

Institutional support and lecturers' ICT readiness: Mediating effects of pre-teaching technology use on integration

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ABSTRACT

Information and communication technology (ICT) can improve the effectiveness and quality of learning activities, including online learning platforms, digital resources, and so forth. Several previous studies have identified factors influencing technology integration in learning, including technological capability, school support, and pre-classroom technology utilisation. This study, adopting a framework from previous studies, aims to determine the relationship between lecturers' readiness for technology (ICT capability and self-efficacy) and institutional support for technology integration in learning activities, as well as pre-classroom technology utilisation as a mediating variable. The study sample consisted of 220 lecturers, using a non-probability sampling technique. The results show that ICT readiness and university support have a direct positive effect on technology integration in classroom learning and an indirect relationship with technology integration mediated by pre-classroom ICT utilisation. Developing lecturers' ICT skills through training in learning applications can enhance their readiness to use technology in teaching. Access to digital resources and technological infrastructure support from the university also assists lecturers in preparing teaching materials and implementing teaching activities.

INTRODUCTION

The world of education continues to evolve with the development of technology, and public awareness of the importance of education for a better future is growing. Technology has a positive impact on facilitating the teaching and learning process in education, but challenges remain, as some educators are not fully prepared for this development (Fitriah & Mirianda, 2019). Information and communication technology in higher education assists lecturers with teaching and learning facilities to enrich their teaching skills and facilitates broader access to knowledge, resulting in a quality education. For example, using computers or smartphones connected to the internet allows for access to information and knowledge (Zen et al., 2022). As instructors in higher education, lecturers play a crucial role in integrating technology, but they still encounter several obstacles in using technology in learning, such as a lack of support from schools regarding the provision of adequate facilities and infrastructure (Syifa & Julia, 2023). Adequate technological infrastructure plays a crucial role in effective learning. This requires support from management, such as smooth and stable access to learning resources, both from devices and networks (Zulfikhar et al., 2024). Another factor that plays a crucial role in technology integration at

universities is the technological skills of lecturers (Wijaya & Iriani, 2020). The quality of human resources in terms of technological skills is one factor that influences technology integration, especially for educators or lecturers who are still low and technologically illiterate (Kintoko & Utami, 2019). Several factors influencing technology integration in learning have been studied by Atman Uslu and Usluel (2019). These factors include the use of information and communication technology before teaching, educators' technological competence, educators' confidence in the use of information and communication technology, and support from the school (Atman Uslu & Usluel, 2019), which is described by a conceptual framework consisting of independent variables (belief, competency, and support) and dependent variables (ICT-use before teaching and integration). However, Atman Uslu and Usluel's (2019) study has limitations, so it recommends that further research examine the indirect influence between variables in the model. Based on the factors studied, this study is vital to determine the influence of these factors on technology integration and position the use of information and communication technology before teaching as mediation. Educators utilise technology when delivering material in the classroom and for personal-professional needs such as planning classes and searching for and compiling materials before class begins (Almerich et al., 2024). Lecturers' ICT skills and confidence in the use of technology are included in their readiness to use ICT (Petko et al., 2018) so this study combines ICT skills and lecturers' confidence in ICT into one variable, namely lecturer readiness. The study conducted by Petko et. Al (2018) has a broad definition of variables but does not examine other variables or factors that can influence technology integration in the classroom, for example, the use of technology by teachers before learning in class (Almerich et al., 2024). Previous research conducted by Santos and Castro (2021) on TPACK (Technological Pedagogical Content Knowledge) and EdTech (Educational Technology) tools found that newly graduated teachers had higher levels of technological knowledge, making them more prepared to integrate technology (Santos & Castro, 2021). This research focused on teacher competency and did not examine other influencing factors, such as school readiness (Petko et al., 2018).

These factors are reinforced by the results of a direct interview conducted by the author with one lecturer of a university in Surabaya, Fajar Annas Susanto, S.Kom., M.Kom. According to him, technology can help him and his students improve the effectiveness of learning, make it easier to understand the materials, and facilitate collaboration. However, he struggled, dealing with the obstacles he faced related to the use of technology. The first is the human resources who are not ready to experience technological developments because it is difficult to adapt. The second arose from within the university, such as policies and budgets managed by the university management. The third is an external factor, namely technology that is developing too quickly, which sometimes is in contrast to the world of education, which requires adoption of new technology. Based on the factors or variables that have been studied, this study combines several previous research variables into one conceptual framework, as shown in Figure 1.

