**Buletin Edukasi Indonesia (BEI)**
DOI: 10.56741/IISTR.bei.001843

**E-ISSN 2962-1674**
**P-ISSN 2962-5742**






# Facility Management in Supporting Scientific Writing Learning at SMAN 10 Surabaya

**[1]Nuphanudin, [1]Nayla Dea Adelia, [1]Raya Naila Feisya, [1]Zulfa Sekar Arum**
Corresponding Author: * nuphanudinnuphanudin@unesa.ac.id
[1] Education Management, Universitas Negeri Surabaya, Surabaya, Indonesia

**Article submitted:** 12 December 2025
**Revised:** 17 December 2025
**Accepted:** 13 February 2026

## Abstract

*This study explores how facility and infrastructure management support scientific writing learning at SMAN 10 Surabaya. Scientific writing is a critical academic competence that requires not only cognitive and literacy skills but also an enabling learning environment supported by adequate educational resources. Using a descriptive qualitative approach, this research investigated the availability of facilities, the roles of teachers and students in facility utilization, and collaborative management strategies that contribute to learning quality improvement. Data were collected through semi-structured interviews with teachers, guidance counselors, school administrators, and students, complemented by direct observations of facility use and document analysis of school inventory and development plans. The findings reveal that SMAN 10 Surabaya provides baseline infrastructure, including a school library, computer laboratories, internet access, and digital learning resources, which collectively support students' academic writing practices. However, limitations remain in terms of updated references, computer availability, and digital access consistency. Teachers play a pivotal role as facilitators by integrating digital academic tools such as Google Scholar, Mendeley, and online mentoring platforms to scaffold students' writing development. Students actively engage in constructivist learning practices through exploration, collaboration, and iterative writing revisions. Furthermore, facility governance is strengthened through participatory planning, transparent procurement, routine maintenance, and continuous evaluation involving multiple stakeholders. Overall, the study concludes that strategic, collaborative, and adaptive facility management functions as a key enabler of scientific writing learning and educational quality enhancement.*

***Keywords:*** *Constructivist Approach; Educational Quality Assurance; Facility Management; School Infrastructure; Scientific Writing Learning; Secondary Education; SMAN 10 Surabaya.*

## Introduction

Facilities and infrastructure management is a critical component of educational governance that plays a central role in ensuring the effectiveness of teaching and learning processes. Educational facilities include classrooms, laboratories, libraries, and digital learning technologies, which collectively provide the physical and virtual environments necessary for academic engagement [1], [2]. In addition, facility management encompasses systematic planning, maintenance, and resource optimization to ensure that learning spaces remain functional, equitable, and aligned with pedagogical goals [3], [4].

In the context of scientific writing learning at the secondary school level, the availability and strategic management of facilities are particularly important. Scientific writing requires students to access scholarly references, utilize digital tools, and engage in structured inquiry-based activities. Resources such as computer laboratories, literacy rooms, and access to online academic repositories significantly enhance students' capacity to develop scientific literacy and produce academically valid

written work [5], [6]. Furthermore, digital learning environments have been shown to increase academic engagement and improve higher-order writing outcomes when effectively integrated into instruction [7], [8].

Although numerous studies have examined the importance of infrastructure in supporting general learning achievement, research that specifically focuses on how facility and infrastructure management support scientific writing learning remains limited. Existing literature often emphasizes physical provision rather than management strategies, utilization patterns, and their synergy with research-based literacy development. This gap is significant because infrastructure effectiveness depends not only on availability but also on how schools govern, optimize, and sustain learning resources over time [9], [10].

Initial observations at SMAN 10 Surabaya indicate that the school possesses various supporting facilities, including computer laboratories, a digital library, and relatively stable internet connectivity. However, the utilization of these facilities has not been maximized to support scientific writing learning. Literacy programs and scientific writing training remain incidental rather than systematically integrated into facility governance structures. Teachers and students continue to face obstacles such as limited access to peer-reviewed digital references, insufficient multimedia tools for writing guidance, and the absence of centralized platforms for publishing student research outputs.

The effectiveness of scientific learning in secondary education is increasingly dependent on digital infrastructure readiness and technology-supported learning systems [11], [12]. Planned and integrated infrastructure management has also been linked to improvements in research-based and project-based learning environments [13], [14]. Moreover, collaboration between school leadership, teachers, and administrative stakeholders is essential for optimizing facility utilization and sustaining learning quality [15], [16]. Nevertheless, in-depth research examining facility management strategies specifically in the context of scientific writing learning within Indonesian public high schools remains scarce.

