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COMPARATIVE STUDY ON THE INTEGRATION OF TPACK IN TEACHING PRACTICES

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Abstract
This study aims to compare the levels of mastery and implementation of Technological Pedagogical Content Knowledge (TPACK) in three study programs at San Pedro University (UNISAP): English Language Education (PBI), Primary School Teacher Education (PGSD), and Physical Education, Health, and Recreation (PJKR). The background of this study is the need to strengthen the integration of technology, pedagogy, and content in digital-based higher education. The research uses a comparative quantitative approach involving 30 lecturers (10 per Study Program) selected through purposive sampling. Data were collected using a TPACK questionnaire based on seven dimensions and analyzed with descriptive statistics and one-way ANOVA to determine differences between programs. Results show that PBI lecturers have the highest TPACK scores (average 4.61), followed by PGSD (4.18) and PJKR (3.93). ANOVA tests indicate significant differences ($F(2,27) = 7.932$, $p < 0.01$). Further Tukey HSD tests reveal significant differences between PBI and PJKR ($p = 0.004$) and between PBI and PGSD ($p = 0.026$), while the difference between PGSD and PJKR is not significant ($p = 0.111$). These results indicate the influence of factors such as disciplinary characteristics, technological readiness, and institutional support on variations in TPACK mastery. This study recommends the development of lecturer training tailored to the needs of each study program as a strategy to enhance professional capacity in technology integration in teaching.
Keywords: Comparative study, TPACK, San Pedro University

INTRODUCTION

The rapid development of information technology over the past two decades has had a significant impact on education. The shift to technology-based learning has prompted educators to adapt their methods and tools (Mishra & Koehler, 2016). Contemporary studies emphasize that the effectiveness of TPACK integration is increasingly crucial in higher education, particularly in enhancing lecturers' capacity to pedagogically adapt technology (Willermark, 2018). Research by Yeh et al. (2021) also found that strong TPACK understanding significantly contributes to digital-based teaching innovation.

One widely adopted model that supports the integration of technology into pedagogical practices is the Technological Pedagogical Content Knowledge (TPACK) framework. This model combines three core knowledge domains that educators must possess: content knowledge (CK), pedagogical knowledge (PK), and technological knowledge (TK) (Koehler, Mishra, & Cain, 2017).

Huang (2025) noted a significant rise in TPACK-related research, particularly in response to the digital transformation in education triggered by the COVID-19 pandemic. In Indonesia, the push for technology-based learning gained momentum during this period, prompting widespread adoption of online teaching. However, challenges persist in optimizing the use of ICT effectively and sustainably, as many educators still struggle to integrate content, pedagogy, and technology seamlessly (Yulia, 2020; Pertiwi, 2021; Pratama & Ariyanti, 2022).

Initial observations at San Pedro University (UNISAP), East Nusa Tenggara (NTT), show variations in how technology is used across study programs. Some lecturers, particularly in the English Language Education Program (PBI), have incorporated digital platforms such as Google Classroom, Quizziz, and Canva. However, in programs like Primary School Teacher Education (PGSD) and Physical Education, Health, and Recreation (PJKR), technology use remains limited and often administrative in nature (Lestari & Hidayat, 2023).

Previous studies support this finding. Sari and Rachmawati (2019) observed that while many educators have adequate TK and CK, their TPK and TPACK mastery is still lacking. Similarly, Ramadhani et al. (2021) reported that limited structured training and inadequate infrastructure are major barriers to TPACK implementation in higher education.

Despite the strategic importance of TPACK, professional development programs that explicitly integrate its components are still rare in university policy. In the context of Merdeka Belajar and Kampus Merdeka, technological competence is essential for creating adaptive and contextualized learning experiences (Kemendikbudristek, 2022). Without structured support, disparities in teaching quality across programs may widen**.**

Based on this background, the present study aims to compare the level of TPACK mastery and implementation across three study programs at UNISAP: PBI, PGSD, and PJKR. The findings are expected to inform institutional strategies in designing context-sensitive training and professional development programs.

