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Implementation of Infrastructure and Facilities Management through the Smart Classroom 5.0 Program in Supporting Digital-Based Learning in Vocational High Schools

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Abstract
The fast growth of digital technology is prompting vocational schools to enhance the quality of education by improving their teaching resources and managing their facilities more effectively. This study seeks to examine how the Smart Classroom 5.0 Program is used to manage facilities and infrastructure, and how this supports digital-based learning in vocational high schools. This study used a qualitative method known as digital ethnography, also referred to as netnography. Data were gathered from official news announcements, school websites, social media pages, and digital documents made available by PT Tera Data Indonusa Tbk (Axioo) and SMK Islam Ruhama. The data that was gathered was examined through an interactive model that involves reducing the data, presenting it in a clear manner, and then forming conclusions based on the analysis. The results show that the introduction of Smart Classroom 5.0 has gone through four management phases: planning, purchasing, using, and maintaining and improving the educational facilities and infrastructure. The program offers a comprehensive digital learning environment that includes interactive screens, laptops, classroom management tools, curriculum based on real-world industries, and learning technologies enhanced by Artificial Intelligence. Working together with schools, industry, government, higher education institutions, and international partners plays a key role in ensuring that digital learning remains sustainable over time. This study finds that managing facilities and infrastructure effectively, with input from various stakeholders, is crucial for enhancing digital learning and raising the standard of vocational education.

Keywords: *digital learning; facilities and infrastructure management; netnography; smart classroom 5.0; vocational high school*

INTRODUCTION

Digital transformation has brought significant changes to various aspects of life, including education. The development of information and communication technology encourages schools to utilize digital technology in learning, making the learning process more effective, interactive, and aligned with contemporary needs. In this context, schools must not only focus on providing conventional learning facilities but also be capable of managing digital-based facilities and infrastructure as part of efforts to improve the quality of educational services. Therefore, the management of infrastructure and facilities becomes a crucial aspect in supporting the success of digital transformation within the school environment (Suranto et al., 2022). Infrastructure and facilities management encompasses a series of actions including planning, procurement, utilization, maintenance, inventory recording, and disposal of educational facilities in an effective and efficient manner. Proper management fosters a comfortable learning atmosphere, thereby enhancing the quality of the learning process and achieving educational objectives more effectively. Alongside the advancement of digital technology, the concept of infrastructure and facilities management has also evolved; it is no longer solely oriented toward physical facility provision but also encompasses the integration of digital devices, internet networks, application-based learning systems, and interactive

learning media (Nugroho et al., 2022; Suranto et al., 2022). An example of innovation in managing digital-based learning facilities is the implementation of the Smart Classroom. A Smart Classroom is a learning space concept that integrates hardware, software, internet networks, and digital learning systems to create a more interactive, collaborative, and adaptable learning experience in response to technological advancements. Studies indicate that the implementation of Smart Classrooms not only improves learning effectiveness but also strengthens student engagement and supports the integrated management of technology-based learning (Farwati & Arifin, 2023; Kaur et al., 2022).

As part of the effort to support vocational education in Indonesia, PT Tera Data Indonusa Tbk (Axioo), through the Smart Classroom 5.0 Program, presents a digital learning ecosystem that integrates interactive displays, computer devices, class management systems, industrial curricula, and Artificial Intelligence (AI)-based learning. This program is a collaboration among corporations, the government, and schools to enhance students' skills, ensuring they are better prepared to meet future employment demands. The existence of these facilities demonstrates that progress in digital transformation in schools relies not solely on the presence of technology, but also on how schools effectively manage these infrastructures and facilities so they can be continuously utilized in the teaching and learning process. Although numerous studies have discussed infrastructure and facilities management as well as the implementation of Smart Classrooms, the majority of these studies predominantly focus on the digital school concept or the effectiveness of technology use in the teaching and learning process. Research that specifically analyzes the implementation of infrastructure and facilities management through the Smart Classroom 5.0 Program as a supporting strategy for digital-based learning in Vocational High Schools remains relatively limited. Therefore, this study aims to describe the implementation of infrastructure and facilities management through the Smart Classroom 5.0 Program in supporting digital-based learning in Vocational High Schools, aiming to contribute to the development of technology-based educational facility management practices in the era of digital transformation.

