



# Analyzing the Influence of Digital Literacy and Pedagogical Knowledge on TPACK in Elementary School Teachers

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## ABSTRAK

Perkembangan teknologi menuntut pendidikan untuk beradaptasi dengan literasi digital agar proses pembelajaran lebih relevan dengan kebutuhan abad ke-21. Namun, banyak guru belum menguasai kerangka kerja Technological Pedagogical Content Knowledge (TPACK) secara optimal, terutama dalam mengintegrasikan teknologi ke dalam pembelajaran. Penelitian ini bertujuan untuk menganalisis pengaruh literasi digital terhadap TPACK serta pengaruh pengetahuan pedagogik terhadap TPACK pada guru sekolah dasar. Penelitian ini menggunakan metode kuantitatif dengan desain *ex post facto*. Teknik pengambilan sampel yang digunakan adalah sampel jenuh, di mana seluruh anggota populasi yang terdiri dari 35 guru sekolah dasar diambil sebagai sampel. Instrumen pengumpulan data berupa angket literasi digital, pengetahuan pedagogik, dan TPACK. Data dianalisis menggunakan teknik regresi linear berganda. Hasil penelitian menunjukkan bahwa literasi digital tidak memiliki pengaruh yang signifikan terhadap TPACK dengan nilai signifikansi 0,147. Sebaliknya, pengetahuan pedagogik memiliki pengaruh signifikan terhadap TPACK dengan nilai signifikansi 0,015. Temuan ini mengindikasikan bahwa meskipun literasi digital penting, penguasaan pengetahuan pedagogik lebih berperan dalam meningkatkan kemampuan guru dalam mengintegrasikan teknologi ke dalam pembelajaran. Kesimpulannya, peningkatan pengetahuan pedagogik dapat memperkuat kompetensi guru dalam menggunakan teknologi secara efektif dalam proses pembelajaran di sekolah dasar.

## ABSTRACT

The rapid development of technology requires the education sector to adapt digital literacy to make the learning process more relevant to 21st-century needs. However, many teachers have yet to master the Technological Pedagogical Content Knowledge (TPACK) framework, particularly in integrating technology into teaching practices. This study aims to analyze the influence of digital literacy on TPACK and the influence of pedagogical knowledge on TPACK among elementary school teachers. The research employs a quantitative method with an *ex post facto* design. A saturated sampling technique was used, involving all 35 elementary school teachers as respondents. Data were collected through structured questionnaires on digital literacy, pedagogical knowledge, and TPACK competencies. The data were then analyzed using multiple linear regression techniques. The results indicate that digital literacy has no significant influence on TPACK, with a significance value of 0.147. In contrast, pedagogical knowledge shows a significant influence on TPACK, with a significance value of 0.015. These findings suggest that while digital literacy is essential, pedagogical knowledge plays a more substantial role in improving teachers' ability to integrate technology into the learning process. In conclusion, enhancing pedagogical knowledge can strengthen teachers' competencies in effectively utilizing technology in elementary school education.

## 1. INTRODUCTION

The industrial revolution 4.0 is referred to as the 4<sup>th</sup> generation directing all areas of life, especially in the fields of digital technology, intelligent intelligence, big data and robotics. No exception in the field of education, entering the industrial revolution 4.0 the world of education is required to construct learning that involves technology, education 4.0 is a term used by education experts to implement technology into learning (Sawitri, 2019; Mukti Sintawati & Indriani, 2019). A previous study by Ali Sadikin et al. on the major impact of using technology in teacher learning following the development of the 4.0 revolution which is able

to use website-based technology that has been developed shows that 90% are very good to use, 87.5% on students' understanding of the material and 88% aspects of interest to students (Muliastri, 2019; Sadikin et al., 2020). Technological pedagogical content knowledge (TPACK) has an impact on teachers, considering the inherent relationship between technology, pedagogy and content, teachers face major challenges in the shift in changes in technology, pedagogy, subject matter and current classroom contexts. Teachers should become more active as curriculum designers (Nopiantari & Agung, 2021; Pertiwi et al., 2021). A preliminary study stated that the role of teachers in the current era should be able to provide a positive contribution to the development of Indonesian people by utilizing information and communication technology in learning.

