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Implementation of TPACK in Improving The Competence of Early Childhood Teachers in Sukabumi City (Study on PAUD in Sukabumi City)

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Abstract

This study aims to analyze the influence of Technological Pedagogical Content Knowledge (TPACK) on the competence of Early Childhood Education (PAUD) teachers in Sukabumi City. This study uses a quantitative approach with a survey method. The research sample consisted of 165 PAUD teachers spread across seven sub-districts in Sukabumi City, which were selected using the proportional random sampling technique. Data collection was carried out through questionnaires and limited interviews as supporting data. The data was analyzed using simple linear regression analysis with the help of the SPSS program. The results of the study show that the level of TPACK mastery of PAUD teachers is in the high to very high category. The results showed that TPACK had a positive and significant effect on the competence of PAUD teachers, with an effect of 75.5%. The findings of the study also reveal that the main obstacle in the implementation of TPACK lies in the aspect of Technological Pedagogical Knowledge (TPK), where technology is still used technically and has not been integrated pedagogically in accordance with the characteristics of early childhood learning. Thus, it can be concluded that mastery of TPACK is an important factor in improving the competence of PAUD teachers, but there is still a need to strengthen the aspects of technology integration and pedagogy so that technology-based learning can take place more effectively and meaningfully.

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Keywords: TPACK, Teacher Competence, Early Childhood Teachers, Learning Technology, Early Childhood Education.

INTRODUCTION

The development of information and communication technology (ICT) has brought significant changes in various aspects of life, including the field of education. Digitalization of education requires educational institutions to adapt to the use of technology as an integral part of the learning process (Bintang et al., 2024). In the context of early childhood education (PAUD), technology has the strategic potential to support children's cognitive, social, emotional, and creative development when used appropriately and responsibly (Silvester et al., 2024). Early childhood education is the main foundation in the formation of character, learning attitudes, and readiness of children to enter the next level of education, so that the quality of learning at this stage greatly determines the success of long-term education (Hasanah, 2024).

Early childhood teachers play a central role as learning facilitators who are tasked with creating a safe, fun, and meaningful learning environment. However, in the digital era, the demands of professionalism of PAUD teachers are increasingly complex. Teachers are not only required to master pedagogic competence and content, but also the ability to integrate technology in learning according to the characteristics of children's development (Saputri et al., 2023). This challenge is even more evident when the technology gap still occurs, especially in non-metropolitan areas, which is characterized by limited access to ICT devices, low digital literacy of teachers, and lack of technology-based professional training (Hardiyanti & Alwi, 2022; Qayyum et al., 2024).

The use of technology in early childhood learning has great potential to improve the quality of the learning process. Interactive digital media, educational videos, and game-based learning applications can help teachers present material in a more varied and engaging way (Bintang et al., 2024). However, the use of technology without a strong pedagogical foundation has the potential to have negative impacts, such as learning distractions and the use of media that are not appropriate for the child's age (Obos et al., 2023). Therefore, the integration of technology in early childhood education must be designed selectively, planned, and based on a clear pedagogical framework.

One of the conceptual frameworks that is widely used to explain the integration of technology in learning is Technological Pedagogical Content Knowledge (TPACK). The TPACK framework emphasizes that the effectiveness of the use of technology in learning does not

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depend only on technological mastery, but on the ability of teachers to integrate technological knowledge, pedagogy, and content simultaneously and contextually (Koehler et al., 2013; Koehler & Mishra, 2005). In the context of early childhood education, the implementation of TPACK requires special adaptation because of the characteristics of students that are different from other levels of education, such as learning through play, short attention spans, and high need for social interaction (Ren et al., 2025).

In Indonesia, research interest in TPACK has continued to increase in recent years. However, most of the research still focuses on primary and secondary education levels as well as on specific subjects such as science and mathematics (Fuada et al., 2020). Research that specifically examines the implementation of TPACK in PAUD teachers is still relatively limited, especially in the context of regions with limited infrastructure and educational resources. This shows that there is a contextual gap in the TPACK literature that has not fully accommodated the needs and characteristics of PAUD teachers (Maisarah et al., 2025). Empirically, a number of studies show that PAUD teachers generally have a fairly good mastery of pedagogic and content, but are still weak in the aspects of Technological Knowledge (TK) and Technological Pedagogical Knowledge (TPK). Research by Nurhayani et al. (2022) shows that the technological competence of early childhood education teachers is in the medium category, while Anisa (2025) found that TPK is the weakest component in PAUD teachers' perception of TPACK. Similar findings were also reported by Al-Huwaida & Efendi (2024) which states that PAUD teachers have difficulty in integrating technology meaningfully into early childhood learning activities.

