IJOLAE Indonesian Journal on Learning and Advanced Education

http://journals.ums.ac.id/index.php/ijolae

# Digital Transformation in Education: Investigating the Interplay of Teacher Motivation, Digital Literacy, and TPACK

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**DOI: 10.23917/ijolae.v7i2.9209**
Received: March 18th, 2025. Revised: April 10th, 2025. Accepted: April 18th, 2025
Available Online: May 12nd, 2025. Published Regularly: April, 2025

## Abstract

The rapid advancement of technology in education has not been fully aligned with elementary school teachers' ability to integrate it into their teaching practices. This gap persists due to the limited development of Technological Pedagogical Content Knowledge (TPACK) and the lack of research examining the combined influence of digital literacy and teacher motivation on TPACK. This study aims to analyze these two factors and their impact on TPACK among elementary school teachers. The study employed a quantitative correlational design; data were collected from 98 teachers through validated questionnaires on digital literacy, teacher motivation, and TPACK. Data were analyzed using descriptive and inferential statistics by linear regression analysis. The findings of this research lie in its exploration of the relationship between digital literacy, teacher motivation, and TPACK. It addresses a significant gap in the literature by examining the simultaneous interaction of these two variables on TPACK. The findings indicate a significant positive relationship between digital literacy and teacher motivation with TPACK, with correlation coefficients of 0.857 and 0.866, respectively. Digital literacy accounts for 73.5% of the variability in TPACK, while teacher motivation explains 75.1%. This study contributes to the existing literature by providing empirical evidence on the simultaneous effects of digital literacy and motivation on TPACK, a perspective often overlooked. Limitations include the study's focus on self-reported measures and a single geographic context, which may impact generalizability. The findings support the need for targeted professional development programs emphasizing both digital literacy and motivational strategies to enhance technology-based teaching in elementary education.

**Keywords:** advanced competence, digital learning, digital literacy, lifelong learning, online learning, technological advancements

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## 1. Introduction

The integration of technology into education has become a crucial aspect of modern teaching and learning. However, in elementary education, teachers often struggle to effectively incorporate technology into their instructional practices (Nordito, 2023; Vlassopoulos et al., 2023). This problem mainly arises because teachers have gaps in their Technological Pedagogical Content Knowledge (TPACK), which is a framework that highlights the need to blend technology, teaching methods, and subject knowledge for effective teaching (Imran et al., 2023; Mardiana, 2020). While numerous studies have explored factors influencing TPACK, limited research has examined the combined role of digital literacy and teacher motivation in shaping teachers' technological competencies.

A key issue among Indonesian educators is the deficiency in their professional

competencies (Sulisworo et al., 2017). This study highlights the critical importance of Technological Pedagogical Content Knowledge (TPACK) in fulfilling professional teaching responsibilities. TPACK encapsulates the essential integration of technology, pedagogy, and content knowledge required to support effective teaching and learning. Mastery of TPACK significantly influences the success of the learning process, enhances student motivation (Maryani & Martaningsih, 2015), and improves student outcomes (Akturk & Ozturk, 2018). It is fundamental for teachers to develop effective teaching strategies that utilize technological tools. Consequently, various initiatives have been undertaken to promote TPACK, including the implementation of online learning (Wijayati et al., 2024), digital platform training (Sudrajat & Firmansyah, 2022; Wijayanti et al., 2023), and teacher workshops focused on designing digital learning environments (Martaningsih et al., 2021).

In this context, teachers' digital literacy and motivation play a pivotal role in advancing educational quality. Digital literacy refers to teachers' proficiency in understanding and integrating information technology into their instructional practices (Rusydiyah et al., 2020). Conversely, teacher motivation represents an internal factor that determines the extent of their willingness and capability to employ technology in the classroom (Han & Yin, 2016). Despite the critical importance of these factors, there is still limited understanding of how digital literacy and teacher motivation interact to shape TPACK. While several studies have examined the individual influence of these factors (Joo et al., 2018; Sharma & Srivastava, 2020; Stumbrienė et al., 2024), few have explored their combined impact on TPACK within the educational context.

