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Development of a TPACK Training Module through AI Integration to Improve the Pedagogical Skills of Arts Teachers

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Abstract: This study aims to develop a training module for lesson planning using the Technological Pedagogical Content Knowledge (TPACK) approach integrated with Artificial Intelligence (AI) to enhance the pedagogical competence of junior high school art teachers in Salatiga. The research employed a Research and Development (R&D) method based on the Borg & Gall model, limited to the first five stages. The development process involved expert validation and limited field testing with 21 MGMP members. The research instruments included validation sheets, questionnaires, and pre-test/post-test assessments, while data were analyzed using descriptive statistics and paired-sample t-tests. The validation results indicated a high level of feasibility (average 90% for material and 83.6% for module). The effectiveness tests revealed a statistically significant improvement in teachers' pedagogical competence, with higher post-test scores (77.86) compared to pre-test scores (61.43), and a significance value (Sig. 0.000 < 0.05). The module, designed to be self-instructional, self-contained, adaptive, and user-friendly, demonstrates the potential of AI-enhanced TPACK training to improve the quality of art education. These findings imply that integrating AI into teacher professional development can effectively enhance pedagogical competence, with broader implications for designing innovative training models across various subject areas.

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Introduction

Teachers play a pivotal role in improving education quality through five core responsibilities (5Ms): planning, implementing, assessing, guiding, and evaluating learning, as outlined in the Rumah Pendidikan framework of the Ministry of Education and Culture. Among these, lesson planning is fundamental, shaping instructional strategies, classroom effectiveness, and overall learning quality. Research indicates that systematic, context-responsive instructional design enhances competency-oriented learning (Nurmayanti et al., 2023) and that professional development in lesson planning significantly improves teaching practices (Halala & Seni, 2022).

Learning is shaped by dynamic teacher–student interactions, with personal engagement playing a critical role in determining its effectiveness (Ning et al., 2024). Teachers are not only knowledge transmitters but also facilitators, motivators, and role models (Soares et al., 2025). Teachers must continually upgrade competencies to keep pace with technological advances and evolving learner needs. As key agents in education, they must design creative and interactive learning experiences that foster student engagement (Wiraadi et al., 2024). The appropriate use of methods, models, and interactive media not

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only supports classroom interactivity but also enhances understanding, motivation, and overall learning quality (Muhaimin et al., 2023).

Based on a preliminary survey of junior high school arts and culture teachers in Salatiga City, several challenges were identified. One major issue is the unequal distribution of teachers across the three main art disciplines—music, dance, and visual arts. Data from the MGMP (Subject Teacher Forum) and the SIMPKB system shows that out of 32 schools, none have a complete set of specialized arts teachers. From 30 teachers, only 10 teach within their area of expertise, while the remaining 20 teach both within and outside their specializations. This means that about 66.6% of teachers are assigned to subjects outside their core discipline. For instance, a music teacher may be required to teach visual arts, which often leads to difficulties in delivering skill-based content. Teachers often focus on mastering the subject content, while lesson planning is sometimes overlooked. Planning is usually done by informally sharing materials or copying existing modules or lesson plans (RPP). However, teachers still make efforts to teach effectively based on student needs. These efforts include using online resources to present varied content and joining online training to develop instructional media. Interviews with several arts and culture teachers also showed a preference for in-person training sessions. As a professional community at the junior high school level, MGMP serves as a forum to support teachers' needs. In collaboration with the local Education Office, MGMP can organize training programs tailored for arts and culture teachers in Salatiga. One possible program is training on instructional design. MGMP activities help to improve teacher competencies and also provide a space for sharing knowledge and experiences.

Over the past two years, arts and culture teachers have had limited access to training programs aimed at developing their pedagogical and professional competencies. Most available training has addressed general teaching skills rather than the specific needs of arts and culture educators. Practical training aimed at producing interactive media often encounters challenges, such as limited mentoring, time constraints, and a shortage of qualified trainers. To address these issues, innovative training approaches are needed, including the use of modules tailored to participants' needs. Training modules serve as key resources, offering structured content, methods, scope, exercises, and evaluation tools (Kurniawan & Aysia, 2022). Effective training involves not only content and participants, but also instructional media, trainers, and appropriate venues (Artha et al., 2021). A well-designed training module functions as a comprehensive and systematic learning tool to help participants achieve the intended competencies. Today, training can be delivered either online or in-person, using both electronic and printed modules, depending on participants' needs.