METHOD

This study employed a qualitative approach utilizing a non-participatory netnography (*passive netnography*) method. The netnography method is an extension of ethnography applied to the digital environment to understand social phenomena through various digital traces published on the internet. In its development, netnography is not only conducted by researchers actively engaging in an online community, but it can also be performed by observing publicly available digital artifacts. However, researchers must continuously pay attention to the context, research ethics, and a systematic data interpretation process (Gambetti & Kozinets, 2022; Kozinets & Gretzel, 2024). This study utilized this approach to examine the implementation of infrastructure and facilities management through the Smart Classroom 5.0 Program in supporting digital-based learning in Vocational High Schools.

The research data sources were acquired from various officially published digital media, such as school social media posts, the social media of PT Tera Data Indonusa Tbk (Axioo), online news, photo and video documentation of activities, and other information related to the implementation of the Smart Classroom 5.0 Program. Data were selected using a purposive sampling technique, considering the relevance of the information to the research focus, namely the implementation of digital-based educational infrastructure and facilities management. Utilizing diverse digital sources aimed to obtain more comprehensive information regarding the management of technology-based learning facilities (Kozinets, 2022). Data collection was conducted through online observation of digital artifacts available on social media platforms and official online media. The researcher identified, collected, classified, and documented various posts containing information regarding the planning, procurement, utilization, maintenance, and evaluation of the Smart Classroom 5.0 facilities. Furthermore, the researcher compiled digital field notes as part of the data interpretation process, ensuring that every piece of acquired information could be traced back to its original source (Kozinets & Gretzel, 2024).

RESULTS AND DISCUSSION

Planning of Smart Classroom 5.0 Infrastructure and Facilities

Based on observation results from official news, websites, and the official social media of SMK

Islam Ruhama and PT Tera Data Indonusa Tbk (Axioo), the implementation of the Smart Classroom 5.0 Program was initiated through a planning process involving various stakeholders, namely the school, the industrial sector, the regional government, the Ministry of Primary and Secondary Education, Universitas Muhammadiyah Prof. Dr. Hamka (UHAMKA), and the Embassy of the People's Republic of China. This collaboration demonstrates that the provision of digital-based learning infrastructure and facilities was systematically designed to support the quality improvement of vocational education. The observation results also indicated that the primary objective of implementing the Smart Classroom 5.0 is to create a learning environment that integrates digital technology with the needs of the industrial sector. This planning aligns with the concept of infrastructure and facilities management, which positions the planning stage as the foundation for determining facility needs to successfully support the achievement of learning objectives (Suranto et al., 2022).

Table 1. Digital Evidence and Thematic Coding of Smart Classroom 5.0 Implementation

Code	Theme	Digital Evidence	Interpretation
D1	Planning	Program publication and multi-stakeholder collaboration	Planning is conducted collaboratively
D2	Procurement	Documentation of the Smart Classroom 5.0 package	Procurement takes the form of a digital facility ecosystem
D3	Utilization	Documentation of digital device utilization	Facilities are utilized for interactive learning
D4	Maintenance	Publication of the Axioo Class Program development	Sustainability is maintained through program development
D5	Development	Publication of training and collaboration	Facility management is accompanied by human resource development
D6	Collaboration	News/posts of school-industry collaboration	Digital transformation is supported by multiple parties

The procurement was conducted by providing one Smart Classroom 5.0 package to SMK Islam Ruhama. Based on the acquired information, the available facilities encompass interactive digital displays, laptops, automated class management systems, an industry-based curriculum, Artificial Intelligence (AI)-based learning tools, and various other supporting devices that formulate a comprehensive digital learning ecosystem. These facilities were created to support a more interactive learning process capable of adapting to technological advancements. In addition to providing learning devices, the research results demonstrated that the procurement of Smart Classroom 5.0 is also equipped with industrial curriculum support as part of Axioo's long-term commitment to developing technology-based vocational education. These findings indicate that the procurement of facilities did not focus solely on the provision of physical hardware but also involved the establishment of an integrated digital learning ecosystem (Kaur et al., 2022).

