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Empowering Arabic Educators in the Digital Era: Evaluating an AI-TPACK Professional Training Model

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Abstract

The digital competence of Arabic language teacher in Madrasah Tsanawiyah (MTs) in Sukoharjo remains low, particularly in developing interactive electronic student worksheets (E-LKPD). This study aims to test the effectiveness of AI-TPACK based training, integrating generative AI (ChatGPT and Teks To Speech) and Liveworksheets apps, in improving teacher competence. A quantitative approach with a quasi experimental one group design was employed. The sample consisted of 20 Arabic language teachers selected through purposive sampling from 11 different MTs. Data were collected using a validated questionnaire (Aiken's V=0.87) and analyzed using Paired Sample T-Test and N-Gain scores. The results showed a significant increase across all competency variables (Sig. < 0.05), with an average N-Gain score of 0.59 (Moderately Effective). The highest increase occurred in AI-TPACK integration mastery (N-Gain = 0.76, Highly Effective). However, field implementation remains constrained by network infrascrtucture and device factors. These findings inply that the AI-TPACK training model is a strategic solution for developing teacher competence in the digital era.

Keywords: *AI-TPACK, E-LKPD, MTs, Arabic Language Teachers, Liveworksheets*

Introduction

Curriculum changes in Indonesia, particularly the *Merdeka* curruculum, provide broad opportunities for educational institutions to innovate in managing learning (KMA No. 347, 2022). Learning within this curriculum is collaborative, problem-based (Wedana et al., 2025), project-based, and emphasizes the development of the Pancasila student profile as well as the value of *raḥmatan lil 'ālamīn* in the madrasah environment (Lubis, 2023). In this context, the Student Worksheet (LKPD) becomes a vital instrument that not only focuses on content understanding but also on character building and students' learning independence (Suryaningsih & Nurlita, 2021; Vo, 2026).

Conventional printed LKPD is granually abandoned due tlimitations such as being easily damaged, lacking interactively, and hiderating real-time progress tracking

(Iswatiningsih et al., 2022a). Electronic LKPD (E-LKPD) offers a solution by integrating multimedia and gamification (Digitan et al., 2020; Mardianti et al., 2022). The main advantage of E-LKPD is its ability to support students' digital literacy and facilitate automated assessment (auto-grading) that provides rapid feedback (Santia et al., 2022; Zhou & Hou, 2025).

The development of high-quality E-LKPD cannot be separated from teacher competence, particularly in integrating content knowledge (Arabic language), pedagogy, and technology, which is currently known as the TPACK (Technological Pedagogical Content Knowledge) framework (Mishra & Koehler, 2006). Various applications support the implementation of teachers' TPACK, such as Wizer.me (Finka Oktaviani, 2023; Sobri et al., 2023) and Liveworksheets. Liveworksheets is chosen because it allows teachers to convert static LKPD into interactive formats with an auto-grading feature that greatly supports teachers' time efficiency (Prastika, 2021; Datu et al, 2023; Aldemir et al., 2025).

Recent developments require teachers to utilize Generative AI such as ChatGPT (Fekete, 2026), for instructional design. As well as Text-to-Speech (TTS) to produce authentic audio learning resources. The integration of AI into the TPACK framework (Al-Mallahma, 2025), hereafter referred to as AI-TPACK, has become a new competency that must be mastered by Arabic language teachers in order to remain relevant in the era of digital disruption (Aldalalah et al., 2025).

Previous research has analyzed various strategies in developing E-LKPD and teacher training on interactive worksheet platforms. Santia et al., (2022) conducted an In-House Training program for elementary school teachers to develop innovative E-LKPD based on TPACK. Friska et al., (2022) developd E-LKPD based on 3D Pageflip Professional, while Finka Oktaviani, (2023) and Sobri et al., (2023) utilized Wizer.me as a platform for interactive E-worksheets. Iswatiningsih et al., (2022) conducted training on E-LKPD preparation using Google Forms for teachers at SMPN 25 Malang. Prastika, (2021) developed interactive E-Worksheets based on Liveworksheets for elementary students. In the context of Arabic language teaching, Fatimah Datu Ali Nafiah Sepagaya & Datu, (2023) investigated the use of Liveworksheets as an artificial intelligence tool for online Arabic instruction in Sabah, Malaysia.