This study offers a novel contribution by integrating the TPACK framework with Artificial Intelligence (AI) in the professional development of arts and culture teachers, an approach that has been largely overlooked in previous research. The significance of this work lies in its potential to provide a practical, technology-enhanced training solution that directly addresses teachers' pedagogical needs while strengthening the quality and sustainability of arts and culture education in schools. This study aims to develop a TPACK-based instructional design module that integrates artificial intelligence to support the improvement of pedagogical competencies among junior high school arts and culture teachers.

Research Method

In order to address the identified challenges and to design an effective training solution, this study adopted a Research and Development (R&D) approach. The development

process was guided by the Borg and Gall model, adapted to the first five stages to ensure systematic and practical implementation.

(1) Research design

This study adopts the Borg and Gall research and development (R&D) model, implementing five out of the ten original stages: (1) research and information gathering, (2) planning, (3) developing the initial product draft, (4) preliminary field testing, and (5) product revision. These steps guide the process of designing, testing, and refining the training module. The following figure presents the research and development flow based on the Borg and Gall model:

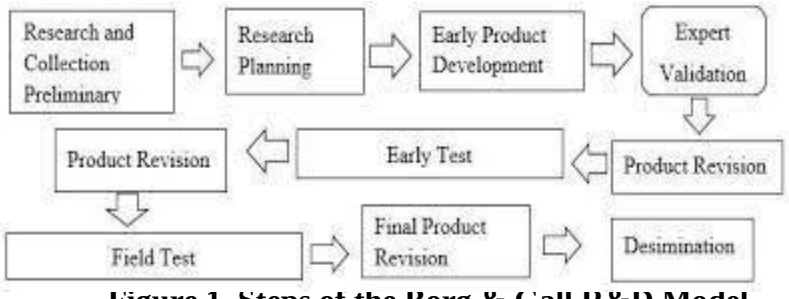

Figure 1. Steps of the Borg & Gall R&D Model

(2) Population and samples

This study involved 21 cultural arts teachers from the Salatiga MGMP who participated in training. Using total sampling, the entire population was included as the research sample (n = 21) (Sugiyono, 2021).

(3) Sample collection techniques and instrumental development

The module was designed with five key characteristics: self-instructional, self-contained, stand-alone, adaptive, and user-friendly (Rejeki et al., 2023). Informed by literature on training modules, TPACK-based learning, and AI integration in lesson design, the planning stage produced a TPACK–AI-based training module designed to advance the pedagogical competence of arts and culture teachers. The initial product underwent expert validation in both content and design, and revisions were made based on expert feedback. A small-scale trial involving 21 MGMP teachers was then conducted through a training session using the module. Trial results informed further revisions by identifying strengths and addressing weaknesses to improve the module's overall effectiveness.

(4) Data analysis techniques

The validation process was conducted separately for qualitative and quantitative data in accordance with their respective characteristics to ensure accuracy, reliability, and alignment with research objectives. Qualitative data, collected through interviews and document analysis, were validated using source triangulation and respondent member checks to confirm the consistency and credibility of interpretations (Sugiyono, 2018). Quantitative validation employed a module validation questionnaire administered to four experts (two content specialists and two module experts) using a five-point Likert scale (SD–SA) to assess feasibility and quality. The results were analyzed to determine the module's feasibility, while its effectiveness was evaluated through pretests and posttests

measuring participants' competency improvements. Instrument validity and reliability were further examined using IBM SPSS v22.

This research and development study employed a mixed-method approach. Interview data were analyzed using the Huberman and Miles (2002) technique, encompassing data reduction, display, conclusion drawing, and verification. Module validation and test results were examined through descriptive statistics (scores, means, and percentages), while observation data were categorized into defined intervals.

