

Mapping Lecturers' Technological Pedagogical Content Knowledge in Indonesian Higher Education

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ABSTRACT

The effective integration of technology in higher education requires lecturers to combine technological, pedagogical, and content knowledge rather than master these domains independently. However, empirical evidence on the Technological Pedagogical Content Knowledge (TPACK) competencies of university lecturers in Indonesia remains limited, particularly across its seven interconnected components. This study employed a descriptive quantitative survey to examine lecturers' TPACK competencies. Data were collected from 108 lecturers from the Faculty of Economics at Universitas Negeri Jakarta and Universitas Halu Oleo using a five-point Likert-scale questionnaire adapted from established TPACK instruments. Descriptive statistics were used to analyze seven components: Technological Knowledge (TK), Content Knowledge (CK), Pedagogical Knowledge (PK), Technological Pedagogical Knowledge (TPK), Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), and Technological Pedagogical Content Knowledge (TPACK). The mean scores were 73.42 for TK, 31.44 for CK, 36.46 for PK, 22.35 for TPK, 34.11 for PCK, 29.99 for TCK, and 17.16 for TPACK. The findings reveal variations across the seven knowledge domains and highlight the importance of examining lecturers' ability to integrate technology, pedagogy, and disciplinary content as interconnected competencies. The results underscore the need for professional development that moves beyond separate technological or pedagogical skills toward integrated digital learning design. Higher education institutions should therefore provide sustained training, mentoring, and collaborative instructional-design activities to strengthen lecturers' TPACK competencies.

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1. INTRODUCTION

The rapid digital transformation of higher education has changed the ways lecturers design, deliver, and evaluate learning. Digital technologies are no longer used merely as supplementary tools for presenting instructional materials but increasingly shape communication, collaboration, assessment, access to learning resources, and the overall organization of teaching and learning. Consequently, lecturers are expected not only to possess disciplinary expertise and pedagogical competence but also to make informed decisions about how particular technologies can support specific learning objectives and student needs. Research on digital pedagogy in higher education similarly indicates a continuing shift toward more flexible and technology-supported pedagogical practices, requiring educators to adapt their teaching approaches to diverse digital learning environments (Santoveña-Casal & López, 2024). Thus, effective digital teaching depends not simply on lecturers' ability to operate technological tools but on their capacity to connect technology meaningfully with pedagogy and disciplinary content.

One of the most established theoretical frameworks for understanding this integration is Technological Pedagogical Content Knowledge (TPACK). Developed from the concept of Pedagogical Content Knowledge, the TPACK framework conceptualizes effective technology-integrated teaching as an interaction among three fundamental knowledge domains: Content Knowledge (CK), Pedagogical Knowledge (PK), and Technological Knowledge (TK) (Mishra & Koehler, 2006). Their intersections produce Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), and the integrated domain of Technological Pedagogical Content Knowledge (TPACK). Rather than treating technological competence as an independent skill, TPACK emphasizes educators' ability to select and apply technologies that correspond appropriately to the content being taught and the pedagogical strategies employed (Koehler et al., 2013; Mishra & Koehler, 2006).

The integrative nature of TPACK is particularly relevant in higher education. University lecturers typically possess substantial disciplinary expertise, yet disciplinary knowledge alone does not necessarily ensure effective technology-enhanced teaching. Similarly, familiarity with digital tools does not automatically translate into the pedagogically appropriate use of those tools. TPACK therefore provides a useful perspective for examining whether lecturers can move beyond possessing separate technological, pedagogical, and content-related competencies toward combining these domains in authentic instructional situations. Recent research has reinforced this perspective by describing TPACK as a complex, situated, and dynamic form of professional knowledge rather than merely an accumulation of independent competencies (Schmid et al., 2024). Accordingly, examining the individual and integrated TPACK components can provide a more comprehensive understanding of lecturers' readiness to design meaningful technology-supported learning.

Despite extensive research on TPACK, important conceptual and empirical challenges remain. A recent second-order systematic review found that recurring theoretical and methodological issues in TPACK research remain unresolved, particularly regarding the operationalization and measurement of its interconnected knowledge domains (Schmid et al., 2024). Research on TPACK-based interventions has also demonstrated that professional development frequently emphasizes particular components, especially technological knowledge, without necessarily providing explicit opportunities to develop integrated TPACK (Fabian et al., 2024). This distinction is important because educators may demonstrate adequate competence in technology, pedagogy, and content independently while experiencing greater difficulty in coordinating these domains when designing and implementing technology-enhanced instruction. Consequently, assessing lecturers' profiles across the seven TPACK components can help identify areas in which individual knowledge domains are relatively developed as well as areas where further professional development may be required.

