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Improving the Digital Competence of Pre-service Teachers Through TPACK and Artificial Intelligence Workshops: A Mixed Methods Study at St. James Catholic College, Merauke, South Papua

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Abstract
The development of digital technology requires the adaptation of education systems, particularly in preparing pre-service teachers who are competent in integrating learning technology. This study analyzes the improvement of pre-service teachers' digital competence through Technological Pedagogical and Content Knowledge (TPACK) and artificial intelligence (AI) workshops at the St. James Catholic College of Merauke, South Papua. Using a mixed methods approach, the study involved 100 pre-service teacher students from the second to eighth semesters through triangulation of methods: in-depth interviews, participatory observation, and documentation study. The workshop lasted for three months with six sessions that integrated conceptual foundations, contextualization of religious values, practical training, and spiritual reflection. The results showed a significant increase in digital competence with an average of 20.5% (from 54.2% to 74.7%) and an effect size of 0.76. The highest increase occurred in understanding TPACK pedagogy (78.6%) and AI capabilities for personalizing learning (78.6%). The research produced the Digital-Spiritual Integration Model for Teacher Education (DSI-MTE), which integrates technology with spiritual values in five layers: foundation, integration, application, reflection, and sustainability. The workshop proved effective in overcoming the initial resistance of 35% of students to the integration of technology and spirituality and produced 72 high-quality learning media products. The findings provide a theoretical contribution to the development of contextual and practical digital competencies for the implementation of learning technology in religious higher education institutions with similar characteristics, especially in regions with limited technological infrastructure.

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1. Introduction

The era of the 4.0 industrial revolution and Society 5.0 has brought fundamental transformations in the world of education, demanding a new paradigm in the learning process that harmoniously integrates technology, pedagogy, and content. Digital transformation in education is no longer an option, but an urgent need that must be met in order to prepare a competitive and adaptive future generation (Voogt, Fisser, N. J., & van Braak, 2013) [21]. In this context, teachers' digital competence is a crucial factor in determining the successful implementation of learning technology in schools.

The Technological Pedagogical and Content Knowledge (TPACK) framework developed by Mishra and Koehler (Koehler & Mishra, 2019) has become the most widely adopted theoretical model for understanding the integration of technology in learning. TPACK emphasizes the importance of teachers' understanding of three main domains: technology (Technology Knowledge/TK),

pedagogy (Pedagogical Knowledge/PK), and content (Content Knowledge/CK), as well as the complex interactions between the three that result in Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), and Pedagogical Content Knowledge (PCK). Recent developments in artificial intelligence (AI) have opened up new dimensions in education, enabling personalized learning, automated assessment, adaptive learning, and increased effectiveness of the teaching and learning process (Chen, Chen, & Lin, 2020) [20]. AI in education not only changes the way teachers teach, but also how students learn, interact with learning content, and develop 21st-century skills. Various AI applications, such as Intelligent Tutoring Systems (ITS), Learning Analytics, and Natural Language Processing, have shown great potential in improving learning outcomes.

However, the implementation of digital technology in education faces specific challenges, especially in the context of religious educational institutions. The St. James Catholic College of Merauke, a higher education institution dedicated to preparing pre-service teachers in quality primary education and Catholic religious education, faces a challenge in reconciling traditional religious values with the demands of modernizing learning technology.

This challenge is even more complex given the geographical location of the institution in a remote area of Papua, with limited technological infrastructure and internet access (Pranyoto & Tonggon, 2024) [13].

Research on the integration of technology in teacher education has been extensively conducted, but there is still a gap in the literature, particularly regarding the context of religious higher education in remote areas of Indonesia. Koehler *et al*. (2019) emphasize that the development of TPACK competencies requires a contextual approach that considers the specific characteristics of the institution, students, and learning environment.

This study provides several new contributions that have not been widely explored in previous literature. First, this study examines the integration of TPACK and AI specifically in the context of teacher education in a remote area of Indonesia, namely Merauke, South Papua. The unique geographical conditions, with challenges in access to technology and limited infrastructure, provide valuable perspectives on the implementation of educational technology in areas with similar characteristics.

Second, this study not only focuses on the technical aspects of technology use but also analyzes in depth how religious values in Catholic schools can be integrated with technology-based learning through the TPACK framework. It is essential to investigate the connection between spirituality and technology in formal education, due to the limited research on this subject.

