THE ROLE OF SELF-REGULATED LEARNING IN MEDIATING THE EFFECT OF PERFORMANCE EXPECTANCY, EFFORT EXPECTANCY, FACILITATING CONDITIONS, AND SOCIAL INFLUENCE ON TECHNOLOGICAL PEDAGOGICAL CONTENT KNOWLEDGE (TPACK) COMPETENCE AMONG EDUCATION STUDENTS AT UNIVERSITAS NEGERI SURABAYA

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ABSTRACT

Digital transformation has required pre-service teachers to possess Technological Pedagogical Content Knowledge (TPACK) to effectively integrate technology, pedagogy, and subject matter in the learning process. This study aims to examine the effects of Performance Expectancy, Effort Expectancy, Facilitating Conditions, and Social Influence on TPACK and Self-Regulated Learning (SRL), as well as to investigate the mediating role of SRL among students of the Office Administration Education Study Program at Universitas Negeri Surabaya. This research employed a quantitative approach with a causal-associative research design. The Research population consist of 187 and research samples amounted to 126 students were selected using the proportional random sampling technique. Data were collected through a Likert-scale questionnaire and analyzed using Partial Least Squares–Structural Equation Modeling (PLS-SEM) with SmartPLS software. The findings revealed that Performance Expectancy, Facilitating Conditions, and Social Influence had a positive and significant effect on SRL, whereas Effort Expectancy had no significant effect. Furthermore, all four independent variables, as well as SRL, showed no significant direct effect on TPACK. The mediation analysis also indicated that SRL did not mediate the relationships between Performance Expectancy, Effort Expectancy, Facilitating Conditions, Social Influence, and TPACK. These findings suggest that improving TPACK requires additional supporting factors beyond technology acceptance and self-regulated learning, such as digital literacy, teaching practicum experience, and pedagogical competence. Future studies are recommended to incorporate additional variables and involve broader research settings across different study programs to develop a more comprehensive research model.

***Keywords**: Performance Expectancy, Effort Expectancy, Facilitating Conditions, Self-Regulated Learning, TPACK.*

ABSTRAK

Transformasi digital dalam pendidikan menuntut mahasiswa calon pendidik memiliki kompetensi Technological Pedagogical Content Knowledge (TPACK) agar mampu mengintegrasikan teknologi, pedagogi, dan materi pembelajaran secara efektif. Namun, tingginya pemanfaatan teknologi dalam pembelajaran belum diikuti oleh optimalnya kompetensi TPACK mahasiswa. Kondisi tersebut menunjukkan bahwa faktor penerimaan teknologi dan kemampuan Self-Regulated Learning (SRL) perlu dikaji untuk mengetahui perannya dalam meningkatkan kompetensi TPACK. Penelitian ini bertujuan menganalisis pengaruh Performance Expectancy, Effort Expectancy, Facilitating Conditions, dan Social Influence terhadap kompetensi TPACK, pengaruh keempat variabel tersebut terhadap SRL, pengaruh SRL terhadap TPACK, serta peran SRL sebagai variabel mediasi. Penelitian menggunakan pendekatan kuantitatif dengan desain kausal asosiatif. Populasi Penelitian berjumlah 187 mahasiswa dan Sampel penelitian berjumlah 126 mahasiswa Program Studi Pendidikan Administrasi Perkantoran Fakultas Ekonomika dan Bisnis Universitas Negeri Surabaya yang dipilih menggunakan teknik proportional random sampling. Data dikumpulkan melalui kuesioner dengan skala Likert dan dianalisis menggunakan Partial Least Squares-Structural Equation Modeling (PLS-SEM) berbantuan SmartPLS. Hasil penelitian menunjukkan bahwa Performance Expectancy, Facilitating Conditions, dan Social Influence berpengaruh positif signifikan terhadap SRL, sedangkan Effort Expectancy tidak berpengaruh signifikan terhadap SRL. Selain itu, Performance Expectancy, Effort Expectancy, Facilitating Conditions, Social Influence, maupun SRL tidak berpengaruh signifikan terhadap kompetensi TPACK. Hasil pengujian mediasi juga menunjukkan bahwa SRL tidak mampu memediasi pengaruh keempat variabel tersebut terhadap kompetensi TPACK. Temuan ini mengindikasikan bahwa peningkatan kompetensi TPACK tidak hanya ditentukan oleh persepsi terhadap teknologi dan kemampuan regulasi diri, tetapi juga memerlukan faktor lain, seperti pengalaman mengajar, literasi digital, dan kompetensi pedagogik. Penelitian selanjutnya disarankan mengembangkan model penelitian dengan menambahkan variabel lain serta memperluas cakupan responden.