This phenomenon is also reflected in the condition of PAUD in Sukabumi City. The results of initial observations show that the use of technology in learning is still very limited and tends to be conventional, such as the use of lecture methods and simple print media. This condition is not caused by a rejection of technology, but by limited training, low digital literacy, and lack of institutional support for the use of technology in early childhood learning (Astari & Yulianto, 2025). In addition, there is a gap between the demands of education policies that encourage the digitalization of learning and the actual readiness of PAUD teachers in the field (Utomo et al., 2024). From a theoretical perspective, the latest study highlights the gap between the ideal concept of TPACK and its implementation in learning practice. Schmid et al. (2024) emphasized that TPACK is often used as a normative framework without contextual operational guidance, making it difficult for teachers to apply consistently. Meanwhile, Li & Bai (2025) stated that most of TPACK's research is still descriptive and has not been able to bridge the relationship between theory and real classroom practice, especially at the early childhood education level. In addition,

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there is an empirical gap shown by research findings that are not consistent regarding the level of mastery and implementation of TPACK by PAUD teachers. Differences in regional context, technology access, training experience, and policy support led to significant variations in research results (Abdullah & Mahmud, 2024; Aldalalah et al., 2025). This shows that the implementation of TPACK is strongly influenced by the local context and the characteristics of the respondents, so more specific and contextual empirical research is needed.

Based on the background of the problems, theoretical, contextual, and empirical gaps that have been described previously, the purpose of this study is to obtain a comprehensive picture of the implementation of Technological Pedagogical Content Knowledge (TPACK) in Early Childhood Education (PAUD) teachers in Sukabumi City. Thus, this research has an academic contribution in the development of TPACK literature as well as a practical contribution in efforts to improve the quality of PAUD learning in a sustainable manner.

LITERATURE REVIEW

Technological Pedagogical Content Knowledge (TPACK)

TPACK is an approach as well as a cutting-edge field of study that must be mastered by educators in order to be able to apply it effectively in the modern learning process. Understanding TPACK is an important foundation for teachers to integrate technology into teaching and learning activities optimally. This approach requires educators to be able to use a variety of appropriate learning models and methods, while utilizing technology to deliver certain subject matter efficiently. According to Koehler & Mishra (2013), TPACK serves as a framework that can be used to assess the extent of teachers' knowledge in integrating technology in the learning process. Meanwhile, Shulman (1987) argues that *Pedagogical Content Knowledge* (PCK) is a teacher's in-depth understanding of how a particular topic or problem can be presented to suit students' abilities and interests. The idea of PCK has been the focus of much scientific research and discussion, as it is considered an important foundation in the development of teacher competence. Niess & Gillow-Wiles (2017) added that the development of PCK includes various aspects of teacher knowledge such as understanding of students, pedagogy, materials, curriculum, and school environment, all of which are interrelated and form a complex unit. Along with the advancement of information and communication technology in the 21st century, computers and the internet have brought great changes in the world of education (Anih, 2016). This technological innovation provides easy access to information and opens up opportunities for improving the quality of learning (Sole & Anggraeni, 2018). The results of the study show that the

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integration between technology and subject matter can improve student understanding, provided that the technology is used appropriately and in the context (Isti'ana, 2024; Sholeh & Efendi, 2023).