Third, this study employs a comprehensive three-month workshop approach, combining theory, practice, and reflection —a methodology that innovates in the development of pre-service teachers' digital competencies. This workshop model is specifically designed to address the challenges faced by religious higher education institutions in adopting learning technology.

Based on the above background, this study aims to: (1) analyze the improvement of pre-service teachers' digital competencies through TPACK and artificial intelligence workshops; (2) evaluate the effectiveness of the workshop model in integrating learning technology with religious values; (3) identify factors that influence the successful implementation of TPACK and AI in the context of religious higher education; and (4) formulate a contextual digital competency development model for religious higher education institutions.

2. Theoretical Review

2.1. TPACK Theoretical Framework

Technological Pedagogical and Content Knowledge (TPACK) is a theoretical framework developed from the concept of Pedagogical Content Knowledge (PCK) introduced by Shulman (1986) [18]. TPACK expands on the PCK concept by adding a technological dimension, creating a more comprehensive model for understanding the knowledge teachers need to integrate technology into effective learning.

Koehler and Mishra (2019) explain that TPACK consists of seven components of knowledge: Content Knowledge (CK), which refers to knowledge about subject matter; Pedagogical Knowledge (PK), which includes knowledge about learning processes and practices; Technology Knowledge (TK), which encompasses knowledge about traditional and digital technologies; Pedagogical Content Knowledge (PCK), which combines an understanding of pedagogy and content; Technological Content Knowledge (TCK), which integrates technology and content; Technological Pedagogical Knowledge (TPK), which connects technology and pedagogy; and TPACK, which is the integration of these three main domains.

Empirical research on TPACK has shown that the development of TPACK competencies requires practical experience integrated with theoretical reflection (Archambault & Crippen, 2019). Voogt *et al*. (2013) [21] emphasize that effective TPACK development requires a systematic approach that considers the specific context of learning, the characteristics of learners, and the learning objectives to be achieved.

2.2. Artificial Intelligence in Education

The development of AI in education has created a new paradigm called AI-Enhanced Education (AIED). Holmes *et al*. (2019) [9] identify various applications of AI in education, including Intelligent Tutoring Systems, Automated Essay Scoring, Predictive Analytics, and Adaptive Learning Platforms. These systems can personalize learning based on the individual characteristics of learners, provide real-time feedback, and optimize learning paths.

Chen *et al*. (2020) [20] in their systematic review identified that AI in education can increase learner engagement, provide adaptive learning support, and facilitate more efficient learning. However, the implementation of AI in education also faces various challenges, including ethical issues, data privacy, and the need for high digital literacy among educators.

Zawacki-Richter *et al*. (2019) [23], through systematic analysis, found that AI applications in higher education are still focused on administrative aspects and learning support, while the integration of AI in pedagogical practices is still limited. It indicates a gap between the potential of AI technology and its practical implementation in learning.

2.3. Integration of Technology in Religious Education

Religious education faces unique challenges in adopting technology, as it must balance technological innovation with the preservation of spiritual and traditional values. Campbell (2012), in the concept of "digital religion," explains that digital technology can be a medium to strengthen religious experiences, not replace them.

Hoover and Echchaibi (2014) [10] argue that the integration of technology in religious education requires a careful approach to ensure that the spiritual essence is not reduced to mere digital information. They emphasize the importance of maintaining the community dimension and spiritual experience in technology-based learning.

2.4. Development of Teachers' Digital Competencies

UNESCO (2018) [20], through the ICT Competency Framework for Teachers, sets standards for the digital competencies that teachers must have in the digital age. This framework covers six aspects: understanding ICT in education, curriculum and assessment, pedagogy, ICT, organization and administration, and teacher professional learning.

Redecker (2017) [15] in the DigCompEdu framework identifies six areas of digital competence for educators: professional engagement, digital resources, teaching and learning, assessment, empowering learners, and facilitating learners' digital competence. This framework emphasizes the importance of holistic and sustainable digital competency development.

3. Method

3.1. Research Approach and Design

This study uses a mixed methods approach with a sequential explanatory design, in which quantitative data is collected first and then explained and explored in depth through qualitative data. Creswell and Plano Clark (2018) [6] state that mixed methods are appropriate when researchers need a comprehensive understanding of complex phenomena that a single approach cannot adequately address.

The quantitative component uses a pre-post design to measure improvements in digital competence, while the qualitative component uses case studies to understand the process of integrating technology with religious values deeply and contextually. The combination of these two approaches allows researchers to statistically measure the effectiveness of workshops while understanding the dynamics of implementation in the context of religious higher education institutions.