A teacher must master two knowledge in carrying out learning in a balanced way, namely digital literacy knowledge and pedagogical knowledge. However, often the passage of time and the increasing needs of students, teachers must not only have the ability of subject matter and pedagogical knowledge, but teachers must also be able to teach material by utilizing technology and mastering technology in the learning process (Adifta et al., 2022; Nurhayati et al., 2020). A previous study of the formation of classroom communication in the theory of pedagogical content knowledge expanded as discourse knowledge has success in teaching not only about what is said, but also how it is said, by whom, and with what assurance, effective teaching goes beyond the delivery of facts or the absorption of accurate and precise information by students (Hauk et al., 2015). It can be concluded that in order to integrate technology well, a teacher must master the subject matter, pedagogy and technology that interact with each other and form Technological pedagogical content knowledge (TPACK) (Ismail & Imawan, 2021; Rahmadi, 2019).

Madrasah teacher competency test held by the Indonesian Ministry of Religion showed a decline in results. Based on the results of the competency test in 2016, the results of the teacher competency test with an average value of 63.80, while in 2017 there was a decline with the results being 62.22 at the national level of the Indonesian Ministry of Religion. Judging from this condition, Indonesia needs the availability of teachers who are able to master the integrity of technology in the teaching and learning process (Sari & Harjono, 2021; Wahyuni, 2019). Professional competence of teachers is an important thing to always be developed by teachers, teacher competence is directly related to the performance displayed. Professional competence of teachers is that teachers can master the material broadly and deeply so that they can accompany students to achieve the national education standard competencies that have been set (Romlan et al., 2019; Supriyanto, 2019).

21st century teachers are expected to master knowledge of technology, pedagogy, and content in delivering learning materials. However, in reality there are still many teachers who are left behind in terms of using technology to deliver learning, low pedagogical competence of teachers, and lack of understanding in delivering learning content are separate problems in the world of education (Latif, 2020; Pertiwi et al., 2021). The combination of technological, pedagogical, and content knowledge that must be mastered by teachers today is often referred to as Technological Pedagogical and Content Knowledge (TPACK) which is a combined framework of technological knowledge. One form of TPACK application in learning is the use of technology by teachers in teaching certain subject matter (Barišić et al., 2019; Tan et al., 2019).

The many benefits of using technology in learning are a consideration for teachers to utilize technology in learning. However, not all teachers are able to use technology in the learning process. A previous study showed that there are still few teachers who do not master technology, let alone use it as a learning resource and learning media for achieving basic competencies (Yusrizal et al., 2017). The use of technology in the learning process requires competent teachers. Competence means teachers who can integrate professional skills, pedagogical skills, and technology in learning. These three skills are called Technological Pedagogical Content Knowledge (TPaCK). The ability of teachers to master technology in learning can be seen through the TPaCK (Technological Pedagogical Content Knowledge) possessed by teachers. TPaCK is a theoretical framework for integrating technology, pedagogy, and subject matter in learning (Islakhah et al., 2023; Saptano, 2019).

The results of previous research show that several learning technology facilities have been provided by madrasas to support the implementation of digital literacy programs for teachers (Lampropoulos et al., 2019; Pandy et al., 2021). Teachers have not mastered the TPACK framework in the implementation of digital literacy as part of teacher pedagogical competence and the involvement of technology in learning by teachers has not been maximized entirely due to obstacles, such as teachers are still accustomed to implementing learning with old patterns, technology facilities are still alternating with other teachers, and adequate technology facilities, instead they are only diverted by teachers. The implementation of digital literacy has not led to strengthening teacher pedagogical competence and both madrasas must identify by understanding the various problems that occur so that they can be immediately fixed with the best alternative solutions. The quality of education is greatly influenced by teachers who have pedagogical competence as one of the elements that determine the learning process and build a stronger digital system to realize great and dignified education (Irawan, 2022; Juhaeni et al., 2021).

