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Development Of Training Programs To Enhance Teachers' Digital Skills With Technological Pedagogical Content Knowledge (TPACK)

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Abstract
The development of digital skills for teachers is important in the digital era, especially in the effective integration of technology into teaching and learning. This research focuses on the development of a training program based on Technological Pedagogical Content Knowledge (TPACK) to enhance teachers' ability to utilize educational technology. The program was developed using the ADDIE model, which includes the stages of Analysis, Design, Development, Implementation, and Evaluation, to create relevant and adaptive training experiences. The program focuses on a development process designed to meet the diverse needs of participants and address barriers to digital training implementation in various educational contexts. The training results show that most participants successfully mastered the basic TPACK competencies and demonstrated high levels of satisfaction. The program also adapts its approach based on the characteristics and needs of participants at each educational level, incorporating both online and face-to-face sessions. Despite challenges in infrastructure and accessibility, the program has been proven to significantly enhance teachers' digital skills, as evidenced by good graduation rates and positive participant perceptions of the training benefits. Therefore, this TPACK-based training can serve as an effective model in teacher professional development.

Keywords: TPACK, Program Development, Teacher Training, ADDIE Model, Digital Skills

Introduction

In the digital era, the need for technology skills in education is increasing along with the increasing adoption of online and blended learning as the main learning method. The Covid-19 pandemic accelerated the process of digital transformation in education, pushing teachers and educational institutions to adapt technology faster. In Indonesia, the government's efforts in providing online learning facilities through learning accounts for teachers and students, reaching up to 30 million accounts in 2020 (Widyanuratikah, 2020) , shows the importance of digital readiness in all aspects of education. However, infrastructure readiness alone is not enough if it is not accompanied by an increase in teachers' digital competence. Many teachers still struggle to utilize technology in teaching, indicating a lack of ability to integrate technology into learning effectively (Fernández-Batanero et al., 2022; Heitink et al., 2017; Muhaimin et al., 2019). This indicates that improving teachers' digital competencies is an urgent need in an increasingly complex educational domain.

This limited digital readiness among teachers is not only related to technical limitations, but also pedagogical understanding of the application of technology in the learning process. Most teachers face challenges in designing engaging and effective online learning, so they tend to focus on the information transfer aspect without considering student interaction and engagement. This is exacerbated by the lack of digital skills in students who are often considered as “digital natives.” Studies show that students' technology skills are also inadequate to support fully technology-based online learning (Casillas Martín et al., 2020; Valtonen et al., 2011). This lack of student readiness adds to the challenge for teachers in creating engaging and meaningful learning, while being oriented towards optimal outcomes.

From an internal survey conducted at the Cor Jesu Campus, teachers indicated the need for assistance in utilizing technology and information communication to create effective and engaging learning. Based on the results of this survey, teachers need a training program that focuses not only on the introduction of technological tools, but also on practical and pedagogical skills that can be applied directly in daily teaching. Such training programs also need to be designed to accommodate a range of needs and abilities, given that participants come from different levels of education and different digital backgrounds. This underscores the importance of flexible training approaches that meet the specific needs of participants, especially in dynamic learning contexts.

Technology-based teacher training requires not only technical skills but also a holistic pedagogical approach. In some countries, teacher training is geared towards developing evaluation skills and pedagogical reflection, while in countries such as Australia and the United States, training is more focused on evaluating and adjusting education policies that are uniformly organized by the government (Desimone & Garet, 2015; Ling & Mackenzie, 2015). Meanwhile, in Finland and Hong Kong, teacher training

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is more oriented towards improving teacher leadership and developing lifelong learning skills (Bick-har, 2015; Niemi, 2015). In Singapore, training is designed to meet teachers' individual interests, school needs and the national curriculum, with hybrid approaches and collaboration-oriented learning communities (Bautista et al., 2015; Kaur et al., 2019). These different approaches show that effective training requires a high degree of flexibility and differentiation to suit the diverse characteristics and needs of participants and emphasize the importance of local context in the design of more relevant programs.