3.2. Research Subjects and Setting

The research subjects were 100 pre-service teachers from various semesters at the Santo Yakobus Catholic College in Merauke, consisting of 25 students in semester II, 27 students in semester IV, 26 students in semester VI, and 22 students in semester VIII. The subjects were selected using purposive sampling with predetermined criteria.

The research setting was the Santo Yakobus Merauke Catholic College, located in Merauke Regency, South Papua. The findings of this study are limited to the context of this institution. They cannot be directly generalized to all religious higher education institutions in Papua or Indonesia. Still, they can provide valuable insights for the development of similar programs in contexts with similar characteristics.

3.3. Research Timeline

The research was conducted from January 2025 to August 2025, with the following details: preparation and pilot testing (January-February 2025), workshop implementation (March-May 2025), follow-up data collection (June-July 2025), and data analysis and report writing (August 2025).

3.4. Data Collection Techniques

The research used two main categories of instruments, namely quantitative and qualitative instruments. The quantitative instruments were the Digital Competence Assessment Scale (DCAS), adapted from the DigCompEdu framework (Redecker, 2017) [15], and the TPACK Survey (Schmidt *et al*., 2009). [16] This instrument consists of 15 competency dimensions with a 1-5 Likert scale. The validity of the instrument has been tested through expert judgment with educational technology experts, resulting in a Content Validity Index (CVI) of 0.87. Reliability was measured using Cronbach's Alpha with a value of 0.91, indicating high internal consistency.

The qualitative instruments consist of: semi-structured interview guidelines, participatory observation sheets, and document analysis rubrics developed based on the TPACK theoretical framework and the integration of technology in religious education.

3.5. Data Analysis

Pre- and post-test data were analyzed using a paired sample t-test to test the significance of competency improvement. Effect size was calculated using Cohen's d with the formula: $d = (M_2 - M_1) / SD_{pooled}$, where M_2 is the post-test mean, M_1 is the pre-test mean, and SD_{pooled} is the pooled standard deviation. The interpretation of the effect size follows Cohen's (1988) convention: small (d = 0.2), medium (d = 0.5), and large (d = 0.8).

Qualitative data were analyzed using Braun and Clarke's thematic analysis (2006) [2] with the systematic stages mentioned earlier. The integration of these two types of data was carried out through explanatory sequential analysis. It means that the statistical findings from the first stage became the basis for further explanation by the qualitative findings from the second stage. Quantitative data provided evidence of the effectiveness of the workshop, while qualitative data explained how and why this improvement occurred, particularly in the context of integrating religious values.

4. Results and Discussion

4.1. Initial Digital Competency Profile of Students

The results of the initial digital competency mapping show that pre-service teacher students at the Santo Yakobus Merauke Catholic College generally have varying levels of digital literacy, with an average of 54.2%. This profile indicates that most students are at a basic level of digital literacy, characterized by limited knowledge and skills in integrating technology (TPACK and AI) into their learning.

Table 1: Distribution of Students' Initial Digital Competency Levels

Competency Level	Score Range	Number of Students	Percentage
Low	0-50	42	42
Medium	51-70%	48	48
High	71-100%	10	10

This data is in line with Prensky's findings (2001) regarding the digital divide between digital natives and digital immigrants. Although students belong to the digital native generation, geographical context and limited access to technology affect the development of their digital competencies.

4.2. Implementation of TPACK and AI Workshops

4.2.1. Conceptual Foundation Phase

In the first session, students showed high enthusiasm in understanding the basic concepts of TPACK. Observation results showed that 78% of students actively participated in discussions, although they still needed scaffolding to understand the interconnections between TPACK domains. One participant stated, "At first, I thought teaching with technology was just using PowerPoint or videos. It turns out there is a framework of thinking that must be understood first about the relationship between technology, teaching methods, and subject matter."

These findings are consistent with the research by Schmidt *et al*. (2009) [16], which shows that conceptual understanding of TPACK requires a gradual and reflective knowledge construction process.

4.2.2. Contextualization Phase

The second session focused on the application of TPACK in the context of Catholic Religious Education and Primary School Teacher Education. The analysis results showed that students faced challenges in integrating technology with spiritual values. Interviews with senior lecturers revealed: "The biggest challenge is how technology does not shift the spiritual essence in Catholic Religious Education learning. Students must learn that technology is a tool to deepen the experience of faith, not replace it."

