Integrating TPACK and AI: Empowering Educators with Enhanced Awareness in Education

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Abstract

It has been noted that artificial intelligence is now becoming rampant. Most learners are exposed to this technological advancement, and teachers are given no option but to embrace the reality of applying AI in academia. Thus, the study was conducted to assess the preparedness of educators and students in Pamantasan ng Lungsod ng Muntinlupa, Philippines. Specifically, it aims to determine the TPACK competencies and teachers' awareness of integrating AI in teaching their respective courses. Moreover, the perspective of teachers regarding the positive and negative effects of the use of AI on learners was gathered. A correlational research design with a purposive sampling method of choosing 56 tertiary-level professors was utilized. The data was collected, treated, and analyzed using SPSS to obtain the following: frequency, percentage, weighted mean, Pearson r correlation, and t-test for determining the significance and testing of the hypothesis profile. Ethical considerations were emphasized during the gathering of data to ensure that the respondents were protected from their rights. The results of this study showed that there is a significant positive correlation between TPACK and AI concerning educators' approaches to handling 21st-century learners. It was also found that there is a positive outlook on the use of AI in teaching and learning; therefore, it is crucial to provide more adept training and continuously monitor the improvement of skills among teachers and learners. The study's findings led to the recommendation of the following: seamless integration of technology with subject matter and teaching methodologies to improve learning outcomes. Further, there must be continual support, professional development, and collaboration with peers from other institutions to refine educators' skills in leveraging technology for improved teaching and learning experiences.

Keywords*: *artificial intelligence, technology, pedagogy, content, knowledge, TPACK

1. Introduction

TPACK, or Technological Pedagogical Content Knowledge, is a framework that has become essential for improving instructors; proficiency in AI instruction (Ning et al., 2024; Celik, 2023). It is a class of knowledge central to teachers' work with technology. Its importance has been highlighted by Karan (2022) and Yao (2021) in a recent study, which demonstrates how it has radically changed educators; perceptions of and use of AI in teaching and learning environments. Research has shown how TPACK-based professional development programs significantly improve teachers; self-efficacy, teaching abilities, and knowledge of AI in the classroom (Sun et al., 2023), as well as their understanding of AI. In addition, the framework's adaptation has broadened its use and improved instructors; knowledge of AI's incorporation into the classroom (Ng et al., 2023). Notably, it has played a vital role in classifying and detecting South Korean elementary school instructors' AI integration competencies (Kim & Kwon, 2023). To develop instructors; competence, awareness, and skills—essential for effective AI education—the TPACK framework takes on a central role.

This understanding is substantiated by a comprehensive review of literature focusing on AI's role in education. These insights highlight the nascent nature of AI applications in education, emphasizing the pressing need for further exploration into their integration into teaching and learning practices, (Zawacki-Richter et al., 2019). Additionally, a dearth of research exists on the incorporation of AI technologies across various educational domains, revealing uncharted territories in this evolving field (Chiu et al., 2023). Mishra and Koehler (2006) developed the TPACK framework, which makes sense of the complicated data that teachers need to know to properly incorporate technology into the classroom. This framework functions as an indicator, encompassing content, technological, and educational knowledge.

According to Harris, Koehler, and Mishra, Punya (2009), the Technological Pedagogical Content

Knowledge (TPACK) framework serves various pivotal purposes in education, as evidenced by its multifaceted contributions, uncovering the intricate relationship between technology, pedagogy, and content to enhance teaching and learning (Koehler, M. J., & Mishra, P., 2009); guiding curriculum development and teacher training for effective technology assimilation Papanikolaou, K., Makri, K. & Roussos, P. (2017); providing a comprehensive roadmap for seamless technology integration in classrooms; aiding teachers in strategic planning; acting as an evaluative tool for instructors; knowledge, potentially shaping professional development endeavors, Kurt (2018); and offering a comprehensive perspective on educators and digital competencies through diverse knowledge dimensions Basilotta-Gómez-Pabloset al.(2022). Teachers acquire a comprehensive understanding of the complex interaction between technology, content, and pedagogy by implementing the TPACK framework. This understanding enables them to use these technology components in educational contexts more effectively, leading to better learning outcomes and increased use of it. One of the biggest challenges is ensuring that teachers are adequately trained and equipped to use technology in the classroom (Park et al., 2023). Many teachers still feel intimidated or overwhelmed by technology, which can lead to a reluctance to incorporate it into their lessons. Another challenge is keeping up with the ever-evolving landscape of technology. New tools and platforms are constantly emerging, and it can be difficult for teachers to stay on top of the latest trends. As for artificial intelligence (AI), one of the main challenges is ensuring that it is used ethically and responsibly. There is a concern that AI could be used to perpetuate bias and discrimination, particularly if it is not programmed properly or trained on biased data sets. In this scenario, this study was conducted to determine the TPACK competencies and teachers' awareness of integrating AI in their respective lessons.

