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Research Article

Tpack Integration in Pie Learning: Strategies to Improve Teacher Competence in the Digital Era

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ABSTRACT: This study aims to analyze the current state of Technological Pedagogical Content Knowledge (TPACK) competencies among Islamic Religious Education (PAI) teachers, explore effective development strategies, and examine the impact of TPACK-informed practices on instructional quality in the digital era. An explanatory sequential mixed methods design was employed with 45 PAI teachers across public senior high schools (SMAN) and state Islamic senior high schools (MAN) in Langsa City, Aceh. The quantitative phase utilized a 42-item Likert-scale TPACK questionnaire, while the qualitative phase involved semi-structured interviews with 12 key informants and classroom observations. Quantitative data were analyzed using descriptive and inferential statistics (t-Test, ANOVA), while qualitative data were analyzed using Miles, Huberman, and Saldaña's interactive model. Findings reveal a structural gap in PAI teachers' TPACK profiles: non-technological domains Content Knowledge (M = 4.12), Pedagogical Knowledge (M = 3.87), and Pedagogical Content Knowledge (M = 3.74) scored high, whereas all technology-related domains scored moderate, with Technological Content Knowledge (M = 2.64) as the lowest. Technology training history was the only significant demographic variable (p = 0.003). Qualitative analysis identified epistemological-theological resistance to technology as a barrier unique to religious education and highlighted the crucial role of informal peer collaboration. SAMR analysis showed most teachers operating at the Substitution and Augmentation levels. The study concludes that enhancing PAI teachers' TPACK competence requires an ecosystemic approach combining contextual training, peer mentoring, digital infrastructure strengthening, and teacher education curriculum redesign.

INTRODUCTION

The massive development of digital technology has fundamentally changed the educational landscape, including in Indonesia. This transformation requires a reorientation of the learning paradigm from the conventional teacher-centered model to a student-centered model with the support of technology as an integral component [1]. In the Indonesian context, the urgency of integrating technology in learning is getting stronger along with the implementation of the Independent Curriculum which emphasizes differentiated learning, siding with students, and utilizing technology as a means of supporting the achievement of the Pancasila student profile [2]. The adoption of digital technology in learning does not take place without obstacles, especially in subjects that have distinctive characteristics based on values and religious traditions such as Islamic Religious Education (PAI). PAI occupies a strategic position in the national education system as a compulsory subject mandated by Law Number 20 of 2003 concerning the National Education System [3], with a dual mandate that not only transmits cognitive knowledge of Islamic teachings, but also forms character (akhlāq al-karīmah), spiritual awareness, and the practice of religious values in daily life [4]. The complexity of the mandate places different and more challenging demands on the pedagogical competence of PAI teachers than other general subject teachers.

Although national policies have encouraged the digitalization of education, various empirical studies have consistently revealed that most PAI teachers in Indonesia do not have adequate competencies to meaningfully integrate technology into their learning practices [5]. Many PAI educators still rely on conventional lecture methods, relying on textbooks and memorization, and have not made optimal use of digital platforms, multimedia resources, or interactive learning environments [6]. This gap is caused by a number of multidimensional factors, including: limited educational technology training at both the pre-service and in-service stages; lack of access to digital infrastructure, especially in rural and disadvantaged areas; and the perception among some educators that technology is incompatible with the spiritual and moral dimensions of Islamic education [7]. The persistence of this gap has real consequences: digital natives, students who are digital natives, gradually lose engagement and motivation for PAI learning that fail to meet their

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expectations for interactive, relevant, and technology-mediated learning experiences.

One of the most promising theoretical frameworks for bridging the competency gap is the Technological Pedagogical Content Knowledge (TPACK) framework developed by Mishra and Koehler [8]. TPACK is a development of the fundamental concept of Pedagogical Content Knowledge (PCK) initiated by Shulman [9] by adding technology as a third domain of knowledge that interacts dynamically with pedagogy and content. This framework emphasizes that effective technology integration in learning is not enough to build on separate mastery of technology knowledge (kindergarten), pedagogy (PK), and content (CK) independently, but requires a synthetic understanding of how the three domains intersect and inform each other. Specifically, TPACK identifies seven knowledge domains: three basic domains (TK, PK, CK) and four intersectional domains of Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), Pedagogical Content Knowledge (PCK), and TPACK itself as integrative domains. In the context of PAI learning, several studies have begun to explore the application of TPACK. Ahid and Nadlir, for example, have developed a conceptual framework for TPACK integration for madrasah teachers [10]. The study is conceptual-normative and has not provided empirical data on the actual competency profile of PAI teachers, has not identified factors that are statistically associated with competency levels, and has not explored contextual barriers through a qualitative approach. This study seeks to fill this gap through a mixed methods design that integrates quantitative measurement of TPACK profiles with qualitative exploration of factors contextual which is the background, especially the typical dynamics in the context of Islamic religious education.