Competencies of Early Childhood Education Teachers

The term competency generally refers to individual abilities that include knowledge, skills, and attitudes that are integrated in the professional performance of a task. In the context of education, teacher competence is a fundamental element that determines the quality of learning and the achievement of educational goals. Teachers are not only required to have theoretical knowledge of the teaching material, but also pedagogical skills and professional attitudes that support an effective learning process. Teacher competence serves as a foundation for teachers in designing, implementing, and evaluating learning in a systematic and sustainable manner. Mulyasa & Dyah Aryani (2017) states that teacher competence is a combination of intellectual, emotional, and moral abilities that are reflected in teachers' professional performance. Thus, teacher competence is not static, but must continue to be developed along with changing needs of students and the development of the world of education (Sanjaya, 2016). Juridically, the concept of teacher competence in Indonesia has been clearly regulated in Law Number 14 of 2005 concerning Teachers and Lecturers. This law emphasizes that teacher competence is a set of knowledge, skills, and behaviors that must be possessed, appreciated, and mastered by teachers in carrying out their professional duties. This provision places teachers as a profession that has certain competency standards, thus demanding high professional responsibility and commitment. In addition, the regulation emphasizes that teachers are required to have academic qualifications and competencies obtained through professional education. According to Widiastuti et al. (2019), The recognition of teachers as a profession requires clear competency standards so that the quality of education services can be guaranteed nationally. Thus, this regulation becomes the legal basis for the development and evaluation of teacher competencies in Indonesia.

Teacher competence as regulated in national regulations includes four main aspects, namely pedagogic competence, personality competence, social competence, and professional competence. Pedagogic competence is related to the teacher's ability to understand the characteristics of students, design learning, carry out an effective learning process, and conduct assessments and evaluations. Personality competencies reflect the teacher's steady, stable, mature, and authoritative personality so that they can be role models for students. Social competence is related to the ability of teachers to communicate and interact effectively with

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students, fellow educators, parents, and the community. Meanwhile, professional competence requires teachers to master learning materials in depth and develop professionalism in an ongoing manner (Permendiknas No. 16 Tahun 2007; Kunandar, 2011; Widiastuti et al., 2019). Professional teachers are required not only to meet minimum competency standards, but also to be able to develop their professionalism in a sustainable manner in accordance with the dynamics of the development of science, technology, and the needs of students. Widiastuti et al. (2019) emphasizing that professional competence requires teachers to continue learning, reflecting, and improving the quality of their performance through various self-development activities. This is in line with Permendiknas Number 16 of 2007 which states that every teacher is required to meet academic qualifications and competencies that apply nationally. Further, Kunandar (2015) mentioning that teachers who have high competence will be able to create innovative, effective, and meaningful learning for students. Therefore, strengthening teacher competence is the main key to improving the quality of education in a sustainable manner.

METHODOLOGY

Types and Approaches to Research

This study uses a descriptive approach with quantitative descriptive research methods (Sugiyono, 2025). This approach was chosen because the main purpose of the research is to systematically describe and analyze the level of mastery and obstacles to the implementation of *Technological Pedagogical Content Knowledge (TPACK)* in PAUD teachers in Sukabumi City, without conducting certain treatments or experiments. The descriptive method is used to obtain a factual picture of the real conditions in the field related to the mastery of the TPACK component by PAUD teachers, including *Content Knowledge (CK), Pedagogical Knowledge (PK),* and *Technological Knowledge (TK),* as well as the obstacles faced in their implementation. This approach is considered appropriate because the research focuses on actual phenomena.

Data Collection Techniques

Data collection techniques are carried out using several methods to obtain valid and comprehensive data (Sugiyono, 2025). The questionnaire was used to measure the level of mastery of PAUD teachers over the TPACK components, especially CK, PK, and TK. The questionnaire was compiled based on the TPACK indicator developed by Koehler and Mishra and adapted from the Schmidt et al. (2009). The measurement scale used is the Likert scale, because this scale is effective for measuring respondents' attitudes, perceptions, and mastery of a

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construct.