2. Objectives

The study was conducted to determine the relationship between the TPACK competency and the awareness of faculty respondents about integrating artificial intelligence (AI) in facilitating learning. Specifically, the study aimed to:

1. Determine the level of TPACK competency of faculty members in terms of technology, pedagogy, content, and knowledge;
2. Determine the level of awareness of faculty respondents about the integration of artificial intelligence in facilitating learning;
3. Examine the faculty respondents' perceptions of the integration of artificial intelligence in facilitating learning;
4. Determine the significant relationship between the TPACK competency and the awareness of faculty-respondents in the integration of AI in facilitating learning; and
5. Recommend possible TPACK AI training workshops that consider the specific demographic characteristics of teachers, aiming to enhance their skills and confidence in utilizing technology for improved 21st-century teaching pedagogy.

3. Materials and Methods

This study utilized a correlational research design to investigate both TPACK competencies and awareness of AI integration in teaching. Through purposive sampling, 56 faculty members teaching Mathematics, Social Science, Language, and Science were selected as participants. The AI instrument survey, adapted from Safer Internet for Children, gauged teachers' awareness of AI integration in teaching, while a standardized TPACK instrument from ISTE (2009) assessed participants' competencies in technology, pedagogy, and content knowledge. Data analysis employed frequency, percentage, weighted mean, and Pearson r correlation for hypothesis testing. Findings informed the formulation of a training workshop intervention on TPACK competencies and AI teaching integration. Faculty members teaching general education courses were chosen due to their significance in foundational education delivery, facilitating a focused exploration of TPACK competency within interdisciplinary teaching. Interpretation of results in Tables 1-5 involved classification based on mean scores, standard deviation, and benchmark value comparison, supplemented by qualitative analysis for deeper insight into participants' proficiency levels and confidence.

4. Results and Discussion

In the following section, the results of the study on the Technological Pedagogical Content Knowledge (TPACK) competency of faculty members are presented. The investigation sought to assess the extent of TPACK proficiency across four key domains: technology, pedagogy, content, and overall knowledge. Through rigorous analysis of survey data and assessment outcomes, this section provides valuable insights into the readiness and capabilities of faculty members to integrate technology effectively into their teaching practices. Each domain is examined individually to comprehensively understand the strengths and areas for improvement within faculty TPACK competency. These findings highlight the importance of educators being ready to meet the challenges of modern teaching environments.

Table 1: Technology

	Mean	Std. Deviation	Sample Size
I know how to solve my technical problems.	3.39	1.26	56
I can learn technology easily.	3.54	1.14	56
I keep up with important new technologies.	3.52	1.08	56
I frequently play around with technology.	3.41	1.25	56
I know about a lot of different technologies.	3.36	1.26	56
I have the technical skills I need to use technology.	3.45	1.26	56
I have had sufficient opportunities to work with different technologies.	3.3	1.22	56

Table 1 shows that participants' average scores fall within a moderate range, suggesting a balanced perception of their technology-related skills. However, there is some variability in responses, indicating that views on technology usage are not uniform. These moderate results imply that participants express neither very low nor very high levels of confidence in using technology for teaching. This finding was aligned with the study of Elvianasti et al. (2023). The average scores suggest that participants' competence in using technology to facilitate learning is average, possibly due to exposure to various technologies provided by their institution.

Table 2: Content Technology

	Mean	Std. Deviation	Sample Size
I have various ways and strategies for developing my understanding of Mathematics.	3.38	1.12	56
I have sufficient knowledge about Social Studies.	3.36	1.05	56
I can use a historical way of thinking.	3.5	1.06	56

I have various ways and strategies for developing my understanding of Social Studies.	3.52	1.08	56
I have sufficient knowledge about Science.	3.66	1.08	56
I can use a scientific way of thinking.	3.54	1.03	56
I have various ways and strategies for developing my understanding of Science.	3.55	1.04	56
I have sufficient knowledge about Literacy.	3.59	1.02	56
I can use a Literacy way of thinking.	3.66	0.99	56
I have various ways and strategies for developing my understanding of Literacy.	3.71	0.98	56

Table 2 indicates a moderate level of confidence among participants in teaching Mathematics, Social Studies, Science, and Literacy. A slightly stronger proficiency in Literacy is observed. Moderate standard deviations suggest variability in responses, highlighting individual differences. Specifically, educators exhibit moderate confidence in utilizing content-specific knowledge and thinking strategies across subject areas. This includes moderate confidence in Mathematical Thinking and Understanding, Social Studies Knowledge and Thinking, and Scientific Knowledge and Thinking.