Numerous studies have underscored the significance of digital literacy, teacher motivation, and Technological Pedagogical Content Knowledge (TPACK) in addressing the challenges posed by the digital era. A bibliometric analysis of research articles published within the TPACK framework from 2012 - 2021 reveals fluctuations in the volume of educational research utilizing this framework. Notably, collaborative writing predominantly occurred among researchers within the same country (Putri et al., 2022; Simangunsong et al., 2023). TPACK has emerged as a pivotal framework for understanding teachers' competencies in integrating technology, pedagogy, and content into their teaching practices (Alharbi, 2022). Teachers with high levels of TPACK tend to create more effective learning environments (Koh et al., 2014; Roussinos & Jimoyiannis, 2019; Yeh et al., 2015), and its positive impact extends to enhancing students' scientific literacy (Huriyah et al., 2022), higher-order thinking skills (Maryani et al., 2022), and lesson planning abilities (Fazilla et al., 2022). Efforts to improve TPACK include supporting teachers in assessment design (Maryani & Martaningsih, 2017), providing virtual laboratory training (Maryani & Okimustava, 2021), and fostering academic interest among prospective teachers (Zou et al., 2022).

In response to the growing need for enhanced TPACK among educators, this research will investigate the influence of two critical variables digital literacy and teacher motivation on TPACK development programs. Digital literacy extends beyond technical proficiency, encompassing information, media, and communication literacy (Reddy et al., 2022), as well as the ability to critically apply technology in educational settings (Fraillon et al., 2020). It is vital to education, healthcare, and economic well-being (Purnama et al., 2021). Teachers' digital literacy is a key determinant in the acceptance and integration of technology into education

(Antonietti et al., 2022), a factor increasingly critical for preparing students with the skills necessary for thriving in a digital world (Hutchison et al., 2012).

The second crucial variable is teacher motivation in executing their professional responsibilities. However, this study provides new insights by demonstrating that motivation is an equally significant predictor, supporting theories that highlight the role of intrinsic and extrinsic motivation in teacher development (Beardsley et al., 2021), and positively influencing professional development (Osman & Warner, 2020; Zhang et al., 2021), teaching skills, and overall teaching performance (Anwar et al., 2021; Taryana et al., 2023). In terms of student outcomes, teacher motivation affects student performance, learning achievements (Bardach & Klassen, 2021; Engin, 2020), student interest in learning (Tambunan et al., 2021), students' perceptions of their teachers (Bernaus & Gardner, 2008), and student motivation within the classroom (Ahn et al., 2021; Scales et al., 2019).

A scientometric analysis of 1,365 research publications from the Scopus database resulted in the thematic map presented in Figure 3. Using RStudio software, the research themes related to TPACK, digital literacy, and teacher motivation were categorized into four thematic quadrants.