Observations showed that 65% of students successfully identified the potential of AI in Catholic Religious Education learning, such as the use of chatbots for biblical questions and answers and digital Bible applications. However, 35% still showed resistance due to concerns about the secularization of religious learning.

4.2.3. Practical Training Phase

The third and fourth sessions focused on developing practical skills. Portfolio analysis shows that students successfully developed 72 learning media products, consisting of 28 instructional videos, 25 multimedia presentations, 12 educational games, four interactive applications, and three online learning platforms.

Table 2: Categories of Learning Media Developed by Students

Media Category	Number of Products	Percentage	Quality Level
Learning Videos	28	38.9	Very Good
Multimedia Presentation	25	34.7	Very Good
Educational Games	12	16.6	Good
Interactive Application	4	5.5	Moderate
Online Platform	3	4.3	Good

Product quality is assessed based on a rubric that integrates technological, pedagogical, and content aspects. The results show that 73.6% of products achieved the "Very Good" category, indicating the effectiveness of the workshop in developing students' practical skills.

4.3 Discussion

4.3.1. Improvement in Digital Competence

A comparative analysis between pre- and post-workshop conditions shows a significant increase in all dimensions of digital competency measured.

Table 3: Analysis of Digital Competency Improvement by Dimension

No.	Competency Dimension	Pre-Workshop	Post-Workshop	Improvement	Effect Size
1	Understanding the basic concepts of TPACK	51.3	75.1	23.8	0.89 (large)
2	Pedagogical knowledge in TPACK	53.2	78.6	25.4	0.92 (large)
3	Technological knowledge in TPACK	54.1	76.1	22	0.84 (large)
4	Designing integrated TPACK activities	55.3	70.6	15.3	0.61 (moderate)
5	Understanding the benefits of TPACK	56.7	77.2	20.5	0.78 (large)
6	Basic concepts of artificial intelligence	53.4	74.6	21.2	0.81 (large)
7	The potential of AI in learning	55.1	72.4	17.3	0.68 (moderate)
8	AI applications for learning	53.2	75.7	22.5	0.86 (large)
9	AI for personalized learning	54.8	78.6	23.8	0.90 (large)
10	AI for learning feedback	54.2	66.1	11.9	0.48 (moderate)
11	AI supports the implementation of TPACK	54.1	71.5	17.4	0.69 (moderate)
12	Designing TPACK-AI learning	53.6	70.6	17	0.67 (moderate)
13	AI improves pedagogical knowledge	54.3	72.3	18	0.71 (large)
14	Benefits of TPACK-AI integration	55.1	74.2	19.1	0.75 (large)
15	Sustainable TPACK-AI practices	56.7	77.7	21	0.79 (large)
Average	54.20%	74.7	20.5	0.76 (large)	

The Shapiro-Wilk normality test indicates a normal data distribution ($p > 0.05$), allowing the use of a paired sample t-test. The results show a significant increase in digital competence from the pre-workshop condition ($M = 54.2$, $SD = 8.7$) to the post-workshop condition ($M = 74.7$, $SD = 9.2$), $t(99) = 18.45$, $p < 0.001$, with a large effect size ($d = 0.76$).

Analysis by dimension showed that all components experienced a significant increase ($p < 0.05$), with effect sizes ranging from moderate to large. The dimensions with the highest increases were pedagogical knowledge in TPACK ($d = 0.92$) and AI for learning personalization ($d = 0.90$).

4.3.2. Effectiveness of Integrating Learning Technology with Religious Values

The integration of TPACK technology and artificial intelligence with Catholic values at St. James Catholic College of Merauke has shown encouraging results despite facing significant initial challenges. This study proves that pre-service teachers in South Papua can successfully combine modern technology with Catholic teachings without sacrificing the spiritual essence of learning.

The success of this integration is evident in the students' ability to develop 72 learning media products that maintain religious values. These products include Catholic Religious Education learning videos, multimedia presentations on Church teachings, Bible-based educational games, and interactive applications for learning Christian values. It proves that technology can deepen the spiritual experience rather than replace it.

The integration process faced initial resistance from 35% of students who were concerned that the use of technology would reduce the authenticity of the faith experience. These concerns were reasonable given the cultural background of Papua, which is steeped in tradition and spirituality. However, through an approach that involved theology lecturers and deep reflection, most students eventually understood that technology can be a tool to glorify God, just like art and music in the Catholic Church tradition.