METHOD

Research Design

This study uses a comparative quantitative approach with the aim of comparing the level of integration of Technological Pedagogical Content Knowledge (TPACK) in teaching practices across three study programs at UNISAP. This approach was chosen because the researcher wants to determine whether there are differences in the level of mastery and implementation of TPACK among lecturer groups from PBI, PGSD, and PJKR, while still considering the equality of institutional and geographical contexts. The comparative research design is highly suitable for identifying differences or gaps between two or more groups in specific variables that can be measured objectively (Ary, Jacobs, Sorensen, & Razavieh, 2018). Comparative studies based on TPACK have also been widely used in higher education contexts, as shown in research by Kabakçı Yurdakul et al. (2019), which emphasizes the importance of considering variations in academic backgrounds when evaluating TPACK competence among instructors across disciplines.

Research Location

The research was conducted at UNISAP in NTT, which has a vision of developing technology-based learning in the digital era. The institution is currently developing a Learning Management System (LMS)-based learning system and is committed to improving lecturers' competencies through ICT training. However, based on initial observations and internal campus reports, the level of technology integration in learning practices across study programs still varies and is not yet evenly distributed.

Research Participants

The research participants consisted of 30 lecturers from three study programs: PBI, PGSD, and PJKR. Each program was represented by 10 lecturers selected through purposive sampling with the following criteria: (1) actively teaching for at least 3 years, (2) directly involved in ICT-based online/offline learning processes, and (3) willing to complete the research instrument. Participant identities were anonymized using ethical codes such as D1-PBI, D2-PGSD, and D3-PJKR. The equal number of participants from each program aims to maintain comparative balance and the validity of the statistical analysis conducted.

Research Instrument

The main instrument used was a TPACK questionnaire developed based on the model by Schmidt et al. (2009), consisting of seven main dimensions, namely:

- Technological Knowledge (TK)
- Pedagogical Knowledge (PK)
- Content Knowledge (CK)
- Pedagogical Content Knowledge (PCK)
- Technological Content Knowledge (TCK)
- Technological Pedagogical Knowledge (TPK)
- Technological Pedagogical Content Knowledge (TPACK)

The questionnaire consists of 35 statement items using a 5-point Likert scale, ranging from "Strongly Disagree" (1) to "Strongly Agree" (5). The content validity of the questionnaire was consulted with two educational technology experts and two instructional experts from other universities. Reliability testing showed a Cronbach's Alpha value of 0.87, indicating that the instrument has high reliability (Sugiyono, 2019).

Data Collection Technique

Data were collected via Google Form, which was distributed directly to participants through the official lecturer groups of each study program. The data collection procedure was conducted over two weeks, and before completing the questionnaire, participants were given a research information sheet and an informed consent statement to uphold research ethics.

Data Analysis Data Analysis Technique

The collected data were analyzed using descriptive statistics and one-way ANOVA (One-Way ANOVA) to determine significant differences between study programs in TPACK dimensions. This test was used because the collected data met the assumptions of normality and homogeneity of variance (Ghozali, 2018). If significant differences were found, a follow-up Tukey HSD test was conducted to determine which groups had the most notable differences. All analysis processes were carried out using SPSS version 25.0.

RESULTS AND DISCUSSIONS

This section presents the main findings of the research regarding the level of Technological Pedagogical Content Knowledge (TPACK) mastery among lecturers from three different study programs at UNISAP: English Language Education (PBI), Primary School Teacher Education (PGSD), and Physical Education, Health, and Recreation (PJKR). The results are focused on the average scores of the seven TPACK dimensions measured through questionnaires, which are then analyzed descriptively and inferentially. The discussion aims to explore the meaning and implications of these findings by relating them to theory and previous research, as well as identifying factors that contribute to differences in TPACK mastery levels among study programs. Through this approach, readers are expected to gain a comprehensive understanding of the dynamics of TPACK integration in higher education teaching practices, including challenges and future development opportunities.

