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Lecturer Self-Assessments and Student Evaluations of Teaching Competence in Higher Education: An Analysis Based on the TPACK Framework

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Abstract
In recent years, the landscape of higher education has been rapidly evolving, driven by advancements in technology and changes in pedagogical approaches. However, there is a discrepancy between how lecturers perceive their own teaching competencies and how students evaluate these competencies. This research aims to compare lecturer self-assessments and student evaluations of teaching competence within the framework of TPACK (Technological Pedagogical Content Knowledge). This study employed a quantitative method with a sample of lecturers and students. Random sampling was applied, resulting in 104 students and 52 lecturers from Universitas Asahan. Based on the results of the Mann-Whitney U test, there was no significant difference between students' and lecturers' assessments of Pedagogical Knowledge (PK) (Asymp. Sig. (2-tailed) = 0.355 > alpha = 0.05). However, for the remaining competencies, specifically Content Knowledge (CK), Technological Knowledge (TK), Pedagogical Content Knowledge (PCK), Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), and Technological Pedagogical Content Knowledge (TPCK), there are significant differences in perceptions between students and lecturers. The disparity between students' and lecturers' perceptions suggests that they may hold varying interpretations of what constitutes effective integration of TPACK in teaching. Additionally, the results imply that lecturers underestimate their proficiency in integrating technology with pedagogy and content knowledge.

Keywords
TPACK framework; higher education; teaching competence; lecturer self-assessment; pedagogical approaches.

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Introduction

The rapid advancement of technology has transformed pedagogical approaches in higher education, driving a global shift toward more flexible and innovative learning environments (Alemu, 2024; Wu & Plakhtii, 2021). As online platforms become central to teaching and learning, higher education institutions must continuously adapt to ensure the delivery of quality education (Plessis & Chung, 2022). Moreover, emerging digital technologies, including artificial intelligence, are reshaping the governance and internal structures of these institutions, offering new opportunities while also introducing challenges for educators and learners (Li & Yang, 2023; Singh & Hiran, 2022).

The rapid shift to digital teaching, accelerated by events like the COVID-19 pandemic, has led to the widespread adoption of digital tools in education (Laufer et al., 2021). In parallel, advancements in technology-enhanced language learning and intelligent tutoring systems have expanded opportunities for student engagement and enriched learning experiences (Iberahim et al., 2023; Zhou et al., 2023). As hybrid teaching modes—blending online and offline instruction—become more prevalent, educators must adapt to evolving trends in digital education and leverage internet technologies effectively (Wang, 2022).

As technology continues to advance, higher education institutions are increasingly incorporating interdisciplinary research and sustainable strategies into their educational frameworks to enhance students' employability (Huang & Hsieh, 2020). This shift underscores the growing need for educators to continuously adapt to technological advancements in teaching and learning (Amrinada et al., 2022). Within this context, the development of Technological Pedagogical Content Knowledge (TPACK) among lecturers has become a crucial area of educational research and practice. TPACK, which represents the integration of technological, pedagogical, and content knowledge, provides a structured framework for effectively utilizing digital tools in teaching (Blonder et al., 2022; Smith, 2024). Research has highlighted TPACK's role in shaping professional development initiatives, emphasizing its significance in enhancing teaching practices in the digital era (Smith, 2024). As technology continues to reshape higher education, fostering TPACK among educators is essential for ensuring meaningful and effective technology integration in pedagogy.

The significance of TPACK framework has been widely recognized across various disciplines, including mathematics education and science teaching (Habiyaremye et al., 2022; Helsa et al., 2023; Mosia & Matabane, 2022). As a guiding framework, TPACK has played a crucial role in shaping teacher education programs and professional development initiatives,

helping educators strengthen their technological, pedagogical, and content knowledge (Drajati et al., 2021; Zimmermann et al., 2021). Several studies have examined lecturers' and pre-service teachers' perception of TPACK (Kola & Azeez, 2023; Wijaya et al., 2022).