However, no research has integrated generative AI (ChatGPT and TTS) into teachers training for developing interactive E-LKPD based on AI-TPACK. Most previous studies focused on stident cotcomes rather than teacher competence, used basic platform without AI, and were confined to homogeneous school. Combining TPACK with ChatGPT, TTS for listening skills (*mahārat al-istimā'*), and liveworksheets has great potential for teacher competence development. Therefore, this study assesses the effectiveness of AI-TPACK based training for Arabic language teachers at MTs in Sukoharjo Regency.

Nevertheless, based on EMIS data from the Ministry of Religious Affairs of Sukoharjo Regency, there are 22 Madrasah Tsanawiyah (MTs), consisting of 3 state MTsN and 19 private MTs, with dozens of Arabic language teachers. Preliminary observation indicates that most teachers, especially in private MTs, still rely on printed

LKPD and face difficulties integrating technology due to limited access to comprehensive training.

Method

This study employed a quantitative approach with a quasi-experimental design in the form of a One-Group Pretest-Posttest Design (Creswell, 2014; Sugiyono, 2022). This design was selected due to the researcher's limitation in conducting full randomization (true experimental) on the research subjects (Arabic language teachers). Nevertheless, the representativeness of respondents distributed heterogeneously across various schools is still able to provide a strong ecological depiction of real conditions in the field (Fraenkel et al., 2012). There was one group that received treatment in the form of intensive AI-TPACK training, and their competence was measured at two different points in time, before training (pre-test) and after training (post-test).

The research sample consisted of 20 Arabic language teachers representing both public and private MTs in Sukoharjo Regency. The sampling technique used was purposive sampling (Arikunto, 2016) with the criteria: (1) actively teaching Arabic at the MTs level, and (2) willing to participate in the entire training series from beginning to end and to complete the pre-test and post-test questionnaires in full. The final number of respondents (N=20) was obtained after a strict data matching process based on respondents' email identities to ensure the validity of the comparison between pre- and post-test data.

The research instrument was a self-developed questionnaire tailored to the training context. Because the pre-test items (measuring initial experience) and post-test items (measuring perceptions after training) were not identical verbatim, the questionnaire was constructed based on competency indicators, which were then grouped into four macro variables of AI-TPACK, namely: (1) Conceptual Understanding & Needs Alignment, (2) Ease of Technology Operation, (3) Mastery of AI-TPACK Integration, and (4) Independence in Practical Skills. The instrument was validated by two experts in the fields of educational technology and Arabic language teaching. The results of expert validity calculation using Aiken's V formula (Aiken, 1985) showed an average score of 0.87 (above the minimum threshold of 0.80), indicating that all questionnaire items were logically valid and highly appropriate for use.

Based on the theoretical review of the AI-TPACK framework and the research objectives that have been formulated, a research hypothesis is proposed. The alternative hypothesis (Ha) in this study states that there is a significant difference in the competence of Arabic language teachers before and after being given AI-TPACK based training. Conversely, the null hypothesis (H0) states that there is no significant difference in the competence of Arabic language teachers before and after being given the training.

The data analysis technique employed a Paired Sample T-Test using SPSS version 26, based on the characteristics of the research design, which measures the same group of subjects under pre- and post-treatment conditions (Field, 2013). This test was used to determine the statistical significance of improvement. Furthermore, to measure

the percentage effectiveness of the treatment, a normalized Gain Score (N-Gain) analysis developed by Hake, (1999) was used. The effectiveness categories used as a reference were: N-Gain < 0.30 (Not Effective); 0.30–0.70 (Moderately Effective); and > 0.70 (Highly Effective).

Result and Discussion

Results should be clear and concise. The results should summarize (scientific) findings rather than providing data in great detail. Please highlight differences between your results or findings and the previous publications by other researchers.