The higher education context also warrants specific attention because much of the development and measurement of TPACK has historically focused on pre-service teachers and teachers in primary and secondary education. Instruments developed for these populations may not fully represent the characteristics of university teaching, where lecturers operate within discipline-specific environments and have different instructional responsibilities and levels of professional autonomy. Recent research addressing this limitation developed and validated a TPACK survey specifically for university teachers and confirmed the relevance of the seven-component structure in the higher education context (Basilotta-Gómez-Pablos et al., 2024). The study also demonstrated variation among TPACK components and across disciplinary contexts, reinforcing the importance of examining university lecturers as a distinct population rather than assuming that findings obtained from school teachers can be directly generalized to higher education.

Within Indonesia, TPACK research has likewise highlighted the importance of integrating technology, pedagogy, and disciplinary knowledge in contemporary education. Previous studies have investigated TPACK among teachers and prospective teachers, including analyses of educators' competencies and technology-integrated instructional practices (Rahmatiah et al., 2022; Suyanto et al., 2020). More recent Indonesian research has continued to investigate TPACK development in teacher education, demonstrating the continuing relevance of the framework for strengthening educators' capacity to integrate digital technologies into teaching. Nevertheless, empirical evidence concerning university lecturers remains comparatively limited, particularly research that simultaneously maps all seven TPACK components within higher education settings. This limitation is important because lecturers work in contexts characterized by disciplinary specialization, adult learners, greater instructional autonomy, and increasingly diverse forms of technology-supported learning.

This gap is particularly relevant for lecturers in economics and business-related disciplines. Teaching in these fields increasingly involves digital resources, learning management systems, online collaboration, data-based applications, presentation technologies, and other digital environments. However, the presence or availability of these technologies does not necessarily indicate that lecturers are able to integrate them effectively with disciplinary content and appropriate pedagogical strategies. Understanding lecturers' competence across the seven TPACK dimensions can therefore provide an empirical basis for identifying patterns of strength and areas requiring further development. Such evidence can also support universities in designing professional development initiatives that focus not merely on technical digital skills but on the integrated design of technology-enhanced learning.

Against this background, the present study aims to map the Technological Pedagogical Content Knowledge competencies of lecturers at the Faculty of Economics of Universitas Negeri Jakarta and Universitas Halu Oleo by examining seven dimensions: Technological Knowledge (TK), Content Knowledge (CK), Pedagogical Knowledge (PK), Technological Pedagogical Knowledge (TPK), Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), and Technological Pedagogical Content Knowledge (TPACK). Unlike studies that focus primarily on individual technological skills or a single dimension of technology integration, this study provides a multidimensional profile of lecturers' competencies across the complete TPACK framework. By identifying patterns across these seven knowledge domains, the study seeks to contribute empirical evidence on technology-integrated teaching competence in Indonesian higher education and to provide a basis for developing more targeted professional development strategies for lecturers.

2. METHODS

2.1 Research Design

This study employed a descriptive quantitative survey design to examine the Technological Pedagogical Content Knowledge (TPACK) competencies of university lecturers. The descriptive approach was selected because the study aimed to map lecturers' competencies across the seven dimensions of the TPACK framework rather than to test causal relationships among variables. The seven dimensions examined were Technological Knowledge (TK), Content Knowledge (CK), Pedagogical Knowledge (PK), Technological Pedagogical Knowledge (TPK), Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), and Technological Pedagogical Content Knowledge (TPACK).

2.2 Participants

The participants consisted of 108 lecturers from Universitas Negeri Jakarta and Universitas Halu Oleo. Of the total respondents, 100 lecturers were from Universitas Negeri Jakarta and eight were from Universitas Halu Oleo. The respondents represented various study programs, including Management, Accounting Education, Economics Education, Accounting, Office Administration Education, Digital Business, and other related programs.

Because the number of participants from the two universities was substantially unequal, this study did not conduct or emphasize comparisons between institutions. Instead, the data were analyzed collectively to describe the TPACK competency profiles of the participating lecturers. Accordingly, the findings should be interpreted as representing the lecturers included in this study rather than as estimates of differences between the two universities or as representative of Indonesian university lecturers in general.