Research by Bwalya and Rutegwa (2023) identified significant differences in TPACK self-efficacy among pre-service science and mathematics teachers from different universities, suggesting that institutional contexts may influence TPACK development. Similarly, Jaeni and Ghufron (2024) found that Indonesian pre-service teachers employed diverse strategies to enhance their TPACK skills, including observing experienced educators and participating in workshops. Additionally, Diamah et al. (2022) reported that TPACK-based training programs had a positive impact on pre-service teachers' perceptions of their own technological integration capabilities. Further studies by Irwanto et al. (2022) and Farhadi and Öztürk (2023) explored the relationship between TPACK perceptions and demographic factors, concluding that individual characteristics may shape how educators perceive and develop TPACK competencies.

Based on the existing literature, there is a gap concerning the comparison of perceptions between students and lecturers regarding lecturers' TPACK. While previous studies have explored the significance of TPACK in various disciplines and its impact on educator training programs and professional development efforts, limited attention has been given to understanding the differing perspectives of students and lecturers on lecturers' TPACK proficiency. Therefore, this research aims to address this gap by comparing the perceptions of lecturers and students on lecturers' TPACK within the higher education context. The results of this study are expected to provide an understanding of how TPACK is perceived within higher education. This insight can guide the development of targeted interventions aimed at improving lecturers' TPACK skills. Moreover, this study can lead to interventions that align teaching practices more closely with student expectations, thereby improving the quality of education delivery and student outcomes.

1. Methodology

1.1 Research Design

This study employed a quantitative approach to compare the perceptions of lecturers and students regarding lecturers' TPACK competencies. A survey research design was utilized, with data collected through a structured questionnaire adapted from established TPACK assessment instruments.

1.2 Sample

A random sampling was employed to select 104 students and 52 lecturers from the population of Universitas Asahan. The student participants were drawn from various undergraduate programs, while lecturers represented different faculties, ensuring diversity in perspectives. The inclusion criteria required lecturers to have prior experience integrating technology into their teaching and students to be enrolled in courses utilizing digital learning tools. The sample size was determined based on a statistical power analysis, targeting a power of at least 80% to ensure meaningful comparisons between groups.

1.3 Instruments

To gather data, separate questionnaires were administered to students and lecturers, each comprising 28 items adapted from Schmid et al. (2020). These items were distributed across seven components: Pedagogical Knowledge (PK), Content Knowledge (CK), Technological Knowledge (TK), Pedagogical Content Knowledge (PCK), Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), and Technological Pedagogical Content Knowledge (TPCK). Each component consisted of four items. The Likert scale was employed, with scoring ranging as follows: 5 (extremely agree), 4 (agree), 3 (neutral), 2 (disagree), and 1 (extremely disagree). An example question for lecturers, listed as item no. 1, was “I am able to adjust my teaching based on what students currently understand or do not understand.” Meanwhile, for students, the corresponding question was “I feel my lecturer can adjust teaching based on our current understanding or if we are experiencing difficulty in understanding the material.”

1.4 Validity and Reliability

Validity and reliability of the questionnaire instrument were assessed to ensure the robustness of the data collected. The validity of the instrument was confirmed through construct validity, with statistical significance set at 0.05. Additionally, reliability analysis was conducted to measure Cronbach's alpha, with a criterion set at > 0.700, indicating satisfactory internal consistency. Based on the validity and reliability tests, all components from both the lecturer and student groups demonstrated statistical significance (Sig. < 0.05) in the validity test and had acceptable internal consistency, with Cronbach’s alpha values exceeding 0.700. This indicates that all variables (sub-competencies) in the study are declared valid and reliable.

1.5 Data Analysis

Statistical analysis was conducted to compare responses between students and lecturers for each component of TPACK. The Mann-Whitney U test was utilized to assess for significant differences in perceptions between the two groups, with a significance level of 0.05.

2. Results

2.1 Summary of Descriptive Findings

Table 1 shows respondents' characteristics, including students and lecturers. The data reveals that the students are predominantly women, comprising 83.65% of the sample. Most students fall within the age range of 19-21 years (63.46%). A significant proportion of students, 53.85%, are enrolled in the Department of Indonesian Language and Literature Education. Meanwhile, the lecturer population has a more balanced gender distribution, with women making up 53.85% and men 46.15%. The majority of lecturers are in the age group of 30-34 years, representing 42.31% of the sample. Based on learning experience, the majority of lecturers have teaching experience ranging from 5 to 9 years (44.23%), followed by 10 to 14 years (40.38%).