Kata Kunci: Performance Expectancy, Effort Expectancy, Facilitating Conditions, Self-Regulated Learning, TPACK.

A. INTRODUCTION

The development of digital technology has brought significant changes to the education system and encouraged learning transformation toward a more flexible, adaptive, and technology-based environment (Sandy et al., 2023). Technology

integration is no longer only considered a supporting tool, but has become an essential component in improving the effectiveness of 21st-century learning. This condition requires prospective educators to have the ability to combine technology, pedagogical strategies, and content mastery, known as Technological Pedagogical Content Knowledge (TPACK). TPACK competence is becoming increasingly important because the development of Learning Management Systems (LMS), digital media, and artificial intelligence has changed the way educators design and implement learning activities (Zou et al., 2024). In the Indonesian context, strengthening TPACK competence has also become a major concern because the integration of technology, pedagogy, and content is an important factor in improving the quality of digital learning (Puspasari et al., 2025). In addition, successful TPACK development also requires Self-Regulated Learning (SRL) skills because students need to independently organize, control, and evaluate technology-based learning processes (Aydogmus & Ibrahim, 2022; Li, 2022).

The digital transformation of education continues to increase along with the extensive use of technology by educational institutions and students. (Ctori, IHennelly, 2022) reported that more than 220 million students worldwide have been affected by changes in higher education systems toward the utilization of digital technology and online learning. In Indonesia, internet penetration reached 79.5% of the total population or approximately 221.56 million users in 2024, indicating significant opportunities for utilizing digital technology in education. However, high technology access does not always reflect students' ability to use it effectively because the success of digital learning is also influenced by technology acceptance. The Unified Theory of Acceptance and Use of Technology (UTAUT) model explains that Performance Expectancy (perceived usefulness), Effort Expectancy (ease of use), Social Influence, and Facilitating Conditions are important factors in educational technology acceptance (Xue et al., 2024). Technology acceptance is related to students' self-regulation abilities and the development of TPACK competence

in digital learning (Altawalbeh & Al-Said, 2025; Barz et al., 2024). Therefore, the integration of technology acceptance, self-regulation skills, and TPACK competence is becoming increasingly relevant in preparing prospective educators to face digital education transformation (Insani et al., 2025; Mafa & Govender, 2025; Yang, 2025; Yuliani & Heru, 2024).

Various previous studies have discussed the relationship between technology acceptance, self-regulation abilities, and technology integration competence in learning. (Altawalbeh & Al-Said, 2025) showed that the integration of UTAUT and TPACK models was able to predict the intention to use artificial intelligence technology in learning, indicating that technology acceptance is an important factor in the successful implementation of educational technology. (Barz et al., 2024) found that technology acceptance in digital learning is associated with Self-Regulated Learning (SRL), because students with good self-regulation abilities tend to utilize learning technology more effectively. (Aydogmus & Ibrahim, 2022) showed that prospective educators' TPACK competence is related to self-regulated learning skills, which help students develop technological and pedagogical abilities. (Alyoussef, 2022) found that technology acceptance factors based on the UTAUT model influence the successful use of learning technology because Performance Expectancy, Effort Expectancy, and Facilitating Conditions can improve students' acceptance of digital learning systems.

Although various previous studies have examined the relationship between technology acceptance, SRL, and TPACK, several limitations remain as research gaps. Most previous studies have focused on the direct relationship between technology acceptance and the use of learning technology, while studies explaining psychological mechanisms through the role of Self-Regulated Learning as a mediator in the relationship between UTAUT factors (PE, EE, FC, SI) and TPACK remain limited. In addition, research on the integration of these three variables among education students, particularly prospective educators in economics and administration fields, is still rarely conducted. Therefore, this

study aims to analyze the effect of Performance Expectancy (PE), Effort Expectancy (EE), Facilitating Conditions (FC), and Social Influence (SI) on Technological Pedagogical Content Knowledge (TPACK) competence with Self-Regulated Learning (SRL) as a mediating variable. The results of this study are expected to contribute to the development of models for improving prospective educators' digital competence and provide a foundation for higher education institutions in designing more effective technology-based learning strategies.