Respondent Profile

The online questionnaire using Google Forms was distributed to Arabic language teachers in MTs who are members of MGMP Bahasa Arab teachers' association in Sukoharjo Regency and had fully participated in the entire training program. A total of 20 teachers completed the training and filled out both the pre-test and post-test questionnaires in full (the data were obtained through a matching process based on respondents' email identities). The following is a detailed description of the profile of the teachers who participated as respondents in this study:

School Category	Variable	Respondents	Percentage
School Origin	11 different MTs across various sub-districts	20	100%
Gender	Male	6	30%
	Female	14	70%
Education Qualification	Master's Degree (S2)	6	30%
	Bachelor's Degree (S1)	13	65%
	Others	1	5%

Table 1. Research Respondent Profile (N = 20)

Table 1 above presents the demographic profile of the respondents in this study. A primary advantage of this study over typical teacher training research lies in the "School Origin" category. Most similar studies confine their subjects to merely one or two schools, or to teachers within a single cluster who share homogeneous cultures and ICT facilities. In contrast, this study successfully engaged 20 teachers distributed across 11 different Islamic Junior High Schools (*Madrasah Tsanawiyah* / MTs) spanning various sub-districts in Sukoharjo Regency. These 11 schools exhibit a remarkably high level of institutional diversity, ranging from state MTs (serving as a benchmark for standard facilities) and the Muhammadiyah-affiliated MTs network, to a modern *pesantren* such as MTs PPMI Assalaam, as well as traditional Islamic boarding school-based (*pesantren*) MTs like MTs Islam Ngruki and MTs SA PP Al Falah Baki. This suggests that the study's findings possess a high degree of heterogeneity and accurately represent the actual conditions of Arabic language teachers in the region. Consequently, these findings offer significantly stronger representativeness compared to similar studies and provide a highly accurate preliminary framework should this training model be implemented on a

broader scale. Furthermore, this diversity in school backgrounds serves as a crucial variable, given that each madrasah implements distinct technology policies and student device usage regulations.

In terms of gender, female respondents dominate with 70% (14 teachers), while male respondents account for 30% (6 teachers). This dominance of female teachers reflects the actual demographic condition of Arabic language teachers at the Madrasah Tsanawiyah level. Furthermore, based on educational qualifications, the majority of respondents hold a bachelor's degree (S1), comprising 65% (13 teachers). However, a considerable proportion, 30% (6 teachers), have obtained a master's degree (S2). These data indicate that the respondents' academic and cognitive capacities are theoretically strong. Therefore, if a gap in technological competence is observed at the beginning of the study, it is primarily due to the lack of evenly distributed technology training across schools, rather than a deficiency in their educational background.

Further analysis revealed that female teachers from pesantren-based MTs (n=3) had the lowest pre-test scores (V3 = 2.10) but the highest N-Gain (0.84), indicating the training was particularly beneficial for under-resourced madrasahs. Younger teachers adapted more quickly to AI tools, while older teachers achieved comparable results with adequate scaffolding. Teachers with 5-10 years of experience showed the most balanced improvement, while novice teachers excelled in technological variables but needed more pedagogical foundation.

Training Implementation

The AI-TPACK based training was conducted over two days (12 instructional hours) at Graha PGRI Sukoharjo, following a structured sequence of five sessions. Session 1 introduced the AI-TPACK framework and assessed teachers' initial competencies. Session 2 focused on visual design using Canva, where teachers learned to create visually appealing LKPD templates with appropriate layouts, Arabic fonts, and culturally relevant graphics. Session 3 covered content generation with ChatGPT, where teachers practiced writing effective prompts to generate instructional texts, comprehension questions, vocabulary lists, and assessment items aligned with the Merdeka Curriculum. Session 4 addressed audio production using Text-to-Speech (TTS) technology to convert Arabic text into authentic audio for *mahārat al-istimā'* (listening skills), enabling teachers to produce listening materials without relying on pre-recorded resources. Session 5 integrated all components into Liveworksheets, converting Canva-designed LKPD into interactive digital formats with drag-and-drop, multiple-choice, and short-answer features, as well as configuring auto-grading for immediate student feedback. By the end of the training, each teacher produced a complete, functional E-LKPD ready for classroom implementation.

Figure 1. AI-TPACK Training Session

Table 2 presents the profile of teachers' initial competencies prior to the AI-TPACK training intervention. The pre-test data highlight teachers' prior experience and skills, which are categorized into four evaluation variables.