2.3 Research Instrument

Data were collected using a questionnaire adapted from established studies on the TPACK framework, particularly Mishra and Koehler (2006), Schmidt et al. (2009), Koehler et al. (2013), and Suyanto et al. (2020). The questionnaire measured seven dimensions of lecturers' professional knowledge: (1) Technological Knowledge (TK), referring to knowledge and skills related to the use of technology; (2) Content Knowledge (CK), referring to knowledge of the subject matter; (3) Pedagogical Knowledge (PK), referring to knowledge of teaching and learning processes; (4) Technological Pedagogical Knowledge (TPK), referring to knowledge of how technology can support pedagogical practices; (5) Pedagogical Content Knowledge (PCK), referring to knowledge of how particular subject matter can be taught effectively; (6) Technological Content Knowledge (TCK), referring to knowledge of how technology can represent and support disciplinary content; and (7) Technological Pedagogical Content Knowledge (TPACK), referring to the integrated knowledge required to combine technology, pedagogy, and content in teaching.

All questionnaire items were measured using a five-point Likert scale ranging from *strongly disagree* to *strongly agree*. Higher scores represented higher self-reported competency in the corresponding TPACK dimension. The questionnaire was administered electronically using Google Forms.

2.4 Data Collection

Data collection was conducted by distributing the questionnaire to lecturers electronically through Google Forms. Participants completed items measuring the seven TPACK dimensions and provided demographic information, including university affiliation, age range, and study program. A total of 108 completed responses were included in the analysis, with no missing observations reported in the descriptive statistics.

The indicators and questionnaires that will be used in this study to measure TPACK variables are as follows.

Table 1. Technological Pedagogical Content Knowledge Component/Indicators

Variable	Component/indicators	Source
TPACK	Technological Knowledge	(Koehler, M. J., Mishra, P., Akcaoglu, M., & Rosenberg, J. M. (2013). <i>The Technological Pedagogical Content Knowledge Framework for Teachers and Teacher Educators</i> , n.d.; Mishra & Koehler, 2006; Schmidt et al., 2009; Suyamto et al., 2020b)
	Content Knowledge	
	Pedagogical Knowledge	
	Technological Pedagogical Knowledge	
	Pedagogical Content Knowledge	
	Technological Content Knowledge	
	Technological Pedagogical Content Knowledge	

2.5 Data Analysis

The data were analyzed using descriptive statistical techniques in accordance with the exploratory and descriptive objectives of the study. Each TPACK dimension was analyzed separately to provide a profile of lecturers' self-reported competencies. The descriptive statistics included the number of valid responses (*N*), mean, standard error of the mean, median, mode, standard deviation, variance, range, minimum score, maximum score, and total score.

The analysis focused on describing the distribution and central tendency of scores for TK, CK, PK, TPK, PCK, TCK, and TPACK. Given the descriptive research design and the unequal distribution of respondents between the two participating universities, no inferential comparison between institutions was conducted. The results were therefore interpreted primarily as a descriptive profile of TPACK competencies among the lecturers participating in the study.

3. FINDINGS AND DISCUSSION

3.1. Findings

3.1.1 Respondent Identity

Data collection was conducted using Google Forms with a questionnaire instrument. This study categorized respondents based on their university of origin, age range, and study program. Respondents were lecturers from the Faculty of Economics at Jakarta State University and lecturers at Halu Oleo University, with the following ratio.

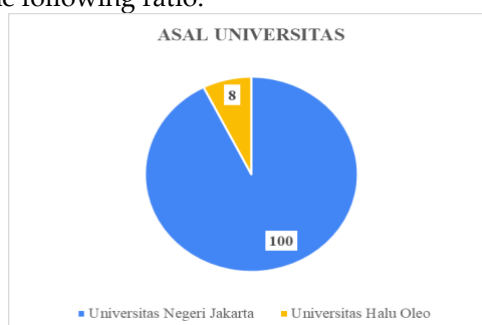


Figure 1. Respondent Diagram Based on the University

Source: data processed by researchers (2024)

Based on Figure 1, it can be seen that the number of respondents who are lecturers at the Faculty of Economics, Jakarta State University, is 100. Meanwhile, the number of respondents who are lecturers at Halu Oleo University is 8.