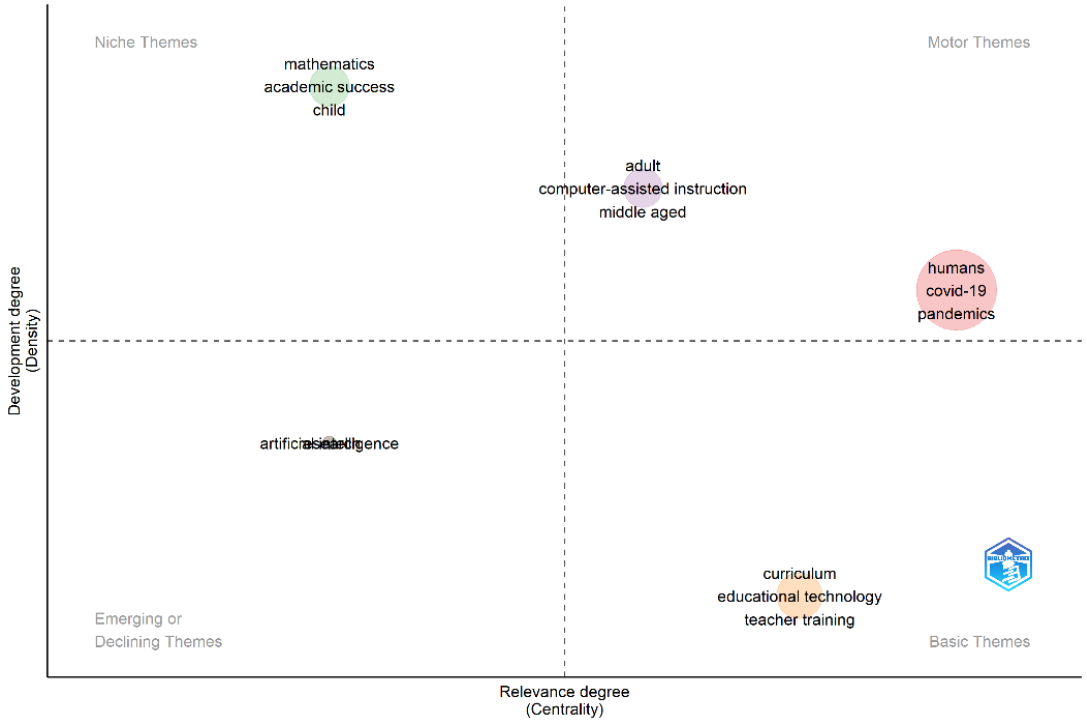


**Figure 1. Thematic Map of Research on TPACK, Digital Literacy, and Teacher Motivation**

Figure 1 presents a thematic map highlighting key research areas related to TPACK, digital literacy, and teacher motivation. The themes identified as having significant research potential (niche themes) include mathematics, academic success, and child development. In the context of this study, "academic success" pertains to the learning outcomes of students taught by teachers possessing advanced TPACK competencies. The "child" theme is particularly pertinent, given the focus on elementary school students as the primary subjects of this research. Digital literacy is essential for teachers to navigate and

integrate technology into their pedagogy, yet its role in enhancing TPACK is often discussed in isolation. Similarly, teacher motivation has been recognized as a key driver of professional development and instructional effectiveness, but its specific contribution to TPACK remains underexplored. This study aims to address this gap by investigating how digital literacy and teacher motivation jointly influence TPACK development among elementary school teachers. By examining these variables simultaneously, this research provides a more comprehensive understanding of the factors supporting teachers' ability to integrate technology in the classroom. Research Objectives in this study include (a) what is the current state of digital literacy and motivation among elementary school teachers in Balikpapan; (b) What is the relationship between digital literacy and the TPACK of elementary school teachers in Balikpapan; (c) what is the relationship between motivation and the TPACK of elementary school teachers in Balikpapan.

## 2. Method

### a. Research Design

This study employs a quantitative correlational design to examine the relationship between digital literacy, teacher motivation, and TPACK among elementary school teachers. We selected the correlational method to identify patterns and relationships between these key variables without manipulating the study environment.. This approach is particularly suitable for assessing how teachers' competencies and motivational factors influence their ability to integrate technology into teaching.

### b. Participants and Sampling

The study sample consists of 98 elementary school teachers who are active members of the teacher community in Balikpapan, Indonesia. A saturated sampling technique was used, meaning all teachers in the population meeting the inclusion criteria were included in the study. This method was chosen to ensure a comprehensive representation of teachers actively engaged in professional learning communities.

### c. Instruments and Measurement

This research involves the collection of quantitative data on digital literacy, motivation, and teachers' TPACK. Digital literacy and motivation were assessed through a questionnaire utilizing a semantic differential scale, while TPACK was measured using a multiple-choice test. The indicators for the digital literacy variable were synthesized from several prior studies (Arvianto et al., 2023; Rusydiyah et al., 2020; Sánchez-Cruzado et al., 2021; Siero, 2017). The indicators and sub-indicators for teacher motivation in performing professional duties were derived from the works of (Appova & Arbaugh, 2018; Greenier et al., 2023; Yalçınkaya et al., 2021). Similarly, the TPACK indicators were synthesized from studies by (Kaplon-Schilis & Lyublinskaya, 2020; Li et al., 2022; Singh & Malik, 2022). The appendix provides a detailed blueprint of the instruments.

We tested the validity and reliability of each variable using Jamovi software. The analysis confirmed that all items were both valid and reliable. A comprehensive summary of the validity and reliability results can be found in Table 1.

**Table 1. Validity Test Results**

| Digital Literacy | | Self-Development Motivation | | TPACK | |
|---|---|---|---|---|---|
| Item | Item-rest correlation | Item | Item-rest correlation | Item | Item-rest correlation |
| 1 | 0.823 | 1 | 0.764 | 1 | 0.730 |
| 2 | 0.871 | 2 | 0.818 | 2 | 0.811 |

| Digital Literacy | | Self-Development Motivation | | TPACK | |
|---|---|---|---|---|---|
| Item | Item-rest correlation | Item | Item-rest correlation | Item | Item-rest correlation |
| 3 | 0.780 | 3 | 0.693 | 3 | 0.820 |
| 4 | 0.766 | 4 | 0.596 | 4 | 0.769 |
| 5 | 0.775 | 5 | 0.566 | 5 | 0.786 |
| 6 | 0.818 | 6 | 0.787 | 6 | 0.862 |
| 7 | 0.849 | 7 | 0.834 | 7 | 0.834 |
| 8 | 0.891 | 8 | 0.842 | 8 | 0.858 |
| 9 | 0.897 | 9 | 0.828 | 9 | 0.884 |
| 10 | 0.911 | 10 | 0.865 | 10 | 0.876 |
| 11 | 0.908 | 11 | 0.922 | 11 | 0.900 |
| 12 | 0.909 | 12 | 0.881 | 12 | 0.903 |
| - | - | 13 | 0.837 | 13 | 0.906 |
| - | - | 14 | 0.862 | 14 | 0.909 |