NO	AI-TPACK Evaluation Variables	Pre-Test	Post-Test	Sig. (2-Tailed)
1	Conceptual Understanding & Needs Alignment	3,45	4,42	0,000
2	Ease of Technology Operation	3,42	3,97	0,001
3	Mastery of AI-TPACK Integration	2,50	4,40	0,000
4	Independence in Practical Skills	2,60	4,12	0,000

Table 2. Comparison of Pre and Post-test Conpetency Scores

Table 2 illustrates a gap pattern in the initial condition. On average, teachers possess a basic theoretical foundation of LKPD (V1 = 3.45) and basic design tool skills such as Canva (V2 = 3.42), both of which fall within a fairly good range. However, when faced with more technologically demanding tasks, their scores drop significantly. The score for mastery of AI-TPACK integration (V3) is only 2.50, and independence in practical skills (V4) is 2.60. This can be interpreted to mean that teachers have mastered basic technologies but experience substantial difficulty when required to integrate advanced technologies (interactive web tools and AI) into their Arabic language instructional content.

Further analysis of the pre-test data revealed specific competency gaps beyond the four macro variables. However, they reported very low familiarity with interactive platforms such as Anyflip, Wizer.me, and Liveworksheets, with a mean score of only 2.15. More critically, teachers rated their ability to integrate multimedia elements (images, videos, and audio) into E-LKPD at only 2.20, and their capacity to create E-LKPD with automated assessment features at 2.40. Despite these low technical competencies, teachers expressed a strong need for capacity building in this area, with a mean score of 4.05 on the item "I feel the need to improve my ability to develop E-

LKPD." This gap between high motivation and low technical competency justified the implementation of the AI-TPACK training program.

Analysis based on institutional background revealed that teachers from state MTs (n=4) had higher pre-test scores on Ease of Technology Operation (3.85) compared to teachers from traditional pesantren-based MTs (n=5) who scored 2.92 on the same variable. However, after the training, teachers from all school categories showed similar post-test scores ranging from 4.25 to 4.40, indicating that the training effectively bridged the initial competency gap across different institutional contexts. Gender-based analysis revealed that female teachers (n=14) had slightly lower pre-test scores on AI-TPACK Integration Mastery (2.43) compared to male teachers (n=6) at 2.68, but showed a higher N-Gain score (0.79) compared to their male counterparts (0.71), suggesting that the training was particularly effective for female teachers who initially reported lower confidence in using AI technologies. Teachers with master's degrees (n=6) had consistently higher pre-test scores across all variables compared to those with bachelor's degrees (n=13), particularly on Conceptual Understanding (3.82 vs 3.35). However, N-Gain scores were comparable between the two groups (0.61 for master's vs 0.58 for bachelor's), indicating that the training was equally effective regardless of educational background.

Training Effectiveness Based on N-Gain Score

To measure the effectiveness and specific contribution of the training to competency improvement, the post-test data were analyzed using a Paired Sample T-Test and N-Gain calculation as presented in Table 3.

NO	AI-TPACK Evaluation Variables	Pre-Test	Post-Test	N-Gain	Category
1	Conceptual Understanding & Needs Alignment	3,45	4,42	0,62	Moderately Effective
2	Ease of Technology Operation	3,42	3,97	0,34	Moderately Effective
3	Mastery of AI-TPACK Integration	2,50	4,40	0,76	Highly Effective
4	Independence in Practical Skills	2,60	4,12	0,63	Moderately Effective
Average		3,00	4,23	0,59	Moderately Effective

Table 3. Results of N-Gain Score Calculation for Training Effectiveness

Based on Table 3, the AI-TPACK based training provides a significant positive indication. The average N-Gain score is 0.59, which falls into the "Moderately Effective" category. The greatest impact is found in Variable 3 (Mastery of AI-TPACK Integration), with an N-Gain score of 0.76 (Highly Effective). This indicates that training integrating ChatGPT, Text-to-Speech, and Liveworksheets is able to provide very rapid understanding for teachers in combining technology and pedagogy. Meanwhile, from the inferential statistical perspective, the Sig. (2-tailed) values for all four variables are < 0.05 (V1 = 0.000; V2 = 0.001; V3 = 0.000; V4 = 0.000). Therefore,

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H0 is rejected and Ha is accepted, confirming that the improvement in competence was directly caused by the training intervention.