Population and Sample

Population is a whole subject or object that has certain characteristics and is the focus of research. According to Sugiyono (2025), Population is a generalized area consisting of objects or subjects that have certain qualities and characteristics that are determined by the researcher to be studied and then drawn conclusions. In the context of this study, the population in question is all PAUD (Early Childhood Education) teachers who teach in formal PAUD institutions in Sukabumi City. A formal PAUD institution under the auspices of the Sukabumi City Education Office. Based on data from the Sukabumi City Education Office regarding the Early Childhood Education Unit (SPAUD) which was uploaded to the opendata.sukabumikota.go.id in 2024, with the number of active PAUD registered as many as 150 spread across 7 sub-districts in the Sukabumi City area. Meanwhile, the number of educators is 1,004, with the number of students as many as 5,054. These PAUD-PAUD have varied educational backgrounds, working periods, and technological capabilities, making them the right population to describe the phenomenon of TPACK implementation in a real context. With a population of 1,004 PAUD teachers and a confidence level of 95% as well as an error rate of 5% and an expected response rate of 85%, the sample taken of 165 respondents is considered representative to describe the entire population of PAUD teachers in Sukabumi City. This means that the results of the study can be generalized with high accuracy to the actual population.

Data Analysis Techniques

After the data is obtained, the next step is to create a frequency distribution table to describe the frequency of each variable in the percentage calculation. The classification of subjects in this study is divided into three categories. The categories used are very low, low, medium/moderate, high and very high. Before the hypothesis test is carried out, the validity and reliability test is carried out first, then the prerequisite test of analysis is carried out using the normality test, the linearity test, and ends with the hypothesis test.

RESULTS

Respondent Description

The respondents in this study are Early Childhood Education (PAUD) teachers who teach in formal and non-formal PAUD units in the Sukabumi City area. The identities of the respondents

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in this study consisted of gender, age, and education level. The identity of the respondents is presented in table 1 as follows:

Table 1. Characteristic Respondent

No	Remarks	Quantity	Percentage %
Gender			
1	Man	40	24,2%
2	Woman	125	75,8%
Age			
1	25 – 35 Year	80	48,5%
2	36 – 45 Year	60	36,4%
3	46 – 50 Year	25	15,1%
Education Level			
1	Diploma III	60	63,6%
2	Bachelor	105	36,4%
Total		**165**	**100%**

Based on table 1 above, it is explained that this study involved 165 PAUD teachers, which were dominated by female respondents as many as 125 people (75.8%), while male respondents amounted to 40 people (24.2%), which reflects the real condition of PAUD educators who are generally dominated by women; Judging from age, the majority of respondents were in the range of 25-35 years as many as 80 people (48.5%), followed by 60 people (36.4%) and 25 people (15.1%) at 46-50 years old, which shows that most teachers are at a productive age and relatively adaptive to learning innovations, then based on education level, respondents with bachelor's education dominate as many as 105 people (63.6%), while Diploma III graduates amounted to 60 people (36.4%), which indicates that the majority of PAUD teachers have adequate academic qualifications, so that overall the characteristics of these respondents are considered representative and support the analysis of the influence of TPACK on the competence of PAUD teachers.

Data Feasibility Test

Validity Test

Before distributing the questionnaire, instrument tests were first carried out on 30 respondents who had the same criteria. In the testing of the instrument, validity and reliability

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tests are used. The validity test aims to determine the level of validity of the instrument before it is further analyzed. The validity test compares between r count and r table, where there are 165 respondents in this study. The r table of 165 respondents is 0.1519. The validity test of the instrument is presented in table 2 as follows:

Table 2. Validity Test Results

Instruments	r count	r table	Remarks
X1	0,837	0,1519	Valid
X2	0,762	0,1519	
X3	0,664	0,1519	
X4	0,824	0,1519	
X5	0,843	0,1519	
X6	0,549	0,1519	
X7	0,526	0,1519	
Y1	0,733	0,1519	Valid
Y2	0,783	0,1519	
Y3	0,864	0,1519	
Y4	0,800	0,1519	

Source: Researcher-processed data, 2026

Based on table 2 of the validity test results, all items of the research instrument, both in variables X (X1–X7) and variable Y (Y1–Y4), showed a greater calculated r value compared to the table r value of 0.1519. This indicates that all statement items used in the research instrument have met the validity criteria, so that they are able to measure the construct in question precisely and accurately. In more detail, the calculated r-value of variable X is in the range of 0.526 to 0.843. The highest value is found in item X5 of 0.843, which indicates that the item has a very strong correlation rate with the total variable score. Meanwhile, the lowest calculated r value on variable X remains above the table's r minimum, so all items remain valid. In variable Y, the calculated r-value ranges from 0.733 to 0.884, with the highest value in item Y3 of 0.884. This shows that the items on variable Y also have a strong relationship with the construct being measured. The high r-value of the calculation on all items indicates that each statement in the instrument has a good ability to represent the research variable. Thus, the instruments used not only meet the aspect of statistical validity, but also have good measurement quality. Therefore, all instrument items are

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suitable for use in the next stage of analysis without the need for revision or elimination, so that it is expected to produce valid and scientifically accountable data.

