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Technological Innovation in Educational Facilities Management: Building a Competitive Learning Environment in the 21st Century at Kuala Kampar 1 Senior High School, Pelalawan Regency

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A B S T R A C T

The management of educational facilities faces challenges, particularly in technology adoption. Many institutions have yet to optimize technology to enhance administration and learning quality. This study aims to identify technological innovations applicable to educational facility management for fostering a competitive 21st-century learning environment. A qualitative research method with descriptive analysis and literature review was used at SMAN 1 Kuala Kampar. The study identifies various innovations, including online education, numerical methods, ICT integration, community-based institutional development, and learning quality enhancement. The evaluation indicates improved management efficiency, learning quality, institutional sustainability, mathematics achievement, project-based learning, and distance learning. Technology-based management models are crucial for global competitiveness, equipping graduates with innovative technological skills.

INTRODUCTION

The 21st century has seen rapid advancements in science and technology, significantly impacting education. Beyond knowledge transfer, education now focuses on developing skills relevant to modern demands (Aver et al., 2021). However, managing educational facilities remains a challenge, particularly in technology integration (Sjahruddin et al., 2022). Many institutions struggle with low technology adoption, inadequate infrastructure, and educators' limited digital proficiency (Malik, 2018). This issue extends globally, with developing countries facing limited access to stable internet and digital tools (Bascopé et al., 2019), while developed nations contend with high costs, resistance to change, and data security concerns (Care et al., 2018). Ineffective facility management can hinder learning experiences, widen educational gaps, and leave graduates unprepared for a digital workforce (Nguyen et al., 2023). SMAN 1 Kuala Kampar, a remote secondary school, exemplifies these challenges, as inadequate technological infrastructure limits its ability to provide interactive and competitive learning environments. Addressing this issue requires strategic technological innovation to bridge the educational divide and enhance facility management.

This study explores technological innovation strategies to improve educational facilities at SMAN 1 Kuala Kampar, integrating qualitative analysis and literature review to offer a comprehensive perspective. Prior research highlights the role of technology in education, from enhancing science learning (Baktiarso et al., 2023) to infrastructure improvements (Fitriani et al., 2022) and gamification in mathematics education (Permastasari et al., 2022). Additionally, studies on e-learning during the COVID-19 pandemic emphasize technology's transformative potential (Habibah et al., 2020). By synthesizing these findings with local context, this study aims to develop a technology-based facility management model that fosters a competitive learning environment. The findings will provide practical recommendations for policymakers and stakeholders to optimize technology use in educational facility management, ultimately improving education quality in Indonesia and preparing graduates for global competition.

METHODS

This study employs a descriptive qualitative research method using a case study approach and literature review (Agustianti et al., 2022). Data collection methods include: (1) participant observation, where researchers directly observe school conditions; (2) in-depth interviews with key stakeholders, including the principal as the institutional leader, teachers, and student representatives; and (3) document analysis, which involves collecting research-related documentation such as photographs, school records, letters, and other supporting materials (Creswell, 2017).

Data analysis in qualitative research follows a structured process, beginning with planning, followed by observation during the study, and concluding with data processing. According to Miles and Huberman (1992) in Charismana et al. (2023), qualitative data analysis involves three key stages: data reduction, where

irrelevant information is filtered out; data display, which organizes findings into a structured format; and conclusion drawing/verification, where final interpretations and verifications are made to ensure validity.

RESULTS AND DISCUSSION

A. Identification of Technological Innovations Applicable to Educational Facility Management

Various technological innovations can be implemented to enhance the efficiency, effectiveness, and quality of learning at SMAN 1 Kuala Kampar. One relevant innovation is the integration of technology in online education. According to Adeline and Irwansyah (2022), technology has become an integral part of online learning, offering new alternatives to understand its significance in education. This highlights technology's crucial role in transforming education toward a more advanced system. A specific example of technological innovation is the application of numerical methods, such as the Gauss-Seidel Method, in solving electrical circuit problems, as demonstrated by Mutoharoh et al. (2022). Implementing such numerical methods at SMAN 1 Kuala Kampar not only optimizes problem-solving approaches but also expands opportunities for broader technological applications in education. Furthermore, integrating Information and Communication Technology (ICT) into education, as discussed by Salsabila et al. (2023), enables students to master various fields of knowledge and enhances their competitiveness in an increasingly challenging educational landscape. By leveraging ICT, educational facility management can become more efficient and effective in delivering learning materials to students.

