the ability to write Javanese with Javanese writing and Latin writing obtained an average data value of >4, which means that respondents agree with the statement items about content knowledge. In contrast, for understanding the structure and characteristics of Javanese Language and Literature and knowledge of tembang macapat in Javanese language and literature, the number <4 is obtained, meaning respondents expressed doubt.

C. Technology Knowledge (TK)

Technology Knowledge (TK) refers to an understanding of various digital technologies that can be used in teaching and learning and the ability to use them (Schmidt, 2009; Kohler et al., 2014; De Rossi & Trevisan, 2018). Responses to questions were submitted via Google web forms by selecting Strongly Disagree (1), Disagree (2), Average (3), Agree (4), and Strongly Agree (5). The answer results are as follows:

Table 3. Results of the Technology Knowledge (PT) questionnaire

No	Item	Score	%
1	I know various tools and technological applications that can be used in Javanese language learning.	2	20

2	I know how to integrate technology tools and applications in Javanese language learning.	3.9	62
3	I can use technology to create interesting Javanese learning materials.	4	55
4	I have skills in using the necessary tools and technological applications in learning Javanese.	3	40
5	I can guide students in using technology as a Javanese learning tool.	3.8	78

Regarding knowledge about various tools and technological applications that can be used in learning Javanese, only 20% of respondents gave responses that fell into the intermediate category with a score of 3.6. Respondents who know and can integrate technology tools and applications in Javanese language learning, have skills in using technology tools and applications needed in Javanese language learning, and can guide students in using technology as a Javanese learning tool obtained the same category, showing a figure of 3.8 from 78% of respondents. Meanwhile, only 20% can use the technology applications needed to learn Javanese.

D. TPCK

Pedagogical knowledge and technology content, or TPCK, is a term used to describe the ability to incorporate technology into a curriculum on a particular subject (Schmidt & Mishra, 2009; Kohler et al., 2014). Table 7 shows the results of questionnaire data analysis for pedagogical elements of technology and content knowledge by selecting Strongly Disagree (1), Disagree (2), Average, Agree (4), and Strongly Agree(5).

Table 4. Results of the Technological, Pedagogical, and Content Knowledge (TPCK) questionnaire

No	Aspects	Indicator	%
1	I know various tools and technological applications that can be used in Javanese learning	3.9	45
2	I know how to integrate technology tools and applications into Javanese learning.	3.9	66
3	I can use technology to create interesting Javanese learning materials	4	60
4	I have skills in using the necessary tools and technological applications to learn Javanese.	3.9	65
5	I can guide students in using technology as a Javanese learning tool	3.9	78

The ability to integrate content knowledge, pedagogical knowledge, and technological knowledge in Javanese language learning in the first part about various specialized tools and applications that can be used in Javanese language teaching 45% of respondents obtained a figure of 3.9. This means to agree strongly. The same result was obtained for the second question: using technology effectively to support Javanese language teaching. The percentage is higher at 66%. Respondents also agreed that 40% could choose and integrate appropriate technology tools and applications with Javanese learning materials. The following data on teaching Javanese using technology creatively obtained 3.9 from 65% of respondents. The ability to use technology to facilitate and guide students obtained 3.9 figures from 78% of the respondents. This means that respondents strongly agree with using TPCK in Javanese language learning. More data can be found in Table 4.

IV. DISCUSSION

In today's digital era, technology in learning is becoming increasingly important. One approach that can be used is technology teaching content knowledge (TPCK), which integrates technology, pedagogy, and content knowledge. Applying TPCK can significantly improve students' learning experience in Javanese language learning. This discussion will explore technology and learning strategies when implementing TPCK in essential Javanese learning (Koehler, 2006) (P. Mishra & Koehler, 2006).

Using technology when learning Javanese can involve various tools and applications that support interactive and technology-based learning. The use of technology to understand Javanese includes applications, both web-based and android-based, or IOS. There are various applications specifically designed to learn Javanese. These apps often provide interactive content such as vocabulary, grammar, and pronunciation exercise that students can access independently. The Internet-based application offers various Javanese language resources, such as online dictionaries, folklore, traditional songs, and learning videos.