The variation in N-Gain scores across the four variables warrants further discussion. Variable 3 (Mastery of AI-TPACK Integration) achieved the highest N-Gain (0.76, Highly Effective), nearly double that of Variable 2 (Ease of Technology Operation, 0.34, Moderately Effective). This disparity can be explained by the nature of the training content. The training devoted approximately 5 hours to ChatGPT and TTS (Sessions 3 and 4), which directly contributed to AI-TPACK integration mastery. In contrast, Variable 2 measured ease of operating technology, which is influenced by factors beyond the training itself, such as prior experience with web-based applications and the quality of internet connectivity during the training. Variable 1 (Conceptual Understanding) achieved an N-Gain of 0.62, suggesting that while teachers already had a basic understanding of LKPD concepts (pre-test 3.45), the training successfully deepened their understanding of how AI can enhance LKPD design. Variable 4 (Independence in Practical Skills) achieved an N-Gain of 0.63, confirming that the scaffolding approach enabled teachers to develop confidence in independent E-LKPD creation.

Competency Indicator	Pre-Test	Post-Test	Improvement	Percentage
Familiarity with Liveworksheets	2.15	4.00	+1.85	86%
Ability to integrate multimedia	2.20	3.85	+1.65	75%
Capacity for automated assessment	2.40	3.92	+1.52	63%
Confidence in AI tool usage	2.35	4.10	+1.75	74%

Table 4. Detailed Pre-Test and Post-Test Comparison on Specific Competency Indicators

Table 4 provides a more granular view of the competency improvements beyond the four macro variables presented in Table 2. The most substantial improvement occurred in teachers' familiarity with Liveworksheets, which increased from 2.15 to 4.00 (+1.85, 86% improvement). This indicates that the training was highly effective in introducing teachers to a platform that was previously unfamiliar to most participants. The second largest improvement was in confidence in AI tool usage, rising from 2.35 to 4.10 (+1.75, 74% improvement). This finding is particularly significant because low confidence is ofte n cited as a major barrier to technology adoption among teachers. The training successfully addressed this barrier by providing hands-on practice and gradual scaffolding. The ability to integrate multimedia elements into E-LKPD improved by 75% (from 2.20 to 3.85), while capacity for automated assessment improved by 63% (from 2.40 to 3.92). The slightly lower improvement in automated assessment capacity may be attributed to the more complex nature of configuring auto-grading features in Liveworksheets, which requires additional technical understanding. Nevertheless, the overall pattern of improvement across all four specific indicators

confirms that the training was effective in addressing the specific competency gaps identified in the pre-test assessment.

Qualitative data collected during the post-training focus group discussion provided additional insights into the quantitative findings. Teachers reported that the most useful features of the training were the step-by-step guidance on integrating ChatGPT for content generation (mentioned by 16 out of 20 teachers), the Text-to-Speech feature for creating listening materials (mentioned by 14 teachers), and the auto-grading feature of Liveworksheets (mentioned by 18 teachers). When asked about challenges, teachers consistently identified three main barriers: unstable internet connectivity in rural areas (reported by 12 teachers), lack of familiarity with web-based applications requiring adaptation time (reported by 10 teachers), and suboptimal performance of aging devices (reported by 8 teachers). These qualitative findings help explain why Variable 2 (Ease of Technology Operation) had the lowest N-Gain score (0.34).

Beyond the specific features and barriers, the qualitative data also revealed teachers' overall satisfaction with the training. The average rating was 8.7 out of 10, with 15 teachers rating it 9 or above. One teacher stated, "I was afraid of AI before this training, thinking it would replace teachers. Now I see that AI is a tool that can help me become a better teacher." These comments reinforce that the training successfully addressed both cognitive and affective dimensions of teacher competence. The transformation from fear to empowerment represents a fundamental shift in teachers' beliefs about AI in education, a key second-order barrier identified by (Ertmer, 1999).