A previous study examined pedagogical skills and knowledge in the field of accounting which had a significant positive effect on students' readiness to become teachers (Handini & Mustofa, 2022; Perdani & Andayani, 2021). This means that the better the technological skills, pedagogical skills, and accounting knowledge of prospective teacher students, the better their readiness to become teachers. Therefore, this study is expected to be able to become literature material and insight for students regarding TPACK skills towards readiness to become teachers (Ambaryanti et al., 2020; Perdani & Andayani, 2021).

The basic concept of TPACK emphasizes the relationship between subject matter, technology and pedagogy. The interaction between the three components has the power and appeal to foster active learning that is focused on students. This can also be interpreted as a form of shift in learning that was originally centered on teachers to students. TPACK emphasizes the relationships between technology, curriculum content and pedagogical approaches that interact with each other. In the TPACK scheme there is a relationship between the components, overlapping between material, pedagogy and technology that influence the context of learning, the interaction between the three components has the power and appeal to foster active learning that is focused on students (Ismail & Imawan, 2021; Mishra, 2019). Research conducted by Desi Baktiningsih Strengthening learning with the TPACK approach has a positive impact from this, it is able to increase student learning activities, namely 100% of the number of class V students are stated to be active in learning and get a value of more than or equal to KKM with an average value reaching 86. This is because teachers can master the material combined with TPACK (Baktiningsih et al., 2020).

Based on this, this study aims to analyze the influence of digital literacy on technological pedagogical content knowledge (TPACK) and pedagogical knowledge on technological pedagogical content knowledge (TPACK). Digital literacy in education is still a developing concept, especially in the context of elementary education. This study focuses on how elementary school teachers' digital literacy skills can influence their ability to integrate technology into teaching through the TPACK model. The novelty here lies in the exploration of the specific relationship between digital literacy and the overall dimensions of TPACK, which include technology, pedagogy, and content.

## 2. METHOD

This study uses quantitative research methods. Quantitative research methods are research methods based on the philosophy of positivism, which are usually used to research certain populations or samples, sampling tactics are generally carried out randomly, data collection using research instruments, quantitative/statistical data analysis (Sugiyono, 2018). The purpose of testing the established hypothesis. This type of research was chosen because it is in accordance with the purpose of the study, namely to determine whether there is an influence of the variables (X1) literacy, pedagogy (X2) on the variable (Y) TPACK of teachers. The population in this study were teachers of SDN 7 Bengkulu. The sample of this study was determined by a non-probability technique, namely a census technique where all members of the population were used as samples. The sampling technique is a saturated sample technique where all members of the population are used as samples. So, the number of samples used in this study was 17 teachers of SDN 7 Bengkulu. The data collection technique in this study used a questionnaire method that was given online by answering via google form. The data analysis technique used by the researcher was a validity test comparing the r-count value with the r-table (df) = n-2, if the r-count is greater than the r-table then the statement is declared valid. The reliability test was measured using the Cronbach Alpha coefficient. A variable is declared reliable if the Cronback Alpha value is >0.6. If the reliability value is less than 0.6 then the value is not good. The hypothesis test of this test method is partial (t-test) if the t count > t table (0.05) then the hypothesis is supported but if the t count < t table (0.05) then the hypothesis is not supported, the data was tested using SPSS version 22 to see the effect of the variables (X1) literacy, Pedagogy (X2) on the variable (Y) teacher TPACK. Alternative answers are shown in Table 1.