This research is important because its findings are expected to inform the development of effective facility management models that support science-based literacy learning in secondary education. By understanding how SMAN 10 Surabaya manages and utilizes educational infrastructure to foster scientific writing competence, other schools may adopt similar good practices. In addition, this study contributes to educational management literature by expanding the exploration of infrastructure governance in the context of student academic literacy development. Based on this background, the main research question is: What are the strategies for managing facilities and infrastructure to support scientific writing learning at SMAN 10 Surabaya?

## Literature Review

### A. Theory of Educational Facilities and Infrastructure Management

Educational facility management is generally conceptualized through four primary phases: planning, procurement, maintenance, and evaluation. These stages are intended to ensure that learning resources effectively support instructional goals and remain sustainable over time. Needs-based planning is considered essential because it improves efficiency by aligning facility acquisition with

school priorities and budget constraints [3], [2]. Procurement processes utilize multiple funding sources, including governmental support and community contributions, to ensure adequate infrastructure availability. Once facilities are provided, routine maintenance becomes necessary to ensure usability and prevent disruptions to learning activities. Periodic evaluation is also critical for assessing the suitability of existing infrastructure and guiding policy decisions related to facility improvement and renewal [1], [4]. In the context of scientific writing learning, effective facility management ensures that students can access academic literacy resources such as libraries, ICT laboratories, and digital repositories. Studies have shown that infrastructure adequacy significantly influences student motivation, engagement, and academic achievement [17], [18].

**B. Constructivism Theory in Learning**

Constructivist learning theory emphasizes that students develop knowledge through active engagement, social interaction, and meaningful experiences. Learning environments that support collaboration, inquiry, and experiential practice play a crucial role in shaping academic competencies [19], [13]. Adequate infrastructure, such as computer laboratories and access to digital academic platforms, enables students to experiment, reflect, and engage in collaborative writing practices. Technology-supported scaffolding has also been shown to improve student writing outcomes, particularly when guided by teacher facilitation [7], [8]. Thus, scientific writing competence develops most effectively when students are supported by both physical learning environments and digital infrastructures that foster inquiry-based learning and peer collaboration [20], [21].

**C. Theory of Quality Assurance in Education**

Educational quality assurance frameworks emphasize that learning quality improvement requires optimal resource governance, including facility management and infrastructure sustainability. Quality is increasingly evaluated through service effectiveness, institutional trust, and responsiveness to stakeholder needs [9], [10]. Service quality research demonstrates that infrastructure adequacy and institutional support contribute significantly to student satisfaction and academic engagement [15], [22]. Furthermore, the integration of digital transformation into educational services has become essential for ensuring sustainable academic quality in contemporary schooling systems [6], [23].

## Material and Methods

**A. Research Design**

This study employed a descriptive qualitative approach to obtain an in-depth understanding of how the management of school facilities and infrastructure supports the learning of scientific writing. A qualitative design was considered appropriate because it enables researchers to explore phenomena in their natural settings, capture participants' perspectives, and understand processes as they unfold in real contexts [24]. Through this approach, the researcher was able to observe actual school conditions, listen to the experiences of key stakeholders, and interpret how facility management practices contribute to academic learning outcomes.

The study was conceptually grounded in three major theoretical frameworks: (1) educational facilities and infrastructure management, (2) constructivist learning theory, and (3) educational quality

assurance. These frameworks guided the formulation of the research focus, the development of data collection instruments, and the interpretation of findings. Educational facility management theory emphasizes systematic processes of planning, procurement, maintenance, and evaluation of school resources to ensure their effective use in supporting learning activities [25], [26]. Constructivist learning theory highlights the importance of learning environments that encourage active engagement, collaboration, and experiential learning [27], [28]. Meanwhile, quality assurance theory provides a lens to assess how facility management contributes to sustainable improvements in educational quality and learning effectiveness [29], [30].

Based on the educational facilities and infrastructure management framework, this study examined four key stages: planning, procurement, maintenance, and evaluation. During the planning stage, the researcher explored how schools identified facility needs to support scientific writing learning, including priority setting and budget allocation. At the procurement stage, the study investigated funding sources such as government support, school operational funds, or external contributions, as well as procedures for providing relevant learning resources. The maintenance stage focused on how schools ensured that facilities remained functional through routine care and monitoring. Finally, the evaluation stage examined how schools assessed the effectiveness of existing facilities and implemented follow-up strategies when limitations or gaps were identified [25], [31].