Improvement in teacher competence in TPACK-based lesson planning with AI is reflected when participants achieve a minimum post-test score of 75. This score functions as a contextual benchmark for assessing understanding and application, although it has not been universally recognized as a global standard (Ignalig et al., 2024; Widajati & Mahmudah, 2023; Ning et al., 2024; Yopi, 2024). The training is deemed effective when it achieves an overall success rate of at least 80%.

Results and Discussion

Instructional Design by Arts and Culture Teachers to Accommodate the Diverse Interests and Talents of Students

The preliminary findings of this research underscore the importance of both pedagogical competence and contextual expertise among arts and culture teachers. Without targeted professional development in these areas, teachers may struggle to meet the diverse needs of their students and effectively cover the broad subject matter they are expected to teach (Aliksiichuk et al., 2024; Kim, 2024). For instance, visual arts teachers may also be assigned to teach music or dance, and in some cases PPPK teachers from non-arts backgrounds are appointed to arts and culture classes to address teacher shortages. Data were collected from arts and culture teachers in schools with staffing shortages through interviews and document analysis. Teachers teaching within their specialization reported greater ease and produced more comprehensive lesson plans. In contrast, those assigned outside their expertise encountered reduced instructional effectiveness and frequently relied on copied lesson plans from colleagues.

As noted in the interview with Mrs. CR, her expertise lies in visual arts; however, she is also assigned to teach music and dance. When teaching outside her specialization, she limits instruction to areas within her capability and often relies on colleagues for materials. In contrast, when teaching visual arts, she demonstrates greater confidence, develops more comprehensive lesson plans and modules, and provides more effective instruction and guidance. The interview with Mrs. JR, a Javanese language teacher appointed as a PPPK under the Arts and Culture formation, revealed similar challenges. She reported difficulties in teaching arts and culture due to limited competence in the field and therefore relied on online content as instructional media. She further emphasized the importance of regular MGMP Arts and Culture activities to better support teachers in delivering engaging and meaningful lessons.

BW, an Arts and Culture teacher at a foundation school specializing in music, reported challenges in teaching other subjects such as visual arts. To address this, BW utilizes technology, self-learning, and online tutorials to create engaging materials. She highlighted that professional competence alone is insufficient and emphasized the need for ongoing pedagogical development, advocating for training in instructional design and for the MGMP Arts and Culture community to support continuous professional growth.

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Types of Training and Efforts to Improve the Pedagogical Competence of Arts and Culture Teachers through the Use of Technology

Based on interviews with respondents VG, RD, and CR, teachers participate in both online and offline training to improve their competencies. The forms of training that teachers have attended are as follows:

a) Teachers participate in online or in-house training focused on pedagogical competence, but these rarely include examples specific to arts and culture. Most examples target subjects such as English, science, Indonesian, and mathematics, and independent training for arts and culture teachers remains limited.
b) Training on integrating technology into arts and culture instruction is scarce and underutilized. This study offers an opportunity for teachers, particularly within the MGMP Arts and Culture community in Salatiga, to enhance their competencies.
c) Current technology use among arts and culture teachers is mostly limited to presenting materials (e.g., PowerPoint, Canva) and conducting quizzes (e.g., Google Forms, Quizizz). Usage is constrained by inadequate infrastructure, leading many teachers to rely on YouTube tutorials for learning support.
d) Teachers often share teaching materials and modules, including those outside their specialization. Lesson planning remains largely independent, and AI tools like ChatGPT are used for creating modules or lesson plans. However, effective utilization of technology is limited by insufficient training, reducing its potential impact on teacher competence and student outcomes.

Development of a Training Module for TPACK-Based Lesson Design Using AI to Enhance the Pedagogical Competence of Arts and Culture Teachers

The development of a training module grounded in TPACK-based lesson design with AI is well substantiated by contemporary educational research. Beyond its theoretical contribution to the discourse on technology-enhanced pedagogy, the integration of collaborative practices (Njiku et al., 2021), experiential activities (Tee & Lee, 2011; Koh & Divaharan, 2011), and advanced digital tools (Hidayati et al., 2022; Benedicto et al., 2023) establishes this initiative as a practical and effective framework for advancing the pedagogical competencies of arts and culture teachers. To ensure that the module addresses real classroom needs, the researcher also investigated the current teaching conditions and challenges faced by arts and culture teachers in Salatiga.