Reliability Test

After the validity test is carried out, the next step is to test its reliability. The reliability test was carried out using Cronbach's Alpha formula through the SPSS program. According to Arikunto (2016), An instrument is said to be reliable if the value of the reliability coefficient (α) ≥ 0.60. The higher the alpha value obtained, the greater the level of consistency between the statements in the questionnaire. In the following table 3, the results of the reliability test are presented as follows:

Table 3. Reliability Test Results

Variable	Cronbach's Alpha	Critical Values	Remarks
TPACK	0,833	0,600	Reliable
Competencies of Early Childhood Education Teachers	0,806	0,600	

Source: Researcher-processed data, 2026

Based on table 3 which presents the results of the reliability test, it can be seen that the two research variables, namely TPACK and Early Childhood Education Teacher Competence, have a greater Cronbach's Alpha value compared to a critical value of 0.600. This shows that all instruments used in the study have met the reliability criteria, so that they can be declared to have a good level of consistency and are suitable for use in data collection. In detail, the TPACK variable obtained a Cronbach's Alpha value of 0.833. This value falls into the category of excellent reliability, which indicates that the statement items on the variable have a high level of internal consistency. This means that each question item in the TPACK variable correlates well in measuring the same construct, namely the ability to integrate technology, pedagogy, and content by teachers. This high alpha value also indicates that respondents provide relatively consistent answers to each item submitted. Meanwhile, the PAUD Teacher Competency variable obtained a Cronbach's Alpha value of 0.806, which is also in the category of good reliability. This shows that the instruments on these variables have adequate stability in measuring teacher competence, both from pedagogical, professional, and social aspects.

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Classic Assumption Test

Normality Test

The Normality Test is used to determine whether the measurement data in this study is distributed normally or not. The results of the normality test are presented in table 4 below:

Table 4. Normality Test Results

One-Sample Kolmogorov-Smirnov Test	
	Unstandardized Residual
N	165
Asymp. Sig. (2-tailed)	.080[c]

Source: Researcher-processed data, 2026

Based on table 4 above, it is explained that the results of the normality test using *the One-Sample Kolmogorov–Smirnov Test*, it is known that the number of research samples (N) is 165 respondents. The test results show the value of Asymp. The sig. (2-tailed) is 0.080, and the limit of its normality value must be greater than 0.05, so that it can be concluded that the data is normally distributed (Ghozali, 2016).

Linearity Test

The linearity test is used to find out whether or not an independent variable and a bound variable have a linear relationship. The following is presented in table 5 of the results of the linearity test.

Table 5. Linearity Test Results

ANOVA Table							
			Sum of Squares	df	Mean Square	F	Sig.
Early Childhood Teacher Competencies * TPACK	Between Groups	(Combined)	1008.481	13	77.575	30.301	.000
		Linearity	809.073	1	809.073	316.023	.000
		Deviation from Linearity	199.409	12	16.617	6.491	.090
	Within Groups		386.585	151	2.560		
	Total		1395.067	164			

Source: Researcher-processed data, 2026

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Based on table 5, it is explained that the results of the linearity test are tested to find out whether the relationship between the TPACK variable and the PAUD Teacher Competency is linear. The results of ANOVA's analysis showed that in the Linearity row, a significance value (Sig.) of 0.000 was obtained, which is smaller than 0.05. This indicates that there is a significant linear relationship between TPACK variables and PAUD Teacher Competencies. Furthermore, in the line Deviation from Linearity, a significance value of 0.090 was obtained, which is greater than 0.05. These results show that there is no significant deviation from the linear relationship between the two variables. In other words, the pattern of relationships that form can be expressed following a straight line. Thus, it can be concluded that the relationship between TPACK and the Competence of Early Childhood Teachers meets the assumption of linearity.