In line with constructivist perspectives, the study also highlighted the role of facilities in supporting meaningful and student-centered learning processes. Observations were conducted to understand how students utilized classrooms, libraries, and computer laboratories during scientific writing activities. Particular attention was given to how these environments facilitated learning through peer discussions, group work, direct practice, and teacher guidance. The study further examined how access to technology and learning resources supported students in gradually developing academic writing competencies [28], [32].

Furthermore, drawing on educational quality assurance theory, this research assessed the extent to which facility and infrastructure management contributed to improving learning quality. The analysis focused on the alignment of facilities with educational standards, student needs, and the objectives of scientific writing instruction. Within this framework, facility management was not only viewed in terms of physical availability, but also in terms of its functional contribution to creating an effective, supportive, and sustainable learning environment [29], [33].

**B. Data Collection Techniques and Instruments**

Data were collected through three primary techniques: semi-structured interviews, direct observations, and document analysis. Semi-structured interviews were conducted with teachers, school administrators, and staff responsible for facility management and scientific writing instruction. An interview guide was developed based on the theoretical frameworks, covering themes such as facility planning, procurement procedures, utilization in learning, and perceived challenges. Each interview lasted approximately 45–60 minutes and was audio-recorded with participants' consent to ensure accuracy and completeness of the data [34].

Direct observations were carried out to examine the physical condition and utilization of facilities such as classrooms, libraries, and ICT laboratories. An observation checklist was used to document aspects including availability, accessibility, functionality, and student engagement during scientific writing activities. Observations were conducted over a period of several weeks to capture routine practices rather than isolated events [35], [36].

In addition, document analysis was employed to strengthen the rigor of the study. Relevant documents included school facility inventories, maintenance reports, budget allocation records, lesson plans, and school academic policy documents. Document review provided supplementary evidence and enabled triangulation of findings from interviews and observations [37].

**C. Data Analysis and Trustworthiness**

The collected data were analyzed descriptively using thematic analysis. The researcher systematically organized the data through coding, categorization, and interpretation to identify recurring patterns related to facility management practices and their contribution to scientific writing learning [38]. To ensure validity and trustworthiness, triangulation was applied by comparing evidence across interviews, observations, and documents. Member checking was also conducted by sharing preliminary interpretations with participants to confirm accuracy and credibility [39]. Through these methodological procedures, the study provides a comprehensive description of how strategic management of school facilities and infrastructure supports scientific writing learning and contributes to the improvement of educational quality.

## Results

**A. Availability of Facilities and Infrastructure**

The findings reveal that SMAN 10 Surabaya has established a foundational infrastructure to support scientific writing learning, including a school library, computer laboratories, internet connectivity, and access to digital learning resources. These facilities represent essential components for students to engage in academic literacy activities, conduct literature reviews, and develop structured scientific papers. However, field evidence indicates that although facilities are available, their adequacy and accessibility remain limited, affecting the overall effectiveness of scientific writing instruction.

Direct observation showed that the library serves as a central academic space for students, particularly during scientific writing training sessions. Students were frequently observed searching for reference materials, discussing research topics, and consulting teachers within the library environment.

A teacher highlighted this limitation:

> *"The library is helpful, but most of the books are still general textbooks. When students need references for scientific papers, we often rely more on online sources."*
> *(Teacher Interview, July 2025).*

Similarly, a guidance counselor emphasized that scientific writing activities require stronger infrastructure support:

> *"Scientific writing training is part of our literacy program, but the resources are not always adequate. Students need more access to journals and updated references." (Guidance Counselor Interview, July 2025)*

In addition to library constraints, the computer laboratory plays a critical role in enabling students to draft papers, search for online literature, and manage citations. Observations indicated that the computer lab is actively utilized during writing sessions, yet the number of available computers is not proportional to the number of students participating. As a result, students often work in groups and take turns using devices, which can reduce productivity.

One student explained:

*"Sometimes we have to share one computer with two or three friends. It makes writing slower, especially when we need to search for references at the same time."*
*(Student Interview, July 2025).*

A school administrator further acknowledged this challenge:

*"Facilities are available, but we admit that they are still limited compared to the needs. The computer units are not enough for intensive academic writing activities." (Administrator Interview, August 2025)*

Internet access was another key facility supporting scientific writing and learning. Teachers reported that students increasingly depend on digital platforms such as Google Scholar, online journal databases, and educational websites to compensate for limited printed resources. However, connectivity issues and restricted access schedules occasionally hinder students' ability to conduct continuous research.