Utilization of Smart Classroom 5.0 Infrastructure and Facilities

Based on observations of various official digital sources, the Smart Classroom 5.0 facilities were utilized in the teaching and learning process by leveraging interactive displays, computers, class management systems, and artificial intelligence-based learning tools. The presence of these facilities enables teachers and students to utilize digital technology as a more engaging and interactive learning tool. Furthermore, this program also assists in the implementation of an industry-aligned curriculum, allowing students to acquire learning experiences that are more attuned to the needs of the professional world. These findings demonstrate that the utilization of Smart Classroom 5.0 functions not merely as a learning tool but also serves as a method to enhance students' digital skills. The utilization of integrated technology in the learning process is one of the primary characteristics of a smart classroom, capable of creating a more active and collaborative learning experience (Kaur et al., 2022). The research results demonstrated that the implementation of Smart Classroom 5.0 did not culminate merely at the stage of providing learning facilities. Based on information published through

official media, PT Tera Data Indonusa Tbk (Axioo) continuously expands the Axioo Class program, which has encompassed more than 1,300 schools and higher education institutions in Indonesia, aiming to add 100 new schools by 2025. This program indicates an effort to maintain the sustainability of facility utilization through industrial curriculum development, training, and continuous collaboration with educational institutions. Moreover, observation results revealed vocational training plans involving collaborations between universities and companies in China as part of the effort to improve students' competencies. This demonstrates that efforts to sustain the management of infrastructure and facilities are conducted not solely by maintaining existing hardware, but also through human resource development to ensure the available facilities can be utilized optimally (Suranto et al., 2022).

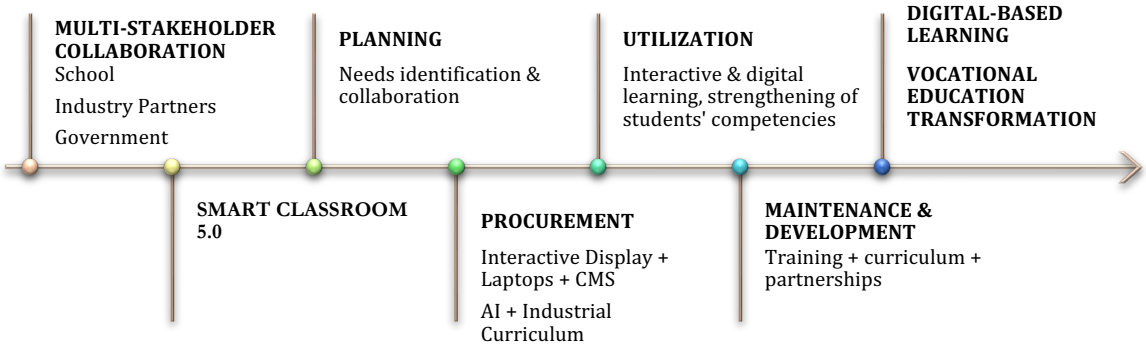


Figure 1. Implementation Model of Smart Classroom 5.0-Based Educational Facilities Management

Summary of Implementation Results

Generally, the research results indicated that the implementation of infrastructure and facilities management was conducted through various stages, namely the planning, procurement, utilization, and development of digital-based learning facilities via the Smart Classroom 5.0 Program. The program's implementation demonstrated harmonious collaboration among the school, government, industrial sector, and international partners in building a learning ecosystem that drives changes in vocational education. Based on observations of various official digital sources, Smart Classroom 5.0 not only provided modern learning facilities but also offered support in the form of industrial curricula, vocational training, and the development of students' digital competencies to support digital-based learning in Vocational High Schools.