Table 3: Pedagogical Knowledge

	Mean	**Std. Deviation**	**Sample Size**
I know how to assess student performance in a classroom.	3.77	0.95	56
I can adapt my teaching based on what students currently understand or do not understand.	3.77	1.04	56
I can adapt my teaching style to different learners.	3.67	0.97	56
I can assess student learning in multiple ways.	3.66	0.97	56
I can use a wide range of teaching approaches in a classroom setting.	3.61	1	56
I am familiar with common student understandings and misconceptions.	3.58	1.01	56
I know how to organize and maintain classroom management.	3.69	0.98	56

The findings suggest educators perceive themselves as competent in various subject areas, including science and literacy, demonstrating solid knowledge and thinking skills. Table 3 indicates confidence in selecting effective teaching approaches across Mathematics, Social Studies, Science, and Literacy, with low standard deviations indicating uniformity. Educators exhibit moderate to high confidence levels in selecting

effective teaching approaches tailored to specific subject needs, with slightly higher confidence in Social Studies and Literacy, reflecting recognition of the importance of literacy skills and broader pedagogical strategies in education.

Table 4: Technology Content Knowledge

	Mean	Std. Deviation	Sample Size
I know about technologies that I can use for understanding and doing mathematics.	3.52	0.93	56
I know about technologies that I can use for understanding and doing literacy.	3.64	1.03	56
I know about technologies that I can use for understanding and doing science.	3.52	0.91	56
I know about technologies that I can use for understanding and doing social studies.	3.54	1.04	56
I can choose technologies that enhance the teaching approaches for a lesson.	3.61	0.98	56
I can choose technologies that enhance students' learning for a lesson.	3.71	0.99	56
My teacher education program has caused me to think more deeply about how technology could influence the teaching approaches I use in my classroom.	3.79	0.89	56
I am thinking critically about how to use technology in my classroom.	3.82	0.89	56
I can adapt the use of the technologies that I am learning about to different teaching activities.	3.71	0.89	56

Table 4 outlines educators' proficiency and confidence in technology content knowledge across subjects. Key findings show moderate to high levels of knowledge across different subjects (e.g., mathematics, literacy, science, and social studies), with variability in comfort levels indicated by standard deviations. Participants also express confidence in selecting technologies to enhance teaching approaches and student learning experiences. Moreover, teacher education programs effectively promote reflection on technology's impact on teaching, fostering critical thinking and adaptability in technology integration. Overall, the results indicate a generally positive outlook among educators regarding their technology content knowledge and its integration into teaching practices. While there is a notable level of confidence in utilizing technology across subjects and teaching contexts, ongoing professional development and support may further enhance educators' capacity to leverage technology effectively in the classroom.

Table 5: Technology Pedagogy Content Knowledge

	Mean	SD	Sample Size
I can teach lessons that appropriately combine mathematics, technologies, and teaching approaches.	3.54	1.008	56

I can teach lessons that appropriately combine literacy, technologies, and teaching approaches.	3.55	1.007	56
I can teach lessons that appropriately combine science, technology, and teaching approaches.	3.57	0.89	56
I can teach lessons that appropriately combine social studies, technologies, and teaching approaches.	3.5	1.009	56
I can select technologies to use in my classroom that enhance what I teach, how I teach, and what students learn.	3.69	0.89	56
I can use strategies that combine content, technologies, and teaching approaches that I learned about in my coursework in my classroom.	3.55	0.91	56
I can provide leadership in helping others coordinate the use of content, technologies, and teaching approaches at my school and/or district.	3.64	0.92	56
I can choose technologies that enhance the content of a lesson.	3.71	0.89	56

Table 5 presents educators' confidence in integrating technology with content knowledge across subjects. They exhibit moderate to high levels of confidence in blending subject content, technologies, and teaching approaches. They also show confidence in selecting and using technologies to enhance lessons. Although they demonstrate some confidence in implementing the pedagogical strategies they have learned in coursework, they may require additional support. Most respondents are willing to lead technology integration efforts, reflecting a positive outlook. Ongoing support and development can enhance educators' abilities to leverage technology for teaching and learning.