**Table 1. The Alternative Answers**

No	Information	Score
1	Strongly agree	5
2	Agree	4
3	Doubtful	3
4	Don't agree	2
5	Strongly disagree	1

In measuring the research variables, respondents were asked to state their perceptions by choosing answers on a scale of one to five. The questionnaire to diagnose the level of digital intensity, teacher

pedagogy and teacher TPACK. The scale of measuring teacher pedagogy digital literacy against teacher TPACK is shown in Table 2.

**Table 2. The Digital Pedagogical Literacy Measurement Scale of Teachers Against Teachers' TPACK**

No	Information	Score
1	Strongly agree	80% - 100%
2	Agree	60% - 79%
3	Doubtful	40% - 59%
4	Don't agree	20% - 39%
5	Strongly disagree	0% - 19%

Research instruments play an important role in determining the quality of a study. According to Sugiono, "A research instrument is a data collection tool used to measure natural or social phenomena that are observed". In research, the data collection tool or instrument used is a non-test, namely in the form of a questionnaire. Statements or questions in the questionnaire are developed based on theories that are relevant to each research variable. The development of instruments for each research variable is shown in Table 3 Table 4 and Table 5.

**Table 3. The Digital Literacy Research Instruments**

No	Aspect	Indicator	Item Number Statement	Amount
1.	Functional skills and beyond	ICT Skills Ability.	1, 2	2
2.	Creativity	Product creation or output in various formats and models by utilizing digital technology. Creative and imaginative thinking skills include planning, weaving together content, exploring ideas and controlling the creative process.	3 4, 5	1 2
3.	Collaboration	Ability to participate in digital spaces. Able to explain and negotiate ideas with others in the group.	6 7, 8	1 2
4.	Communication	Able to communicate through digital technology media. The ability to understand and comprehend the audience (so that when creating content they estimate the audience's needs and impact).	9 10,11	1 2
5.	The Ability to find and select Information	Ability to search and select information.	12, 13	2
6.	Critical Thinking and Evaluation	Able to contribute, analyze and sharpen critical thinking when dealing with information.	14, 15, 16	3
	Cultural and Social Understanding	In line with the context of social and cultural understanding.	17	1
7.	E-safety	Ensuring security when users explore, create, collaborate with digital technology.	18,19,20	3
<b>Amount</b>				<b>20</b>

**Table 4. The Pedagogical Knowledge Instruments**

No	Aspect	Indicator	Question Item Number	Amount
1.	Mastering Student Characteristics	a. Understanding the characteristics of students. b. Identifying student potential. c. Identifying students' initial abilities. d. Identifying learning difficulties of participants.	1,2,3,4	4

No	Aspect	Indicator	Question Item Number	Amount
2.	Curriculum Development	a. Understand various learning theories and educational learning principles related to five elementary school subjects. b. Implementing various approaches, strategies, methods, and learning techniques that educate creatively in five elementary school subjects. c. Implementing a thematic learning approach, especially in early grades of elementary school. d. Determining the objectives of five elementary school subjects. e. Determining appropriate learning experiences to achieve the objectives of five elementary school subjects. f. Selecting five elementary school/Islamic elementary school subject materials related to learning experiences and learning objectives	10,11,12	3
3.	Educational Learning Activities	a. Developing learning design components. b. Prepare a complete learning plan, both for activities in the classroom, laboratory, and field. c. Carrying out educational learning in the classroom, in the laboratory, and in the field.	13,14,15	3
4.	Development of Student Potential.	a. Providing various learning activities to encourage students to achieve optimal learning achievements. b. Providing various learning activities to actualize students' potential, including their creativity.	16,17	2
7.	Communication with Students	a. Understand various strategies for effective, empathetic and polite communication, both verbally and in writing. b. Communicate effectively, empathetically, and politely with students using distinctive language in learning interactions that are built cyclically.	18,19,20	3
<b>Amount</b>				<b>20</b>

