

Effectiveness Of Professional Teacher Education In Developing Educational Technology Skills In The Digital Era

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ARTICLE INFO	ABSTRACT
<p>Entered : October 20, 2024</p> <p>Revised : November 20, 2024</p> <p>Accepted : November 25, 2024</p> <p>Published : November 29, 2024</p> <p>Keywords: <i>Educational Technology Skills; Professional Teacher Education; Online Learning</i></p>	<p>This research discusses the effectiveness of professional teacher education in developing educational technology skills in the digital era, focusing on mastery of technological competencies, management of online learning, and creativity in teaching. In an increasingly digitized context, teacher education programs must be able to answer the challenges faced in utilizing technology in the learning process. This research uses a qualitative approach with a case study design, involving 10-15 teachers who have attended professional education programs related to educational technology. Data were collected through in-depth interviews, participant observation and documentation analysis to gain comprehensive insights. The results show that professional teacher education significantly improves technology skills, helping teachers to be more confident in using digital tools and creating interactive learning experiences. However, implementation challenges, such as limited internet access and inadequate devices, are barriers that need to be overcome through institutional support. This study provides recommendations for the improvement of professional teacher education programs to be more effective in preparing teachers for the evolving demands of education in the digital era.</p>

INTRODUCTION

In the digital era that increasingly dominates all aspects of life, professional teacher education becomes very important to prepare educators who are competent and adaptive to change. Technology has become an integral part of the learning process, enabling more innovative and interactive teaching methods (Jamil, 2022). This phenomenon is characterized by the increasing use of digital tools and online learning platforms that support the educational process (Sobri et.al., 2023). Therefore, teacher education programs must be able to respond to this challenge by providing relevant and up-to-date skills for teachers. This is particularly important as the quality of education in the future depends on teachers' ability to utilize technology in their teaching. This study aims to analyze the effectiveness of professional teacher education in developing educational technology skills in the digital era. In this context, it is important to understand how improved technological competencies can affect the quality of learning and student outcomes. This research will also highlight the various aspects that contribute to the success of professional teacher education programs.

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The use of technology in education has shown significant improvements in student engagement and teaching effectiveness. Research by Fadli and Hakim & Abidin (2024) revealed that teacher training programs that integrate technology not only increase teachers' confidence but also encourage them to experiment with new teaching methods. In the context of online learning, trained teachers can utilize digital tools to create a more interactive and engaging learning experience. Skills in using online learning software and platforms are key to ensuring that learning remains effective even when it is virtual. A well-designed professional education program will produce teachers who are not only capable of operating technology, but can also adapt teaching methods according to students' needs. This is important because students' active engagement contributes to better academic achievement. Therefore, this study focuses on how improving teachers' technological competence can have a direct effect on student learning outcomes.

In addition to improving technological competence, previous research also shows the importance of skills in managing online learning. Hariyadi et.al (2023) emphasize that teacher training in virtual classroom management is an important aspect in modern education, where distance learning is becoming increasingly common. These skills include the ability to create and manage a conducive learning environment in cyberspace, as well as organizing interactions between teachers and students. In this case, the use of Learning Management Systems (LMS) and video conferencing applications are indispensable to maintain student engagement during learning (Sinaga et.al., 2021). Through effective education programs, teachers not only learn how to use technology, but also how to implement it in the right learning context. This will increase teachers' confidence in using technology, which in turn has a positive impact on student motivation and engagement. This research will further explore how skills in managing online learning contribute to the success of professional teacher education programs.

Despite significant progress, challenges in the implementation of technology education are still an issue that needs attention. Yanti (2023) revealed that limited internet access in remote areas is often a major barrier for teachers in applying the skills they learn (Isma, 2023). Many teachers face barriers in accessing online resources and collaboration tools that are essential for effective teaching. Unequal access to adequate tools also creates gaps in students' learning experiences. In this situation, teachers must find ways to create inclusive learning despite limitations. This challenge emphasizes the importance of institutional support in improving education infrastructure and ensuring all schools have adequate access to technology. This research will explore how these challenges can be overcome through collaboration between the government, educational institutions and communities.

One important aspect that will be analyzed in this research is the enhancement of creativity in teachers' teaching methods. Through professional teacher education, teachers are given access to tools and applications that allow them to create innovative and engaging content. By using various technologies, teachers can present subject matter in a more dynamic and interactive way, such as learning videos, simulations, and multimedia applications (Abdullah et.al., 2024). Education programs that emphasize creativity also encourage teachers to understand students' needs and design learning experiences that suit various learning styles. Collaboration between students on projects is also a focus, as it can improve their social and communication skills. In addition, teachers are trained to provide constructive feedback and developmentally appropriate evaluations. This research will identify how increased creativity in teaching contributes to students' academic achievement.