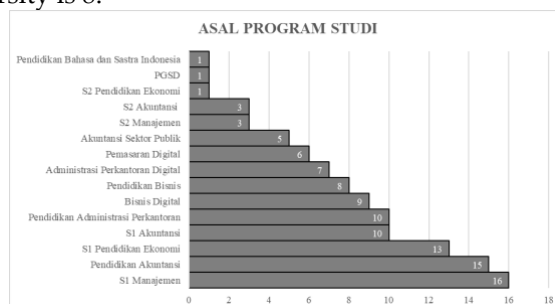


Figure 2. Respondent Diagram Based on Program of Study

Source: data processed by researchers (2024)

In Figure 3, we look in terms of academic background. Most respondents came from Bachelor of Management (16 people), followed by Accounting Education (15 people), Bachelor of Economics Education (13 people), Bachelor of Accounting and Office Administration Education (10 people each), and Digital Business (9 people). The rest were spread across various other study programs with relatively smaller numbers. Overall, the respondent profile shows a variety of academic backgrounds and a diverse age range, thereby supporting the representativeness of the data in this study.

3.1.2 Descriptive Analysis

a. Technological Knowledge (TK)

Table 2. Descriptive Data of Technological Knowledge

Statistics		
Technological Knowledge		
N	Valid	108
	Missing	0
Mean		73.42
Std. Error of Mean		0.722
Median		74.00
Mode		81
Std. Deviation		7.500
Variance		56.245
Range		35
Minimum		50
Maximum		85
Sum		7929

Source: data processed by researchers (2024)

The number of valid respondent data (N) was 108, with no missing data. The mean score was 73.42. The median score was 74, while the mode was 81. The standard deviation was 7.500, and the variance was 56.245. The minimum score was 50, and the maximum score was 85, resulting in a range of 35. The total sum of the data was 7,929.

b. Content Knowledge (CK)

Table 3. Descriptive data of Content Knowledge

Statistics		
Content Knowledge		
N	Valid	108
	Missing	0
Mean		31.44
Std. Error of Mean		0.304
Median		32.00
Mode		35
Std. Deviation		3.160
Variance		9.986
Range		12
Minimum		23
Maximum		35
Sum		3395

Source: data processed by researchers (2024)

The number of valid respondent data (N) was 108, with no missing data. The mean score was 31.44. The median score was 32, while the mode was 35. The standard deviation was 3.160, and the variance was 9.986. The minimum score was 23, and the maximum score was 35, resulting in a range of 12. The total sum of the data was 3,395.

c. Pedagogical Knowledge (PK)

Table 4. Descriptive Data of Pedagogical Knowledge

Statistics		
Pedagogical Knowledge		
N	Valid	108
	Missing	0
Mean		36.46
Std. Error of Mean		0.406
Median		37.00
Mode		40
Std. Deviation		4.217
Variance		17.784
Range		20
Minimum		30
Maximum		50
Sum		3938

Source: data processed by researchers (2024)

The number of valid respondent data (N) was 108, with no missing data. The mean score was 36.46. The median score was 37, while the mode was 40. The standard deviation was 4.217, and the variance was 17.784. The minimum score was 30, and the maximum score was 50, resulting in a range of 20. The total sum of the data was 3,938.

d. *Technological Pedagogical Knowledge (TPK)***Table 5.** Descriptive data of Technological Pedagogical Knowledge

Statistics		
Technological Pedagogical Knowledge		
N	Valid	108
	Missing	0
Mean		22.35
Std. Error of Mean		0.230
Median		23.00
Mode		25
Std. Deviation		2.389
Variance		5.707
Range		10
Minimum		15
Maximum		25
Sum		2414

Source: data processed by researchers (2024)

The number of valid respondent data (N) was 108, with no missing data. The mean score was 22.35. The median score was 23, while the mode was 25. The standard deviation was 2.389, and the variance was 5.707. The minimum score was 15, and the maximum score was 25, resulting in a range of 10. The total sum of the data was 2,414.

e. *Pedagogical Content Knowledge (PCK)***Table 6.** Descriptive data of Pedagogical Content Knowledge

Statistics		
Pedagogical Content Knowledge		
N	Valid	108
	Missing	0
Mean		34.11
Std. Error of Mean		0.380
Median		33.00
Mode		32
Std. Deviation		3.944
Variance		15.558
Range		16
Minimum		24
Maximum		40
Sum		3684

Source: data processed by researchers (2024)

The median score was 33.00, while the mode was 32. The standard deviation was 3.944, and the variance was 15.558. The minimum score was 24, and the maximum score was 40, resulting in a range of 16. The total sum of the data was 3,684.

f. Technological Content Knowledge (TCK)