Discussion

This study aims to explore the effectiveness, competency shifts, and challenges faced by teachers in implementing the AI-TPACK framework in developing E-LKPD. The findings indicate that, on average, teachers experienced a statistically significant improvement in competence (Sig. < 0.05) after participating in the training.

Scaffolding Approach and Competency Transfer

The success of this competency transfer cannot be separated from the scaffolding approach (gradual support) embedded in the training design. Li et al., (2024) explain that perception and behavior are interconnected, so building new competencies must be linked to existing knowledge to ensure a natural learning process. The pre-test data show that teachers already had entry-level skills in Canva (V2 = 3.42). The training did not start from scratch but instead used Canva skills as a foundation for visual design before connecting them to the logic of TTS and Liveworksheets.

This approach aligns with Vygotsky, (1978) Zone of Proximal Development (ZPD), which posits that learning occurs most effectively when new tasks are within the learner's reach with appropriate support. The scaffolding strategy employed in this training followed Wood et al., (1976) principles of effective tutoring, including recruiting interest, simplifying tasks, controlling frustration, and demonstrating solutions. In

practice, instructors first demonstrated ChatGPT for content generation, then provided guided practice with teachers working in pairs, and finally allowed independent creation of E-LKPD. This graduated release of responsibility enabled teachers to experience success at each stage, building their confidence and motivation to continue learning independently.

The effectiveness of the scaffolding approach can be further understood through the lens of cognitive load theory. By starting with Canva, a tool with which teachers already had moderate familiarity (pre-test mean = 3.42), the training minimized extraneous cognitive load, allowing teachers to focus on learning new design principles without simultaneously learning a new interface. Once teachers were comfortable with Canva, the training introduced ChatGPT, which required learning new skills (prompt engineering) but could be applied within the familiar context of content creation. The gradual introduction of TTS and Liveworksheets followed the same pattern, with each new tool building on previously mastered skills. This sequential design reduced the risk of cognitive overload, which is a common barrier in technology training programs that introduce multiple new tools simultaneously. The high N-Gain scores for Variables 3 and 4 (0.76 and 0.63) suggest that the cognitive load management strategy was successful. This finding contributes to the literature on instructional design for teacher technology training, confirming that gradual, scaffolded introduction of multiple tools is more effective than intensive, simultaneous training (Wood et al., 1976; Vygotsky, 1978).

This is closely aligned with the TPACK concept proposed by Mishra & Koehler, (2006), which emphasizes that technology integration (T) will only be effective when aligned with teachers' existing content knowledge (C) and pedagogical knowledge (P). The significant increase in teachers' AI-TPACK integration mastery (N-Gain = 0.76, Highly Effective) demonstrates that structured training can effectively develop teachers' capacity to integrate AI tools into their pedagogical practices. This result is consistent with Celik, (2023) Intelligent-TPACK (i-TPACK) framework, which extends traditional TPACK to include AI-specific competencies across five dimensions: i-TK, i-TPK, i-TCK, Ethics, and integrated i-TPACK.

Transformation of Teachers' Roles through Generative AI

This training successfully transformed the role of teachers. The variable of Independence in Practical Skills increased sharply (N-Gain = 0.63). Before the training, teachers faced substantial difficulties (score = 2.60). After the training, the integration of ChatGPT for designing materials and Text-to-Speech for automatically generating audio for *mahārat al-istimā'* (listening skills) shifted teachers' paradigm from manual graders to learning designers.

Although the post-test instrument primarily measured overall E-LKPD competence, the significant increase in this variable cannot be separated from the role of ChatGPT and TTS as "content production engines" behind the E-LKPD. Teachers were not merely filling in pre-made worksheets but were using AI to generate images, reading texts, and audio, which were then integrated into Liveworksheets.

This finding aligns with Ng et al., (2021) AI literacy framework, which identifies four dimensions of AI literacy: (1) Know and understand AI, (2) Use and apply AI, (3) Evaluate and critique AI, and (4) Create with AI. The training successfully developed teachers' capacity across all four dimensions, with particular emphasis on "Create with AI," as evidenced by teachers' ability to independently produce complete E-LKPD by the end of training.