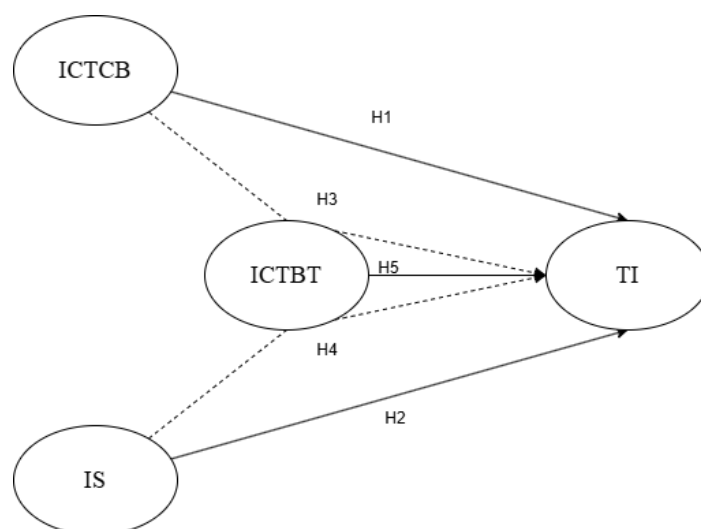


Figure 1. Conceptual framework

The first hypothesis (H1) was that lecturer readiness (ICTB) influences technology integration (IT). The second hypothesis (H2) was that university support (IS) influences technology integration (IT). The third hypothesis (H3) was that lecturer readiness (ICTCB) to integrate technology (IT) is influenced by the use of technology before teaching (ICTBT). The fourth hypothesis (H4) was that university support (IS) to integrate technology (IT) is influenced by the use of technology before teaching (ICTBT). The fifth hypothesis (H5) was that the use of technology before teaching (ICTBT) influences technology integration (IT). By using this theoretical framework, it is expected to determine the influence of lecturer readiness and university support on technology integration with the use of technology before teaching as a mediating variable.

The first hypothesis was the relationship between lecturer readiness and technology integration (Petko et al., 2018). Lecturer readiness includes the ability and confidence of lecturers in terms of information and communication technology that influences the use of technology during classroom learning. The second hypothesis was the relationship between university support and technology integration (Atman Uslu & Usluel, 2019). University management plays a role in technology integration, which is needed for both learning and administrative activities. University management can implement various initiatives, including policies, resources, and technological infrastructure (Zulfikhar et al., 2024), which is referred to as school readiness (Petko et al., 2018). The third hypothesis was the relationship between lecturer readiness and technology integration, mediated by the use of technology before teaching (Atman Uslu & Usluel, 2019). Lecturers use technology not only when teaching in class but also to compile materials or prepare teaching materials before class (Almerich et al., 2024). Teachers or lecturers who use technology when compiling teaching materials have higher technological skills, which also influences the use of technology when teaching in class (König et al., 2024). The fourth hypothesis was the relationship between university support and technology integration, mediated by the use of technology before teaching (Atman Uslu & Usluel, 2019). University support provided includes not only policies or the provision of technology used during learning, but also technological support when lecturers develop teaching materials, such as requiring internet access and e-resources to access learning resources available online. The fifth hypothesis was the relationship between the use of technology before teaching and technology integration. The use of technology before teaching is the precursor to the use of technology during teaching (Almerich et al., 2024). The use of technology before learning can help improve lecturers' experiences interacting with technology (Atman Uslu & Usluel, 2019).

METHOD

This research is a quantitative study with a positivist paradigm because it explains a phenomenon that occurs (Yuhertiana, 2008) and investigates objective and universal facts in the field. A quantitative approach was chosen because this research aims to understand the relationship between research variables (Bambang, 2020) based on the collected data, thereby demonstrating the compatibility of the data with the existing theories (Bandur & Prabowo, 2021). The study examines 5 variables. The independent variables are ICTCB (faculty readiness) and IS (university support). The dependent variables are TI (technology integration) and ICTBT (technology use before teaching), which also serve as the mediating variable.