B. METHODS

This study employed a quantitative approach with a causal associative method to analyze the relationships and effects among research variables. The population in this study consisted of Office Administration Education students from the Faculty of Economics and Business, Universitas Negeri Surabaya, who met the criteria as prospective educators with experience in technology-based learning. The sampling technique was carried out using purposive sampling with the criteria of students who had completed educational courses and had experience using technology in the learning process. Data collection was conducted by distributing questionnaires using a Likert scale developed based on the indicators of Performance Expectancy (PE), Effort Expectancy (EE), Facilitating Conditions (FC), and Social Influence (SI) from the Unified Theory of Acceptance and Use of Technology (UTAUT), Self-Regulated Learning (SRL), and Technological Pedagogical Content Knowledge (TPACK). The collected data were analyzed using the Partial Least Square Structural Equation Modeling (PLS-SEM) method through SmartPLS software to test validity, reliability, direct relationships among variables, and the mediating role of Self-Regulated Learning in the effect of PE, EE, FC, and SI on students' TPACK competence.

C. RESULTS AND DISCUSSION

Results

Research data were obtained through questionnaire distribution to Office Administration Education students from the Faculty of Economics and Business, Universitas Negeri Surabaya, to determine the

role of Self-Regulated Learning in mediating the effect of Performance Expectancy (PE), Effort Expectancy (EE), Facilitating Conditions (FC), and Social Influence (SI) on Technological Pedagogical Content Knowledge (TPACK) competence.

Tabel 1 Descriptive Statistics of Research Variables

Variable	N	Minimum	Maximum	Mean	Standard Deviation
Performance Expectancy, Effort Expectancy, Facilitating Conditions, Social Influence (X)	126	2.75	5.00	4.21	0.563
Self-Regulated Learning (SRL) (Z)	126	2.82	5.00	4.15	0.591
Technological Pedagogical Content Knowledge (TPACK) (Y)	126	2.89	5.00	4.28	0.527

Based on the descriptive statistical results in Table 1, the Performance Expectancy, Effort Expectancy, Facilitating Conditions, and Social Influence (PE, EE, FC, SI) variable obtained an average score of 4.21 with a standard deviation of 0.563. These results indicate that students' level of technology acceptance is in the high category, meaning that students have positive perceptions of technology benefits, ease of use, social support, and the availability of technological facilities to support the learning process. The Self-Regulated Learning (SRL) variable obtained an average score of 4.15 with a standard deviation of 0.591, indicating that students have good self-regulation abilities in planning, monitoring, and evaluating technology-based learning processes. Furthermore, the Technological Pedagogical Content Knowledge (TPACK) variable obtained the highest average score of 4.28 with a standard deviation of 0.527. This indicates that students have good abilities in integrating technology, pedagogical strategies, and content knowledge. Overall, the standard deviation values that are smaller than the mean values indicate that the data distribution is relatively homogeneous and respondents' answers have a low level of variation.

The research data were then analyzed using the Partial Least Square Structural Equation Modeling (PLS-SEM) method with the assistance of SmartPLS software to determine the relationships among variables, measurement model validity, and direct and indirect effects among research constructs.

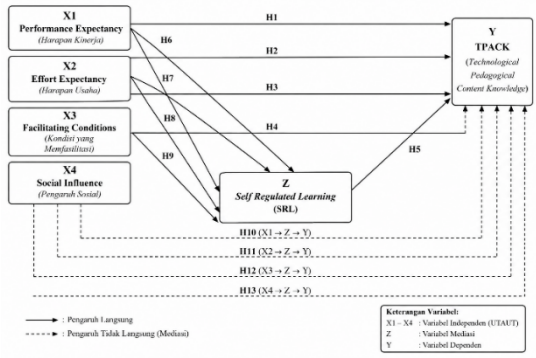

Figure 1. Results of Research Model Processing Using SmartPLS

Based on the results of research model processing using SmartPLS, the structural relationship among Performance Expectancy (PE), Effort Expectancy (EE), Facilitating Conditions (FC), Social Influence (SI), Self-Regulated Learning (SRL), and Technological Pedagogical Content Knowledge (TPACK) variables was obtained. The model shows that each research construct has been represented by its respective indicators, namely PE, EE, FC, and SI as independent variables describing students' technology acceptance, SRL as a mediating variable describing students' ability to independently regulate their learning process, and TPACK as a dependent variable describing the ability to integrate technology, pedagogy, and learning content. The outer loading values of each indicator indicate the contribution of each indicator in forming latent constructs, while the path coefficient values describe the direction and strength of relationships among variables. This model was used as the basis for further testing of validity, reliability, and hypotheses regarding direct effects and the mediating role of Self-Regulated Learning in the relationship between PE, EE, FC, SI and TPACK.