ANALYSIS RESULTS

Simple Linear Regression Analysis

Simple regression analysis was used in this study to determine and analyze the influence of one independent variable on one dependent variable quantitatively. This analysis technique aims to see the direction of the relationship, the magnitude of the influence, and the ability of independent variables to predict changes in dependent variables based on data obtained from respondents. In the context of this study, a simple regression analysis was carried out to test the extent to which TPACK affects the competence of PAUD teachers. The results of simple regression analysis are presented in the following table 5:

Table 6. Results of Simple Linear Regression Analysis

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.877	1.210		.725	.470
	TPACK	.586	.039	.762	15.002	.000
a. Dependent Variable: Competencies of Early Childhood Education Teachers						

Source: Researcher-processed data, 2026

Based on Table 6 of the results of a simple regression analysis, it can be seen that the TPACK variable has an influence on the Competence of Early Childhood Teachers. The results of

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data processing showed that the regression coefficient value (B) was 0.586 with a calculated t-value of 15.002 and a significance level (Sig.) of 0.000. The significance value is less than 0.05, so it can be concluded that the TPACK variable has a positive and significant effect on the competence of PAUD teachers. This means that the higher the TPACK ability possessed by the teacher, the higher the competence possessed in carrying out learning. The constant value in the regression model of 0.877 indicates that when the TPACK variable is zero, the PAUD Teacher Competency still has a basic value of 0.877. This indicates that there are other factors outside of TPACK that also affect teacher competence, although in this study the main focus remains on the influence of TPACK.

Based on the value of the regression coefficient, a simple regression equation is obtained, namely:

$$Y = 0{,}877 + 0{,}586X$$

Where Y is the Competence of Early Childhood Teachers and X is TPACK. This equation shows that every one unit increase in the TPACK variable will be followed by an increase in the Early Childhood Education Teacher Competency by 0.586 units. Thus, the direction of the relationship between the two variables is positive and unidirectional. In addition, *the high Standardized Beta score* shows that TPACK has a strong contribution to the Competence of Early Childhood Teachers. This strengthens the finding that the ability to integrate technology, pedagogy, and content is an important aspect in improving the quality of teacher competence. Therefore, the professional development of PAUD teachers needs to be directed at improving the mastery of TPACK through training, *workshops*, and continuous mentoring, so as to support the creation of more effective, innovative, and in accordance with the demands of the digital era. Thus, the results of this simple regression analysis confirm that TPACK is an important factor that contributes significantly to improving the competence of PAUD teachers, so strengthening TPACK mastery needs to be a concern in efforts to develop teacher professionals.

Coefficient Determination Analysis

Below are the results of the determination analysis calculation.

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Table 7. Determination Analysis Results

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.762[a]	.580	.577	1.89606
a. Predictors: (Constant), TPACK				

Source: Researcher-processed data, 2026

Based on Table 7, the results of the determination coefficient analysis were obtained, an R value of 0.762 was obtained, which shows a strong relationship between the TPACK variable and the competence of PAUD teachers. This correlation value indicates that there is a close relationship, where an increase in TPACK ability tends to be followed by an increase in the competence of PAUD teachers. In other words, the relationship between the two variables is positive and quite significant in the context of this study. Furthermore, the R Square value of 0.580 shows that the TPACK variable is able to explain 58% of the variation that occurs in the Competence of Early Childhood Teachers. This means that more than half of the changes in teacher competency can be affected by the level of TPACK mastery. This contribution of 58% can be categorized as a fairly strong influence. Meanwhile, the remaining 42% was influenced by other factors outside the research model that were not studied, such as work experience, motivation, work environment, institutional support, and training attended by teachers. Thus, the results of this analysis confirm that TPACK is the dominant variable in influencing the competence of PAUD teachers, and the regression model used is good enough and feasible to explain the relationship between the two variables scientifically.