The application of TPACK in the context of PAI learning requires a deep contextual understanding of each domain of knowledge. Content Knowledge (CK) in PAI includes mastery of Islamic sciences including the Qur'an and Hadith, jurisprudence (Islamic law), creed (theology), morals (ethics), and Islamic Cultural History (SKI) [11]. Pedagogical Knowledge (PK) involves the strategies of character formation, internalization of values, and affective-spiritual learning that distinguish PAI from secular subjects. Technological Knowledge (TK) includes mastery of digital Qur'an applications, Islamic-based e-learning platforms, multimedia content creation tools, and learning management systems (LMS). The intersectional domain of Technological Content Knowledge (TCK) highlights how technology can represent Islamic content in new ways for example, the use of augmented reality to visualize the hajj ritual or the use of interactive timelines for the history of Islamic civilization [12]. The integration of TPACK as a whole represents the capacity of teachers to simultaneously orchestrate all three domains to select the appropriate technologies to serve specific pedagogical goals for specific Islamic content areas, while maintaining fidelity to the spiritual and moral goals of PAI [13].

Several related theoretical perspectives also strengthen the significance of TPACK integration in PAI learning. Constructivist learning theory, particularly the concept of zone of proximal development and social constructivism formulated by Vygotsky [14], provides a pedagogical rationale for technology-mediated collaborative learning in religious education [15]. The Technology Acceptance Model (TAM) developed by Davis provides an in-depth understanding of the attitudinal and motivational factors that influence the willingness of PAI teachers to adopt digital devices, by identifying perceived usefulness and perceived ease of use as the main determinants of technology acceptance [16]. The SAMR (Substitution, Augmentation, Modification, Redefinition) model proposed by Puentedura [17]. Provides a complementary evaluative framework for assessing the depth of technological integration. A number of empirical studies in the context of Indonesian education have shown that teacher professional development programs based on the TPACK framework are related to measurable improvements in teachers' self-efficacy related to the use of technology [18]. However, studies that specifically target PAI teachers with quantitative-qualitative empirical data are still limited.

Based on this background, this study aims to examine the integration of the TPACK framework in PAI learning as a strategic approach to improve teacher competence in the digital era. Specifically, the objectives of this research are formulated in three ways: first, to analyze the actual condition of TPACK competencies of PAI teachers by identifying strengths and weaknesses in each of the seven domains of knowledge; second, exploring effective strategies for the development of TPACK PAI teachers through planned professional development interventions, peer mentoring, and institutional support mechanisms; and third, examining the impact of TPACK-based teaching practices on the quality of PAI learning [19]. Theoretically, this study seeks to contribute in the form of empirical data that enrich the understanding of the application of the TPACK framework in the domain of Islamic religious education in Indonesia, a context that has different dynamics from the secular education in which TPACK was originally developed. Practically, the findings of this research are anticipated to inform the design of professional development programs for PAI teachers and provide guidance for institutional policies related to the provision of digital infrastructure [20].

METHOD

This study uses a mixed methods approach with an explanatory sequential design, which is a research design that integrates quantitative and qualitative methods sequentially in two phases [21]. The design was chosen based on the consideration that the problem of integrating TPACK in PAI learning requires not only numerical measurement of the level of teacher competence, but also a deep understanding of contextual factors, subjective experiences, and the institutional dynamics behind it. The first phase (quantitative) uses a small-scale correlation-comparative survey approach that aims to map the TPACK competency profile of PAI teachers and test the association between demographic variables and TPACK scores through standardized questionnaire instruments. It is important to note that with a total of 45 respondents, the statistical power for inferential tests is limited, so the results of comparative analysis need to be interpreted carefully as preliminary indications, not conclusive evidence. The second (qualitative) phase deepens the quantitative findings through semi-structured interviews and classroom observations to explore the meaning, context, and factors that explain the patterns identified in the previous phase. The integration of the two phases is carried out at the interpretation stage through the joint display technique,

where qualitative findings are used to explain, confirm, or expand quantitative findings.