The research data were further analyzed through the outer model evaluation stage to determine the validity and reliability of each indicator in representing the latent variables used in this study.

Table 2. Outer Model Testing Results

Construct	PE (X1)	EE (X2)	FC (X3)	SI (X4)	TPACK (Y)	Self Regulated Learning (Z)
X1.1	0,966					
X1.2	0,958					
X2.1		0,962				
X2.2		0,959				
X3.1			0,970			
X3.2			0,942			
X4.1				0,958		
X4.2				0,971		
Y1.1					0,786	
Y1.2					0,845	
Y1.3					0,858	
Y1.4					0,828	
Y1.5					0,767	
Y1.6					0,847	
Y1.7					0,817	
Y1.8					0,844	
Y1.9					0,826	
Z1.1						0,826
Z1.10						0,821
Z1.11						0,860
Z1.2						0,828
Z1.3						0,847
Z1.4						0,837
Z1.5						0,860
Z1.6						0,811
Z1.7						0,853
Z1.8						0,833
Z1.9						0,838

Based on the outer model testing results in Table 2, all indicators of the Performance Expectancy, Effort Expectancy, Facilitating Conditions, and Social Influence (PE, EE, FC, SI), Self-Regulated Learning (SRL), and Technological Pedagogical Content Knowledge (TPACK) variables have fulfilled the criteria for convergent validity. This is indicated by the outer

loading values of all indicators being above 0.70, meaning that all items are able to represent the measured constructs. In addition, the Average Variance Extracted (AVE) values of all variables exceeded the minimum threshold of 0.50, indicating that each construct can explain more than half of the variance of its indicators. The composite reliability values for all variables were also greater than 0.70, indicating that the research instruments have good internal consistency. Therefore, all variables in this study have met the validity and reliability requirements to proceed to the structural model analysis stage.

Discriminant validity testing was carried out to confirm that each construct in the research model could be distinguished from the others based on its measurement characteristics. Table 3 presents the results using the Fornell-Larcker criterion, where the top row and the leftmost column list the constructs being compared. The diagonal values represent the square root of the Average Variance Extracted (AVE) for each construct, while the values below the diagonal show the correlations between that construct and the others.

Table 3. Fornell Larcker Results

	Performance Expectancy (X1)	Effort Expectancy (X2)	Facilitating Condition(X3)	Social Influence (X4)	Self Regulated Learning (Z)	TPACK (Y)
Performance Expectancy (X1)	0,962					
Effort Expectancy (X2)	-0,083	0,961				
Facilitating Condition(X3)	0,024	0,011	0,956			
Social Influence (X4)	0,045	-0,066	0,059	0,964		
Self Regulated Learning (Z)	0,480	0,372	0,281	0,423	0,838	
TPACK (Y)	0,404	0,322	0,366	0,421	0,774	0,825

As shown in Table 3, the square root of the AVE for every construct was higher than its correlations with the other constructs. Performance Expectancy reached a value of 0.962, Effort Expectancy 0.961, Facilitating Conditions 0.956, and Social Influence 0.964, while Self-Regulated Learning obtained 0.838 and TPACK obtained 0.825. These results indicate that each construct explains its own indicators better than it correlates with other constructs, so the Fornell-Larcker criterion was satisfied and all research constructs can be regarded as empirically distinct from one another.

Path significance testing was performed through the bootstrapping process in SmartPLS to determine the direct and indirect effects among variables in the research model.

Table 4. Results of Path Coefficient and Specific Indirect Effect Testing

Relationship Between Variables	Path Coefficient (β)	T-Statistic	P-Value
PE → SRL	0.492	8.644	0.000
PE → TPACK	0.173	2.471	0.014
EE → SRL	0.438	8.336	0.000
EE → TPACK	0.169	2.754	0.006
FC → SRL	0.239	4.341	0.000
FC → TPACK	0.213	4.060	0.000
SI → SRL	0.416	7.949	0.000
SI → TPACK	0.209	3.076	0.002
SRL → TPACK	0.480	5.326	0.000
PE → SRL → TPACK	0.236	5.174	0.000
EE → SRL → TPACK	0.210	4.538	0.000
FC → SRL → TPACK	0.115	3.140	0.002
SI → SRL → TPACK	0.200	4.300	0.000