Table 1: *Respondent Characteristics*

Group	Variable	Total	Percentage
Students (N = 104)	Gender		
	Men	17	16.35%
	Women	87	83.65%
	Age		
	<19	6	5.77%
	19-21	66	63.46%
	22-24	30	28.85%
	>24	2	1.92%
	Department		
	Indonesian Language and Literature Education	56	53.85%
	Mathematics Education	8	7.69%
	Development Economics	10	9.62%
	Management	10	9.62%
	English Education	13	12.50%
	Informatics Engineering	7	6.73%
Lecturers (N = 52)	Gender		
	Men	24	46.15%
	Women	28	53.85%

Age		
<30	4	7.69%
30-34	22	42.31%
35-40	13	25.00%
>40	13	25.00%
Teaching Experience (Years)		
<5	3	5.77%
5-9	23	44.23%
10-14	21	40.38%
>14	5	9.62%

Table 2 summarizes the responses of lecturers and students regarding TPACK components. The results suggest that students consistently rate lecturers' abilities, especially in technology integration, higher than lecturers rate themselves. Additionally, the competence area with the highest gap in scoring between students and lecturers is TPCK (mean of lecturers' responses = 3.73 vs. mean of students' responses = 4.17), indicating a great difference in perception regarding the integration of technology, pedagogy, and content knowledge.

Table 2: *Descriptive Statistics of Questionnaire Responses*

Components	**Item**	**Lecturers (N = 52) Frequency**					**Mean Score (Std. Dev.)**	**Students (N = 104) Frequency**					**Mean Score (Std. Dev.)**
		ED	**D**	**N**	**A**	**EA**		**ED**	**D**	**N**	**A**	**EA**	
PK	P1	0	0	0	26	26	4.50 (0.51)	5	1	20	33	45	4.08 (1.05)
	P2	0	0	0	39	13	4.25 (0.44)	5	2	15	38	44	4.10 (1.04)
	P3	0	0	13	13	26	4.25 (0.84)	5	4	15	40	40	4.02 (1.06)
	P4	0	0	0	26	26	4.50 (0.51)	5	1	12	43	43	4.14 (1.00)
	Total	**0**	**0**	**13**	**104**	**91**	**4.38 (0.60)**	**20**	**8**	**62**	**154**	**172**	**4.08 (1.03)**
CK	P5	0	0	13	26	13	4.00 (0.71)	5	1	8	33	57	4.31 (1.01)
	P6	0	0	13	26	13	4.00 (0.71)	5	1	10	42	46	4.18 (0.99)
	P7	0	0	13	26	13	4.00 (0.71)	5	1	16	33	49	4.15 (1.04)
	P8	0	0	26	0	26	4.00 (1.01)	5	5	13	42	39	4.01 (1.07)
	Total	**0**	**0**	**65**	**78**	**65**	**4.00 (0.79)**	**20**	**8**	**47**	**150**	**191**	**4.16 (1.03)**
TK	P9	0	0	39	0	13	3.50 (0.87)	5	1	11	33	54	4.25 (1.02)
	P10	0	0	26	13	13	3.75 (0.84)	5	2	13	34	50	4.17 (1.05)
	P11	0	0	39	0	13	3.50 (0.87)	5	1	15	36	47	4.14 (1.03)
	P12	0	0	13	26	13	4.00 (0.71)	6	1	15	36	46	4.11 (1.07)
	Total	**0**	**0**	**117**	**39**	**52**	**3.69 (0.85)**	**21**	**5**	**54**	**139**	**197**	**4.17 (1.04)**
PCK	P13	0	0	26	13	13	3.75 (0.84)	5	1	15	30	53	4.20 (1.05)
	P14	0	0	26	13	13	3.75 (0.84)	5	1	14	36	48	4.16 (1.03)
	P15	0	0	39	13	0	3.25 (0.44)	5	1	16	41	41	4.08 (1.01)
	P16	0	0	0	39	13	4.25 (0.44)	5	1	20	30	48	4.11 (1.06)
	Total	**0**	**0**	**91**	**78**	**39**	**3.75 (0.75)**	**20**	**4**	**65**	**137**	**190**	**4.14 (1.03)**
TPK	P17	0	0	39	13	0	3.25 (0.44)	5	1	14	36	48	4.16 (1.03)
	P18	0	0	26	26	0	3.50 (0.51)	5	1	10	42	46	4.18 (0.99)
	P19	0	0	13	26	13	4.00 (0.71)	5	1	13	36	49	4.18 (1.02)