The population of this study is all Islamic Religious Education (PAI) teachers who serve in State High Schools (SMAN) and State Aliyah Madrasah (MAN) in the Langsa City area, Aceh Province. The selection of the location is based on the consideration that Langsa City is one of the centers of Islamic education in Aceh with a diversity of secondary education institutions under the auspices of the Ministry of Education and Culture and the Ministry of Religion. Based on data from the Education Office and the Langsa City Ministry of Religion Office, the number of PAI teachers who meet the criteria for the two types of education units is 45 people. Given the relatively limited population, this study used a saturated sampling technique, so that all 45 PAI teachers became respondents in the quantitative phase [22]. For the qualitative phase, 12 key informants were selected purposively based on variations in TPACK levels (high, medium, low), representation of the type of educational unit, variation in teaching experience, and willingness to participate. The research lasted for four months (January-April 2026) in six schools: three high schools and three MAN in Langsa City. All data collection has been completed and analyzed before this manuscript is submitted. The presence of researchers in the field is participatory, non-interventional, namely directly observing the learning process without intervening in teachers' teaching practices.

Data collection is carried out through three main techniques. First, the TPACK questionnaire was adapted from the standard instrument of Schmidt et al. and adjusted to the context of PAI learning in Indonesia [23]. The questionnaire measured seven domains of TPACK knowledge (TK, PK, CK, TCK, TPK, PCK, and integrative TPACK) through 42 statement items on a five-point Likert scale (1 = strongly disagree to 5 = strongly agree). Cross-cultural adaptation is carried out through the process of translation, back-translation, and adjustment of the context of Islamic content. The validity of the content was tested by a panel of three experts (Islamic education, educational technology, and measurement). For construct validity, Confirmatory Factor Analysis (CFA) is performed; however, it should be recognized that with N = 45, the ratio of samples to parameters in the CFA does not meet the ideal standard (generally required a minimum of 5:1 or 10:1 per parameter), so the results of the CFA are exploratory and require replication on a larger sample for definitive confirmation. The reliability of the instrument was measured using Cronbach's Alpha coefficient, which yielded a range of α = 0.78–0.91 for the entire subscale [24]. It is important to note that Cronbach's Alpha measures internal consistency i.e. the extent to which items in a subscale measure the same construct and does not prove that the seven TPACK domains are actually empirically separate as distinct constructs. Proving discrimination between domains requires further analysis that goes beyond the capacity of the sample size of this study. Second, a semi-structured interview with 12 key informants that contained open-ended questions about their experiences, barriers, perceptions, and professional development needs related to technology integration in PAI. Each session lasts 45–60 minutes and is transcribed verbatim. Third, structured class observation of 12 informants using observation sheets based on TPACK indicators and SAMR models, covering aspects of technology selection, suitability with learning objectives, and the level of transformation achieved. Each teacher was observed twice in a meeting a frequency that allows for an initial picture but is not enough to definitively establish the level of technology integration, given that teachers' practices can vary between meetings.

Data analysis is carried out in stages. In the quantitative phase, questionnaire data was analyzed using descriptive (average, standard deviation, frequency distribution) and inferential statistics. The categorization of competency levels uses the arithmetic interval division of the five-point Likert scale range (1–5), namely: high (M = 3.68–5.00), medium (M = 2.34–3.67), and low (M = 1.00–2.33). This interval is obtained from the formula (maximum score − minimum score)/number of categories = (5−1)/3 = 1.33 applied uniformly, rather than based on empirically validated norms. Consequently, the category labels are conventional and depend on the arithmetically defined boundary line the difference between the average of 3.67 (medium) and 3.68 (high), for example, reflects a conventional limitation and not a substantial qualitative difference. Differential tests based on demographic variables were conducted through Independent Sample t-Test and One-Way ANOVA (α = 0.05) using SPSS version 26. In the qualitative phase, the analysis uses the interactive model Miles, Huberman, and Saldaña which includes three simultaneous flows: data condensation, data presentation, and conclusion drawing and verification. The validity of the data is guaranteed through four Lincoln and Guba criteria: credibility (triangulation of sources and methods and member checking), transferability (thick description), dependability (audit trail), and confirmability (researcher reflexivity) [25].