However, in Indonesia, training that focuses on technology mastery in learning is still limited and generally generic, thus failing to meet teachers' specific needs. Teachers in Indonesia need training that fills the gap in their technology-in-learning skills. In this context, the Technological Pedagogical and Content Knowledge (TPACK) framework offers an ideal solution. TPACK focuses on the effective integration of technology with pedagogical and content elements in learning, helping teachers to utilize technology thoroughly and relevantly in their teaching context. This approach has also been proven effective in improving teacher competencies in various parts of the world, including in pre-service and in-service teachers and lecturers (Castéra et al., 2020; Chai et al., 2020; Habibi et al., 2020; Harris, 2016; Oda et al., 2020; Schmid et al., 2021; Tondeur et al., 2020). This underscores the relevance of TPACK as a framework to address the digital skills gap in education.

This research aims to develop a TPACK-based teacher training program that focuses on digital and pedagogical skills in online and blended learning. The program is designed to provide in-depth and applicable training, which not only introduces technology but also emphasizes pedagogical integration and the ability to assess the effectiveness of the designed learning. By using this approach, the training program is expected to address the challenges faced by teachers in the field and contribute to the continuous improvement of teachers' professional competence in adopting educational technology, as well as supporting the creation of more adaptive and innovative learning in the future.

Method

The training program uses the ADDIE model for its flexibility in identifying learning needs and objectives through stages of Analysis, Design, Development, Implementation, and Evaluation. It also applies the TPACK approach to integrate technology into teaching practices, focusing on the TPK domain to select appropriate technologies for the teaching approach.

Table 1 ADDIE Development Steps

Stage	Objective	Strategy	Media
Analysis	Identify performance gaps	Needs survey, Transformation report	Questionnaire, Transformation Report
Design	Design goals and strategies	TPK objectives, expert validation	TPACK Module, Weekly Guide
Development	Developing learning materials	Video tutorials, theory and practical assignments	Google Classroom, Google Drive
Implementation	Implementation of learning sessions	Online session, asynchronous consultation	Google Meet, Google Chat
Evaluation	Assess the effectiveness of the training	Weekly and final questionnaires	Digital questionnaire, motivation quadrant

Analysis

The analysis phase aims to identify performance gaps in teachers' digital skills. This process involves conducting Needs and Motivation Survey through questionnaires and interviews to gather data on teachers' current digital skills and motivation for training. The survey includes questions on technological challenges and important topics. The Transformation Report provides data on the use of Google Workspace for Education in schools, showing a need for training to enhance teachers' digital skills.

Design

During the design stage of training activities, objectives are formulated based on needs identified at the analysis stage. These include validating materials, developing weekly guides, and matching instructional objectives with TPK indicators in TPACK. Objectives focus on teachers' digital skill identification, technology use in teaching, and interactive learning management. Validation involves experts and internal review, with weekly guides providing clear guidelines for trainees on material, tasks, and skill targets.

Development

During the Development phase, training materials were created for participants to easily access and learn new skills. The materials, including videos, guides, and modules from Google for Education, support self-directed learning. Tasks from Fundamentals Training and the Skill Checklist for Google Certified Educator assess participants' ability in using Google Workspace. Google Classroom was used as the main platform for training.

Implementation

During the implementation phase, participants receive training through online face-to-face sessions, asynchronous consultations, and direct face-to-face sessions as needed. Weekly sessions and consultations are held via Google Meet and

Google Chat to address technical difficulties. Materials are distributed through Google Classroom, including tutorial videos and assignments. Mentors offer tailored support through Google Chat. Formative evaluations are conducted weekly through feedback questionnaires to improve future sessions based on participant input.

Evaluation

Formative evaluation methods were used to assess participants' progress in acquiring new skills. Weekly and final evaluations, as well as motivation and perception data, were collected. Feedback helped gauge session effectiveness. Questionnaires on comprehension, media use, and suggestions for improvement were given. A more detailed questionnaire at the end focused on motivation and application of skills. Data was analysed using a quadrant graph to assess participants' readiness in applying TPACK skills.

Findings

Program Development and Adjustment

The development of the training program in the first week shows implementation in accordance with the initial design. Participants showed a good level of satisfaction with the content and teaching methods. Most participants successfully mastered the basic competencies taught, indicating that the difficulty level of the material is suitable for the participants' initial abilities. However, there were obstacles in the pattern of collecting practical tasks that tended to approach the deadline, limiting participants' opportunities to receive optimal feedback from mentors.