The object of this research is the integration of technology in the learning process, and the subjects are lecturers at higher education institutions. The population sampled consists of lecturers in Surabaya, East Java. Indonesia has 4,437 higher education institutions, with the highest concentration located in West Java, totaling 601, while East Java ranks second with 559. However, the number of educators in East Java is higher, with 43,938 lecturers, compared to West Java, which has 40,928 lecturers (Direktorat Jenderal Pendidikan Tinggi Riset dan Teknologi, 2023). These lecturers are distributed across various higher education institutions in cities in East Java, with the highest number located in Surabaya, totaling 11,618 lecturers. Therefore, this research takes a sample of the population of lecturers in Surabaya (Badan Pusat Statistika Jawa Timur, 2023).

The sampling uses a non-probability sampling technique, with the minimum sample size calculated using the formula developed by Hair et al. (2021), which is 5-10 multiplied by the number of variable indicators, resulting in the minimum sample size as shown in the Formula 1.

$$N = \text{Indicator number} \times 10 \quad [1]$$

$$n = 15 \times 10$$

$$n = 150$$

The collected data consists of 220 respondents, with the main research instrument being a questionnaire developed using a 5-point Likert scale. This research employed a questionnaire method with data collection through personally administered questionnaires, which involved delivering the questionnaire directly to the respondents (see Table 1). Additionally, secondary data obtained from literature, journals, and related documents were used to strengthen the research results. The research flow begins with problem identification, followed by data collection and processing, leading to the results and conclusions, as illustrated in Figure 2.

Table 1. Variables and indicators

No	Variables	Indicators	No. Items	Number of Items
1	Lecturer Readiness (ICTCB)	Understanding, believing in and wisely utilising technology, as well as being able to improve the teaching process optimally with digital technology.	1,2	2
2	Institution Support (IS)	Providing and supporting the needs for digital technology and offering solutions.	3,4,5,6,7	5
3	Technology use before teaching (ICTBT)	Utilising technology to prepare materials and obtain source of knowledge.	8,9,10,11	4
4	Technology Integration (TI)	Utilising technology for learning and administrative needs, encouraging students to use technology and believing that technology can enhance the quality of student learning.	12,13,14,15	4

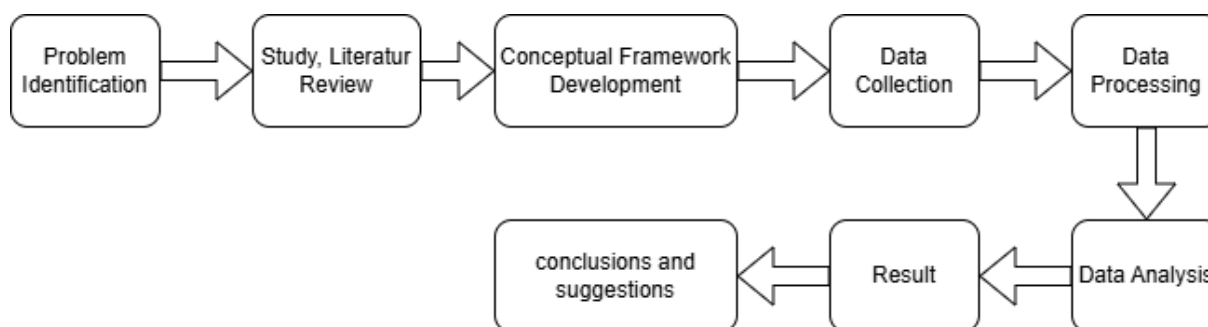


Figure 2. Research flowchart

The data analysis technique used in this research is PLS-SEM (Partial Least Squares Structural Equation Modeling), which aims to analyse relationships simultaneously within a complex model (Hair et al., 2019). The two stages of testing using PLS-SEM are outer model testing and inner model testing. The outer model test is conducted to evaluate the instruments through validity and reliability tests. The validity test examines convergent validity and discriminant validity, while the reliability test assesses Cronbach’s Alpha and Composite Reliability (Sarstedt et al., 2021). The inner model test is a hypothesis test that looks at multicollinearity, the coefficient of determination, PLS Predict, and path coefficients, resulting in direct and indirect relationships (Rahadi, 2023).