Item-rest correlation values above 0.7 are generally considered indicative of good validity, demonstrating that each item consistently contributes to the construct being measured. For the digital literacy variable, all items show strong correlations, ranging from 0.766 to 0.911, indicating high validity. tems 10, 11, and 12 exhibit a very strong contribution to the instrument, with correlation values close to or exceeding 0.9. These results affirm that the instrument is highly valid for assessing teachers' digital literacy.

In the self-development motivation variable, items 8, 10, 11, and 12 exhibit strong correlations. Items with moderate correlations, including items 1, 2, 6, 7, 13, and 14, display correlation values ranging from 0.764 to 0.834, which are within an acceptable range. Items 3, 4, and 5, which demonstrate low correlations, contribute less to the overall construct. While the instrument overall exhibits excellent validity, items 4 and 5 may require further examination to ensure they effectively measure teacher motivation in alignment with the intended construct.

For the TPACK variable, items 11, 12, 13, and 14 demonstrate high correlations, with item-rest correlation values exceeding 0.9, indicating these items are particularly robust in measuring teachers' TPACK. Strong correlations, ranging from 0.834 to 0.884, demonstrate the consistency of items 6, 7, 8, 9, and 10 with the assessed construct. Item 1, with a moderate correlation of 0.730, contributes less in comparison to the other items but remains within the acceptable range. The result suggests that while item 1 plays a role in measuring TPACK, it is not as strong as the other items. Overall, the TPACK instrument demonstrates high validity, with strong item-rest correlations for most items. Notably, items 11, 12, 13, and 14 exhibit particularly strong contributions, whereas item 1, while less robust, remains valid.

The results of the reliability test, using Cronbach's α, are presented in Table 2.

**Table 2. Reliability Test Results**

| | Cronbach's α |
|---|---|
| Digital Literacy | 0.972 |
| Self-Development Motivation | 0.960 |
| TPACK | 0.974 |

The Cronbach's α value for the Digital Literacy scale is 0.972, indicating very high reliability. Similarly, the Self-Development Motivation scale demonstrates a high reliability coefficient of 0.960, as does the TPACK scale, with a value of 0.974. Cronbach's α assesses the internal consistency of a scale, with values close to 1 signifying that the items within the scale are highly consistent in measuring the same construct, whether related to digital literacy, self-development motivation, or TPACK.

**d. Data Analysis**

Based on the research problem, this study employs several data analysis techniques, including the following:

1. Descriptive Analysis: Utilizing descriptive statistics such as mean, standard deviation, and categorization to summarize and interpret the data.
2. Hypothesis Testing with Inferential Statistics: Hypothesis testing is conducted in two main stages:
   a. Assumption checks, including normality, heteroscedasticity, and linearity tests, were conducted before hypothesis testing to validate the statistical models.
   b. Hypothesis Testing: Hypothesis testing is conducted in two main stagesn.

**e. Research Hypothesis**

*Hypothesis 1*

$H_0$ : There is no relationship between digital literacy and the TPACK of elementary school teachers.

$H_1$ : There is a relationship between digital literacy and the TPACK of elementary school teachers.

*Hypothesis 2*

$H_0$ : There is no relationship between motivation and the TPACK of elementary school teachers.

$H_1$ : There is a relationship between motivation and the TPACK of elementary school teachers.

## 3. Result and Discussion

This study examines the relationship between digital literacy, teacher motivation, and TPACK among elementary school teachers. The findings reveal a strong positive correlation between digital literacy and TPACK (r = 0.857) and teacher motivation and TPACK (r = 0.866). Regression analysis indicates that digital literacy explains 73.5% of TPACK variance, while teacher motivation accounts for 75.1%, suggesting both factors play a critical role in shaping teachers' ability to integrate technology into their teaching practices.