A teacher stated:

*"Digital resources are very important, but sometimes internet access is unstable, and students cannot always access journals smoothly." (Teacher Interview, July 2025).*

Photographic documentation collected during fieldwork illustrates the conditions of the library and computer lab facilities. These images demonstrate that while the infrastructure is functional, improvements in equipment availability, updated academic resources, and learning space optimization are needed (see Fig. 1 and Fig. 2).



**Fig. 1.** Condition of the Computer Laboratory during Writing Sessions



**Fig. 2.** Students Utilizing the School Library for Scientific Reference

Overall, the findings suggest that SMAN 10 Surabaya has developed baseline facilities for scientific writing learning, yet challenges remain in ensuring the adequacy, accessibility, and sustainability of infrastructure. Facility improvement is therefore essential to enhance the quality and effectiveness of scientific writing programs.

**B. The Role of Teachers and Students in Utilization**

The results indicate that teachers at SMAN 10 Surabaya play a pivotal role in maximizing the utilization of existing facilities and infrastructure to support scientific writing learning. Teachers act as facilitators and mentors, guiding students through the stages of academic writing, including topic identification, research design, data collection, analysis, and reporting. Despite facility limitations, teachers demonstrate strong commitment and innovation in utilizing available resources. For example, teachers encourage students to integrate digital tools into their writing process, such as searching references through Google Scholar, organizing citations using Mendeley, and collaborating through WhatsApp discussion groups. These practices align with constructivist learning theory, where teachers provide scaffolding to help students gradually build knowledge and skills through interaction and guided support [28].

A guidance counselor explained:

*"We continuously encourage students to participate in scientific writing competitions. Teachers guide them step by step, even though resources are limited." (Guidance Counselor Interview, July 2025).*

Another teacher emphasized their responsibility:

*"Teachers must be creative. Even if facilities are not perfect, we can still guide students by maximizing what we have, such as the library, online journals, and simple technology." (Teacher Interview, July 2025)*

Teachers were also found to provide structured mentoring sessions, both face-to-face and online. Observations showed that teachers often reviewed student drafts, provided feedback, and suggested improvements in argumentation and academic style. Online mentoring through messaging applications was particularly useful when students needed guidance outside school hours.

A teacher noted:

*"We use WhatsApp groups to guide students remotely. They can ask questions anytime, and we can give feedback on their writing progress." (Teacher Interview, July 2025).*

Students, meanwhile, were identified as active agents in the learning process. Scientific writing learning at SMAN 10 Surabaya emphasizes student-centered exploration, where students actively search for references, conduct small-scale research, and revise drafts iteratively. Observations revealed that students frequently engaged in peer discussions, collaborative writing, and group-based research projects.

A student participant stated:

*"Writing scientific papers is difficult at first, but we learn by doing. We discuss with friends, search references online, and revise after teachers give feedback." (Student Interview, July 2025).*

Another student highlighted the role of facilities:

*"The library helps us find basic references, but most journals we access online. The computer lab is important for typing and editing our papers." (Student Interview, July 2025).*

The constructivist approach was evident in how students learned through direct experience, collaboration, and gradual skill development. Students developed critical and reflective thinking by identifying research problems, formulating hypotheses, and presenting findings logically.

A teacher observed:

*"Scientific writing trains students to think critically. They learn how to structure arguments, analyze data, and write systematically." (Teacher Interview, July 2025).*



Overall, the findings confirm that facility utilization is strongly shaped by the roles of teachers and students. Teachers' facilitation strategies and students' active engagement compensate for limited infrastructure, enabling scientific writing learning to remain meaningful and effective.

**C. Collaboration and Management Strategy**

Facility and infrastructure management at SMAN 10 Surabaya is implemented through collaborative strategies involving teachers, students, school leadership, the school committee, and the broader community. The school adopts participatory planning mechanisms to identify facility needs aligned with learning priorities and budget constraints. Document analysis of the school development plan confirmed that facility improvement is considered part of the school's academic quality enhancement agenda. Planning discussions are conducted regularly to ensure that facility management supports key programs such as literacy development and scientific writing training.

A school administrator stated:

*"Facility planning is always linked to learning priorities. Scientific writing programs require specific resources, so we try to allocate budgets accordingly." (Administrator Interview, August 2025).*

Teachers also play an important role in identifying facility needs:

*"Teachers provide input on what facilities are needed for learning, especially for scientific writing, such as better internet access and updated references." (Teacher Interview, July 2025).*

Procurement processes were found to be conducted transparently, utilizing government operational funds and support from the school committee. Teachers also receive training to optimize facility usage in learning activities.