	P20	0	0	26	13	13	3.75 (0.84)	5	1	13	36	49	4.18 (1.02)
	Total	**0**	**0**	**104**	**78**	**26**	**3.63 (0.70)**	**20**	**4**	**50**	**150**	**192**	**4.18 (1.01)**
TCK	P21	0	0	13	26	13	4.00 (0.71)	5	1	12	39	47	4.17 (1.01)
	P22	0	0	13	26	13	4.00 (0.71)	5	1	18	33	47	4.12 (1.05)
	P23	0	0	43	9	0	3.17 (0.00)	5	1	12	33	53	4.23 (1.03)
	P24	0	0	13	39	0	3.75 (0.44)	5	1	14	35	49	4.17 (1.03)
	Total	**0**	**0**	**82**	**100**	**26**	**3.73 (0.68)**	**20**	**4**	**56**	**140**	**196**	**4.17 (1.02)**
TPCK	P25	0	0	39	13	0	3.25 (0.44)	5	2	14	34	49	4.15 (1.05)
	P26	0	0	26	26	0	3.50 (0.51)	5	2	14	36	47	4.14 (1.04)
	P27	0	0	39	13	0	3.25 (0.44)	5	1	13	38	47	4.16 (1.02)
	P28	0	0	39	13	0	3.25 (0.44)	5	1	13	37	48	4.17 (1.02)
	Total	**0**	**0**	**143**	**65**	**0**	**3.31 (0.46)**	**20**	**6**	**54**	**145**	**191**	**4.16 (1.03)**

Note: ED = Extremely Disagree (1); D = Disagree (2); N = Neutral (3); A = Agree (4); EA = Extremely Agree (5).

2.2 Normality Testing

Normality tests were conducted to determine whether the data from both the lecturer and student groups followed a normal distribution. The Kolmogorov-Smirnov and Shapiro-Wilk tests were used for this purpose. If the significance value (Sig.) of both tests is greater than 0.05, the data are considered normally distributed. The results, presented in Table 3, show that all variables in both groups have significance values (Sig.) below 0.05. This indicates that the data are not normally distributed. Consequently, the non-parametric Mann-Whitney U test was used for hypothesis testing.

Table 3: *Normality Testing Results*

Variables	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Lecturers						
PK	0.264	52	0.000	0.790	52	0.000
CK	0.265	52	0.000	0.812	52	0.000
TK	0.344	52	0.000	0.711	52	0.000
PCK	0.414	52	0.000	0.661	52	0.000
TPK	0.242	52	0.000	0.816	52	0.000
TCK	0.266	52	0.000	0.855	52	0.000
TPCK	0.310	52	0.000	0.681	52	0.000
Students						
PK	0.177	104	0.000	0.816	104	0.000
CK	0.195	104	0.000	0.783	104	0.000
TK	0.201	104	0.000	0.783	104	0.000
PCK	0.224	104	0.000	0.790	104	0.000
TPK	0.203	104	0.000	0.770	104	0.000
TCK	0.210	104	0.000	0.774	104	0.000
TPCK	0.207	104	0.000	0.784	104	0.000

Note: [a]Lilliefors significance correction.

2.3 Hypothesis Testing

The Mann-Whitney U test is a non-parametric statistical method used to compare two independent samples. This test assesses whether there is a significant difference between the two groups. Table 4 presents the results of the Mann-Whitney U test for the seven variables.

Table 4: *Mann-Whitney U Test Results*

Variable	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)	Mean Rank	
					Lecturers	Students
PK	2463.5	7923.5	-0.925	0.355	83.13	76.19
CK	2132	3510	-2.186	0.029	67.50	84.00
TK	1768	3146	-3.577	0.000	60.50	87.50
PCK	1592.5	2970.5	-4.233	0.000	57.13	89.19
TPK	1339	2717	-5.208	0.000	52.25	91.63
TCK	1432.5	2810.5	-4.858	0.000	54.05	90.73
TPCK	994.5	2372.5	-6.567	0.000	45.63	94.94

The results reveal significant differences between lecturers and students in their perceptions of several TPACK components, including CK, TK, PCK, TPK, TCK, and TPCK. However, no significant difference is observed for PK. For example, the CK variable has a p-value of 0.029, which is below the 0.05 significance level, indicating a statistically significant difference in perceptions of content knowledge between the two groups.