Further analysis indicates that the majority of teachers exhibit moderate levels of digital literacy (74%) and motivation (73%), while only a small percentage have high digital literacy (11%) and high motivation (13%). These findings suggest that while most teachers have foundational competencies in digital literacy and motivation, there is still room for improvement in maximizing their technological pedagogical skills.

**a. Digital Literacy**

An analysis conducted on a sample of 98 elementary school teachers in Balikpapan, East Kalimantan, Indonesia, yielded a distribution of digital literacy levels among teachers, as illustrated in Figure 2.

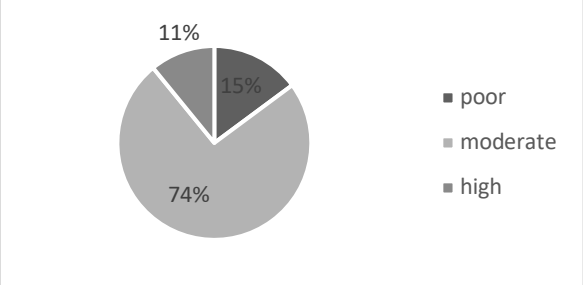


**Figure 2. Categories of Teachers' Digital Literacy**

The analysis of the digital literacy data reveals that respondents' digital literacy skills are categorized into three levels: low, medium, and high. As illustrated in Figure 2, the majority of respondents (74%) fall within the medium digital literacy category. In contrast, 15% of respondents exhibit low digital literacy, indicating limited proficiency in the effective use of digital technology. Only 11% of respondents demonstrate high digital literacy, reflecting a small portion of the population with advanced competence in utilizing digital tools. These results highlight a notable disparity in digital literacy, with most respondents positioned at a medium level and relatively few achieving higher proficiency.

### b. Self-Development Motivation

Figure 3 presents an analysis of the self-development motivation of elementary school teachers in Balikpapan.

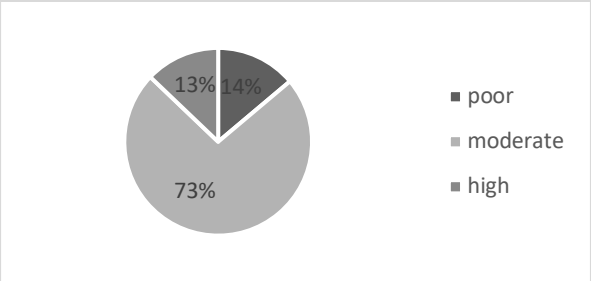


**Figure 3. Categories of Teachers' Self-Development Motivation**

As shown in Figure 3, respondents' self-development motivation is classified into three categories: low, medium, and high. The majority, 73%, exhibit a medium level of motivation. A smaller proportion, 14%, falls into the low category, indicating limited inclination toward self-improvement. Only 13% of respondents demonstrate a high level of self-development motivation. These results suggest that overall, the respondents' motivation predominantly resides in the medium range, with a relatively equal distribution between the low and high categories. This disparity highlights the need for targeted interventions to enhance motivation, particularly among teachers with lower levels of self-development motivation.

### c. TPACK (Technological Pedagogical Content Knowledge)

The analysis of TPACK among elementary school teachers in Balikpapan is presented in Figure 4.

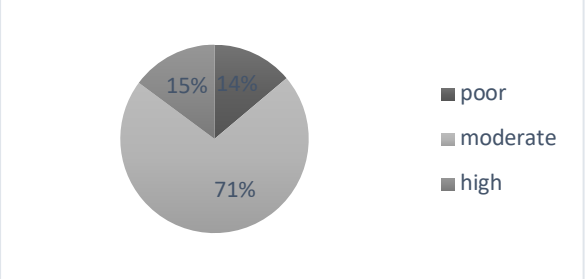


**Figure 4. TPACK Categories of Teachers**

Figure 4 categorizes the percentage distribution of respondents' Technological Pedagogical Content Knowledge (TPACK) into three levels. The majority, comprising 71%, fall within the moderate TPACK category. Approximately 14% demonstrate low TPACK, highlighting limitations in their ability to integrate technology, pedagogy, and content effectively in the learning process. In contrast, only 15% of respondents exhibit a high level of TPACK, indicating that a small segment possesses a strong aptitude for integrating these three critical elements. These results imply that while a significant portion of respondents demonstrates adequate competence, there is ample opportunity for further improvement in merging technology with effective teaching practices.