Table 7. Descriptive data of Technological Content Knowledge

Statistics		
Technological Content Knowledge		
N	Valid	108
	Missing	0
Mean		29.99
Std. Error of Mean		0.342
Median		30.00
Mode		28
Std. Deviation		3.559
Variance		12.663
Range		16
Minimum		19
Maximum		35
Sum		3239

Source: data processed by researchers (2024)

The number of valid respondent data (N) was 108, with no missing data. The mean score was 29.99. The median score was 30, while the mode was 28. The standard deviation was 3.559, and the variance was 12.663. The minimum score was 19, and the maximum score was 35, resulting in a range of 16. The total sum of the data was 3,239.

g. Technological Pedagogical Content Knowledge (TPACK)

Table 8. Descriptive data of Technological Pedagogical Content Knowledge

Statistics		
Technological Pedagogical Content Knowledge		
N	Valid	108
	Missing	0
Mean		17.16
Std. Error of Mean		0.203
Median		16.50
Mode		16
Std. Deviation		2.110
Variance		4.452
Range		8
Minimum		12
Maximum		20
Sum		1853

The number of valid respondent data (N) was 108, with no missing data. The mean score was 17.16. The median score was 16.50, while the mode was 16. The standard deviation was 2.110, and the variance was 4.452. The minimum score was 12, and the maximum score was 20, resulting in a range of 8. The total sum of the data was 1,853.

3.2 Discussion

This study examined lecturers' competencies across the seven dimensions of the Technological Pedagogical Content Knowledge (TPACK) framework. The findings revealed different score patterns across Technological Knowledge (TK), Content Knowledge (CK), Pedagogical Knowledge (PK), Technological Pedagogical Knowledge (TPK), Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), and integrated TPACK. The mean scores were 73.42 for TK, 31.44 for CK, 36.46 for PK, 22.35 for TPK, 34.11 for PCK, 29.99 for TCK, and 17.16 for TPACK. Because these dimensions contain different numbers of items and therefore have different possible score ranges, their raw means should not be interpreted as directly comparable measures of relative competence. Nevertheless, the descriptive profiles provide useful evidence regarding how technological, pedagogical, and content-related knowledge is represented among the lecturers participating in this study.

The TK results indicate that lecturers possessed technological knowledge to varying degrees, as reflected by the mean score of 73.42 and standard deviation of 7.50. This variation is relevant because technology integration in higher education increasingly requires lecturers to adapt to changing digital environments rather than simply operate individual technological tools. Within the TPACK framework, TK includes an understanding of technology and the capacity to adapt as technologies evolve (Mishra & Koehler, 2006). Consequently, technological competence should not be interpreted solely as familiarity with presentation software, learning management systems, or online communication platforms. More importantly, lecturers need to understand how digital tools can be selected and adapted to particular instructional purposes. This interpretation is consistent with Hidayat and Khotimah (2019), who emphasized the importance of digital technology in supporting contemporary learning activities.

The results for CK and PK further indicate the importance of considering disciplinary and pedagogical knowledge as fundamental components of lecturers' professional competence. The CK mean of 31.44 suggests that respondents reported substantial knowledge related to their respective subject areas, while the PK mean of 36.46 reflects their self-reported understanding of pedagogical practices. These domains form two of the three core components of the TPACK framework (Mishra & Koehler, 2006). In higher education, disciplinary expertise is particularly important because lecturers are responsible for communicating specialized concepts, theories, and disciplinary practices. However, disciplinary expertise alone is insufficient for effective teaching. Lecturers must also understand instructional strategies, assessment, classroom management, and how students learn. Thus, CK and PK should be viewed as complementary foundations for developing more integrated forms of professional knowledge.

The findings for PCK are particularly important in this regard. The mean PCK score was 34.11, indicating that respondents reported competencies related to connecting disciplinary content with appropriate pedagogical approaches. PCK differs conceptually from possessing CK and PK independently because it concerns how particular content can be transformed into forms that are pedagogically accessible to learners. Within the broader TPACK framework, this relationship remains essential because effective technology integration depends on an existing connection between what is taught and how it is taught (Mishra & Koehler, 2006). Therefore, professional development should not treat pedagogical and disciplinary competencies as separate areas but should encourage lecturers to design instructional strategies around the distinctive characteristics of the concepts they teach.