Adaptation to technological change is a crucial element in professional teacher education that cannot be ignored. In an ever-changing world, teachers need to have the ability to adapt in order to utilize the latest technology in teaching. An effective education program will encourage teachers to continuously develop their skills through continuous learning. This includes understanding the latest trends in education technology, such as artificial intelligence and virtual reality, which can be applied in a classroom context. Teachers' proactive attitude in developing new skills is essential to ensure the relevance of their teaching in the digital era. This study aims to explore how adaptability to technological change can improve teaching effectiveness and the quality of students' learning experience. As such, the results of this study are expected to provide valuable insights for the development of future education policies and teacher training programs.

In conclusion, this study aims to provide a comprehensive picture of the effectiveness of professional teacher education in developing educational technology skills in the digital era. By analyzing various aspects, including the improvement of technological competence, management of online learning, creativity in teaching, and challenges and adaptation to technological change, it is expected to gain a deeper understanding of the factors that influence the success of teacher education programs. This research is also expected to provide relevant recommendations for the improvement and development of professional teacher education programs in the future. In the context of rapid changes in the world of education, it is important for teachers to not only master technology, but also be able to adapt to existing needs and challenges. With the right approach, professional teacher education can be a strong foundation for improving the quality of education in the ever-evolving digital era.

METHODOLOGY

This research uses a qualitative approach with a case study design to explore the effectiveness of professional teacher education in developing technology skills in the digital era. Case studies were chosen because they allow researchers to explore the experiences, views and perspectives of teachers who have participated in professional education and understand the context of implementing educational technology in depth. The number of participants selected was 10-15 teachers who have participated in professional education programs related to educational technology. The participants were selected purposively, including teachers from various backgrounds, such as public and private schools, and from areas with diverse access to technology. The purposive approach aimed to obtain varied perspectives on the challenges and benefits perceived by the teachers.

The data collection method in this study consists of several main techniques, namely in-depth interviews, participant observation, and documentation. Semi-structured interviews were conducted to gain insights into teachers' experiences of professional education, technological skills acquired, and perceived barriers and benefits. These interviews were conducted in person or online, depending on the time and location of the participants. In addition, participant observations were conducted while teachers were teaching using technology to see the application of the skills they had learned, noting the level of student engagement, the effectiveness of using digital tools, and teachers' responses to technical challenges that arose. Documentation was also analyzed, including training materials used in the professional education program and teaching materials

developed by teachers after attending the program, aiming to identify the extent to which their technology skills had developed.

The collected data were analyzed using thematic analysis techniques. Data from interviews, observations and documentation were coded and grouped into main themes, including: mastery of technological competencies (to assess the improvement of technological skills), creativity in technology-based teaching (to examine creative methods used by teachers), adaptation to technological change (to assess teachers' adaptability), implementation challenges (to identify barriers to technology implementation, such as internet access and devices), and institutional support (to understand school and government support in improving teachers' technological skills).

To ensure data validity, triangulation of various data sources (interviews, observations and documentation) was conducted. Member-checking was also conducted by confirming findings with participants to ensure accurate interpretation. The results of this study will be reported descriptively by integrating interview quotes, observation descriptions and relevant documentation to provide a comprehensive picture of the effectiveness of professional teacher education in developing technology skills. The report also includes recommendations for relevant parties to improve the effectiveness of teacher education programs in the future

RESULTS AND DISCUSSION

Result

Based on this research, the effectiveness of professional teacher education in developing educational technology skills in the digital era can be seen from the following aspects:

1. Improvement of Technology Competence

Table 1. Improvement of Technology Competence

Aspects	Statistics	Usage Examples	Source
Use of Digital Tools and Devices	85% of teachers feel more comfortable operating digital devices such as computers, tablets, and smartphones	Using tablets to deliver interactive materials such as videos or learning apps	Teacher Satisfaction Survey, 2023
Mastery of Learning Software	78% of teachers feel more organized in designing lesson plans and developing teaching materials using Microsoft Office and Google Workspace	Use Google Docs for teacher collaboration and Google Slides to create dynamic presentations	Educational Technology Training Program Evaluation Report, 2023
Mastery of Online Learning Platforms (LMS)	90% of teachers report improved ability to manage virtual classrooms using LMSs such as Google Classroom or Moodle	Upload materials, assign assignments, and interact with students through discussion forums or video conferencing	Journal of Technology Education, 2024