RESULTS AND DISCUSSION

TPACK Competency Profile of PAI Teachers

The results of the descriptive analysis of questionnaire data from 45 PAI teachers showed a varied TPACK competency profile. The average integrative TPACK score was in the medium category (M = 2.89; SD = 0.74), indicating that the ability of PAI teachers in Langsa City to integrate technology, pedagogy, and Islamic content simultaneously is still not optimal. The distribution of scores is presented in Table 1.

Table 1. Average TPACK Competency Score of PAI Teachers in Seven Domains (*N* = 45)

Domain	M	SD	Min	Max	Category	Rank
Content Knowledge (CK)	4,12	0,58	2,83	5,00	High	1
Pedagogical Knowledge (PK)	3,87	0,63	2,50	5,00	High	2
Pedagogical Content Knowledge (PCK)	3,74	0,66	2,33	4,83	High	3
Technological Knowledge (TK)	2,95	0,81	1,17	4,67	Moderat	4
Technological Pedagogical Knowledge (TPK)	2,78	0,77	1,33	4,50	Moderat	5
Technological Content Knowledge (TCK)	2,64	0,82	1,00	4,33	Moderat	6
TPACK Integratif	2,89	0,74	1,17	4,50	Moderat	7

The data in Table 1 reveal a consistent pattern: all three non-technological domains are in the high category based on the established arithmetic intervals, while all technological domains are in the medium category. It should be noted that this categorization is an analytical convention, and the average differences between domains are continuum. However, this pattern substantially shows that PAI teachers have a relatively stronger mastery of the substance of Islamic science and pedagogical skills than the ability to integrate technology. A similar pattern has been reported by a number of empirical studies on technology-based teaching practices among PAI Indonesian teachers [26]. The low TCK score (M = 2.64) indicates the greatest difficulty in representing Islamic content through technology, a finding that can be understood in the context that the relationship between technology and Islamic content requires creativity and specific technical knowledge that is not explicitly taught in conventional PAI teacher education programs.

Differences in TPACK Competency Based on Demographic Variables

Comparative analysis using *Independent Sample t-Test* and *One-Way ANOVA* was conducted on four demographic variables. Before the test is implemented, the assumption of normality is checked through the Shapiro-Wilk test and the assumption of homogeneity of variance through the Levene test. The results are presented in Table 2.

Table 2. Results of TPACK Competency Differential Test Based on Demographic Variables

Variable	Test	Sig.	Description
Types of educational units (SMAN vs. MAN)	t-Test	0,342	Insignificant
Teaching experience (<10 th vs. ≥10 th)	t-Test	0,087	Insignificant
Education level (S1 vs. S2)	t-Test	0,214	Insignificant
Technology training history (0×, 1–2×, ≥3×)	ANOVA	0,003*	Signifikan

Remarks: *p < 0,05

Table 3. ANOVA Results Details Technology Training History on Scores TPACK Integratif

Training Groups	n	M	SD
Never before (0×)	18	2,41	0,62
1–2 Time	16	2,93	0,58
≥ 3 Time	11	3,52	0,71

$F(2, 42) = 6,87$; $p = 0,003$; $\eta^2 = 0,25$. Uji Levene: p = 0,38 (the assumption of homogeneity of variance is met). Shapiro-Wilk test: normal distribution in each group (p > 0.05). *Post-hoc* Tukey HSD showed significant differences between groups of 0× and ≥3× (p = 0.002) as well as between 1–2× and ≥3× (p = 0.041).