Technology introduces another layer of complexity through TCK and TPK. The mean TCK score of 29.99 reflects lecturers' reported knowledge concerning relationships between technology and disciplinary content. TCK involves understanding how particular technologies can represent, modify, or provide access to disciplinary knowledge (Koehler et al., 2013; Mishra & Koehler, 2006). Technology can, for example, provide different ways of visualizing information, accessing digital resources, or interacting with discipline-specific content. However, the educational value of these technologies depends on whether they are appropriately aligned with the nature of the subject matter. Technology should therefore be selected because of its contribution to understanding particular content rather than simply because it is available.

Similarly, the TPK mean of 22.35 reflects respondents' knowledge concerning relationships between technology and pedagogical practice. TPK emphasizes understanding how teaching and learning processes can change when particular technologies are introduced (Mishra & Koehler, 2006). This distinction is important because using technology during instruction does not necessarily constitute meaningful technology integration. Technology may reproduce conventional teaching practices without substantially changing students' learning experiences. Effective TPK requires lecturers to consider whether a technological tool supports interaction, collaboration, assessment, feedback, student engagement, or other pedagogical objectives. Previous research has similarly emphasized that developing educators' TPACK requires not only technological competence but also the ability to integrate technology into pedagogical and professional practices (Farikah & Al Firdaus, 2020; Suyamto et al., 2020).

The integrated TPACK dimension provides the most comprehensive perspective on these relationships. Respondents obtained a mean score of 17.16, with scores ranging from 12 to 20. Rather than interpreting this score independently as "high" or "low," it is more appropriate to understand TPACK as the intersection of technological, pedagogical, and content-related knowledge. Mishra and Koehler (2006) emphasize that effective technology-integrated teaching emerges from interactions among these knowledge domains rather than from expertise in any single domain. Accordingly, a lecturer may possess technological skills, disciplinary expertise, and pedagogical knowledge while still needing to develop the capacity to coordinate these competencies within specific instructional contexts. This distinction explains why TPACK development should extend beyond stand-alone digital-skills training.

The findings therefore have practical implications for lecturer professional development. Universities should consider professional development activities that require lecturers to apply technology, pedagogy, and disciplinary content simultaneously rather than addressing each domain separately. Collaborative instructional design, peer mentoring, technology-integrated lesson development, and reflective evaluation of digital teaching practices may provide opportunities for lecturers to strengthen these connections. Rahmatiah et al. (2022) similarly emphasize the relevance of TPACK for developing innovative instructional practices, while Ait Ali et al. (2023) demonstrate the broader applicability of the framework for teaching and research in higher education-related professional contexts. Professional development based on authentic teaching problems may therefore be more valuable than training focused primarily on mastering particular digital applications.

These findings should nevertheless be interpreted within the methodological boundaries of the study. The results are based on lecturers' self-reported responses and therefore represent perceived rather than directly observed TPACK competencies. In addition, the participants were unevenly distributed between Universitas Negeri Jakarta and Universitas Halu Oleo, with 100 and eight respondents, respectively. The findings consequently should not be interpreted as institutional comparisons or generalized to all Indonesian university lecturers. Future studies could combine self-report instruments with classroom observations, interviews, teaching artifacts, or performance-based measures and involve larger and more balanced samples across institutions. Such approaches would provide stronger evidence of how lecturers translate their TPACK knowledge into actual technology-integrated teaching practices.

4. CONCLUSION

In conclusion, the findings indicate that lecturers generally demonstrated moderate to high competence in the separate components of TPACK, particularly in Content Knowledge (CK), Pedagogical Knowledge (PK), Technological Pedagogical Knowledge (TPK), and Technological Content Knowledge (TCK). Meanwhile, Technological Knowledge (TK) was categorized as moderate, indicating that lecturers were able to use basic digital technologies but had not yet fully optimized technology for innovative learning practices.

However, the results also revealed that Pedagogical Content Knowledge (PCK) and overall Technological Pedagogical Content Knowledge (TPACK) were still relatively low. This finding suggests that strong mastery of individual competencies does not automatically lead to effective integration of technology, pedagogy, and content in learning practices. Lecturers may understand each component separately yet still experience difficulties in designing contextual and technology-integrated learning experiences.

Therefore, higher education institutions need to strengthen lecturers' integrative competencies through continuous professional development programs, such as digital learning workshops, mentoring activities, collaborative lesson design, and technology-integrated teaching practices. This study is limited by the use of self-report questionnaires, unequal respondent distribution between institutions, and descriptive analysis only. Future research is recommended to involve larger and more balanced samples, classroom observations, and mixed-method approaches to obtain a more comprehensive understanding of lecturers' TPACK competencies.

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