**Table 5.**The Technological Pedagogical Content Knowledge (TPACK) Instrument

No	Aspect	Indicator	Statement Number		Amount
			Positive	Negative	
1.	Technological Knowledge (kindergarten)	a. Can teach students using the web (e.g. email).	1		1
		b. Have technical skills in using technology.	2		1
		c. Can integrate the use of technology for student learning.	3,4,5,6		4
2.	Pedagogical Knowledge(PK)	a. Can guide students to learn independently.	7,8,14		3
		b. Can plan learning activities for students.	10,11,12,13,15,16		6
		c. Can choose the right learning strategy.	9		1
3.	Content Knowledge(CK)	a. Have knowledge of learning materials.	19,21		2

No	Aspect	Indicator	Statement Number		Amount
			Positive	Negative	
4.	Technological Content Knowledge(TCK)	b. Have the ability to deliver material well.	17,18,20		3
		a. Can use appropriate technology to deliver learning materials.	22	23	2
		b. Can use the right technology to make it easier for students to do assignments.	25,26		2
		c. Can carry out the learning process with technological media such as computers and LCD projectors.	24		1
5.	Pedagogical Content Knowledge (PCK)	a. Can prepare learning plans before teaching and learning activities take place.	27,28		2
		b. Can carry out educational and dialogical learning in accordance with the RPP.	29,30		2
		c. Conducting evaluation of student learning outcomes.	31		1
6	Technological Pedagogical Knowledge (TPK)	a. Can influence the teaching approaches used in the classroom.	33		1
		b. Think critically about how to use technology in the classroom.	32		1
		c. Can adapt the use of technology learned for different teaching activities.	33,34	35	3
7.	Technological Pedagogical Content Knowledge (TPACK)	a. Can use strategies that combine technology, teaching approaches and content.	36		1
		b. Can choose to use technology in the classroom to enhance the learning process, what students learn and how I teach.	38		1
		c. Can teach the right lessons by integrating subjects, technology and teaching methods.		37	1
<b>Amount</b>					<b>38</b>

### 3. RESULT AND DISCUSSION

#### Result

This study has three variables, namely digital literacy variables (X1), pedagogical variables (X2) and TPACK variables (Y). This study was conducted on 17 respondents. The description of the data in the study can be seen in [Table 6](#).

**Table 6.** The Statistical Data Description

Parameters	Digital Literacy	Pedagogy	TPACK
N Valid	17	17	17
Missing	0	0	0
Mean	74.24	66.18	82.47
Median	75.00	66.00	81.00
Mode	63	70	81
Std. Deviation	7.27	6.50	7.53
Minimum	63	55	69
Maximum	88	78	95

Based on Table 6 above shows that the digital literacy variable (X1) has a mean value of 74.24; median 75.00; mode 63; std. Deviation 7.27; minimum value 63; and maximum value 88. The pedagogical variable (X1) has a mean value of 66.18; median 66.00; mode 70; std. Deviation 6.50; minimum value 55; and maximum value 78. The TPACK variable (Y) has a mean value of 82.47; median 81.00; mode 81; std. Deviation 7.53; minimum value 69; and maximum value 95. Before conducting a hypothesis test, a prerequisite test is conducted first. The test used is the Shapiro-Wilk normality test. The results of the normality test can be seen in Table 7.

**Table 7. Shapiro-Wilk Normality Test**

Variable	Sig.
Digital Literacy	0.682
Pedagogy	0.940
TPACK	0.237

Based on Table 7 above that the results of the Shapiro-Wilk normality test on the digital literacy variable show a significance value of  $0.682 > 0.05$  so that it is stated to be normally distributed. The pedagogical variable shows a significance value of  $0.940 > 0.05$  so that it is stated to be normally distributed and the TPACK variable shows a significance value of  $0.237 > 0.05$  so that it is stated to be normally distributed. To test the influence of digital literacy variables (X1) and pedagogy (X2) on variable Y in this study using multiple linear regression analysis. The results of the multiple linear regression hypothesis test can be seen in Table 8.

