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Pedagogical Transformation in the Technological Era: A Qualitative Study of Digital Education Practices in Indonesian Senior High Schools

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Abstract: This study explores the pedagogical transformation driven by digital education technologies in Indonesian State Senior High Schools, particularly in Pamekasan Regency. Employing a qualitative approach, data were collected through in-depth interviews, classroom observations, and document analysis from 15 teachers and 20 students. Thematic analysis was used to identify core patterns and themes. Results reveal significant shifts in the teaching and learning paradigm, where digital tools such as Google Classroom and Zoom enable more flexible, accessible, and student-centered learning. However, challenges such as limited infrastructure, digital skill gaps, and reduced face-to-face interaction persist. The role of educators is evolving from knowledge transmitters to facilitators. Successful implementation of digital education requires robust infrastructure, sustained teacher training, and inclusive policies. Policymakers should prioritize equitable access to digital tools and upskilling programs for educators. Future research should expand geographically and adopt mixed methods to improve generalizability.

Keywords: Digital Education, Digital Literacy, Educational Technology, Pedagogical Transformation, Qualitative Approach

A. Introduction

The digital era has brought about significant changes to various aspects of life, including education. Advances in information and communication technology allow for faster and wider access to information and create more interactive and flexible learning methods. However, this transformation also poses challenges such as the digital divide and the need for adequate digital literacy (Garrison & Vaughan, 2008; Redecker & Punie, 2017). One of the positive impacts of the digital era in education is ease of access to learning resources. Students and teachers can access a wide range of educational materials online, which has previously been difficult to reach. In addition, digital technology enables global collaboration among students from different parts of the world, enriching their perspectives and understanding (Anderson, 2008; Wang et al., 2024). However, the digital era presents challenges in education. One is the gap in access to technology between urban and rural areas. Many regions in Indonesia still

experience difficulties in accessing the Internet and digital devices, which cause differences in the quality of education (Onitsuka et al., 2018; Puspitasari & Ishii, 2016). Many educators and learners lack sufficient readiness for digital transformation, particularly in under-resourced settings (Muyambi & Ramorola, 2025). Low mastery of technology, especially among senior educators, is an obstacle to the implementation of technology-based learning. Students also need good digital literacy skills to optimally utilise technology in the learning process (Cwala, 2022).

Digital technology offers opportunities to improve learning efficiency and effectiveness (Qureshi et al., 2021). Through online learning platforms, the teaching and learning processes can be carried out without time and place restrictions, allowing for greater flexibility for students and teachers. Additionally, digital technology can be used to create more interesting and interactive learning content, thereby increasing students' learning motivation (Barut Tugtekin & Dursun, 2022). However, the integration of technology in education also poses risks such as a lack of student focus due to distraction from digital devices and the potential for decreased social interaction (Haleem et al., 2022). Therefore, a wise approach is needed to implement technology in learning, considering the balance between the use of technology and face-to-face interaction (Stoian et al., 2022).

By understanding the challenges and opportunities offered by the digital age, educators and policymakers can design effective strategies to leverage technology to improve the quality of education, while minimizing the negative impacts that may arise (Gabriel et al., 2022; Zarei & Mohammadi, 2022). While digital technology offers various benefits in education, its implementation is not always seamless. Some of the main issues that have emerged include the gap in access to technology, lack of digital skills among teachers and students, and potential distractions posed by digital devices (Timotheou et al., 2023). In addition, there are concerns that dependence on technology can reduce students' social interactions and character formation (Cockerham et al., 2021). While various studies have examined digital learning in urban contexts or higher education, fewer focus on how digital transformation unfolds in secondary schools in semi-urban and rural Indonesian settings. This research aims to explore qualitative perspectives related to pedagogical transformation in the technological era. This study examines how teachers and students adapt to the integration of technology in the learning process, the challenges they face, and the strategies used to overcome these obstacles. In addition, this study will examine the impact of technology use on classroom dynamics and student learning outcomes.

This study is expected to make a theoretical and practical contribution to digital education in Indonesia and the world. Theoretically, this research adds insight into the dynamics of pedagogical transformation in the digital era, especially in the Indonesian context. Practically, the findings of this study can be used as a reference for educators and policymakers to design and implement effective and inclusive

technology-based learning strategies. In addition, this research is expected to encourage the development of training programs for teachers to improve their digital skills as well as formulate policies that support equal access to technology in education.

B. Methods

Research Approach

The qualitative approach used in this study aims to explore the experiences, perceptions, and views of the research subjects in depth. This method is considered appropriate for understanding pedagogical transformation in the technological era because it can comprehensively explore the context, meaning, and complexity of the research subject's experience (Coronella & Aiken-Wisniewski, 2023; Creswell & Poth, 2018). The qualitative approach allows researchers to explore how teachers and students face challenges and opportunities in implementing digital technology in the educational environment (Khlaif et al., 2023).