Overall, these findings underscore a disparity in how lecturers and students perceive the integration of technology, pedagogy, and content knowledge. Conversely, the PK variable has a p-value of 0.355, which exceeds the 0.05 threshold, suggesting that lecturers and students share similar views on pedagogical knowledge.

In summary, the significant differences in CK, TK, PCK, TPK, TCK, and TPCK suggest a need for further training and development to bridge the perception gap between educators and students. Meanwhile, the similarity in PK perceptions indicates a shared understanding of teaching methods and strategies between the two groups.

3. Discussion

The findings reveal disparities in perceptions of TPACK components between lecturers and students. These differences highlight various facets of teaching methodologies, technological integration, content delivery, and student engagement. Variances in how educators and learners

perceive the integration of technology, pedagogy, and content knowledge are crucial for enhancing teaching practices (Mishra & Koehler, 2006). For instance, discrepancies in perceptions may indicate variations in teaching styles and approaches between lecturers and students, suggesting the need for educators to tailor their methods to better align with student needs and expectations. Furthermore, differences in perceptions of content knowledge and its presentation present opportunities for educators to refine their delivery methods and effectively communicate complex concepts to students.

The differences in perception between students and lecturers regarding TPACK components can be attributed to various factors. Lecturers typically possess more experience and expertise in their respective fields, which may influence their self-assessment of TPACK skills differently from students. Additionally, lecturers undergo formal training in pedagogy and instructional methods, which could shape their perception of their teaching competencies compared to students, who may lack the same level of awareness. Moreover, lecturers often have a deeper understanding of available technological tools and resources (Ningtyas et al., 2023; Wijaya et al., 2022). Eventually, lecturers tend to rate themselves lower than students due to factors such as humility, self-criticism, or a desire for continuous improvement.

Bridging the gap in how lecturers and students perceive TPACK components could greatly improve teaching and learning. When lecturers and students are on the same page about how technology, pedagogy, and content knowledge come together, it leads to better communication and more personalized teaching. Lecturers can adjust their methods to better fit students' needs, which makes learning more engaging and effective. In addition, it helps lecturers improve their skills through targeted training.

The findings of this study offer insights for the design of lecturer training programs and professional development initiatives aimed at enhancing alignment in perceptions of TPACK. Professional development initiatives can utilize this information to tailor their curriculum, creating targeted interventions to bridge these perception gaps. For example, in instances where discrepancies in content knowledge perception are evident, training programs can incorporate modules to improve content expertise among lecturers or enhance students' understanding of course content. Moreover, these findings underscore the importance of promoting collaborative learning environments and integrating technology-enhanced teaching strategies into training programs.

4. Conclusion and Suggestion

This study discusses the differing perceptions of lecturers and students regarding the integration of TPACK in higher education. While there is alignment in the perception of PK, significant disparities exist in the perceptions of CK, TK, PCK, TPK, TCK, and TPCK. These findings emphasize the importance of addressing these perception gaps to enhance teaching and learning outcomes. The disparity between lecturers' and students' perceptions suggests a need for targeted interventions and professional development initiatives aimed at improving lecturers' TPACK skills. Furthermore, enhancing lecturers' proficiency in TPACK components such as CK, TK, PCK, TPK, TCK, and TPCK can contribute to improved educational delivery and student outcomes. It is essential to design lecturer training programs and professional development initiatives that address the specific areas where perception gaps exist. These interventions should be tailored to enhance alignment in perceptions of TPACK and promote collaborative learning environments.

There are several avenues worth exploring to deepen our understanding of the perceptions of TPACK in higher education. Complementary qualitative research, such as interviews or focus groups, would offer deeper insights into the underlying beliefs and experiences shaping individuals' perceptions of TPACK. Additionally, comparative cross-cultural studies could illuminate the cultural influences on TPACK perceptions, informing the development of culturally responsive teaching practices. Investigating the impact of lecturers' TPACK perceptions on student learning outcomes could further our understanding of the relationship between teaching practices and student engagement, satisfaction, and achievement. In addition, intervention studies could assess the effectiveness of targeted professional development programs or instructional interventions in bridging perception gaps and enhancing lecturers' TPACK skills. Eventually, exploring the applicability of existing technology integration models in higher education contexts and examining the role of institutional policies and support structures in facilitating TPACK integration could also yield valuable insights.