### d. The Relationship Between Digital Literacy and TPACK Among Elementary School Teachers

To investigate the relationship between the variables, hypothesis testing was conducted, preceded by assumption tests, including a normality test and a heteroskedasticity test. The results of the normality test are presented in Table 3.

**Table 3. Normality Tests**

| | Statistic | p |
|---|---|---|
| Kolmogorov-Smirnov | 0.0578 | 0.889 |

Note: Additional results provided by *moretests*

The Kolmogorov-Smirnov test results, as shown in Table 3, confirm that the data are normally distributed, with p-values exceeding the 0.05 threshold, thus satisfying the assumption of normality. The subsequent assumption test, the heteroskedasticity test, is detailed in Table 4.

**Table 4. Heteroskedasticity Tests**

| | Statistic | p |
|---|---|---|
| Goldfeld-Quandt | 1.13 | 0.333 |

Note: Additional results provided by *moretests*

Table 4 indicates that the Goldfeld-Quandt test returns a p-value greater than 0.05, suggesting no significant evidence of heteroskedasticity. This conclusion implies that the assumption of homoscedasticity, or constant error variance, holds in the tested model. The Goldfeld-Quandt test is widely recognized as a reliable method for detecting heteroskedasticity, a condition where residual variance is inconsistent. Failure to account for heteroskedasticity can result in inefficient coefficient estimates and erroneous standard errors, ultimately leading to incorrect inferences. Following these tests, a linearity assessment was performed, with the Q-Q plot presented in Figure 5.

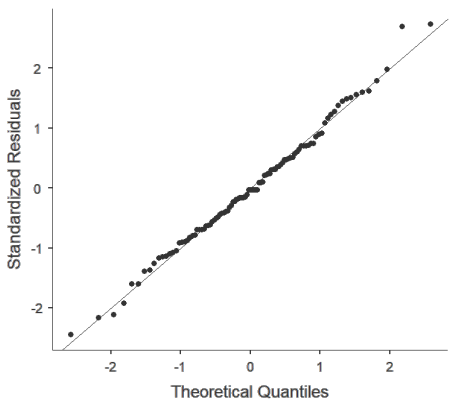


**Figure 5. Q-Q Plot of Digital Literacy and TPACK**

Figure 5 illustrates that the residuals exhibit a largely normal distribution, with only slight deviations in the tails. These minor deviations can be considered negligible, thereby confirming that the assumption of linearity holds. Therefore, we can employ parametric statistics, specifically linear regression, for further analysis. This validation allows the researcher to confidently proceed with a simple linear regression, the results of which are presented in Table 5.

**Table 5. Simple Regression Analysis Results for Digital Literacy and TPACK**

| Model Fit Measures | | | | | | | |
|---|---|---|---|---|---|---|---|
| Model | R | $R^2$ | Adjusted $R^2$ | Overall Model Test | | | |
| | | | | F | df1 | df2 | p |
| 1 | 0,595138889 | 0,51041667 | 0,50833333 | 274 | 1 | 99 | < .001 |

Table 5 presents an $R^2$ value of 0.735, indicating that 73.5% of the variance in digital literacy is accounted for by variations in TPACK. The p-value, less than 0.001, confirms the statistical significance of this relationship, implying that TPACK is a robust predictor of digital literacy. Furthermore, the correlation coefficient (R) of 0.857 reflects a very strong positive relationship between the two variables. The F-statistic of 274 further substantiates the model's overall significance in predicting TPACK, providing compelling evidence of the substantial influence of digital literacy on it. The regression equation, based on these results, is detailed in Table 6.

**Table 6. Model Coefficients for Digital Literacy and TPACK**

| Predictor | Estimate | SE | t | p | Stand. Estimate |
|---|---|---|---|---|---|
| Intercept | 22.918 | 29.037 | 0,35347222 | < .001 | |
| Digital Literacy | 0,439583333 | 0,26527778 | 16.56 | < .001 | 0,59513889 |

The regression equation derived from Table 6 is as follows:

$$Y=22.918+0.633X$$

Where:

- Y represents the dependent variable (TPACK).

- X denotes the independent variable (Digital Literacy).

This equation suggests that for each unit increase in digital literacy, the TPACK score increases by 0.633 units, assuming all other factors are held constant. The predictor is highly significant ($p < .001$) and exhibits a strong positive relationship with TPACK, as evidenced by the standardized estimate of 0.857. In conclusion, digital literacy emerges as a significant and influential predictor of TPACK in this study.