RESULT

The collected data from 220 respondents from public and private higher education institutions are summarised in [Table 2](#). Indicators are measured on a Likert scale, from 1 (strongly disagree) to 5 (strongly agree). [Table 2](#) shows a minimum value of 1 and a maximum of 5, with median values of 4 and 5, indicating a high level of agreement. Mean values for each indicator are above 4, reflecting overall agreement among respondents. The outer model test results confirm the validity and reliability of the indicators, while the inner model test results determine the acceptance or rejection of the hypotheses ([Wardhana & Iba, 2023](#)).

Outer model test – validity test

The outer loading values reflect each indicator's contribution to the latent variable, with all values exceeding 0.70, as shown in [Table 3](#). The Average Variance Extracted (AVE) values for all variables are above 0.50, confirming the validity of the indicators. The discriminant validity test evaluates the distinctness of two latent variables. A construct is valid if the square root of the AVE is greater than its correlations with other variables, as seen in [Table 4](#). Additionally, an indicator's loading value must exceed its cross-loading. The Heterotrait-Monotrait Ratio (HTMT) is another method for assessing discriminant validity, requiring values below 0.90. [Table 5](#) shows HTMT values below 0.90, confirming that all constructs are valid.

Outer model test – reliability test

The reliability test assesses the reliability of latent variable constructs using a Cronbach's Alpha value greater than 0.60 and a Composite Reliability value greater than 0.70. [Table 6](#) shows that all variables meet these criteria, with Cronbach's Alpha values above 0.60 and Composite Reliability values above 0.70, confirming that all constructs are reliable (see [Table 7](#)).

Inner model test

The Inner Model Test uses the Variance Inflation Factor (VIF) values to assess collinearity, with acceptable values being less than 5. [Table 8](#) shows that all indicators have VIF values below 5. The R-squared value measures the model's explanatory power regarding direct or indirect influences between variables. The Predictive Relevance value, indicated by the Q-squared value, must exceed 0; results show that the Q-squared values for the dependent variables ICTBT and TI are above 0, as seen in [Table 8](#). Lastly, the p-value tests significance, requiring it to be less than 0.05 and the T-value to exceed 1.96 (see [Table 9](#)). In the Inner Model Test, hypothesis testing involves both direct and indirect effects. Direct effects refer to variables that influence others directly, while indirect effects involve influence through intermediary variables, assessed using P-values and T-values.

Hypothesis testing results indicate both direct and indirect relationships, as shown in [Table 10](#). H1 shows that lecturer readiness directly and positively influences technology integration, with a P-value of 0.000 and T-value of 4.082.

Table 2. Descriptive analysis

No	Variable	Code	Mean	Median	Min	Max	SD
1	Lecturer Readiness	ICTCB1	4.609	5	3	5	0.532
		ICTCB2	4.641	5	3	5	0.498
2	Institution Support	IS1	4.595	5	3	5	0.592
		IS2	4.491	5	2	5	0.684
		IS3	4.373	4	2	5	0.666
		IS4	4.309	4	1	5	0.735
		IS5	4.295	4	1	5	0.732
3	Technology use before teaching	ICTBT1	4.691	5	3	5	0.509
		ICTBT2	4.645	5	2	5	0.589
		ICTBT3	4.645	5	2	5	0.541
		ICTBT4	4.582	5	2	5	0.546
4	Technology integration	TI1	4.545	5	3	5	0.542
		TI2	4.564	5	2	5	0.565
		TI3	4.627	5	3	5	0.528
		TI4	4.641	5	2	5	0.567

Table 3. Discriminant validity test

Indicator/code	Outer loadings	AVE	Result
ICTCB1	.824	.739	Valid
ICTCB2	.894		Valid
IS1	.758	.666	Valid
IS2	.808		Valid
IS3	.844		Valid
IS4	.865		Valid
IS5	.800		Valid
ICTBT1	.752	.624	Valid
ICTBT2	.768		Valid
ICTBT3	.819		Valid
ICTBT4	.819		Valid
TI1	.793	.611	Valid
TI2	.745		Valid
TI3	.837		Valid
TI4	.747		Valid