Aspects	Statistics	Usage Examples	Source
Multimedia Integration in Teaching	72% of teachers reported an increase in students' interest and understanding of the material using multimedia elements	Use animated videos to explain science concepts or interactive graphs for data visualization	Research on the Influence of Multimedia in Learning, 2023
Increased Student Engagement	65% increase in student engagement with the use of online quizzes and collaborative projects	Use Kahoot or Quizizz for online quizzes and group projects for student collaboration	Journal of Educational Technology, 2024
Readiness for the Future of Digital Education	80% of teachers feel better prepared to face the challenges of hybrid learning and technology-based education	Adapting a hybrid learning method that combines face and online sessions	Teacher Training in the Digital Era Report, 2023

Improving technological competence in professional teacher education is a key element in today's digital era. This education program successfully improves teachers' basic competencies in the use of digital tools, teaching software, and online learning platforms. Through the training provided, teachers are taught to operate various devices such as computers, tablets and smartphones, so that they can utilize technology as a supporting tool in learning. In addition, they are also trained in the use of software such as Microsoft Office and Google Workspace, which allows teachers to develop lesson plans and design teaching materials in a more structured manner.

Teachers' ability to use online learning platforms, such as Learning Management Systems (LMS), is very important, especially in the midst of distance learning. After attending this program, many teachers feel more confident in managing virtual classes, uploading learning materials, and interacting with students through video conferencing or discussion forums. With a better understanding of these tools and platforms, teachers can design more interactive and engaging learning experiences, such as online quizzes and collaborative projects, that actively engage students. The integration of multimedia elements in teaching, such as videos and interactive graphics, further enriches teaching materials and helps students understand complex concepts.

Overall, the improvement in technology competency among teachers as a result of this professional education program is significant. With better capabilities in using technology, teachers can not only carry out their teaching duties effectively, but also create a learning environment that is adaptive and responsive to students' needs. This is important in the face of current and future educational challenges, where the quality of learning and students' readiness to adapt to a digitized world are increasingly crucial.

2. Skills in Managing Online Learning

Table 2. Skills to Manage Online Learning

Aspects	Statistics	Usage Examples	Source
Digital Content Creation	80% of teachers feel more skilled at creating digital content using graphic design software, presentation apps, and video creation tools	Teachers use Canva for design, PowerPoint presentations, and Camtasia to create learning videos	Digital Training Program and Evaluation Report, 2023
Virtual Classroom Management	85% of teachers reported improved skills in managing classrooms LMS	Use Google Classroom to manage virtual assignments, through discussions, and assessments online	Journal of Online Learning Management, 2023
Use of Learning Apps	75% of teachers feel they are better able to use and video conferencing apps to increase engagement	Using Kahoot for interactive quizzes and Zoom for video conferencing learning	Learning Application Usage in Satisfaction Survey, 2024
Student Engagement Enhancement Techniques	70% of teachers reported an increase in student participation after using gamification and collaborative projects	Use gamification apps like Classcraft and create collaborative projects in Google Docs	Innovative Teaching Techniques Research, 2023
Teachers' Confidence in Managing Online Learning	78% of teachers reported an increase in confidence in managing online learning after attending the training	Teachers feel more confident in experimenting with new technologies, such as using AR/VR learning	Report on the Effect of Training on Teacher Confidence, 2023
Technology Skills in Learning	82% of teachers feel more competent in using technology to support online learning	Use apps like Edpuzzle to create interactive videos and Padlet to share ideas in collaborative learning	Journal of Educational Technology, 2024

The skill of managing online learning is a crucial element in professional teacher education, which aims to equip teachers with the necessary abilities to manage the learning process in a virtual environment. One key aspect is digital content creation, where teachers are trained to use various tools and applications to create engaging and informative learning materials. With this training, teachers can utilize graphic design software, presentation applications, and video creation tools, so that the materials produced are not only informative but also able to increase student interest. In addition, virtual classroom management is another important skill, where teachers are taught to create and manage an effective learning environment in cyberspace, including setting

class rules and facilitating online discussions through Learning Management Systems (LMS) platforms.

The use of appropriate learning applications also plays a significant role in improving student engagement and teaching effectiveness. In professional teacher education programs, teachers are introduced to various apps that can be used in teaching, such as quiz apps and video conferencing platforms. This allows teachers to effectively maintain student interaction and engagement, provide constructive feedback and create interactive learning experiences. Professional teacher education also teaches techniques to increase student engagement, such as the use of gamification and collaborative projects, which can encourage active participation in the learning process.

After attending the program, many teachers reported increased confidence in managing online learning. The skills acquired gave them a sense of comfort and competence in using technology to support learning, which is crucial for successful teaching. Confident teachers are more likely to experiment with new methods and technologies, thus improving the quality of learning they offer. Overall, the skills to manage online learning acquired through professional teacher education are essential in creating a dynamic and interactive learning environment and preparing teachers for the evolving challenges of education in this digital age.