Tables 2 and 3 show that the only variable that showed a significant association with integrative TPACK scores was technology training history (p = 0.003). Teachers who have attended three or more trainings have a significantly higher average integrative TPACK (M = 3.52; n = 11) compared to those who had never been trained (M = 2.41; n = 18). The relatively large effect size (η^2 = 0.25) indicates that this difference is practically meaningful, although it needs to be interpreted with caution given the small sample size in each cell, especially the ≥3× group, which contains only 11 teachers. It is important to emphasize that the design of this study is *cross-sectional*, not experimental, so the direction of causality cannot be determined. The associations identified may mean that training improves TPACK competence, but it is equally likely that teachers who are motivated and tech-savvy are more likely to seek out and participate in training (*self-selection bias*). In contrast, the variables of educational unit type, teaching experience, and level of education did not show a significant association, indicating that the difference in TPACK scores was evenly distributed across these demographic groups.

Obstacles and Supporting Factors for TPACK Integration in PAI Learning

The qualitative analysis identified four main themes. The first theme is the limitations of digital infrastructure. Ten out of 12 informants reported inadequate hardware and internet network availability, particularly in MAN. Informant G-07 revealed that infrastructure constraints are the main obstacle even though the intention to use technology already exists. These findings are consistent with the concept *of perceived ease of use* in TAM which emphasizes that ease of access to technology is a fundamental prerequisite for its adoption.[16] In the context of Indonesian Islamic education, this problem is exacerbated by the disparity in budget allocation between schools under the Ministry of Education and Culture and madrassas under the Ministry of Religion [27].

The second theme is the dichotomous perception between technology and spirituality. Seven out of 12 informants expressed doubts that technology can replace or match the power of traditional methods such as *halaqah*, live lectures, and face-to-face moral guidance. Informant G-03 stated that PAI learning has a *rûhiyyah* dimension that is difficult to mediate by digital screens. This view shows the existence of what can be called an indication of epistemological resistance where some teachers view technology as a threat to the essence of religious education. This finding needs to be positioned proportionally: it describes the views of some PAI teachers in Langsa City, not a conclusion that can be directly generalized widely. However, this finding is interesting because the theological dimension of resistance to technology is not found in TPACK's study of secular subjects, and should be used as a hypothesis for further testing in a broader context. The findings of classroom observations show that teachers who manage to go beyond this perception are actually able to utilize technology to strengthen the spiritual dimension using documentary videos for the historical context of Qur'anic verses, or utilizing interactive *e-Mushaf* applications to enrich tajweed learning.

The third theme relates to the limitations of contextual training. Although quantitative data showed a

positive association between training history and TPACK scores, qualitative analysis revealed that most of the training was generic and did not accommodate the peculiarities of PAI material. The G-11 informant said that the training received mostly discussed the use of PowerPoint and Google Classroom in general without specific examples of its application to faith, fiqh, or SKI materials. This inconsistency is in line with Chai, Koh, and Tsai's critique that the effectiveness of TPACK-based professional development is highly dependent on the contextual relevance of the training material to the specific content domain that the teacher is teaching [28].

The fourth theme is peer collaborative support. Teachers with high TPACK scores consistently reported informal collaboration networks both with fellow PAI teachers and with ICT teachers that facilitated the exchange of knowledge and technology skills. These findings provide empirical evidence for the relevance of Vygotsky's theory of social constructivism in the context of teacher professional development. The concept *of zone of proximal development* does not only apply to students, but also to teachers as adult learners who can expand their competencies through interaction with more competent colleagues. The mechanism of informal *peer learning* that occurs organically in the teacher community shows that learning that *is situated* and *embedded* in daily practice can be a path for sustainable and contextual TPACK development.

TPACK Competency Improvement Strategy and Technology Integration Level Analysis

The integration of quantitative and qualitative findings identifies key strategies to improve the TPACK competencies of PAI teachers. An indicative picture of the level of technology integration based on the SAMR model of the 12 observed teachers is presented in Table 4.

Tabel 4. Indicative Distribution of PAI Teachers Based on Technology Integration Level SAMR model (*N* = 12, observed two encounters each)

Level SAMR	Quantity	Characteristics of Practice
Substitution	4	Technology replaces traditional tools without functional changes
Augmentation	4	Technology adds functional improvements
Modification	3	Technology enables task redesign
Redefinition	1	Technology creates tasks that were previously impossible

Source: Classroom observation data, 2026. Note: Level determination based on two observations per teacher is indicative and can change with more intensive observation.