Qualitative data were collected through interviews with ten Arts and Culture teachers from public and private schools who are members of MGMP. The interviews explored teaching conditions, teacher availability, challenges, professional development efforts, and technology use in arts education. Findings revealed that most schools have limited arts specialists, requiring teachers to teach outside their expertise, which affects lesson quality. Document analysis of teaching modules and lesson plans showed that many plans were copied from colleagues or online sources, highlighting the need for targeted support to enhance teaching effectiveness.

To address these challenges, arts teachers participate in training; however, such programs rarely focus specifically on arts education. Teachers need guidance on content, media-based delivery, and ongoing pedagogical development aligned with scientific and technological advances. While technology is used to support instruction, integration skills remain limited. Interviews and document analysis highlight strong potential for professional growth, with all teachers holding at least a bachelor's degree. TPACK-

based lesson design training using AI, delivered through a structured module, is expected to enhance teachers' pedagogical competence and support effective technology integration.

The researcher developed a TPACK-based training module integrating AI to enhance the pedagogical competence of arts and culture teachers across music, visual arts, and dance. The module comprises an introduction, learning materials, pretest, posttest, reflection, and competency evaluation. Expert validation confirmed that the module is self-instructional, adaptive, user-friendly, and meets quality standards in content, presentation, and assessment. Content validation by experts ensured the module's material addresses teachers' instructional needs. The validation results are as follows:

Table 2. Content Expert Validation Results by Validator 1

No	Validated Aspect	Average	%
1	Content and Scope of Material	4.6	90
2	Presentation of Material	5.0	90
3	Evaluation Tools and Module Completeness	4.7	90
Overall Average		**4.7**	90

Table 3. Content Expert Validation Results by Validator 2

No	Validated Aspect	Average	%
1	Content and Scope of Material	4.4	89
2	Presentation of Material	4.0	80
3	Evaluation Tools and Module Completeness	4.3	87
Overall Average		**4.3**	85,1

Table 4. Recapitulation of Content Expert Validation

No	Validated Aspect	Average	%
1	Content and Scope of Material	4.5	90
2	Presentation of Material	4.5	90
3	Evaluation Tools and Module Completeness	4.5	90
Overall Average		**4.5**	**90**

The recapitulation of validation by two content experts shows that the aspects of content and coverage, material presentation, and evaluation tools and completeness each received a score of 90%. Overall, the module achieved a validation percentage of 90%, indicating a very high level of validity. According to validation criteria, the module is deemed suitable for use without major revisions. Thus, both experts confirmed that the module meets the three key content evaluation criteria. However, the content experts provided some notes: (1) the illustrations were unclear or unreadable when accessed; (2) the module needs to expand the explanation of AI concepts; and (3) attention to detail is needed in writing. Based on these suggestions, the module was revised to ensure it can

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be used effectively. The module validation conducted by the module expert aimed to evaluate the feasibility of the module. The validation results are as follows:

Table 5. Recapitulation of Module Validation Results

No	Validated Aspect	Average Score	Percentage (%)
1	Self-Instructional	4.3	85.7
2	Self-Contained	4.3	86.0
3	Stand-Alone	4.0	80.0
4	Adaptive	4.5	90.0
5	User-Friendly	4.6	92.5
	Average	**4.2**	**83.6**

Table 5 summarizes the validation results from two module experts. The Self-Instructional, Self-Contained, Stand-Alone, Adaptive, and User-Friendly aspects received 85.7%, 86%, 80%, 90%, and 92.5%, respectively, yielding an overall average of 4.2 (83.6%), indicating a very high level of validation. This confirms that the module meets all five evaluation criteria. Experts suggested: (1) including indicators of standard competency achievement in the learning objectives; (2) refining content, particularly the AI-based TPACK integration; (3) providing concrete examples of TPACK in lesson planning; and (4) replacing "understanding test" with "competency test" with clear achievement indicators and detailed discussion. The module will be revised accordingly to enhance its effectiveness.