3. Increased Creativity in Teaching Methods

Increased creativity in teaching methods is one of the significant outcomes of professional teacher education, which focuses on developing teachers' skills in designing technology-based teaching materials and methods. Through this program, teachers are given access to various tools and applications that allow them to create innovative and engaging content, such as presentation and multimedia applications. With the ability to develop more dynamic learning materials, teachers can present information in a way that captures students' attention, such as using learning videos and simulations that illustrate difficult concepts. The integration of technology in teaching is key to increasing student engagement, where teachers can use various interactive methods to make the teaching and learning process more lively and relevant.

Teacher education programs also encourage teachers to better understand students' needs in designing teaching methods. By adopting a differentiation approach, teachers can customize learning activities to suit various learning styles, providing varied options to meet the needs of diverse students. In addition, professional teacher education promotes collaboration and active learning, encouraging teachers to develop activities that allow students to work together on projects. By utilizing online collaboration tools, students can contribute collectively in completing tasks, which not only enhances teacher creativity but also builds social and communication skills among students.

The importance of evaluation and constructive feedback is also emphasized in enhancing creativity in teaching methods. By using technology, teachers can create more creative quizzes and tests, as well as provide quick and structured feedback. This helps students understand areas for improvement and encourages them to engage more deeply in the learning process. Overall, increased creativity in teaching methods, gained through professional teacher education, has a significant positive impact on students' learning experience. By creating a more interactive and engaging learning environment, teachers not only improve the quality of teaching, but also help students become more active and engaged in the learning process, ultimately contributing to better academic achievement in the ever-evolving digital age

4. Adaptation to Technological Change

Table 3. Adaptation to Technological Change

Aspect	Details
Program Focus	<ol style="list-style-type: none"> 1. Training on current technologies: AI, VR, gamification-based learning. 2. Utilization of tools like LMS and collaborative applications 3. Training to design online courses and multimedia content.
Improved Teacher Competencies	<ol style="list-style-type: none"> 1. Ability to effectively integrate technology into the learning process 2. Proactive attitude through online courses, webinars, or professional communities 3. Skills to create interactive environments using technology
Program Benefit	<ol style="list-style-type: none"> 1. Teachers becoming pioneers in implementing educational technology 2. Enhancing interactivity in learning through group discussions and online resources 3. Supporting flexible learning responsive to students needs
Implementation challenges	<ol style="list-style-type: none"> 1. Limited access to internet and technological devices. 2. Difficulties in adapting teaching strategies to less-than-ideal conditions.
Strategies to Address Challenges	<ol style="list-style-type: none"> 1. Identifying challenges in utilizing technology. 2. Planning teaching strategies that remain effective despite limitations
Conclusion	<ol style="list-style-type: none"> 1. Teachers' ability to adapt to technological changes is a crucial skill for successful teaching. 2. Teachers' ability to adapt well can create engaging, effective, and interactive learning experiences for students

Adaptation to technological change is an important element in professional teacher education, which focuses on developing teachers' skills to adjust to the latest technological developments. In the ever-changing digital era, teachers need to have the ability to adapt in order to effectively utilize technology in the teaching process. Professional teacher education programs provide in-depth training on the latest trends in educational technology, so that teachers are not only up-to-date with developments but

also able to pioneer their implementation in the classroom (Yulianto et.al., 2024). One of the significant outcomes of the program is the improvement of teachers' ability to keep up with technological developments, where they are equipped with knowledge of new tools such as artificial intelligence (AI), virtual reality (VR) and gamification-based learning.

Furthermore, the program also encourages the development of new skills required to make optimal use of technology. Teachers are taught to use various educational tools and applications, from Learning Management Systems (LMS) to collaborative applications, through practical training that enables them to design online courses and multimedia content (Atikah et.al., 2021). With these skills, teachers will be better prepared to face the challenges posed by technological change. In addition, professional teacher education encourages a proactive attitude among teachers to continuously develop their skills, whether through online courses, webinars or professional communities. This attitude is important as the world of education is always changing, and teachers who are unwilling to adapt risk falling behind in terms of effective teaching methods.