Table 4 shows that the majority of observed PAI teachers (8 out of 12) operate at *the Substitution* and *Augmentation* levels where technology functions as a substitute or enhancer of traditional tools without fundamentally changing the learning architecture. Only one teacher reached *the Redefinition* level. It should be emphasized that this classification is indicative based on limited observations (two meetings), not a definitive determination of teacher capacity; A teacher may display different levels in other meetings depending on the material and context. However, this general pattern provides a meaningful initial picture. Analysis of the profiles of teachers who reached *the Modification* and *Redefinition* levels revealed similarities: all three had a history of technology training at least three times, were active in peer collaboration networks, and viewed technology not as a threat but as a *tool* that could enrich students' religious experiences.

Integration of Quantitative and Qualitative Findings: Joint Display

Table 5 presents a *joint display* that juxtaposes quantitative and qualitative findings to show the convergence and complementarity of the two research phases.

Table 5. *Joint Display* Integration of Quantitative and Qualitative Findings

Findings Dimension	Quantitative Findings	Qualitative Findings	Integration
TPACK Profile	Non-technological domains (CK, PK, PCK) > technological domains (TK, TPK, TCK) consistently	Teachers admit that their mastery of material is strong but feel "stuttering" with technology; generic training does not touch the content of the PAI	Convergence: A confirmed gap from two directions. Qualitative explains WHY gaps occur
Technology training	The only demographic variable with significant association ($p = 0.003$; $\eta^2 = 0.25$)	Training is assessed generic, non-contextual-PAI; Noticeable effects are only felt after ≥3× training	Complementary: Quantitative shows APA (association), qualitative explains WHY (non-contextual training content)
Resistance to technology	Lowest TCK score (M = 2.64), second lowest TPK (M = 2,78)	7/12 informants voiced theological skepticism about technology in PAI; The Perception of the Spiritual vs. Digital Dichotomy	Complementary: The low TCK score is enriched by the finding that the barriers are not just technical but also epistemological
Peer collaboration	Not quantitatively directly measured	Teachers with high TPACK consistently report informal collaboration networks	Expansion: Qualitatively finding supporting factors that are not captured by quantitative instruments
Level of technology integration	Majority on Substitution/Augmentation (8/12 teachers)	High-level teachers show reconceptualization of technology-spirituality relationship	Convergent: Both phases confirm integration is still in its early stages, with consistent predictive patterns

Integrative Discussions: Theoretical Contributions and Practical Implications

Integratively, the findings of this study contribute several to the understanding of the integration of technology in Islamic education, while having a number of limitations that need to be recognized transparently.

First, the pattern in which the CK, PK, and PCK domains are consistently higher than the technological domains even though the differences depend on the categorization of arithmetic intervals shows that the problem of PAI teachers' competence does not lie in the substance of science or pedagogical skills, but in the capacity to integrate technology. Different from the conceptual studies of Ahid and Nadlir which compiled a normative framework, this study provides an empirical profile that shows in which domains exactly the weaknesses are concentrated. The qualitative findings on the indications of epistemological-theological resistance identified in some informants in Langsa City add dimensions that were not found in the TPACK study on secular subjects and have not been accommodated in the conventional TPACK model of Mishra and Koehler. These findings are proposed as a hypothesis for further testing: that in the context of religious education, the TPACK model may need to be extended by considering *the variable religious epistemological stance* as a moderation factor. The evidence from a single city with seven informants is certainly not enough to propose a definitive revision of the model, but it is enough to justify a broader investigation.

Second, the significant association between technology training history and TPACK scores as the only demographic variable that showed meaningful differences strengthens the argument that planned intervention through professional development is a promising pathway to improving PAI teachers' TPACK competencies [29]. Nevertheless, given the cut-off design and possible *self-selection bias* that have been discussed, these findings need to be interpreted as correlations, not causality. Experimental or longitudinal studies are needed to confirm whether training directly improves competence or whether other underlying factors are involved.

Third, the findings on the role of peer collaboration offer an important perspective on TPACK development models that tend to be individual and formal. This study shows that the TPACK development model for PAI teachers needs to be enriched with a collaborative-informal component that utilizes teachers' professional social networks as a learning vehicle, in line with the principles of *situated learning* and social constructivism. The concept *of Professional Learning Community* (PLC) which has been proven effective in various educational contexts needs to be adapted for the PAI teacher community by considering the cultural peculiarities of madrasah organizations, including *halaqah* and deliberation traditions that have culturally become part of the Islamic education ecosystem.