Based on the path testing results in Table 4, all nine direct relationships and all four indirect relationships proved significant. Performance Expectancy (PE) had a positive and significant effect on both Self-Regulated Learning (β = 0.492, t = 8.644, p = 0.000) and TPACK (β = 0.173, t = 2.471, p = 0.014). Effort Expectancy (EE) likewise showed a positive and significant effect on SRL (β = 0.438, t = 8.336, p = 0.000) and TPACK (β = 0.169, t = 2.754, p = 0.006). Facilitating Conditions (FC) had a positive and significant effect on SRL (β = 0.239, t = 4.341, p = 0.000) and on TPACK (β = 0.213, t = 4.060, p = 0.000). Social Influence (SI) also had a positive and significant effect on SRL (β = 0.416, t = 7.949, p = 0.000) and TPACK (β = 0.209, t = 3.076, p = 0.002). SRL itself had a positive and significant effect on TPACK (β = 0.480, t = 5.326, p = 0.000), the strongest single path in the model. Consistent with these direct effects, the specific indirect effect results confirmed that SRL significantly mediated the influence of PE (β = 0.236, p = 0.000), EE (β = 0.210, p = 0.000), FC (β = 0.115, p = 0.002), and SI (β = 0.200, p = 0.000) on TPACK. These findings indicate that higher levels of PE, EE, FC, and SI not only strengthen students' self-regulated learning but are also channeled through that capacity into meaningfully stronger technology, pedagogy, and content integration competence.

Discussion

The results of this study showed that Performance Expectancy (PE) had a positive and significant direct effect on students' Technological Pedagogical Content Knowledge (TPACK) competence (β = 0.173, t = 2.471, p = 0.014). This finding indicates that students who believe technology can improve their academic performance and learning effectiveness tend to have stronger TPACK competence. This result is in line with (Insani et al., 2025; Mafa & Govender, 2025), who found that perceived usefulness of technology contributes positively to technology

integration ability in learning, and it is consistent with the core proposition of UTAUT that individuals are more willing to adopt and make productive use of a technology once they perceive it as beneficial for achieving their goals. PE also had a positive and significant effect on Self-Regulated Learning (β = 0.492, t = 8.644, p = 0.000), the strongest predictor of SRL in the model, indicating that students who perceive greater benefits from technology are considerably more likely to plan, monitor, and manage their learning process independently, consistent with (Chen, 2023; Fan et al., 2023)who explained that positive perceptions of a learning tool support more structured self-regulation.

The results also showed that Effort Expectancy (EE) had a positive and significant effect on both TPACK (β = 0.169, t = 2.754, p = 0.006) and SRL (β = 0.438, t = 8.336, p = 0.000). This finding suggests that students who find technology easy to learn and operate are better able to regulate their own learning process and to integrate that technology into pedagogical practice. This is consistent with (Xue et al., 2024)who found that ease of use is an important factor explaining technology acceptance in higher education. A plausible explanation is that once technical barriers are minimized, students can redirect their cognitive resources away from operating the tool itself and toward more substantive tasks, such as selecting appropriate pedagogical strategies, developing learning materials, and organizing their own study process (Hosseini et al., 2026).

The results further showed that Facilitating Conditions (FC) had a positive and significant effect on SRL (β = 0.239, t = 4.341, p = 0.000) and on TPACK (β = 0.213, t = 4.060, p = 0.000). This indicates that the availability of infrastructure, devices, internet access, and institutional support does more than simply enable technology use; it also helps students manage their learning process more independently and translates into stronger technology-pedagogy-content integration ability. This finding is supported by (Bayaga & du Plessis, 2024), who emphasized facilitating conditions as a key determinant of successful technology use, and is in line with (Pham et al., 2023), who positioned supporting conditions as an important factor in the success of technology integration. The result

suggests that adequate facilities provide not only the technical foundation for independent learning, but a direct contribution to prospective teachers' TPACK competence itself.

The results also proved that Social Influence (SI) had a positive and significant effect on SRL (β = 0.416, t = 7.949, p = 0.000) and on TPACK (β = 0.209, t = 3.076, p = 0.002). This indicates that support and encouragement from lecturers, peers, and the broader academic environment encourage students to organize their learning process more independently and, at the same time, contribute directly to their ability to integrate technology, pedagogy, and content. This is in line with (Insani et al., 2025), who showed that Social Influence contributes to the psychological aspects associated with technology use, and it extends the perspective of (Alowayr, 2022) by showing that social influence relates not only to the intention to use technology but also to the actual competence to apply it pedagogically.