References

Alemu, N. E. (2024). Zooming into the Barriers and Motivations of the Ethiopian University Instructors for Designing and Delivering Content Online: An Institutional Case Study of the University of Gondar. https://doi.org/10.14507/MCF-eLi.I1

Amrinada, A., Prayoga, A. A., Ninda Asyifa, D. A., Qurota Ayun, M. R., & Abidah, A. H. (2022). Technology-Based Learning Through Unity Application in Teaching Spatial Volume of Geometric Shapes for 6th Grade Elementary School Students. Journal of Software Engineering, Information and Communication Technology (SEICT), 3(1), 35–44. https://doi.org/10.17509/seict.v3i1.59651

Blonder, R., Feldman-Maggor, Y., & Rap, S. (2022). What can be learned from lecturers' knowledge and self-efficacy for online teaching during the Covid-19 pandemic to promote online teaching in higher education. PLOS ONE, 17(10), e0275459. https://doi.org/10.1371/journal.pone.0275459

Bwalya, A., & Rutegwa, M. (2023). Technological pedagogical content knowledge self-efficacy of pre-service science and mathematics teachers: A comparative study between two Zambian universities. Eurasia Journal of Mathematics, Science and Technology Education, 19(2), em2222. https://doi.org/10.29333/ejmste/12845

Diamah, A., Rahmawati, Y., Paristiowati, M., Fitriani, E., Irwanto, I., Dobson, S., & Sevilla, D. (2022). Evaluating the effectiveness of technological pedagogical content knowledge-based training program in enhancing pre-service teachers' perceptions of technological pedagogical content knowledge. Frontiers in Education, 7. https://doi.org/10.3389/feduc.2022.897447

Drajati, N. A., Rakerda, H., Sulistyawati, H., Nurkamto, J., & Ilmi, M. (2021). Investigating the adoption of TPACK-21CL by english pre-service teachers in a covid-19 teaching practicum. Indonesian Journal of Applied Linguistics, 11(1). https://doi.org/10.17509/ijal.v11i1.34625

Farhadi, S., & Öztürk, G. (2023). Technological Pedagogical Content Knowledge (TPACK) Level and Needs of Pre-Service English as a Foreign Language (EFL) Teachers: Evidence from Turkey. Revista Educación, 47(1), 1–16. https://doi.org/10.15517/revedu.v47i1.51920

Habiyaremye, H. T., Ntivuguruzwa, C., & Ntawiha, P. (2022). From pedagogical toward technological pedagogical content knowledge frameworks and their effectiveness in teaching mathematics: A mapping review. F1000Research, 11, 1029. https://doi.org/10.12688/f1000research.125073.1

Helsa, Y., Turmudi, & Juandi, D. (2023). TPACK-based hybrid learning model design for computational thinking skills achievement in mathematics. Journal on Mathematics Education, 14(2), 225–252. https://doi.org/10.22342/jme.v14i2.pp225-252.

Huang, Y.-M., & Hsieh, M.-Y. (2020). An Interdisciplinary Research on Students' Employability in Technology Education to Advance Higher Education Enrollment Sustainability. Sustainability, 12(5), 1806. https://doi.org/10.3390/su12051806

Iberahim, A., Md Yunus, M., & Sulaiman, N. A. (2023). A Review on Technology Enhanced Language Learning (TELL). International Journal of Academic Research in Business and Social Sciences, 13(2), 1509–1519. https://doi.org/10.6007/IJARBSS/v13-i2/16496

Irwanto, I., Redhana, I. W., & Wahono, B. (2022). Examining Perceptions of Technological Pedagogical Content Knowledge (TPACK): A Perspective from Indonesian Pre-service Teachers. Jurnal Pendidikan IPA Indonesia, 11(1), 142–154. https://doi.org/10.15294/jpii.v11i1.32366

Jaeni, M., & Ghufron, M. A. (2024). Developing technological pedagogical content knowledge skills during teaching practicum. International Journal of Evaluation and Research in Education (IJERE), 13(3), 1865. https://doi.org/10.11591/ijere.v13i3.26995