Community-based institutional development for Education 4.0, as proposed by Wuisan and Mariyanti (2023), is another relevant innovation in managing educational facilities. This approach emphasizes collaboration between corporations, governments, and academia to improve education quality by utilizing technology as a key enabler (Meier, 2021). Additionally, technology adoption can enhance the quality of bold and adaptive learning, as highlighted by Fania et al. (2021). Optimally utilizing technology in education provides wider access to knowledge while making learning more effective and efficient. In the context of facility management, applying humanistic learning theory is essential in designing educational technologies that align with students' learning needs, ensuring a more targeted and effective approach (Boiliu et al., 2022). Moreover, considering the role of technology in education within the globalization era, as discussed by Lestari (2018), is crucial. Technology not only supports learning but also serves as a systematic tool to achieve desired educational outcomes (González-Pérez & Ramírez-Montoya, 2022). Based on these references, key technological innovations in educational facility management include numerical methods in education, ICT integration, community-based institutional development, enhanced adaptive learning, humanistic learning theory applications, and technology's role in globalization. Implementing these innovations will make

educational facility management more efficient, effective, and responsive to the dynamic developments in the education sector.

B. *Evaluation of the Impact of Technology Implementation on Management Efficiency and Learning Quality*

Assessing the impact of technology implementation at SMAN 1 Kuala Kampar is essential in today's educational landscape. Research has highlighted various aspects of this issue. For instance, Sulistyadewi et al. (2023) emphasize how technological innovation enhances organizational efficiency, a concept applicable to education, where technology streamlines administrative tasks, optimizes resource allocation, and improves overall efficiency. Similarly, Ikrimah et al. (2022) discuss the role of technology in mathematics education to strengthen character development in the post-new-normal era. Integrating information technology into learning materials enhances educational quality, fostering both academic and character growth among students. Effendi et al. (2020) further support technology-driven learning by demonstrating the effectiveness of ICT-based teaching in electromechanical subjects, proving its potential to enhance learning outcomes in vocational education. Additionally, Ghasya et al. (2021) highlight the viability of remote learning in mathematics education during the COVID-19 pandemic, stressing the need for adaptive strategies to ensure continuity in education during crises (Hordieiev et al., 2023). Meanwhile, Kamilia and Wahyudin (2021) evaluate e-learning in higher education, revealing that while it holds significant potential, its full benefits remain underutilized, indicating room for improvement in integrating technology effectively into learning environments.

Project-based learning leveraging information technology also contributes to educational advancement. Arifiyanti and Wulansari (2022) demonstrate how this approach enhances SME competitiveness, benefiting both students and participating businesses. Furthermore, Septantiningtyas (2018) examines the impact of Google Classroom-based distance learning on student performance, highlighting its positive influence on academic outcomes and learning engagement (Kochetkov, 2022). These findings underscore the transformative role of technology in education, from improving management efficiency to enhancing learning experiences. By strategically and effectively adopting technological advancements, educational institutions can unlock new opportunities to elevate learning standards and outcomes.

C. *Development of a Technology-Based Educational Facility Management Model to Enhance Learning Environment Competitiveness in the 21st Century*

Enhancing facility management through technology at SMAN 1 Kuala Kampar is essential for fostering a competitive 21st-century learning environment. Majdi (2023) and Watuseke et al. (2022) emphasize the need for educational institutions to adapt to global changes by applying learning organization principles. Adaptive management strategies, such as those explored by Gunawan et al. (2021) in SMEs and Utama (2021) in inclusive education, offer valuable insights for improving facility management in schools.

Technology integration plays a vital role in optimizing educational management. Digital learning tools like Microsoft PowerPoint (Putri & Prastowo, 2021) and advanced frameworks like MVVM (Rismayani et al., 2022) enhance efficiency and engagement. Additionally, Wulandari et al. (2022) highlight the importance of a high-quality learning environment, reinforcing the need for both technological and environmental improvements. By implementing adaptive strategies, leveraging technology, and ensuring conducive learning conditions (Lok et al., 2021), SMAN 1 Kuala Kampar can develop an innovative and competitive educational facility management model.

CONCLUSIONS AND RECOMMENDATIONS

Based on research findings at SMAN 1 Kuala Kampar, this study concludes that technological innovations in educational facility management—such as online learning, numerical methods, ICT integration, community-based institutional development, and learning quality enhancement—can be effectively implemented. The evaluation of technology adoption highlights improvements in management efficiency, learning quality, institutional sustainability, academic performance, project-based learning, and distance education.

Developing a technology-based facility management model is essential for enhancing the competitiveness of 21st-century learning environments, emphasizing adaptability, technology integration, and learning environment quality. This study is expected to contribute significantly to improving education in Indonesia, preparing graduates to compete globally through innovative technology adoption.

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