**Table 8. The Results of Multiple Linear Regression Calculation of Digital Literacy (X1) and Pedagogy (X2) against TPACK (Y)**

Variable	count	table	Sig.
Digital Literacy	1.536	2.145	0.147
Pedagogy	2.776	2.145	0.015

Based on Table 8 shows that in the digital literacy variable the  $t_{value}$  is  $1.536 < t_{table} 2.145$  which means there is no influence between digital literacy and TPACK. While in the pedagogical variable the  $t_{value}$  is  $2.776 > t_{table} 2.145$  which means there is an influence between pedagogy and TPACK.

**Discussion**

Digital literacy is a person's knowledge and skills in using digital-based media such as communication equipment and network systems, in managing, using, evaluating, and utilizing them in a good and healthy, wise, careful, appropriate manner and in compliance with legal regulations as an effort to foster interaction and communication in everyday life (Mardina, 2018; Musliha & Revita, 2021). Meanwhile, according to Paul Glister quoted in Rulie Nasrullah, et al., digital literacy is defined as a person's skill in utilizing information and technology in various forms from various sources that can be accessed anywhere and anytime with the help of computer devices. There are several factors that can influence digital literacy, which do not have an influence on TPACK in schools, not all educators have teacher certification, lack of training held in schools, and inadequate facilities and infrastructure (Fazilla et al., 2022; Sulistyarini & Fatonah, 2022). Digital literacy is one of human life skills with skills that are not only part of being able to use ICT devices, but also the ability to socialize, utilize the learning process and have an attitude that is able to think critically, creatively and inspiringly (Angrasari, 2020; Fredlina et al., 2021). Gilang Atus' research shows that information literacy has a significant positive effect on supporting the pedagogical competence of PAI teachers in SMA throughout Blitar Regency. This means that to support pedagogical competence, it is necessary to increase the value of the pedagogical competence variable, the rest is increased by other factors from outside the regression. In supporting the teacher's pedagogical abilities, digital literacy skills are needed in learning (Jamaludin et al., 2021; Rosidi, 2023).

Pedagogical competence can be supported by knowledge and insight into basic skills, namely information literacy, media literacy and digital literacy with insight into the three literacies should be able to improve pedagogical competence and teacher performance. According to previous research, digital literacy is defined as the ability to understand and use information in various forms from a very wide range of sources accessed via computers, laptops and others that can be utilized in the field of education (Suroya, 2021). A teacher in the 4.0 century is intended to be able to utilize active technology, not only prioritizing pedagogical skills but also requiring an understanding of the use of learning technology. Digital literacy is a solution so that teachers can utilize what is developing rapidly in the era of the industrial revolution 4.0 so

that they can play a role in improving the quality of learning (Qurohman et al., 2019; Shanks et al., 2017). The students faced by teachers today are a generation that is no stranger to the digital world. Students are already accustomed to the flow of information and industrial technology 4.0. This shows that as the vanguard in the world of education, teachers must not only have pedagogical skills but must upgrade their competencies to be truly ready to face the era of Education 4.0 (Afriyanti et al., 2018; Mukti Sintawati & Indriani, 2019). Pedagogy is a theory of education that questions what and how to educate in the best way. Meanwhile, according to the Greek understanding, pedagogy is the science of guiding children that discusses problems or issues in education and educational activities, including such as educational goals, educational tools, how to implement education, students, educators and so on (Romlan et al., 2019). Therefore, pedagogy is seen as a process or activity that aims to change human behavior. From several definitions of teacher pedagogical competence and digital literacy, the author concludes that pedagogical competence is an ability that must be possessed by teachers in the learning process related to learning preparation, learning management, understanding of students, development in the use of media and learning resources, and learning evaluation (Sulistyarini & Fatonah, 2022; Suroya, 2021).