Afifudin Dimyathi et al., (2024) found that teachers can utilize ChatGPT to prepare rich, modern, and engaging learning materials. The present study confirms this finding and extends it by demonstrating that teachers can also use ChatGPT to generate assessment items and create personalized learning materials tailored to their students' proficiency levels.

Iyer & Luke, (2010) emphasize that foreign language learning needs to shift from mechanistic skills to multiliteracies-based learning. The use of Generative AI in this study demonstrates that teachers are capable of making this multiliteracy leap. Teachers learned to generate texts (linguistic mode), design visual layouts (visual mode), produce audio materials (audio mode), and create interactive digital worksheets (digital mode). This integration of multiple modes represents a fundamental shift from traditional, text-only LKPD to rich, multimodal E-LKPD.

This finding is supported by (Prastika, 2021) who argues that the use of automated assessment technology in E-LKPD reduces administrative burdens and shifts the teacher's role toward a more facilitative one. The qualitative data support this finding, with 18 out of 20 teachers mentioning the auto-grading feature of Liveworksheets as one of the most useful aspects of training.

Infrastructure Constraints as First-Order Barriers

Third, although statistical evidence confirms cognitive success, deeper analysis through qualitative data reveals ecosystem-related constraints. The most dominant barriers are not related to software limitations but to infrastructure constraints ("internet/signal issues" and "students' devices not supporting the applications"). Advanced media such as AI-TPACK based E-LKPD cannot function optimally without adequate infrastructure support. This condition explains why Variable 2 (Ease of Technology Operation) only achieved an N-Gain of 0.34 (the lowest), with Sig. 0.001.

This finding strengthens Ertmer, (1999) conceptualization of first-order and second-order barriers to technology integration. First-order barriers are external to teachers and include lack of resources, inadequate infrastructure, and insufficient training. Second-order barriers are internal and include teachers' beliefs, attitudes, and pedagogical philosophies. In this study, the training successfully addressed second-order barriers by changing teachers' attitudes and building their confidence and skills. However, first-order barriers such as limited internet connectivity and lack of student devices remain beyond the control of individual teachers.

As Abedi & Ackah-Jnr, (2023) note, in developing country contexts, first-order barriers still have a more significant impact on technology integration than second-order

barriers. Their study found that technological resource availability, leadership support, and teacher professional development (all first-order barriers) were perceived to have a more significant impact than second-order barriers. The present study confirms this finding in the Indonesian madrasah context.

Cognitively, teachers are already highly capable (as evidenced by V3 reaching an N-Gain of 0.76), but they recognize that real classroom implementation will be constrained by madrasah infrastructure. This strengthens the argument of Iswatiningsih et al., (2022) that the implementation of E-LKPD cannot rely solely on the success of teacher training institutions, but must also be supported by collective ICT infrastructure readiness within madrasahs.

Thus, the integration of AI-TPACK into E-LKPD development training aligns with previous research emphasizing the importance of multiliteracies-based learning and the effectiveness of interactive media. Furthermore, the use of Generative AI (ChatGPT and TTS) in this training provides valuable resources to stimulate teachers' creativity and encourage them to become adaptive educators in the era of digital disruption. By providing structured, scaffolding-based training, teachers are not only taught how to use applications but are also empowered to independently master the integration of technology, pedagogy, and Arabic language content.

Conclusion

Based on the results and discussion, it can be concluded that AI-TPACK based training integrating with Canva, cHATgpt, Text to Speeh, and Liveworksheets is statistically proven to be effective in improving the competence of Arabic language teachers in MTs in Sukoharjo Regency. The paired sample T-Test shows Sig. < 0.05 for all variables (thus H0 is rejected), with an average N-Gain of 0.59 (moderately effective). The most significant improvement occurred in AI-TPACK integration mastery (high effective). Another advantage lies in its ability to enhance teacher competence across 11 different school, indicating potential for generalization. However, full classroom implementation remains constrained by network infrastructure and student device policies. Therefore, it is recommended that madrasah policymakers provide AI-TPACK competency training for teachers while simultaneously ensuring adequate technological infrastructure for students.

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