Location and Subject of Research

This research was conducted in State Senior High Schools (SMA Negeri) across the Pamekasan Regency, East Java. Pamekasan Regency was chosen as the location of the research because of its geographical representation and infrastructure that reflects the variety of access to educational technology, both in urban and rural areas. As a developing area in the use of educational technology, Pamekasan provides a real picture of the challenges and opportunities in implementing the digital education paradigm. The research location involved State High Schools with different levels of technology implementation, ranging from schools that already have adequate digital infrastructure to those that are still in the early stages of implementing technology in learning (UNESCO, 2020).

The research subjects were teachers and students at the State High School. Teachers who were the subjects of the study had experience using digital technology in learning, with a minimum of one year of work in technology-based teaching. In addition, the subjects of the study were students in grades 10 to 12, with a variety of digital skill levels to provide a comprehensive picture of their experiences in the technology-based learning process. Purposive sampling was used to select 15 teachers and 20 students from several State High Schools in Pamekasan Regency. This selection aims to ensure that the subject is relevant to the research focus and can provide rich data for analysis (Miles et al., 2014).

Data Collection Instruments

The data in this study were collected using three main instruments: in-depth interviews, participant observations, and document analysis. In-depth interviews were conducted to explore the views and experiences of the research subjects related to the use of technology in learning. Participant observation is carried out in the classroom to understand how technology is used in the direct teaching and learning processes. Documents such as lesson plans, digital materials, and school policies have also been analyzed to gain additional insights into the application of digital technology (Babchuk, 2017; Tisdell et al., 2025).

Data Analysis Techniques

Data analysis was performed using thematic analysis methods. The stages of analysis included familiarization with the data, initial coding, theme identification, theme review, and final interpretation. This technique was used to identify relevant patterns, themes, and categories in the data obtained during the study. Thematic analysis was chosen because of its flexibility in exploring the deep meanings of qualitative data, and its ability to describe the complexity of phenomena (Braun & Clarke, 2024).

Validity and Reliability

To ensure the validity and reliability of the data, this study implemented several strategies, such as triangulation, member checking, and trail audits. Triangulation was carried out by comparing data obtained through interviews, observations, and document analysis to ensure consistency and accuracy of the findings. Member checking was conducted by asking the research subjects to review the results of the interviews to ensure that the researcher's interpretation was in accordance with their views. Audit trials are used to document the entire research process systematically, allowing other researchers to evaluate the validity of the findings (Enworo, 2023).

C. Results and Discussion

Key Findings of the Study

This study found that pedagogical transformation in the digital era in State High Schools in Pamekasan Regency has brought about significant changes to teaching and learning methods. One teacher said, “Now I use Google Classroom to give assignments and materials. This makes learning more structured and accessible to students.” Digital platforms such as Google Classroom, Zoom, and other education-based applications have become an integral part of the teaching and learning process. One student also added, “With an app like Zoom, I can follow lessons even when I’m at home, so it's more flexible.” The use of this technology not only improves efficiency, but also allows for more flexible and personalized learning.

One of the main findings was the change in the role of teachers as facilitators. Teachers no longer only act as the main source of knowledge, but also guide students to find and explore information independently through technology. One teacher explained, "My job now is to guide students to think critically and search for information independently. With technology, they can learn more outside of class hours." The role of teachers has shifted from simply conveying information to guiding the learning process. Students are also required to be more active in learning, especially in project-based assignments that utilize digital resources (Bielik et al., 2022).

Additionally, the use of digital technology allows for the development of 21st-century skills such as critical thinking, collaboration, and digital literacy. One student revealed, "The project assignments we worked on with our friends taught us to work in a team and use online resources to search for information. It helps me think more critically." Teachers and students in Pamekasan report that they find it easier to access high-quality learning resources from the Internet, which helps them understand difficult concepts (Mukhlis et al., 2024). However, technological infrastructure limitations, especially in schools located in rural areas, are significant obstacles. One principal said, "In some rural areas, the internet network is unstable, and that is very disruptive to the smooth running of online learning."