Table 4. Fornell-Larcker

	ICTBT	ICTC	IS	TI
ICTBT	.790			
ICTCB	.414	.859		
IS	.318	.268	.816	
TI	.616	.496	.374	.782

Table 5. Heterotrait-Monotrait

	ICTBT	ICTC	IS	TI
ICTBT				
ICTCB	.560			
IS	.378	.359		
TI	.759	.683	.441	

Table 6. Reliability test

	Cronbach's Alpha	Composite Reliability	AVE
ICTBT	.8	.869	.624
ICTCB	.65	.849	.739
IS	.874	.909	.666
TI	.787	.862	.611

Table 7. Validity and reliability test result

H	Hypothesis	Validity	Reliability
H1	The readiness of lecturers influences technology integration	Valid	Reliable
H2	Institutional support influences technology integration	Valid	Reliable
H3	The readiness of lecturers to integrate technology is influenced by technology use before teaching	Valid	Reliable
H4	Institutional support for technology integration is influenced by technology use before teaching	Valid	Reliable
H5	Technology use before teaching influences technology integration	Valid	Reliable

H2 indicates that institutional support also has a direct and positive influence, with a P-value of 0.008 and a T-value of 2.656. H5 demonstrates that prior technology use directly affects technology integration positively, with a P-value of 0.000 and a T-value of 8.046. H3 reveals that lecturer readiness indirectly influences technology integration through prior technology use, with a P-value of 0.000 and T-value of 4.427. H4 shows that institutional support indirectly influences technology integration, mediated by prior technology use, with a P-value of 0.005 and T-value of 2.75.

Table 8. Inner model test

Variable	Indicator/code	VIF	R Square	Q Square		
ICTCB	ICTCB1	1.805	0.217	0.192		
	ICTCB2	1.302				
IS	IS1	1.785				
	IS2	2.072				
	IS3	2.188				
	IS4	2.489				
	IS5	1.944				
ICTBT	ICTBT1	1.454				
	ICTBT2	1.666				
	ICTBT3	1.815				
	ICTBT4	1.805				
TI	TI1	1.653			0.471	0.285
	TI2	1.546				
	TI3	1.811				
	TI4	1.497				

Table 9. P-value and T-statistic

Path	P-value	T-statistic
ICTBT -> TI	0.000	7.535
ICTCB -> ICTBT	0.000	5.742
ICTCB -> TI	0.000	3.872
IS -> ICTBT	0.000	3.188
IS -> TI	0.012	2.519

Table 10. Hypothesis test result

H	Effect	P value	T-statistic	Result
H1 ICTCB -> TI	Direct Effect	0.000	4.082	Accepted
H2 IS -> TI	Direct Effect	0.008	2.656	Accepted
H5 ICTBT -> TI	Direct Effect	0.000	8.046	Accepted
H3 ICTCB -> ICTBT -> TI	Indirect Effect	0.000	4.427	Accepted
H4 IS -> ICTBT -> TI	Indirect Effect	0.005	2.757	Accepted

DISCUSSION

The results of this research data analysis reveal findings that support the hypotheses, exhibiting both direct and indirect relationships. Hypothesis 1: The readiness of lecturers has been proven to directly and positively influence technology integration in teaching activities. This readiness refers to the ability and confidence in using technology to enhance the teaching process and utilise digital resources. The greater the lecturers' ability and confidence in using technology to improve the quality of learning, the higher their motivation to integrate technology in the classroom (Santos & Castro, 2021). This claim aligns with an article from the journal *Computer in the Schools*, which states that educators' readiness for technology integration affects the integration of technology (Petko et al., 2018). The lecturers' technological competencies include operating personal computers, using the internet, and leveraging learning platforms and applications to create engaging and effective learning experiences. The more technological competencies lecturers possess, the more frequently they will use and integrate technology (Suárez-Rodríguez et al., 2018).

Hypothesis 2: University support for technology has been shown to directly and positively influence technology integration in teaching activities. In this context, the university serves as the primary supporter of technological innovation. Institutions with supportive organisations and regulations tend to have higher levels of technology integration and innovation (Ionescu et al., 2022). Support from the university may include technology-based education, technology policies (Petko et al., 2018), and budget allocations for technology infrastructure (Prawiranegara Gani et al., 2024). Access to the internet and technology provided by the university supports the use of

technology during learning, allowing online learning platforms to enhance learning flexibility and enabling students to participate from anywhere (Turgut & Aslan, 2021).