The ability of a teacher is not only to develop Pedagogical or Content skills in learning, but teachers must also be able to use technology so that learning is in line with developments in the 4.0 era. This is because technology plays an important role in the present and future. Many activities such as science activities are carried out through the help of technology such as computers (Ismail & Imawan, 2021; Wahyuna et al., 2023). One of these conditions requires that teachers must be able to master and develop their technological skills. A teacher must be able to utilize existing technology to create learning media in order to carry out an enjoyable online learning process for students. This is because through media, it can increase enthusiasm and enthusiasm and minimize student boredom, and furthermore, it can facilitate teachers in the process of delivering material to students. The ability to use and develop media, especially in technology-based media, is contained in TPACK (Kivunja, 2013; Zabidi, 2019).

Furthermore, as stated by other researchers, the integration of technology, pedagogical and content in the learning process can create a new framework for teachers to create a learning process called TPACK (Ajizah & Huda, 2020). TPACK is a framework that can collaborate between aspects of technological knowledge and content, so that TPACK creates a new paradigm, how to teach or provide learning materials using technology, Pedagogical, and good content to support supporting technological knowledge. Teachers who master TPACK skills can easily master teacher pedagogy so that they can apply it to learning using technology according to the material, methods and learning strategies. According to Sintawati & Abdurrahman, TPACK is a teacher's ability that makes it easier for students to understand mathematics learning during the teaching and learning process (M. Sintawati & Abdurrahman, 2020).

Pedagogical Competence consists of 1) Knowing the characteristics and potential of students, 2) Mastering learning theories and principles of effective learning 3) Mastering curriculum planning and development 4) Mastering effective learning steps 5) Mastering assessment systems, mechanisms, and procedures. The use of technology in learning affects what is taught and when learning material appears in a curriculum (Andromeda et al., 2020; Mishra et al., 2023). Therefore, teachers need to ensure that the use of technology in learning is effective. In addition, teachers should be able to use technology to increase students' opportunities to construct their own knowledge by choosing ways that can take advantage of what the technology can do well and effectively drawing, visualizing, and calculating (Irawan, 2022; Usmaedi et al., 2020).

The results of this study can be used as a reference for schools and the government in developing teacher training programs that focus on improving digital literacy and pedagogical knowledge. By improving these two aspects, teachers' TPACK competencies will also increase, which supports more effective technology-based learning in elementary schools. By increasing digital literacy and pedagogical knowledge, teachers will be better able to integrate technology into learning, which can improve the quality and attractiveness of the learning process for elementary school students. This can ultimately have a positive effect on the achievement of student learning outcomes.

Technology continues to evolve rapidly, so digital literacy and TPACK skills that are relevant today may be different in the future. This study may not have captured new technological needs that will emerge, which could affect the relevance of the results in the long term. In addition to digital literacy and pedagogical knowledge, there are other factors that also influence TPACK competencies, such as teaching experience, technological support from the school, and personal motivation. This study may not have been able to capture all relevant variables, meaning there are potential variables that influence the results but were not examined.



#### 4. CONCLUSION

The conclusion of this discussion is that digital literacy and pedagogical competence are important skills that teachers must have in the era of education 4.0 to support the success of technology-based learning. Digital literacy includes the ability of teachers to utilize technology appropriately and healthily, which supports the effective use of information from various sources. Meanwhile, pedagogical competence plays a role in the ability of teachers to design, implement, and evaluate learning according to student needs. Both contribute to the mastery of TPACK (Technological, Pedagogical, and Content Knowledge), a framework that allows teachers to effectively integrate technology, pedagogy, and content in the teaching and learning process. The development of training programs for teachers that emphasize digital literacy and pedagogical competence can improve teachers' ability to use technology innovatively and effectively, so that the quality of learning in elementary schools can improve. In addition, although digital and pedagogical literacy are the main factors, teaching experience, technological support, and motivation also have a significant influence on TPACK competence, which needs to be considered in efforts to develop teacher competence as a whole.

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