### e. The Relationship Between Motivation and TPACK Among Elementary School Teachers

Hypothesis testing was conducted to explore the relationship between the variables, following the completion of assumption tests, including assessments of normality and heteroskedasticity. The results of the normality test are displayed in Table 7.

**Table 7. Normality Test Results**

| | Statistic | p |
|---|---|---|
| Kolmogorov-Smirnov | 1.13 | 0.333 |

Note: Additional results provided by moretests

**The Kolmogorov-Smirnov** test results indicate that the assumption of normality is satisfied (p-value > 0.05). Subsequently, the heteroskedasticity test was performed, and the findings are presented in Table 8.

**Table 8. Heteroskedasticity Test Results**

| | Statistic | p |
|---|---|---|
| Goldfeld-Quandt | 0.990 | 0.515 |

Note: Additional results provided by *moretests*

As shown in Table 8**, the Goldfeld-Quandt** test revealed no significant evidence of heteroskedasticity (p-value > 0.05), indicating that the data is homoscedastic. A linearity test was then conducted using a Q-Q lot, with the results depicted in Figure 6.

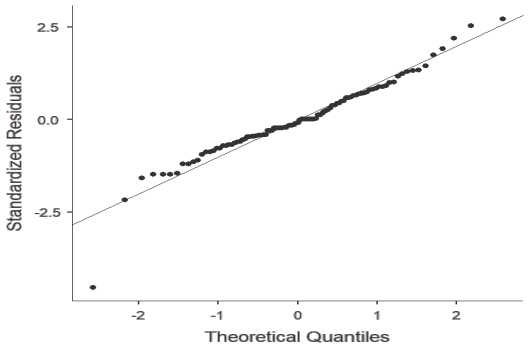


**Figure 6. Q-Q Plot of Digital Literacy and TPACK**

Figure 6 reveals slight deviations from normality, particularly in the lower-left and upper-right tails; however, these deviations are minor and do not violate the assumption of normality for the purposes of this study. As a result, hypothesis testing can proceed with parametric statistical methods, specifically linear regression analysis. The outcomes of the linear regression are summarized in Table 7.

**Table 7. Simple Linear Regression Results: Motivation and TPACK**

| Model Fit Measures | | | | | | | |
|---|---|---|---|---|---|---|---|
| Model | R | $R^2$ | Adjusted $R^2$ | Overall Model Test | | | |
| | | | | F | df1 | df2 | p |
| 1 | 0,601388889 | 0,52152778 | 0,51944444 | 298 | 1 | 99 | < .001 |

Table 7 shows a correlation coefficient (R) of 0.866, indicating a very strong relationship between motivation and TPACK. The $R^2$ value of 0.751 suggests that approximately 75.1% of the variability in TPACK can be explained by self-development motivation. The Adjusted $R^2$ of 0.748, slightly lower than the $R^2$, accounts for the number of predictors and sample size, offering a more accurate estimate of the model's explanatory power. The F-statistic of 298 demonstrates the significance of the overall regression model, indicating that motivation significantly improves the prediction of TPACK compared to a model without predictors. The highly significant p-

value (< 0.001) underscores the model's statistical relevance. The regression equation can be derived from the data provided in Table 8.

**Table 8. Model Coefficients for Motivation and TPACK**

| Predictor | Estimate | SE | t | p | Stand. Estimate |
|---|---|---|---|---|---|
| Intercept | 9.607 | 35.431 | 0,13263889 | 0.008 | |
| motivasi | 0,615972222 | 0,35694444 | 17.26 | < .001 | 0,60138889 |

Based on the results in Table 8, the regression equation for TPACK and self-development motivation is as follows:

$$Y=9.607+0.887X$$

Where:

- Y represents the dependent variable (TPACK).
- X denotes the independent variable (self-development motivation).

This equation implies that for every one-unit increase in self-development motivation, the TPACK score is expected to rise by 0.887 units, assuming all other factors remain constant. The predictor is highly significant ($p < .001$) and shows a strong positive relationship with TPACK, as evidenced by the standardized estimate of 0.866. In conclusion, self-development motivation is a powerful predictor of TPACK in this study.