Hypothesis 3 suggests that the readiness of lecturers indirectly influences technology integration, mediated by technology usage before teaching. Utilising technology to prepare teaching materials before class can support its use during teaching (König et al., 2024). This hypothesis represents an indirect relationship. An article in the journal *Teaching and Teacher Education* discusses two classifications of technology use by lecturers: (1) Personal-professional use: the use of information and communication technology for searching and preparing learning materials, assigning tasks outside the classroom, and managing administrative duties; and (2) With students in the classroom: the use of information and communication technology during teaching activities, such as presentations or distance learning. Additionally, technology is utilised for completing assignments and other needs to support learning (Almerich et al., 2024). Technology aids lecturers in planning and organising classroom activities. Before teaching, lecturers must identify the technologies that can support learning activities tailored to students' needs (Atman Uslu & Usluel, 2019).

Hypothesis 4 assumed that university support is shown to indirectly influence technology integration, mediated by the use of technology before teaching. This is an indirect relationship. Research conducted by Almerich et al. (2024) indicates that lecturers also use technology to prepare teaching materials for the classroom. The use of technology before teaching enhances lecturers' experience with technology (Atman Uslu & Usluel, 2019); therefore, university support in providing internet access and technology is crucial for lecturers to access digital resources and applications for material preparation. Other support may include updating the technology used by lecturers (Turgut & Aslan, 2021).

Hypothesis 5 was that the use of technology before teaching directly influences technology integration during teaching (Atman Uslu & Usluel, 2019). As evidenced by the testing results, the use of technology before teaching positively impacts technology integration during teaching activities. An article in the *Teaching and Teacher Education* journal states that personal-professional technology use positively influences classroom technology use, such as when preparing materials using PowerPoint and when presenting in class, which requires technology hardware like screens or monitors to display the PowerPoint materials. Hence, the classroom planning done by lecturers determines the technology used in the classroom (Almerich et al., 2024).

This research also yields several findings. First, technology integration functions as a dependent variable influenced by a dependent variable, namely the use of technology before teaching, and two independent variables: technological competence and institutional support. Based on the direct effect hypothesis testing results, lecturers' competencies in information and communication technology positively influence technology integration, with a path coefficient of 0.265. Institutional support also positively contributes to technology integration with a path coefficient of 0.157. Meanwhile, the use of technology before teaching has a significant positive effect on technology integration, with a path coefficient of 0.456. This implies that the use of ICT before teaching has a greater influence on technology integration during teaching activities.

The second finding is that the variable of technology use before teaching not only has a significant effect on technology integration but also serves as a mediating variable between the indirect relationships of lecturers' readiness and institutional support towards technology integration. The third finding indicates that the variable of technology use before teaching has the largest total effect on technology integration, with a value of 0.456. It concluded that the use of information and communication technology before teaching has a significant impact on the use of information and communication technology during teaching.

CONCLUSION

This study provides recommendations for addressing challenges in higher education, particularly regarding technology integration in teaching. Integrating technology is crucial for fostering creative and engaging learning experiences. The research identifies key factors influencing technology integration: lecturer readiness (ICTCB), institutional support (IS), and

prior technology use (ICTBT), which have both direct and indirect relationships. The most significant direct influence is from prior technology use, followed by lecturer readiness and institutional support, with indirect influences mediated by prior technology use. Based on these findings, university management should enhance support through policy, infrastructure, planning, and funding. Lecturers are encouraged to stay informed about relevant technological advancements to improve their skills and confidence. As lecturers' technological competencies grow, their ability to integrate technology in teaching will expand. While this study offers valuable insights, it has limitations. One of the main ones is that the subjects were lecturers, while universities also include other subjects, such as students and educational staff. Furthermore, the study's variables are broadly defined, and the indicators used do not specifically address ICT skills. Future research should involve other stakeholders, such as students and educational staff at universities, and break down variables into more specific indicators to yield more specific findings.

Author contributions

The author made significant contributions to the study's conception and design. The author was in charge of data analysis, interpretation, and discussion of results. The final manuscript was read and approved by the author.

Conflict of interest

The authors declare that there is no potential conflict of interest.

Data availability statement

All data are available from the authors.

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