Table 2. Synthesis of Smart Classroom 5.0 Implementation

Management Aspect	Form of Implementation	Facilities / Program	Impact on Learning
Planning	Multi-stakeholder collaboration	Program publication and multi-stakeholder collaboration	Alignment of facilities with vocational needs
Procurement	Provision of a digital ecosystem	Interactive displays, laptops, CMS, AI	A more interactive learning environment
Utilization	Technology integration in learning	Digital and AI devices	Strengthening of digital competencies
Maintenance	Development and training	Axioo Class Program	Sustainability of facility utilization
Development	Partnerships and industrial curriculum	Vocational training & industrial curriculum	Alignment of competencies with the professional world

Infrastructure and Facilities Planning in Supporting Digital-Based Learning

The research results demonstrated that the implementation of Smart Classroom 5.0 commenced with a planning stage involving various engaged stakeholders, including the school, the industrial sector, the government, higher education institutions, and international partners. These findings indicate that the planning of infrastructure and facilities was not conducted in isolation, but rather through a collaborative approach that considered learning needs and technological advancements. This planning served as a crucial foundation in determining the types of facilities to be provided,

ensuring their alignment with digital-based learning objectives. These findings align with the assertion by Suranto et al. (2022) that the planning stage constitutes the first function in infrastructure and facilities management, playing a pivotal role in determining the effectiveness of the procurement and utilization of educational facilities. Comprehensive planning assists schools in providing facilities corresponding to learning needs, thereby enhancing the quality of provided educational services. Furthermore, Hazimah et al. (2022) emphasized that learning success is heavily influenced by the synchronization between curriculum management and infrastructure management as an integrated system. Based on the research results, the collaboration among parties during the planning phase demonstrated that the digital transformation process in schools relies not solely on the school's ability to provide infrastructure independently but also requires assistance from the government and the industrial sector. This condition illustrates a paradigm shift in infrastructure and facilities management, moving from a conventional approach toward collaborative management that is more adaptive to technological developments.

Procurement of Smart Classroom 5.0 as a Digital Learning Ecosystem

The research results indicated that the procurement of Smart Classroom 5.0 did not merely consist of providing learning devices such as laptops and interactive displays; it also encompassed class management systems, industry-based curricula, and technologies utilizing Artificial Intelligence. This finding demonstrates that the applied smart classroom concept is not solely about supplying digital devices but also about creating a comprehensively integrated learning ecosystem. These findings are consistent with the study by Kaur, Bhatia, and Stea (2022), which explained that a smart classroom is the integration of hardware, software, communication networks, learning systems, and supporting technologies working cohesively to enhance learning effectiveness. The implementation of smart classrooms is insufficient if it only provides technology; it must also be capable of integrating this technology with appropriate learning and classroom management strategies. Consequently, the procurement of Smart Classroom 5.0 in this study signifies the evolution of infrastructure and facilities management from focusing on physical facility provision toward the development of a more complete and comprehensive digital learning system. This serves as a supporting factor in transforming vocational education toward learning that is more adaptive to technological advancements.

Utilization of Smart Classrooms in Supporting Digital-Based Learning

Based on the research results, Smart Classroom 5.0 was utilized as a learning tool enabling teachers to integrate digital devices, interactive learning systems, and artificial intelligence technology into teaching and learning activities. Moreover, the utilization of these facilities also aimed to strengthen the implementation of the industrial curriculum, ensuring students acquired learning experiences more relevant to the demands of the professional world. These findings reinforce the research by Kaur et al. (2022), which stated that smart classrooms possess the capability to increase student engagement, strengthen communication between teachers and learners, and foster a more dynamic learning atmosphere by leveraging digital technology. Smart classrooms also offer flexibility in delivering subject matter and assist in building essential 21st-century competencies. The results of this study indicate that the successful implementation of Smart Classroom 5.0 depends not only on the presence of digital devices but also on how these facilities are utilized in the teaching and learning process. Therefore, the task of infrastructure and facilities management is not limited to facility provision but also entails ensuring that all these facilities are utilized optimally to achieve learning objectives.