Entering the second week, the training program maintained a high level of participant enthusiasm. However, technical constraints such as limited internet access and the availability of laptops for participants from foundation units started to be identified. This caused participants to only be able to do tasks while at the office. Previous research revealed that teachers tend to prefer face-to-face assistance in the learning process (Smith & Olexa, 2011). Based on this, the program was developed by adding face-to-face sessions to accommodate participants with limited access.

In the third week, the program underwent several improvisations based on the evaluation of previous implementations. In line with previous research that revealed that kindergarten teachers need more time to learn new technology (Gjelaj et al., 2020; Ihmeideh & Al-Maadadi, 2018). The development of the program includes three main aspects: (1) expanding face-to-face sessions for primary school units, (2) developing a more detailed evaluation checklist to help participants measure their readiness for the GCE Level 1 exam, and (3) adjusting the learning pace for kindergarten units that have difficulty keeping up with the existing training pace.

The development of the program in the fourth week focused on evaluating participants' readiness to take the GCE Level 1 exam. Remedial programs were developed through extending study time and adding face-to-face sessions for participants who need more intensive support. This is in line with research findings on the importance of adjusting programs based on the specific needs of participants (Gjelaj et al., 2020). Specifically, the program for kindergarten units was modified to accommodate their different learning needs and pace compared to other units.

Program Development Effectiveness

The effectiveness of training programs can be seen from several indicators of success. Out of 23 participants who registered, 21 participants successfully took the GCE Level 1 exam, showing a high level of participation. The passing rate reached 61% with 13 participants successfully obtaining certification. The perception evaluation results show that the program is positioned in the High Expectancy - High Value quadrant, indicating the high expectations and beliefs of participants in the benefits of the program. This supports previous findings on the importance of expectations and value in teacher professional development programs

Discussion

Characteristics of Program Development

Training programs are developed with flexibility as the main characteristic. This is in line with the findings of Ihmeideh and Al-Maadadi (2018) which emphasize the importance of adapting programs according to the participants' needs (Ihmeideh & Al-Maadadi, 2018). Program adjustments are made for the varying needs of each educational unit, from kindergarten to high school/vocational school. Learning methods are designed adaptively by combining online and face-to-face learning according to the conditions and needs of the participants.

Factors Supporting Program Development

Accessibility of materials is one of the main supporting factors in program development. Training materials are designed in ready-to-use formats to facilitate implementation in the field. The learning structure is organized with clear and easy-to-follow steps for participants (Smith & Olexa, 2011). Additionally, materials are developed considering the context and situations of the participants to enhance the relevance of learning.

Challenges of Program Development

Infrastructure limitations are the main challenge in program development, especially related to the availability of internet connections and adequate devices. Regarding the importance of infrastructure in adopting learning technologies (Gjelaj et al., 2020). The evaluation system also faces challenges in measuring aspects of motivation and self-regulation abilities in learning.

Implications of Program Development

Future program designs need to consider deeper differentiation based on the characteristics of the participants (Ihmeideh & Al-Maadadi, 2018). Programs require periodic monitoring and evaluation to ensure appropriate adjustments. Institutional support in the form of allocating specific time for training is an important factor in the success of the program

Conclusion

The TPACK training program has successfully demonstrated its effectiveness in improving teachers' digital skills through a systematic and adaptive approach. Each stage in the ADDIE model provides clear and structured guidance, allowing for the customization of training content based on the needs and abilities of participants at various educational levels. Blended learning, hands-on practicum, and mentor support provided during the training have proven to be effective in helping teachers master technical and pedagogical skills relevant to their classroom contexts.

Challenges in program development, such as limited infrastructure and device access, can be overcome through the addition of face-to-face sessions and adjustments to schedules for participants needing more intensive support. Furthermore, the success of the program is also demonstrated by active participant participation in exams and final evaluations, with high graduation rates and participant satisfaction levels. Evaluation results show that the ADDIE model-based program development approach is effective in designing TPACK training that is responsive to field challenges and adaptive to participant needs variations. The program concludes that improving teachers' digital skills requires a comprehensive and flexible training design, as well as institutional support to provide dedicated time for teacher professional development.

Declarations and Statements

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First Author: Conceptualization, Methodology, Data Collection, Writing - Original Draft. *Second Author*: Methodology, Review, Supervision, Review & Editing.

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Data availability
The participants of this study did not give written consent for their data to be shared publicly, so due to the sensitive nature of the research supporting data is not available.

Competing Interest
The authors report there are no competing interest to declare.

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