This research aims to analyze the extent to which the Technological Pedagogical Content Knowledge (TPACK) framework is integrated by lecturers from three study programs at UNISAP. A total of 30 lecturers participated in this study, with 10 from each study program. The data collection instrument used was a questionnaire based on the seven TPACK dimensions, which include: Technological Knowledge (TK), Pedagogical Knowledge (PK), Content Knowledge (CK), Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), and Technological Pedagogical Content Knowledge (TPACK). The average scores for the seven TPACK dimensions for each study program are shown in Table 1.

Table 1. Average Scores of TPACK Dimensions

TPACK dimensions	PBI	PGSD	PJKR
TK	4.53	4.02	3.76
PK	4.61	4.33	4.12
CK	4.75	4.50	4.40
PCK	4.68	4.28	4.03
TCK	4.49	3.90	3.65
TPK	4.56	4.00	3.72
TPACK	4.70	4.20	3.85

The average scores of the seven TPACK dimensions for each study program were subsequently analyzed. Statistical analysis results show that lecturers from the English Language Education program consistently have the highest scores across all TPACK dimensions, with an overall average score of 4.61. The PGSD program is in the middle position with an average score of 4.18, while the PJKR program has the lowest score (average 3.93). The one-way ANOVA test results indicate significant differences among the study programs ($F(2, 27) = 7.932$, $p < 0.01$), with subsequent Tukey HSD tests revealing that significant differences occur between the English Language Education and PJKR programs ($p = 0.004$), as well as between English Language Education and PGSD ($p = 0.026$). However, the difference between PGSD and PJKR is not statistically significant ($p = 0.111$).

Analysis of Differences in TPACK Mastery Levels Among Study Programs

To gain a deeper understanding of the variations in TPACK mastery, this section provides a comparative analysis across the three study programs: English Language Education (PBI), Primary School Teacher Education (PGSD), and Physical Education, Health, and Recreation (PJKR). The analysis draws on both quantitative data and relevant literature to highlight distinctive patterns, contextual challenges, and instructional implications within each academic discipline. These program-specific insights are essential for informing targeted interventions and adaptive professional development strategies.

1. English Language Education

   The dominance of the highest scores by the English Language Education program can be explained by the disciplinary characteristics that strongly demand the use of technology as a means of delivering teaching materials. In the context of language learning, technological media such as interactive videos, digital teaching applications (e.g., Grammarly, Canva, Padlet), and online collaborative platforms (Zoom, Google Classroom) have become primary tools to simultaneously support pedagogy and content. This shows that TPACK integration in this program is not only limited to technical mastery but has permeated the teaching philosophy (Ramadhani et al, 2021). Previous research by Kusuma (2020) shows that TPACK training programs for prospective English teachers in Indonesia have successfully improved their competence in integrating technology into teaching. However, challenges remain, such as limited infrastructure and institutional support in providing adequate resources.

2. Primary School Teacher Education (PGSD)

   PGSD lecturers show a fairly strong tendency in the pedagogical (PK = 4.33) and content (CK = 4.50) aspects, but are still weak in technological dimensions, especially TCK (3.90) and TPK (4.00). This indicates that although there is awareness of the importance of technology, the ability to integrate it creatively and contextually in basic learning practices is not yet fully optimal. Many PGSD lecturers still use technology only as a visual aid, not as part of a holistic pedagogical strategy. Utari et al. (2024) in their research revealed that primary school teachers in Yogyakarta show a developing level of TPACK in differentiated learning. This indicates the need for more intensive and continuous training to improve TPACK competence among PGSD lecturers.

3. Physical Education, Health, and Recreation (PJKR)

   The PJKR program shows the lowest scores in all technology dimensions, such as TK (3.76), TCK (3.65), and TPK (3.72). This reflects major challenges in integrating technology into learning contexts that are physical and practical in nature, such as sports. Many lecturers still rely on lectures and direct practice, with minimal use of digital simulations or interactive learning videos. This condition reinforces the findings of Sari and Rachmawati (2019), who stated that teachers in physical education face serious obstacles in mastering and utilizing technology pedagogically. Research by Agustina et al. (2024) also shows that the integration of adaptive technology in Indonesia's education system faces major challenges, including infrastructure limitations and digital literacy gaps among educators, which is relevant to the conditions in the PJKR program.