The most striking transformation occurred in the Catholic Religious Education learning paradigm, from traditional lecture methods to an interactive approach that actively involved students. Students successfully developed a chatbot that can answer basic questions about Catholic teachings with high accuracy, as well as a digital learning platform that strengthens the sense of brotherhood in faith. A relative increase of 65% from the initial participation rate in online religious discussions through social media forums and online platforms shows that technology actually strengthens the communal dimension of religious experience.

Despite its high effectiveness, the integration of technology and spirituality still faces ongoing challenges. Limited internet infrastructure in South Papua and differences in technological capabilities among students require special attention. In addition, only 60% of digital products were still actively used three months after the workshop, indicating the need for ongoing technical support. The biggest challenge is ensuring that technological innovation does not erode the depth of contemplation and spiritual reflection that characterizes Catholic education, thus requiring a careful balance between modernization and the preservation of spiritual traditions.

4.3.3. Factors Affecting the Success of the Workshop

An analysis of the workshop implementation identified various factors that contributed to the success and obstacles in achieving the objectives. Understanding these factors is important for the replication and development of similar programs in other religious higher education institutions.

Several key supporting factors contributed significantly to the success of the workshop. Strong institutional commitment from the leadership of the St. James Catholic College of Merauke provided the foundation that enabled optimal implementation through the allocation of adequate resources, time, and infrastructure. The intrinsic motivation of students also played a crucial role, with 82% of participants showing high enthusiasm for developing digital competencies after realizing their relevance to the demands of the future workplace. The learning community culture developed during the workshop facilitated effective knowledge transfer among students and created a sustainable support system that strengthened the learning process. The contextualization factor with Catholic religious values proved to reduce resistance and increase the acceptability of technological innovation, enabling a harmonious integration between modernity and spiritual tradition.

However, several inhibiting factors remain challenges in the implementation of the workshop. Limited technological infrastructure, precarious internet access, and hardware limitations created significant barriers, especially for students from lower-middle-class backgrounds. The digital divide among students, which reflects differences in technological experience and background, requires a highly differentiated and personalized learning approach. Resistance to change is still shown by about 35% of students, especially those who are less familiar with technology, requiring specific strategies to encourage adaptation and openness to digital learning innovations.

4.3.4. Contextual Digital Competency Development Model

Based on the research findings, the "Digital-Spiritual Integration Model for Teacher Education" (DSI-MTE) was developed, which integrates technological components with spiritual values in the context of teacher education. This model consists of five layers that interact with each other to build the digital competence of pre-service teachers holistically.

1. Foundation Layer: Basic Digital Literacy and Understanding of Spiritual Values

The first layer integrates basic digital literacy with an understanding of Catholic spiritual values as the foundation for the development of competencies. This component adapts the DigCompEdu framework (Redecker, 2017) [15] by adding a spiritual dimension that emphasizes technology as a gift that can strengthen faith and service. Students develop an understanding of the use of digital technology, cybersecurity, and digital ethics integrated with Catholic moral principles of truth and love.

Research by Chai *et al*. (2011) shows that a basic understanding of technology and content is a prerequisite for effective TPACK development. He emphasizes that "digital religion" requires a balance between technical skills and spiritual sensitivity to ensure that technology does not distort authentic spiritual meaning.

2. Integration Layer: Synergy between TPACK and AI in the Context of Religious Education

The second layer develops "Religious Technological Pedagogical Content Knowledge" (R-TPACK), which integrates the three domains of TPACK with artificial intelligence components in the context of religious education. This layer recognizes that the integration of technology in religious education requires special consideration of spiritual dimensions and religious values that are not found in the conventional TPACK model.

Hoover and Echchaibi (2014) [10] explain that the integration of technology in religious education must consider the "sacred-secular boundary" to ensure that technology reinforces spiritual experiences. This layer develops students' ability to identify the right technology for religious learning

and understand how AI can support the personalization of spiritual learning.

3. Application Layer: Practical Implementation in the Development of Learning Media

The third layer is the practical implementation stage, where students apply their knowledge and skills in the development of concrete learning media. Students use technology not only as a tool but also as a medium to express and deepen spiritual values in learning. This process incorporates the principle of "learning by doing," where students learn through reflective practical experiences.