Table 6: Awareness of Artificial Intelligence in Education

	Yes	**No**	**I do not know**	**Mean**
Used AI tools in the education process	46 (82.14%)	4 (7.14%)	6 (10.71%)	2.71
Noticed students using AI tools for study	46 (82.14%)	8 (14.29%)	2 (3.57%)	2.64
Noticed students using AI tools outside school activities	38 (67.86%)	11 (9.64%)	7 (12.50%)	2.55
Aware of potential risks from students' AI tool usage	48 (85.71%)	4 (7.14%)	4 (7.14%)	2.79
The school uses AI systems for administrative tasks	37 (66.07%)	9 (16.07%)	10 (17.86%)	2.48
Average Total Mean	-	-	-	2.64

As can be seen in Table 6, the majority of respondents, 64.3%, recognize personalized learning experiences as the foremost positive impact of AI in education. Additionally, 48.2% of respondents acknowledge AI's potential in providing training and support for educators, highlighting its role in enhancing teaching practices. Furthermore, respondents identified other significant benefits, such as AI's capability to assist students with difficult tasks and contribute to their competitiveness in the job market. These findings underscore the multifaceted benefits of AI in education, ranging from personalized learning experiences to improved support for educators and students alike, ultimately fostering a more dynamic and effective learning environment.

Table 7: Positive Effects of Artificial Intelligence on the Educational Process in the Future

	f	%
Could provide personalized learning experiences for students.	36	64.3
Could provide great potential in educators' training.	27	48.2
Could support the work of educators.	32	57.1
Could make learning easier for vulnerable groups of students.	31	55.4
Could assist in the early diagnosis of learning difficulties.	19	33.9
Could assist in the administrative duties of educators.	21	37.5
Other response	4	7.1

In Table 7, concerns about AI undermining the role of educators (44.6%) and hindering critical thinking skills (71.4%) were predominant. Additionally, there are worries about AI exacerbating inequality or discrimination (39.3%) and leading to plagiarism issues (51.8%). These findings indicate a cautious approach toward integrating AI in education, highlighting the importance of addressing potential drawbacks. As to the result of the study, the usage of AI will help the students in their editing, providing direction and ideas, and scaffold-making to complete the school tasks and activities given to them (Nikolic et. al., 2023). Supporting the statement of the article about the significance of utilizing technology in an organization and among human beings, which includes biases, discriminations, and data privacy risks.

Table 7.1: Negative Effects of Artificial Intelligence on the Educational Process in the Future

	f	%
Could be undermining the role of the educator.	25	44.6
Could lead to new forms of inequality or discrimination, or exacerbate existing ones.	22	39.3
Could become an obstacle to the cultivation of students' thinking especially their critical thinking.	40	71.4
Could lead to the exaggeration of plagiarism.	29	51.8
Other	7	12.5

As shown in Table 7.1, the most common concern (69.6%) is the failure to cultivate critical thinking skills in children and young people. This contradicts the article, which states that the importance of critical thinking will be elevated. And the success of AI will demand human assistance for it to work efficiently (Gigster, 2023). This is followed by worries about the absence of social interactions (42.9%), which opposed the study stating that there are positive and negative repercussions of AI usage, yet focused on the more positive side of it, which is gaining emotional positive language by increasing the message transmission (Hohenstein et. al., 2023) and potential exposure to misleading or harmful content (50%). According to the study, children are vulnerable to exposure risk due to their unawareness of technology and the online world, which leads to privacy violation vulnerability (Achieng, 2023). These concerns emphasize the need for safeguards and educational initiatives to mitigate the risks associated with AI use among youth.

Table 7.2: Perception of the Effect of Artificial Intelligence on the Educational Process in the Future

	f	%
4 - Very Much	27	48.21
3 - Much	13	23.21
2 - Moderately	8	14.29
1 - Not much	6	10.71
0 - Not at all	2	3.57
Mean	3.55	

Table 7.2 shows that most respondents (48.21%) believe AI will have a moderate impact (rated 4), followed by a significant impact (rated 3) with 23.21%. This indicates a consensus that AI will play a notable role in shaping the future of education. Another study that presents the same result as regards the use of AI

was conducted by Rajesh et al. (2022). In his paper, he focused on how AI enhances and elevates the learning standard in the educational system.

Table 7.3: Perception of the Need for Guidance to Enrich One's Knowledge and Skills in Using Artificial Intelligence Tools in Education

	f	%	Mean
Yes	51	91.07	
No	3	5.36	
I do not know	2	3.57	
Mean			2.88

As shown in Table 7.3, the vast majority (91.1%) of respondents expressed a desire for more guidance to enrich their knowledge and skills in using AI tools in education. As explained in the study, educators are very positive that the ramifications of AI learning and teaching will be beneficial for them. Mentioning that educators must embrace deep discussion with their students (Langreo, 2023)., underscores the importance of providing educators with adequate support and training opportunities to integrate AI into educational practices effectively.