Mastery of technology by teachers is a key factor in the success of this transformation. Teachers who have received digital literacy training tend to be more confident about utilizing technology. One teacher commented,' I find it easier to manage classes and deliver materials through digital platforms after attending the training. Without training, I would have had a hard time." By contrast, poorly trained teachers face challenges in effectively composing digital materials and managing online classes. Students in Pamekasan Regency also face obstacles in the technology-based learning process. Many students report that they have difficulty accessing the Internet at home due to network limitations or costs. One student revealed, "At home I don't always have smooth internet access, sometimes I have to find another place to go to class." This shows that a digital divide can affect equality in education. Other findings suggest that, while digital technology offers flexibility, social interaction in face-to-face learning is difficult to replace. One student said, "Online learning is practical, but I feel that there is a lack of emotional support from teachers or friends. Direct interaction provides more comfort." Teachers also stated that they had difficulty monitoring students' progress holistically in online learning. One teacher said, "It's easier for me to see my students' progress when they're learning in class, whereas online I have a hard time monitoring them fully." Despite these challenges, the use of technology in education has created great opportunities for pedagogical innovation. Several schools in Pamekasan have successfully integrated technology into their curriculum, creating a more engaging and relevant learning experience to meet the needs of the times. A principal stated, "We are trying to continue to develop technology in learning. This opens up many opportunities for students to learn in a

more engaging and effective way." This supports the efforts to make education more innovative and adaptive.

Qualitative Perspective Analysis

The results of interviews with teachers showed that pedagogical transformation in the digital era requires a significant change in mindset. Teachers who previously relied on traditional teaching methods must learn to use technology as their main teaching tool (Boonmoh et al., 2021). This adaptation process is often accompanied by frustration due to technical constraints or a lack of adequate training (Abedi, 2024). From a student's perspective, technology provides a more engaging and interactive learning experience. However, students also feel that mastery of technology by teachers greatly affects learning success. The interviewed students revealed that some teachers were still not proficient in using technology, so learning became less effective (Martin, 2021).

Teachers in schools with adequate technology infrastructure show more innovative uses of technology, such as the use of learning videos, interactive simulations, and online discussions. Meanwhile, teachers in infrastructure-limited schools rely more on conventional methods even though they use digital platforms (Adeniran et al., 2023; Zou et al., 2025). Participant observations showed that students were more motivated when given the freedom to explore material independently through technology. However, some students feel that this freedom can be a distraction, especially in the absence of adequate supervision. This shows the importance of balancing flexibility and structure in digital learning (Rapanta et al., 2021). From the analysis of documents, such as lesson plans, it can be seen that schools that have adopted technology have a curriculum that is more integrated with digital skills. These schools also tend to have more routine teacher training programs that help improve teachers' digital pedagogical competencies (Tisdell et al., 2025). Overall, the results of this study show that pedagogical transformation in the digital era requires strong support from the technology infrastructure, teacher training, and policies that support equitable access to technology.

Discussion

The results of this study are consistent with previous findings that show that technology can improve the accessibility and quality of education but also pose new challenges. As indicated by Heredia et al. (2022), technology flexibility is often accompanied by access gaps and digital capabilities. In contrast to studies in developed countries, this study finds that infrastructure constraints remain a major issue in areas such as Pamekasan. This reinforces the importance of investing in digital infrastructure, especially in rural areas, to support comprehensive pedagogical transformation (UNESCO, 2020).

From a policy perspective, this study shows that digital literacy training for teachers should be prioritized. These findings support Sayaf et al. (2022) argument that teachers' ability to use technology effectively significantly affects the success of digital learning. In practice, this study highlights the importance of a balanced approach between the use of technology and face-to-face interaction. Although technology offers various advantages, social interaction remains an important element in the formation of student characteristics (Anderson, 2008). Another implication of this study is the need to develop a curriculum that is more responsive to the current needs. The curriculum should integrate digital skills as a core part of the learning process, as suggested by Falloon (2020). In conclusion, although pedagogical transformation in the digital era in the Pamekasan Regency still faces many challenges, there is a great opportunity to improve the quality of education through inclusive policies, continuous training, and investment in digital infrastructure.

D. Conclusion

This study shows that the transformation of digital-based pedagogy in SMA Negeri Pamekasan Regency has encouraged learning that is more flexible, efficient, and relevant to the needs of the 21st century. Teachers now play the role of facilitators, while students are encouraged to become independent learners by using technology. However, challenges such as the digital divide, infrastructure limitations, and low technological competence of some educators remain the main obstacles. This study provides a new understanding that the success of digital education requires synergy between technology, teacher training, and supportive policies. As a recommendation, teachers are expected to improve digital literacy through continuous training and adopt pedagogical strategies that effectively integrate technology. The government must invest in technological infrastructure in remote areas and provide policies that support the improvement of teacher competence. Further research should explore the long-term effectiveness of technology in learning, expand the scope of the research area, and use quantitative or mixed approaches for more generalized outcomes. The limitations of this study, including the narrow coverage of the area and the lack of a generalized qualitative approach, may be a concern in future studies.

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