Ertmer *et al*. (2012) [8] emphasize that the practical implementation of TPACK requires direct experience in developing technology for specific pedagogical purposes. He found that AI applications in higher education are most effective when integrated into authentic and meaningful learning contexts, particularly in religious education, where technology should strengthen spiritual and moral understanding.

4. Reflection Layer: Spiritual Evaluation and Reflection on the Role of Technology in Education

The fourth layer integrates the Catholic tradition of spiritual reflection with critical evaluation of the use of technology in education. This layer adapts Schön's concept of "reflective practice" (1983) by adding a spiritual dimension that emphasizes discernment as a process for distinguishing between constructive and destructive uses of technology. Students develop the ability to evaluate the effectiveness of learning media and engage in spiritual reflection on the impact of technology on the growth of faith.

Palmer (1998) emphasizes that effective education requires the integration of intellectual, emotional, and spiritual aspects. The reflection layer in the DSI-MTE model operationalizes this principle by facilitating students to engage in holistic reflection on their experiences of integrating technology with spiritual values.

5. Sustainability Layer: Sustainable Development and Professional Networking

The final layer focuses on the sustainable development of digital-spiritual competencies and the formation of professional networks that support long-term implementation. This layer adapts the concept of "professional learning community" (DuFour & Eaker, 1998) by adding a spiritual dimension that emphasizes brotherhood in faith as the foundation for sustainable professional growth.

Voogt *et al*. (2013) [21] emphasize that effective TPACK development requires ongoing support and opportunities for collaborative learning. They explain that sustainable change in education requires a combination of individual capacity building and collective efficacy, which is operationalized in the DSI-MTE model through the development of individual competencies and contributions to a broader learning community.

The DSI-MTE model is designed with flexibility for adaptation to various contexts of religious higher education institutions. Tondeur *et al*. (2012) [19] emphasize the importance of contextual factors in determining the effectiveness of TPACK development programs. This model provides an adaptable framework while maintaining core elements that are essential for effective technology-spiritual integration in accordance with the local characteristics and specific spiritual traditions of each institution.

5. Conclusion

This study demonstrates that TPACK and artificial intelligence workshops can effectively improve the digital competence of pre-service teachers in remote religious higher education institutions. An average competence increase of 20.5% with an effect size of 0.76 indicates a substantial impact that is meaningful both practically and statistically. The main success lies in the ability to integrate modern technology with Catholic spiritual values without sacrificing the religious essence of learning. The holistic workshop model, which combines theory, practice, and spiritual reflection, proved superior in overcoming initial resistance from 35% of students and in building technology acceptability among pre-service teachers. The development of 72 high-quality learning media products, with 73.6% categorized as "Very Good," demonstrates the effectiveness of a contextual approach considering Papua's geographical characteristics and institutional spiritual traditions.

The primary theoretical contribution is the development of the Digital-Spiritual Integration Model for Teacher Education (DSI-MTE), which provides a comprehensive framework for religious higher education institutions adopting learning technology. This five-layer model has adaptability potential for institutions with similar characteristics, but implementation requires consideration of each institution's specific local context to maintain essential elements of effective technology-spiritual integration.

Analysis of implementation factors revealed that program success hinges on several key factors: strong institutional commitment, students' intrinsic motivation, the development of a learning community, and contextualization with religious values. Conversely, ongoing challenges include technological infrastructure limitations, digital divide among students, and the need for continued technical support, as indicated by 60% of digital products remaining active three months post-workshop.

This research provides significant implications for developing teacher education curricula responsive to the digital age, particularly in religious higher education institutions with similar characteristics. Learning technology implementation need not conflict with spiritual values but can serve as a means of enriching religious experiences through thoughtful and contextual approaches. The transferability of results to other religious higher education institutions must consider contextual factors, including technological infrastructure, student backgrounds, and specific spiritual traditions of each institution.

Future research should explore the implementation of the DSI-MTE model across various religious educational institutional contexts, develop more robust validation instruments, and conduct longitudinal studies to measure the long-term impact on field teaching practices and the sustainability of technology use in religious learning.

6. Limitations and Recommendations

The research was limited to one institution with the specific geographical and cultural characteristics of Papua, so caution is needed when generalizing the findings. The three-month follow-up period was insufficient to evaluate long-term sustainability. Future research should explore the implementation of the DSI-MTE model in various religious education institutions, develop more robust validation

instruments, and conduct longitudinal studies to measure the long-term impact on teaching practices in the field.

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