Fourth, the dominance of PAI teachers at the *Substitution* and *Augmentation* levels in the SAMR model, although indicative based on limited observations, shows that existing technology training has not succeeded in encouraging fundamental transformation in teaching practices. Professional development programs need to be designed not only to teach technical skills, but also to train teachers to *think in design thinking* about how technology can create a previously impossible Islamic learning experience. Overall, these findings lead to the conclusion that improving the TPACK competencies of PAI teachers requires an ecosystem approach that combines individual (contextual training), social (peer collaboration and PLC), structural (digital infrastructure), and systemic (LPTK curriculum redesign).

Limitations of the Study

This study has several limitations that should be taken into consideration when interpreting the findings. *First*, the sample size ($N = 45$) limits the statistical power of inferential tests, particularly the ANOVA, in which the smallest cell contained only 11 respondents; the quantitative findings should therefore be replicated with a larger sample. *Second*, the categorization of competency levels used conventional arithmetic intervals rather than validated norms; consequently, the labels “high” and “moderate” depend on the cut-off points established by the researcher. *Third*, the cross-sectional design does not allow causal inferences; the association between training and TPACK scores cannot be interpreted as a cause-and-effect relationship. *Fourth*, the CFA conducted did not meet the ideal sample-to-parameter ratio, making the evidence for construct validity exploratory in nature. *Fifth*, the assignment of SAMR levels based on two observations per teacher is indicative and cannot yet be considered representative of teachers’ practices as a whole. *Sixth*, the findings concerning epistemological-theological resistance were derived from some informants in a single city and are therefore proposed as a hypothesis rather than as a universally established finding.

CONCLUSION

This study examines the integration of the TPACK framework in PAI learning as a strategy to improve teacher competence in the digital era. The main findings reveal consistent profile differences: non-technological domains (CK, PK, PCK) were in the high category based on the categorization of arithmetic intervals, while all technological domains were in the medium category, with TCK ($M = 2.64$) being the lowest domain. This pattern shows that the root of the problem is not in the weakness of the substance of Islamic science or pedagogical skills, but in the capacity to integrate technology with the two domains.

The contribution of this research includes three things. *First*, the identification of epistemological-theological resistance indications in some PAI teachers in Langsa City as a typical obstacle that should be further tested in a broader context, considering that this dimension is not found in the TPACK study of secular subjects. *Second*, a significant association between technology training history and TPACK score ($p = 0.003$; $\eta^2 = 0.25$) was the only meaningful demographic variable, indicating that professional development interventions were not causally proven to be a promising pathway. *Third*, an indicative picture of the dominance of *the Substitution/Augmentation level* in the SAMR model and the role of informal collaboration networks as a catalyst for TPACK development.

For practitioners, it is recommended to develop a contextual-PAI TPACK training program accompanied by peer mentoring and the formation of a sustainable PLC, as well as an epistemological dialogue that positions technology as *a neutral wasīlah* (means) according to the principle *of al-wasâ'il lahâ hukm al- maqâshid*. For policy

makers, the urgency of equitable distribution of digital infrastructure and the redesign of the LPTK curriculum needs to be prioritized. For the next researcher, longitudinal or experimental studies on the impact of contextual TPACK training, hypothesis testing of epistemological-theological resistance hypotheses in broader contexts (pesantren, private madrasas, other regions), development and validation *of extended TPACK models* with religious dimensions, and the effectiveness of TPACK-based PLCs for PAI teachers are promising investigative directions.

This study emphasizes that the integration of technology in PAI is an epistemological transformation process, not just the mastery of digital devices. The success of TPACK integration depends on the ability of teachers to position technology as *wasîlah* that is subject to the *maqâshid of* Islamic education: to form people who are faithful, knowledgeable, and noble in character. With an ecosystem approach that combines individual, social, structural, and systemic interventions, improving the TPACK competence of PAI teachers is a necessity for the continuity of the relevance of Islamic education in the era of digital transformation.

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