The findings indicate a significant and positive relationship between digital literacy and elementary school teachers' TPACK in Balikpapan, Indonesia. Prior research corroborates this result, highlighting digital literacy as a critical factor in mastering TPACK. Teachers with high levels of digital literacy are better equipped to integrate technology, pedagogy, and content in their teaching practices (Fazilla et al., 2022; Hasanah et al., 2023). A solid foundation in digital literacy enables teachers to effectively utilize information technology, thereby enhancing their capacity to merge various learning components. Consequently, enhancing digital literacy is pivotal in strengthening teachers' TPACK, especially given that many teachers demonstrate intermediate levels of digital literacy (Altun, 2019; Falloon, 2020; Su, 2023).

These findings reinforce previous research indicating that digital literacy is a fundamental component in fostering TPACK (Tondeur et al., 2020; Xiangjun & Lei, 2024). Teachers with higher digital literacy are more likely to engage in technology-supported pedagogy, aligning with studies emphasizing digital literacy as a key enabler of TPACK development (Falloon, 2020). Hence, teacher capacity-building initiatives should prioritize training and professional development programs that emphasize multidimensional digital literacy (Botturi, 2019; Susanti et al, 2024).

In parallel, the study demonstrates that self-development motivation significantly influences TPACK. Teacher motivation, characterized by attributes such as perseverance, curiosity, and a commitment to lifelong learning, is vital in cultivating TPACK competencies (Tanak, 2020). Highly motivated teachers are more likely to engage in professional development opportunities, thereby enhancing their ability to integrate technology with pedagogy and content (Yurtseven Avci et al., 2020). These insights highlight the importance of fostering teacher motivation to ensure active participation in development programs aimed at bolstering TPACK.

Further analysis reveals that the interaction between digital literacy and self-development motivation significantly contributes to improving teachers' TPACK (Muhaimin et al., 2019). Teachers who possess both strong digital literacy and high motivation are better positioned to incorporate technology effectively into their teaching practices. This finding

underscores the importance of a comprehensive intervention strategy that simultaneously enhances digital literacy and motivates teachers to ensure optimal technology integration in education (Valtonen et al., 2020). This aligns with previous studies emphasizing motivation as a key factor in facilitating technology adoption in educational settings (Demirtaş & Mumcu, 2021).

Overall, the study confirms that digital literacy and self-development motivation are two critical factors in enhancing TPACK. These elements complement each other in shaping strong TPACK competencies, which ultimately contribute to improving the quality of learning in elementary schools (Chaidam & Poonputta, 2022; Kumala et al., 2022). Therefore, educational policies and teacher development programs should integrate both aspects to create more effective learning environments that adapt to technological advancements (Fazilla et al., 2022; Yumna et al., 2024).

In conclusion, it is imperative for educational institutions to design training programs that not only focus on enhancing digital literacy but also prioritize fostering teachers' motivation. Such programs should be structured to provide relevant, practical experiences and equip teachers with the tools to overcome challenges in integrating technology into teaching (Xiangjun & Lei, 2024). Furthermore, collaboration among teachers, curriculum developers, and education researchers is essential to devise innovative and effective strategies for TPACK development (Altun, 2019; Ritonga et al., 2024).

In conclusion, it is imperative for educational institutions to design training programs that focus on enhancing digital literacy and prioritize fostering teachers' motivation. Such programs should be structured to provide relevant, practical experiences and equip teachers with the tools to overcome challenges in integrating technology into teaching (Xiangjun & Lei, 2024). Furthermore, collaboration among teachers, curriculum developers, and education researchers is essential to devise innovative and effective strategies for TPACK development.

## 4. Conclusion

This study confirms that digital literacy and teacher motivation significantly influence TPACK development among elementary school teachers, with both factors accounting for substantial variance in TPACK. These findings highlight the need for professional development programs that integrate technical training and motivational strategies to enhance teachers' ability to adopt technology in education. Beyond practical implications, this study contributes to the broader field of educational technology and teacher competency development by providing empirical evidence on the combined impact of digital literacy and motivation. Future research should explore institutional support, access to technology, and peer collaboration to further refine TPACK enhancement strategies. However, limitations such as self-reported data and a limited geographic scope should be addressed in future studies using classroom observations and cross-regional analyses to improve the robustness and applicability of findings.

## 5. Acknowledgement

We extend our sincere gratitude to the Directorate General of Higher Education, Ministry of Education and Culture of the Republic of Indonesia, for their financial support of this research under the Master Thesis Research scheme. This funding was provided through contract No. 107/E5/PG.02.00.PL/2024 dated June 11, 2024; 0609.12/LL5-INT/AL.04/2024 dated June 14, 2024; and 065/PTM/LPPM-UAD/VI/2024 dated June 15, 2024.

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