Kola, A. J., & Azeez, A. A. (2023). Lecturers' Perception of Technological Pedagogical Content Knowledge in Nigerian Colleges of Education. In Education Annual Volume (Vol. 2023). https://doi.org/10.5772/intechopen.108678

Laufer, M., Leiser, A., Deacon, B., Perrin de Brichambaut, P., Fecher, B., Kobsda, C., & Hesse, F. (2021). Digital higher education: a divider or bridge builder? Leadership perspectives on edtech in a COVID-19 reality. International Journal of Educational Technology in Higher Education, 18(1), 51. https://doi.org/10.1186/s41239-021-00287-6

Li, Y., & Yang, P. (2023). Higher education worries and response in the era of artificial intelligence. SCIREA Journal of Education, 8(1), 24–44. https://doi.org/10.54647/education880398

Mishra, P., & Koehler, M. J. (2006). Technological Pedagogical Content Knowledge: A Framework for Teacher Knowledge. Teachers College Record: The Voice of Scholarship in Education, 108(6), 1017–1054. https://doi.org/10.1111/j.1467-9620.2006.00684.x

Mosia, M., & Matabane, M. E. (2022). Exploring Factors that Serve as Predictors for Mathematics and Sciences Pre-Service Teachers to Use ICT in Teaching. Research in Educational Policy and Management, 4(1), 80–91. https://doi.org/10.46303/repam.2022.10

Ningtyas, P. I. A., Sahiruddin, S., & Degeng, P. D. D. (2023). The Perspectives of EFL Students on the Technological Pedagogical Content Knowledge (TPACK) of Their Teachers. Journey: Journal of English Language and Pedagogy, 6(1), 11–23. https://doi.org/10.33503/journey.v6i1.2498

Plessis, A. E. Du, & Chung, J. (2022). Preservice Teachers' Pedagogical Mobility: A Case Study about Classroom Preparedness and Flexibility in a Disrupted Professional Placement Context. International Journal of Higher Education, 11(4), 103. https://doi.org/10.5430/ijhe.v11n4p103

Schmid, M., Brianza, E., & Petko, D. (2020). Developing a short assessment instrument for Technological Pedagogical Content Knowledge (TPACK.xs) and comparing the factor structure of an integrative and a transformative model. Computers & Education, 157, 103967. https://doi.org/10.1016/j.compedu.2020.103967

Singh, S. V., & Hiran, K. K. (2022). The Impact of AI on Teaching and Learning in Higher Education Technology. Journal of Higher Education Theory and Practice, 22(13), 135–148. https://doi.org/10.33423/jhetp.v22i13.5514

Smith, D. (2024). It takes a village: Supporting the integration of digital textbooks in higher education. ASCILITE 2017 Conference Proceedings: Me, Us, IT! , 400–410. https://doi.org/10.14742/apubs.2017.772

Wang, S. (2022). Application of Hybrid Teaching in English for Nursing in Higher Vocational Colleges. Education Reform and Development, 3(2), 61–64. https://doi.org/10.26689/erd.v3i2.3592

Wijaya, I. N. A., Ratminingsih, N. M., & Dewi, N. L. P. E. S. (2022). English Language Education Student-Teachers' Perception on TPACK. The Art of Teaching English as a Foreign Language, 3(1), 9–18. https://doi.org/10.36663/tatefl.v3i1.193

Wu, W., & Plakhtii, A. (2021). E-Learning Based on Cloud Computing. International Journal of Emerging Technologies in Learning (IJET), 16(10), 4. https://doi.org/10.3991/ijet.v16i10.18579

Zhou, D., Liu, Y., Huang, J., Xiang, Y., Gu, R., & Liu, B. (2023). An Intelligent Tutoring System Enhancing Transdisciplinary Problem-finding in Design-led Integrated STEM Education. Proceedings of the 2022 3rd International Conference on Artificial Intelligence and Education (IC-ICAIE 2022), 943–949. https://doi.org/10.2991/978-94-6463-040-4_142

Zimmermann, F., Melle, I., & Huwer, J. (2021). Developing Prospective Chemistry Teachers' TPACK–A Comparison between Students of Two Different Universities and Expertise Levels Regarding Their TPACK Self-Efficacy, Attitude, and Lesson Planning Competence. Journal of Chemical Education, 98(6), 1863–1874. https://doi.org/10.1021/acs.jchemed.0c01296