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Using images, audio, and video (interactive multimedia) in Javanese learning can enrich students' learning experience. Teachers can use interactive multimedia materials to teach vocabulary, grammar, and correct pronunciation.

In addition to technology, Javanese language learning requires the application of appropriate teaching strategies. Some instructional strategies that can be used to implement TPCK are collaborative learning, problem-based learning, authentic assessment, and TPCK integration in Javanese language learning. Integrating TPCK with Javanese learning involves a combination of technical, pedagogical, and content knowledge. Teachers need a strong understanding of relevant technology to facilitate Javanese language learning. Teachers must also develop learning strategies that meet the objectives of learning Javanese. Using TPCK, teachers can design comprehensive, interactive, and relevant learning experiences for students. The overall discussion is explained as follows:

A. Perception of the Use of Technology in the Teaching and Learning Process

The perception of the use of information technology in Javanese language learning contributes to answering this research question. Research findings show that, in general, respondents consider using technology in the learning process to be critical. Technologies, such as specialized language learning applications and digital resources related to Javanese culture, positively impact Javanese language learning. Collaborative lessons through online platforms have also proven effective. However, obstacles to implementing TPCK in Javanese education, such as limited technological devices and lack of guidance for teachers, were identified. Overall, this study contributes significantly to designing more effective teaching materials and policies for using technology in Javanese language learning.

Findings also point to previous research that teachers generally have a positive attitude toward technology integration, as they believe it improves teaching practices, makes learning interactive and engaging, and keeps learners motivated. However, several barriers hinder effective integration, including slow internet speeds, lack of infrastructure, and inadequate training and support. Teachers also face challenges such as lack of knowledge on how to use technology, lack of resources and equipment, and insufficient preparation of materials. It is recommended that clear and effective policies be implemented to allocate sufficient budgets and provide the necessary facilitation in educational institutions. In addition, attention should be paid to the career development of teachers to improve their technological competence. Teacher beliefs and pedagogical paradigms play an essential role in integrating technology, and aligning these beliefs with student-centered pedagogical approaches is necessary for the optimal use of technology (Akram et al., 2022; Wang, 2023) (FadenClick or tap here to enter text.Herdina et al., 2023) (Gorder & Gorder, 2008) (Opre, 2022).

B. Application of TPCK in Javanese language teaching.

Implementing TPCK in Javanese language teaching lt positively impacts Javanese language education if applications related to Javanese culture are used appropriately by combining digital resources and engaging in collaborative lessons through online platforms. However, remember that it also faces obstacles to implementing TPCK in Javanese language education, including limited technological tools, low-quality internet connections, lack of guidance and support for teachers in developing TPCK, and excessive curriculum. In other words, using TPCK in Javanese language learning contributes significantly to the field and provides insights for developing more effective teaching materials and strategies. Data show that pedagogical content technology knowledge (TPCK) in primary schools has been the focus of several studies. The researchers argue that developing valid and reliable instruments to measure teacher TPCK could support professional learning and teacher education program design. One study analyzed TPCK and the educational use of web technologies among teachers in European Union countries. The results showed that teachers had high TPCK self-efficacy and positive attitudes, and age, experience, and gender did not influence these factors. Another study focused on developing a TPCK instrument to measure the TPCK of preservice teachers majoring in primary or early childhood. This instrument has been widely used and adapted by researchers in various countries. In addition, case studies examine the use of ICT in teaching English literature to second-language learners. The study used the TPCK model to analyze the interaction between teachers' technological, pedagogical, and content knowledge in their use of technology (Finger & Capan, 2014; Jordan, 2014; Koh et al., 2015; Fatih, 2015; Jordan, 2014; Nurharsono, et al., 2020).

C. Teacher's understanding of TPCK in Javanese language learning.

The results of this study provide valuable insights into integrating technology and pedagogical strategies for understanding TPCK among Javanese language teachers. According to the results of previous research, teacher understanding is by several conditions, including very few teachers who understand TPCK in their learning. Teachers lack understanding and knowledge of educational tools. It was also found that most respondents had sufficient expertise, and 22% had a super understanding (Apriani et al., 2021; Fasha & Hibana, 2023; Munajib et al., 2021).