Initial Field Testing

The training module was piloted on a limited scale with 21 Cultural Arts teachers from the Salatiga City MGMP, including 16 from public schools and 5 from private schools. The session took place on Wednesday, April 23, 2025, from 12:00 to 16:00 WIB at the SMP Negeri 8 Salatiga Language Laboratory. After an opening and pre-test via QR code, participants engaged in module-based learning activities. Those unable to attend studied independently. The training concluded with a post-test to assess knowledge improvement.

Figure 2. Training Module Activity

Prior to data analysis, a normality test was conducted to determine whether the pretest and posttest data were normally distributed. The Shapiro-Wilk method was applied, as the sample size was fewer than 50. The results of the normality test for both pretest and posttest data are presented in the following table:

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Table 6. Normality Test Results

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	df	Sig.
Pre_Test	,138	21	,200*	,960	21	,514
Post_Test	,190	21	,045	,923	21	,102

The normality test results showed significance (Sig.) values of 0.514 for the pretest and 0.102 for the posttest, both above 0.05, indicating normal distribution. Consequently, a Paired Sample T-Test was conducted to evaluate the effectiveness of the TPACK-based AI training module in enhancing arts and culture teachers' pedagogical competence. The results are presented below:

Table 7. Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pre_Test	61,4286	21	12,95597	2,82722
	Post_Test	77,8571	21	6,62786	1,44632

Table 8. Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Pre_Test & Post_Test	21	,358	,111

Table 9. Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Pre_Test - Post_Test	-16,42857	12,26202	2,67579	-22,01018	-10,84697	-6,140	20	,000

The paired samples statistics indicated a pretest mean of 61.43 and a posttest mean of 77.86, suggesting an improvement in scores. The correlation between pretest and posttest scores was 0.386 (Sig. = 0.111), indicating no significant correlation. The paired sample t-test revealed a 2-tailed significance of 0.000 (< 0.05) with t = 6.140, exceeding the critical value of 2.086, confirming that the TPACK-based AI lesson planning module significantly enhances the pedagogical competence of arts and culture teachers.

Product Revision

In the fifth stage, validation by module and content experts guided the refinement of the TPACK-based AI training module. Expert feedback ensured alignment with best practices in educational research (Rahayu et al., 2023; Rasyid et al., 2023), leading to revisions such as separating learning objectives from training targets, adding competency indicators, focusing content on Cultural Arts teachers' skills, correcting text, and improving visual clarity. Tested with 21 junior high school teachers in Salatiga, the module—self-instructional, adaptive, and user-friendly—integrates content, pedagogy, and technology. Trials showed significant improvement in pedagogical competence, demonstrating TPACK's relevance and AI's potential for educational innovation. The study contributes to theory by illustrating systematic AI integration in lesson planning and offers a replicable model for professional development. Findings suggest policy implications for AI-enhanced, subject-specific training and provide schools with a scalable tool to foster creative, interactive learning. Limitations include small-scale trials and local scope, warranting broader implementation and evaluation of affective and practical outcomes in future research.

Conclusion

This study concludes that arts and culture learning in Salatiga requires improvement, as many teachers instruct outside their expertise, limiting students' skill development. Teachers independently use digital platforms like YouTube, Canva, and ChatGPT, but existing training is general and lacks pedagogical structure. A TPACK-based AI training module was developed following the first five stages of the Borg & Gall model, emphasizing self-instruction, self-contained, stand-alone, adaptive, and user-friendly design. The module covers TPACK concepts, learning models, AI-based media, and AI-based lesson plan development. Expert validation confirmed high feasibility (90% content, 83.6% module), and trials with 21 teachers showed a significant pre- to post-test improvement (61.43 to 77.86, $p < 0.05$), demonstrating enhanced pedagogical competence.

Recommendation

Based on the findings, several recommendations are proposed: (a) Education authorities should assess teacher distribution, needs, and challenges to guide targeted, sustainable training in collaboration with higher education; (b) The Arts and Culture MGMP should conduct regular training using the developed module and promote AI-based, student-centered learning within professional communities; (c) Future R&D should advance through Borg & Gall stages six to ten, involve larger trials, and explore integration into interactive digital platforms.

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