Sustainability of Infrastructure and Facilities Management

This study demonstrated that the implementation of Smart Classroom 5.0 did not conclude merely at the equipment purchasing stage. Axioo continuously strives to expand through the Axioo Class program, vocational training, industrial curriculum enhancements, and increased collaborations with various schools across Indonesia. These findings indicate that sustainability is a critical element in managing digital-based educational infrastructure and facilities. This condition aligns with the smart classroom concept proposed by Kaur et al. (2022), stating that the success of a smart classroom depends on continuous technological advancements, the improvement of user capabilities, and sustainable management support. A smart classroom is not simply a learning space equipped with digital tools, but a system that must be continuously updated in accordance with technological developments and learning needs. Thus, the research results demonstrate that infrastructure and

facilities management in the Smart Classroom 5.0 Program have shifted toward the concept of *continuous improvement*—management that does not stop at facility provision but also encompasses the competency development of teachers and students, as well as partnerships with the industrial world.

Implications of Smart Classroom Implementation for Vocational Education

Generally, the research results indicated that the implementation of infrastructure and facilities management through the Smart Classroom 5.0 Program had a positive impact on enhancing digital-based learning in Vocational High Schools. This implementation demonstrated the integration of facility management, industrial curricula, digital technology utilization, and the improvement of students' capabilities. The findings of this study affirm that digital transformation in schools is inadequate if it merely provides technological devices; it requires planned, integrated, and sustainable infrastructure and facilities management. The practical implication of this research highlights the importance of developing collaborations among schools, the government, and the industrial sector in constructing a digital learning ecosystem. This aims to improve the quality of vocational education and produce graduates ready to meet the demands of the professional world.

CONCLUSION

This study aimed to analyze how the Smart Classroom 5.0 program was utilized in managing infrastructure and facilities to support the digital-based learning process in Vocational High Schools. The research results demonstrated that the program was systematically executed through various stages, including planning, procurement, utilization, as well as the maintenance and development of infrastructure and facilities. This program was implemented through collaborations among the school, the industrial sector, the government, higher education institutions, and international partners, enabling the provision of digital learning facilities aligned with vocational education needs. These findings indicate that well-planned infrastructure and facilities management is a crucial factor in enhancing the effectiveness of digital-based learning (Suranto et al., 2022). The implementation of Smart Classroom 5.0 not only introduced technological devices but also created a learning ecosystem that integrated industrial curricula, training, digital technology utilization, and student competency enhancement. Therefore, this study demonstrates that successful digital learning implementation in Vocational High Schools requires integrated infrastructure and facilities management alongside collaboration between the school and the industrial sector. These findings align with the smart classroom concept, which emphasizes the importance of integrating technology, learning management, and human resource development in creating an effective learning environment (Kaur et al., 2022). This study still possesses several limitations as the utilized data originated from official news, websites, and social media, thus remaining unable to directly depict the experiences of the program implementers in the schools. Consequently, it is recommended to conduct further research using a direct approach through interviews, field observations, or case studies in schools implementing the Smart Classroom 5.0 Program to acquire a more comprehensive understanding of the extent to which infrastructure and facilities management impacts the support of digital-based learning.

DECLARATION OF GENERATIVE AI

During the preparation of this work, the authors utilized Grammarly was employed to proofread the manuscript and enhance the overall language quality. Following the use of these tools, the author(s) thoroughly reviewed and edited the content as needed and takes full responsibility for the final content and integrity of the publication.

CONFLICTING INTEREST STATEMENT

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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