Hypothesis Test

The hypothesis test in this study was carried out to find out whether independent variables have a significant influence on dependent variables. The hypothesis test was carried out by comparing between t calculation and t table. The table in this study with the number of respondents is 165, which is 1,654. The results of the hypothesis test are presented in the following table 7:

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Table 8. Hypothesis Test

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.877	1.210		.725	.470
	TPACK	.586	.039	.762	15.002	.000
a. Dependent Variable: Competencies of Early Childhood Education Teachers						

Source: Researcher-processed data, 2026

Based on Table 4.16 of the t-test results, it can be analyzed that the TPACK variable has an influence on the Competence of Early Childhood Teachers partially. The test results showed a calculated t value of 15.002 which was greater than the table t of 1.654, and a significance value (Sig.) of 0.000 which was smaller than 0.05. Thus, the null hypothesis (H_0) is rejected and the alternative hypothesis (H_1) is accepted. This means that TPACK has a positive and significant effect on the Competence of Early Childhood Teachers. This shows that the higher the level of TPACK mastery that teachers have, the higher the professional competence they have in carrying out learning. The findings of this study are in line with research by Sakti & Eliza (2022) stating that TPACK has a direct effect on teachers' readiness in learning, so that increasing TPACK will improve the quality of teacher performance. Likewise, research by Ren et al. (2025) also shows that TPACK-based training is able to significantly improve teachers' instructional design competencies. This reinforces that TPACK is an important factor in the development of teachers' professional competencies.

DISCUSSION

The Influence of TPACK on the Competence of Early Childhood Education Teachers

Based on the results of the hypothesis test, it is known that the TPACK variable has a calculated t value of 15.002 which is greater than the t-table of 1.654, and a significance value of 0.000 (< 0.05). These results show that TPACK has a positive and significant effect on the Competence of PAUD Teachers in Sukabumi City. Statistically, the value of the regression coefficient of 0.586 indicates that every increase in one unit of TPACK will be followed by an increase in the Competence of Early Childhood Teachers by 0.586 units. This emphasizes that TPACK is a variable that has a determinant role in improving teacher competence, both in pedagogic, professional, social, and personality aspects. These findings provide empirical evidence

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that teachers' ability to integrate technology, pedagogy, and content in an integrated manner greatly affects the quality of teacher performance in learning. Teachers who have a high TPACK level tend to be better able to design innovative learning, utilize technology appropriately, and adapt learning strategies to the characteristics of students, especially early childhood who require a contextual and interactive approach. The results of this study are in line with the theory of *Technological Pedagogical Content Knowledge (TPACK)* put forward by (Koehler et al., 2013; Koehler & Mishra, 2005), which emphasizes that the effectiveness of learning is not only determined by mastery of content and pedagogy alone, but also by the ability of teachers to integrate technology pedagogically. In the framework of TPACK, the three components must interact with each other harmoniously in order to produce meaningful learning that is relevant to the demands of the times.

The findings of this study are in line with various previous studies that have been studied previously. Research from Nurhayani et al. (2022) found that the level of professionalism of early childhood education teachers increased along with the mastery of TPACK, although the technological aspect was still a major weakness. Furthermore, research from (Sari et al., 2024) shows that teachers' perceptions of TPACK are in the good category, which reflects readiness to integrate technology in learning. Likewise with the results of the research (Murtafiah et al., 2022) proving that TPACK-based training is able to significantly improve teachers' ability to integrate technology. Maisarah et al. (2025) revealed that PAUD teachers still need support in the development of TPACK-based learning media, especially in the technological aspect. Sumantri et al. (2023) also shows that TPACK implementation training can significantly increase teachers' knowledge from the category of sufficient to good. Kurniah et al. (2023) found that the integration of technology in TPACK-based learning is able to improve the quality of more innovative and meaningful learning. In addition, the research Li & Bai (2025) showed that teachers with high TPACK levels had better *self-efficacy*, while Yang & Dong (2024) emphasizing the importance of contextual factors such as institutional support in the successful implementation of TPACK. Other findings from Altun (2019) shows that digital literacy and attitudes towards technology have a positive relationship with TPACK competence, while Ren et al. (2025) proving that TPACK-based training can significantly improve instructional competence. Sakti & Eliza (2022) also found that TPACK has a direct effect on teachers' readiness in technology-based learning. Thus, the results of this study not only strengthen previous theories and findings, but also enrich the empirical evidence that TPACK is a key factor in improving the competence of PAUD teachers. This research also emphasizes the importance of sustainable development of TPACK through training,

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institutional support, and improving teachers' digital literacy, especially in the context of early childhood education in Sukabumi City which has its own characteristics and challenges.