Factors Influencing Differences in TPACK Mastery

Research by Ozudogru and Hismanoglu (2020) in Turkey found that lecturers from theory-based study programs tend to have higher TPACK mastery compared to those from practice-

based programs, especially in the TPK and TPACK dimensions. These results reinforce this study's findings regarding the low integration of technology in the physical learning context of physical education. The differences in TPACK mastery levels among study programs can be explained by several main factors:

a. Disciplinary Characteristics and Technology Needs: The English Language Education program naturally demands the use of technology in learning, such as the use of interactive videos, digital teaching applications, and online collaborative platforms. This encourages lecturers to comprehensively integrate technology into their teaching practices (Ramadhani et al., 2021).

b. Availability of Infrastructure and Institutional Support: The availability of technological devices and adequate institutional support affects lecturers' ability to implement TPACK. The lack of technological infrastructure in some universities, especially in remote areas, is an obstacle to the effective implementation of TPACK (Agustina et al., 2024).

c. Training and Professional Development: The lack of adequate training and professional development opportunities for lecturers hampers TPACK mastery. Many lecturers have not received the necessary training to effectively integrate technology, pedagogy, and content knowledge in their teaching practices (Oktaviani & Utami, 2024).

d. Resistance to Change and Technology Adaptation: Some lecturers show resistance to change and difficulty adapting to new technology, especially those who have long taught using traditional methods. This attitude hinders innovation in teaching and reduces the quality of education (Astarina, Sujatna, & Heryono, 2024).

e. Limited Access and Resources: Limited access to technology and resources needed to support TPACK integration, such as adequate hardware and software, is also a significant challenge in implementing TPACK in higher education environments (Agustina et al., 2024).

Comparison with Previous Research

This study expands the scope of TPACK literature, which previously focused heavily on primary and secondary school teachers, by presenting empirical data from higher education settings. By providing a detailed picture of differences in TPACK mastery by study program, this research encourages policymakers to design more specific, targeted, and needs-based professional development for lecturers.

Research by Kusuma (2020) shows that TPACK training programs for prospective English teachers in Indonesia have successfully improved their competence in integrating technology into teaching. However, challenges remain, such as limited infrastructure and institutional support in providing adequate resources.

Utari et al. (2024) in their research revealed that primary school teachers in Yogyakarta show a developing level of TPACK in differentiated learning. This indicates the need for more intensive and continuous training to improve TPACK competence among PGSD lecturers.

Research by Agustina et al. (2024) also shows that the integration of adaptive technology in Indonesia's education system faces major challenges, including infrastructure limitations and digital literacy gaps among educators, which is relevant to the conditions in the PJKR program.

Chang et al. (2024), in their research on the Teacher Professional Education (PPG) program in Indonesia, showed that curricula aligned with TPACK principles can improve the TPACK competence of pre-service science teachers.

Implications and Recommendations

The results of this study emphasize the importance of context-based professional development for lecturers according to their study program. Programs such as English Language Education can serve as a model or center of excellence.

CONCLUSION

This study shows that the level of TPACK integration differs significantly among study programs at UNISAP, with the English Language Education program having the highest mastery, while PJKR faces the greatest challenges in the technology dimension. These findings confirm that disciplinary background and digital readiness greatly influence TPACK implementation in learning. Scientifically, this study expands the understanding of TPACK in the context of Indonesian higher education and provides a foundation for the development of contextual and needs-based lecturer training. Moving forward, institutions should consider developing adaptive TPACK training models tailored to each academic discipline, particularly for practice-based fields like physical education. Additionally, strategies for digital transformation in low-resource environments are critical to ensuring equitable integration of technology in higher education.

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