The results also proved that Self-Regulated Learning (SRL) had a positive and significant effect on students' TPACK competence (β = 0.480, t = 5.326, p = 0.000), the strongest relationship found in the structural model. This indicates that students who are more capable of planning, monitoring, and evaluating their own learning tend to be considerably more capable of integrating technology, pedagogy, and content knowledge. This finding is in line with (Li, 2022), who showed that SRL plays an important role in developing TPACK competence, and is supported by (Aydogmus & Ibrahim, 2022), who found that self-regulated learning skills are closely associated with prospective educators' TPACK abilities. Consistent with this strong direct relationship, the mediation testing results showed that SRL significantly mediated the effect of PE (β = 0.236, t = 5.174, p = 0.000), EE (β = 0.210, t = 4.538, p = 0.000), FC (β = 0.115, t = 3.140, p = 0.002), and SI (β = 0.200, t = 4.300, p = 0.000) on TPACK. This result supports (Tan, 2025; Yang, 2025), who showed that self-regulation plays a mediating role in developing TPACK-related competence among education students, and is consistent with (Reski et al., 2025; Sui et al., 2024), who found that self-regulated learning strengthens the effectiveness of technology-based learning strategies.

Overall, the results of this study indicate that Performance Expectancy, Effort Expectancy, Facilitating Conditions, and Social Influence do not merely function as antecedents of self-regulated learning; through that self-regulation, and to a meaningful extent directly, they also shape prospective teachers' TPACK competence. This pattern suggests that technology acceptance and self-regulated learning are not separate tracks that stop short of teaching competence, but form a connected pathway in which positive perceptions of technology are translated, through independent learning behavior, into applied technology-pedagogy-content integration skills. Program coordinators and lecturers may build on this pathway by continuing to strengthen students' technology acceptance and self-regulation, for instance through structured digital-media projects and guided independent learning tasks, as a practical and evidence-based route to improving TPACK among prospective educators.

This study has several limitations that need to be considered in interpreting the research findings. First, this study was only conducted among education students within one university environment, meaning that the results cannot be fully generalized to education students with different institutional characteristics. Second, the research data were obtained through questionnaires based on respondents' perceptions, which may lead to subjectivity in assessing technology acceptance, SRL, and TPACK abilities. Third, this study only used Performance Expectancy, Effort Expectancy, Facilitating Conditions, Social Influence, and SRL variables to explain TPACK competence, while there are other factors that may influence technology integration abilities, such as digital literacy, teaching experience, learning motivation, and technology self-efficacy. Therefore, future studies are recommended to expand the scope of respondents, apply more diverse methodological approaches, and include additional variables to obtain a more comprehensive understanding of the factors influencing students' TPACK development.

D. CONCLUSION

This study concludes that all four UTAUT-based factors examined Performance Expectancy, Effort

Expectancy, Facilitating Conditions, and Social Influence have a significant positive role in strengthening both students' Self-Regulated Learning (SRL) and their Technological Pedagogical Content Knowledge (TPACK) competence, and that SRL itself has a significant positive direct effect on TPACK and significantly mediates the effect of all four technology-acceptance factors on TPACK. These findings imply that higher levels of technology acceptance help students become more independent and organized learners, and that this independence is a genuine mechanism through which technology acceptance is converted into stronger technology-pedagogy-content integration ability. The findings imply that higher education institutions need to strengthen digital learning environments by improving technological facilities, promoting effective technology adoption, and developing learning strategies that encourage students' self-regulation abilities, while also continuing to invest in practice-based pedagogical training, such as microteaching and supervised technology-integrated lesson design, so that the technology acceptance and self-regulation capacities shown to matter in this study are reinforced by direct teaching practice. Lecturers are also expected to design learning activities that not only introduce technology but also train students to plan, monitor, and evaluate their learning independently. However, this study has limitations because it only involved education students from one university and relied on questionnaire-based data, which may limit the generalizability of the findings. Future research is recommended to involve broader populations, apply different methodological approaches, and include additional variables such as digital literacy, technology self-efficacy, motivation, and teaching experience to obtain a more comprehensive understanding of factors influencing TPACK development.

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