Obstacles for Early Childhood Education Teachers in Integrating TPACK in the Aspect *of Technological Pedagogical Knowledge* (TPK)

Based on the results of descriptive analysis, limited interviews, and a thorough interpretation of the research data, the hypothesis proposed in this study is acceptable. In general, the level of TPACK mastery of PAUD teachers in Sukabumi City is in the high to very high category. This shows that most teachers have a good understanding of the main components of TPACK, namely content knowledge, pedagogical *knowledge*, and technology. However, the results of the field findings reveal that the most dominant obstacle in the implementation of TPACK lies in the aspect of *Technological Pedagogical Knowledge (TPK).* The constraints in this aspect of TPK indicate that even though teachers have understood pedagogic concepts and begun to master the use of technology, they still have difficulty in integrating these two aspects effectively in learning practices. In the context of early childhood education, this integration is very important because learning focuses not only on the delivery of material, but also on how technology can support the process of play while learning, improve interaction between teachers and children, and stimulate various aspects of child development holistically.

Empirically, the weakness in the TPK aspect is reflected in the tendency of teachers who still use technology in a limited and technical way. For example, the use of learning videos or digital applications is only as a visual aid without the design of an integrated pedagogical strategy. Technology has not been optimally utilized to create interactive, exploratory, and contextual learning experiences according to the characteristics of early childhood. This shows that partial mastery of technology has not been able to form a complete integration of TPACK, as emphasized in the theoretical framework of Koehler and Mishra. The findings of this study are in line with various previous studies. Nurhayani et al. (2022) found that the TPK aspect of PAUD teachers is still in the sufficient category, even though pedagogic competence and content are already relatively good. Research by Bintang et al. (2024) also revealed that TPK is the component of TPACK with the lowest level of mastery, so it is the main obstacle in the implementation of technology-based learning. In addition, Maisarah et al. (2025) stated that PAUD teachers still have difficulties in designing TPACK-based learning media due to limited ability to integrate technology with appropriate pedagogical strategies. Furthermore, the constraints on the TPK aspect are not only influenced by individual teacher competency factors, but also by contextual factors. The

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limitations of training that focuses more on the use of technology technically, the lack of continuous mentoring, and the variation in the availability of technological facilities and infrastructure in each PAUD institution are the main inhibiting factors. This is in line with the findings Yang & Dong (2024) which emphasized that the success of TPACK implementation is greatly influenced by institutional support, including policies, facilities, and organizational culture in the school environment.

CONCLUSION

Based on the results of the research on the implementation of Technological Pedagogical Content Knowledge (TPACK) on the Competence of PAUD Teachers in Sukabumi City, it can be concluded that the level of TPACK mastery of PAUD teachers is in the high to very high category, which shows the understanding and positive attitude of teachers towards the use of technology in learning. The results of the analysis show that TPACK has a positive and significant effect on the competence of PAUD teachers with a very strong influence, so that the increase in TPACK mastery actually contributes to the improvement of pedagogic, professional, social, and personality competencies of teachers. However, this study also found that although the mastery of TPACK in general is good, there are still obstacles in the aspect of Technological Pedagogical Knowledge (TPK), where technology tends to be used technically and functionally, not fully integrated pedagogically in accordance with the characteristics of early childhood learning. It is recommended that PAUD teachers continue to improve TPACK competence, especially in the aspects of technology integration and pedagogy, through the development of play-based learning that utilizes technology in a safe, creative, and meaningful way. Early childhood education institutions and education managers are expected to provide more optimal support through the provision of infrastructure facilities and the implementation of continuous training and mentoring oriented towards TPACK-based learning practices. In addition, the Education Office and policy makers are expected to make the results of this research the basis for formulating contextual and sustainable professional development policies for PAUD teachers. For future researchers, it is recommended to develop research with more diverse approaches and variables to gain a more comprehensive understanding of the implementation of TPACK and its impact on the quality of early childhood learning.

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