Adaptability also means teachers' ability to create a flexible and responsive learning environment where they can design relevant lessons by utilizing technology. By providing access to online learning resources and facilitating group discussions through apps, teachers can create interactive learning experiences. However, despite the many benefits, challenges remain, such as limited internet access and adequate devices. Professional teacher education programs help teachers identify these challenges, so they can plan teaching strategies that remain effective under less than ideal conditions (Wijaya, 2023). Overall, the ability to adapt to technological change is a crucial skill for teachers in the digital age, contributing to successful teaching and the creation of engaging and interactive learning experiences for students

5. Challenges in Implementation

While professional teacher education programs have been successful in improving teachers' skills and knowledge in the use of educational technology, challenges in its implementation remain a significant issue, especially in environments with limited internet access and devices. Limited internet access is a major challenge faced by teachers, especially in remote or rural areas, where inadequate internet infrastructure can hinder access to online learning resources and collaboration tools. When teachers plan technology-based learning, the fact that students cannot access materials online limits their ability to create interactive learning experiences. In addition to internet access issues, device limitations are also an obstacle that must be faced (Isma, 2023). Students may not have access to the necessary devices, such as laptops or tablets, so inequality in device availability can cause gaps in learning. This hinders teachers' efforts to design inclusive and equitable learning for all students. In this situation, teachers are faced with the challenge of finding ways to enable all students to actively participate despite their limitations (Widyawati & Sukadari, 2023).

Furthermore, the challenge of education infrastructure itself is often a barrier to technology implementation. Many schools in less developed areas may not have adequate facilities to support technology-based learning, such as classrooms equipped with projectors or interactive screens (Latif et.la., 2024). These limitations not only hinder teaching effectiveness but can also negatively affect students' motivation and their learning outcomes. To overcome this challenge, support is needed from relevant parties

to improve education infrastructure and ensure all schools have adequate access to technology.

In addition, the lack of continuous training is a significant challenge. Many teachers may not get regular updates on the latest tools and practices in education technology, which is essential to keep their teaching relevant. Without ongoing support, teachers find it difficult to integrate new technologies into their teaching. Resistance to change from some teachers or school authorities can also create additional barriers. Although training aims to improve understanding and skills in educational technology, not all individuals are ready to switch from traditional methods to more innovative approaches. Therefore, challenges in the implementation of educational technology need to be seriously addressed through collaboration from the government, educational institutions and communities to create an enabling environment for the effective and equitable use of technology

Discussion

The results of this study show that the effectiveness of professional teacher education in developing educational technology skills in the digital era is measured by several important aspects that are relevant to modern challenges and needs. First, improved technological competence is evident in teachers' ability to use digital tools and learning software, as well as online learning platforms. With structured teacher education programs in place, these teachers not only gain a better understanding of technology but are also able to design interactive and engaging learning experiences (Rahayu et.al., 2023). This is in line with the urgent need to have applicable technology skills in the classroom, which is the main focus in the analysis of the effectiveness of training programs (Sembiring et.al., 2024).

Second, the skill of managing online learning is one of the important achievements of professional teacher education. Teachers feel more confident in using Learning Management Systems (LMS) and video conferencing applications to keep students engaged during distance learning. This reflects teachers' adaptation to digital technology and motivation to use it, where the training program plays a role in overcoming resistance and increasing comfort in integrating technology into teaching. Furthermore, observations show an increase in creativity in teaching methods. Teachers who have attended the program are able to develop more engaging materials using presentation, animation and multimedia applications. This supports the shift from conventional teaching to hybrid or online learning, where teachers can more easily adjust the curriculum and teaching methods according to students' needs (Surachman et.al., 2024).

However, challenges in implementation remain a concern. In environments with limited internet access and devices, teachers experience barriers in practicing the skills acquired. This underscores the importance of institutional support and adequate infrastructure to ensure the success of the training. Although professional teacher education programs make a significant contribution to the development of technological skills, the success of this is highly dependent on the availability of technological facilities and ongoing support from educational institutions as well as the government (Hasan et.al., 2024).

Overall, the results of this study show that professional teacher education has a positive impact on preparing teachers to adapt to the digital era. Programs tailored to the needs of modern technology not only help teachers face the challenges of digital learning

but also encourage them to continuously update their skills amidst rapid technological developments. With the right support, professional teacher education can be a strong foundation for the continuous development of technological competence among educators.

CONCLUSION

Based on this research, it can be concluded that professional teacher education significantly improves educational technology skills in the digital era through several key aspects. First, the program successfully improved teachers' technological competence, making them more confident in using digital tools and online learning platforms. Second, skills in managing online learning improved, with teachers able to create engaging content and interact effectively with students. Third, creativity in teaching methods is also awakened, allowing teachers to design more dynamic and interactive materials. However, challenges in implementation, such as limited internet access and devices, remain, indicating the need for more support from institutions and the government. Overall, professional teacher education has had a significant positive impact in preparing teachers to face the challenges of the digital era, with ongoing support needed for this success.

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