Table 7.4: Perception of the Ways to Effectively Train Educators on Artificial Intelligence Systems

	f	%
University education.	24	42.86
Training seminars/workshops.	35	62.50
Specialized online courses (e.g., MOOCs).	22	39.29
Appropriate educational material (textbooks and other teaching material).	17	30.36
Other	3	5.36

Table 7.4 shows that respondents favored training seminars or workshops (62.5%) and university education (42.9%) as the most effective methods for educating educators on AI systems. Additionally, specialized online courses (39.3%) were considered valuable. These preferences suggest a need for diverse and accessible training avenues to ensure educators are well-equipped to utilize AI technologies effectively. Similar to the conclusions and recommendations of the research study regarding building an AI educational trajectory that will assist educators in professional development (Al-Zyoud, 2020), and according to Diamah et al. (2022), the pre-service teachers have high confidence in their AI application in TPACK due to training programs they have attended. Overall, the survey results indicate a recognition of both the potential benefits and risks associated with the integration of AI in education. While there is optimism about AI's capacity to enhance learning experiences and support educators, there are also concerns about its potential to undermine critical thinking skills and exacerbate inequalities. Addressing these concerns will require comprehensive training programs, robust safeguards, and thoughtful implementation strategies to maximize the positive impact of AI while mitigating potential drawbacks.

Table 8: Correlations between TPACK and AI

		TPACK	AI
TPCK	Pearson Correlation Sig. (2-tailed)	1	.278 .038

	N	56	56
AI	Pearson Correlation Sig. (2-tailed) N	.278* .038 56	1 56

These correlation results indicate a significant positive relationship between Technological Pedagogical Content Knowledge (TPCK) and the integration of artificial intelligence (AI) in teaching methods. The Pearson correlation coefficient between TPCK and AI is 0.278, and the associated p-value is 0.038, which is below the conventional significance threshold of 0.05. This suggests that there is a statistically significant positive correlation between TPCK and AI at the 0.05 level (2-tailed). In simpler terms, these findings imply that as faculty members' proficiency in integrating technology, pedagogy, and content knowledge increases (as measured by TPCK), their awareness or utilization of AI in teaching methods tends to increase as well. This correlation underscores the importance of educators' technological pedagogical content knowledge in shaping their adoption and integration of AI technologies in educational practices.

5. Conclusions and Recommendations

There is a significant awareness of artificial intelligence (AI) among students and educators. It is further recommended that educators and institutions address associated risks and ensure the responsible use of A.I. tools for education by crafting a set of policies for proper guidance. There is a positive outlook on A.I.'s capacity to enhance learning experiences and support educators. On the other hand, there are also concerns about its potential to undermine critical thinking skills and inequalities. It is further recommended to craft a comprehensive strategic training program to optimize its positive impact while mitigating potential risks. There is a neither very low nor a very high level of confidence or experience in using technology as the participants use it in delivering teaching and learning experiences. Further, participants are exposed to the different technologies made available to them by the institution. The educators demonstrate a general awareness of effective pedagogical practices tailored to the specific needs of each course or subject. It is further recommended to subject them to continued professional development (in-house and outside) and collaboration opportunities that can further enhance their pedagogical and technological knowledge and effectiveness in facilitating student learning processes across diverse content areas. There is a capacity to effectively integrate technology with subject content and pedagogical approaches. Ongoing support, professional development, collaborative efforts, and networking with other universities may further enhance educators' abilities to harness the potential of technology to improve teaching and learning outcomes; There is a positive outlook among educators regarding their technological pedagogical content knowledge and its application in instructional contexts. Further, it is imperative to provide ongoing support, professional development, and collaborative efforts to enhance the participants' abilities to harness the potential of technology to improve teaching and learning outcomes.

One limitation of the study "Integrating TPACK and AI: Empowering Educators with Enhanced Awareness in Education" is the potential bias introduced by the correlational research design and purposive sampling method. Also, the way participants were chosen might not include everyone equally, which could affect how well the findings represent all teachers. Furthermore, because the information came from what teachers said about themselves, they might have wanted to look good, which could make the results less accurate. In the future, it would be helpful to use methods that include more types of people and follow them over time to see how things change. Also, using different methods to collect information, such as watching teachers in action, could provide a better understanding of how ready they are to use technology in teaching.

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