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Research also found that teachers have pedagogical competence in facilitating the development of student potential through educational play tools and can use educational play tools in teaching activities to help create a comfortable and practical learning environment (Fransiska, 2022).

Although this differs from this study's findings, a common thread can be drawn that demographic factors strongly influence teachers' understanding of understanding in the application of TPCK. The data found that the age range of respondents was dominated by 20-40 years (>50%), with an undergraduate education background of 86.2%, and the length of teaching varied, dominated by new teachers with a working period of 1-3 years (17.2%), 4–6 years, and more than 25 years (31%), and the situation where to perform municipal learning (56.9%), districts 20.7%, and villages 22.4%. Data shows that the age range of 25-45 years with a service life of between 10 and 20 years is a good condition for understanding TPCK. This age is included in 2013–2023, a period of adequate development of information technology.

D. Impact of using technology in learning.

This study explores the impact of technology and pedagogical strategies on Javanese language learning. It identifies the positive effects of technology, such as specialized language learning applications, digital resources, and online collaboration. Data from previous research on the use of technology in learning states that technology has not entirely positively impacted learning. The main obstacle is poor internet connectivity, so TPCK cannot be appropriately implemented in Javanese education. Internet network facilities are available in almost 96.6% of elementary schools in East Java. However, in prolonged network conditions, it was found that the average data speed only ranged from 10 to 20 Mbps. In addition, the limited ability of teachers also contributes to the non-optimal implementation of TPCK. This condition does not occur in all elementary schools. There are 15% of schools that are not included in these conditions. These findings contribute significantly to the field, providing insights for designing effective teaching materials and policies for integrating technology in Javanese language learning (Wiyanti et al., 2022) (Siregar & Musawaris, 2021).

V. CONCLUSION

Using technology and appropriate teaching strategies in Javanese learning in elementary schools can improve students' learning experience. By applying the TPCK methodology, teachers can integrate technical, pedagogical, and content knowledge to create a practical Javanese learning experience. Using technologies such as learning applications, online resources, and interactive multimedia, coupled with teaching strategies such as collaborative learning, problem-based learning, and authentic assessment, can provide students with a better opportunity to develop Javanese language skills in a fun and meaningful way.

Research on the application of TPCK in Javanese language learning that focuses on technology and teaching strategies shows that TPCK has significant benefits for students' learning experience. In the context of Javanese learning in elementary schools, combining technology with the right teaching strategies can improve learning efficiency and student engagement.

Technology such as Javanese language learning applications, online resources, and interactive multimedia make accessing Javanese content more accessible and enjoyable. Students can deepen their vocabulary, grammar, and pronunciation understanding through interactive and rich multimedia. In addition, technology facilitates authentic assessments where students can record themselves in Javanese in real-life situations.

Implementing the right teaching strategies while learning Javanese is also an essential factor. Collaborative learning allows students to work, discuss, and collaborate in Javanese. Problem-based learning will enable students to solve real-world problems in Javanese, thus enhancing their critical thinking skills and creativity. Authentic assessment through technology allows students to use Javanese in real situations.Through integrating TPCK, teachers comprehensively understand Javanese technology, pedagogy, and content. This allows them to design and implement effective and engaging learning experiences. Teachers can choose the right technology, integrate it with relevant teaching strategies, and provide appropriate guidance and feedback to students.Overall, applying TPCK in Javanese learning with the right technology and learning strategies can improve language learning in elementary schools. Students can effectively develop Javanese language skills while engaging in relevant learning experiences through the holistic integration of technology, pedagogy, and content knowledge.

Improving Learning Efficiency: TPCK Implementation Research Improves Javanese Language Learning Efficiency in Elementary Schools. Integrating appropriate technology and learning strategies through the TPCK approach can enrich students' learning experience, facilitate a better understanding of Javanese language content, and increase student involvement in learning. In addition, it can increase motivation and interest in learning and provide opportunities for students to work independently. Online resources give students access to study materials anytime, anywhere, allowing the development of Javanese language

skills alone. Using technology in their learning, students become familiar with digital tools and applications, thus improving their digital literacy.

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