A committee representative explained:

*"We collaborate with the school to provide support. Facilities are important for student development, so procurement must be planned carefully." (Committee Interview, August 2025).*

Maintenance is carried out periodically, involving multiple stakeholders. Students are encouraged to participate in maintaining learning spaces, fostering a sense of responsibility and ownership.

A guidance counselor noted:

*"Students are also involved in keeping facilities clean and functional. This builds awareness that infrastructure supports their learning." (Guidance Counselor Interview, July 2025).*

Regular evaluations are conducted to assess facility effectiveness. Observation data indicated that evaluation meetings often result in adjustments, such as improved computer lab access schedules or increased emphasis on digital resource subscriptions.

A school leader emphasized:

*"Evaluation is important. Facilities must not only exist but must also be effective in supporting learning quality." (Principal Interview, August 2025)*

This collaborative approach creates a conducive learning environment that supports students' cognitive, affective, and psychomotor development. Facility management is therefore not merely administrative but strategic, adaptive, and oriented toward continuous quality improvement. Overall, SMAN 10 Surabaya demonstrates an adaptive and responsible infrastructure management strategy. By

involving all stakeholders, the school strengthens learning quality, enhances student motivation, and fosters a sustainable culture of collaboration in supporting scientific writing learning.



## Discussion

The present study examined how facility and infrastructure management at SMAN 10 Surabaya supports scientific writing learning, with a particular focus on availability, utilization by teachers and students, and collaborative management strategies. The findings contribute to the growing body of research emphasizing that educational facilities are not merely physical assets, but strategic resources that shape learning processes and outcomes when managed effectively. This discussion situates the findings within existing theoretical and empirical literature, highlights similarities and divergences from prior studies, and outlines implications for educational management and learning quality enhancement.

### A. Facility Management as a Strategic Enabler of Learning Quality

The findings demonstrate that SMAN 10 Surabaya has established baseline infrastructure to support scientific writing learning, including a functional library, computer laboratories, internet access, and digital resources. These facilities form the foundation for academic literacy activities such as literature review, drafting, editing, and citation management. This aligns with facility management theory, which conceptualizes infrastructure as a strategic enabler that supports the achievement of educational objectives when systematically planned, maintained, and evaluated [31], [40]. The present findings confirm these perspectives, showing that the availability of libraries and ICT resources at SMAN 10 Surabaya provides students with opportunities to engage in scientific writing practices.

However, the study also highlights that facility availability remains constrained in terms of updated academic references, sufficient computer units, and stable internet connectivity. These limitations resonate with global evidence suggesting that many schools, particularly in developing contexts, face persistent infrastructure gaps that hinder the implementation of advanced academic programs [30], [41]. Yet, unlike studies that emphasize facility scarcity as a primary barrier, SMAN 10 Surabaya demonstrates how proactive facility governance can mitigate constraints through strategic optimization and stakeholder collaboration.

Thus, this study refines existing knowledge by showing that while infrastructure adequacy remains essential, the effectiveness of facility management lies not only in availability but also in strategic utilization, maintenance, and continuous improvement. Quality assurance in education requires institutions to view resources as part of a dynamic system of improvement rather than static physical provisions.

### B. Needs-Based Planning and Accountability in Facility Governance

One of the central findings is the systematic cycle of facility management at SMAN 10 Surabaya, where planning, procurement, maintenance, and evaluation are implemented as interconnected processes. This reflects principles of effective educational management, emphasizing efficiency, transparency, and sustainability. Regular inventory monitoring and transparent documentation practices enable the school to identify facility needs and allocate resources more effectively. Well-

structured facility planning significantly improves learning effectiveness by ensuring that infrastructure aligns with educational priorities.

Comparatively, many studies in resource-constrained contexts report that facility management often remains administrative rather than strategic. Schools frequently focus on routine inventory without integrating facility planning into broader learning quality goals. The present study diverges from such findings by illustrating that SMAN 10 Surabaya adopts an adaptive approach, where facility governance is directly linked to scientific writing learning objectives.

This suggests that accountability and strategic planning are critical determinants of facility effectiveness. Strategic management requires organizations to align resources with long-term goals, evaluate performance, and adjust strategies accordingly. SMAN 10 Surabaya exemplifies this alignment by integrating infrastructure management into academic literacy development programs.

**C. Teacher Facilitation and Innovation in Facility Utilization**

Beyond facility availability, this study highlights the pivotal role of teachers in maximizing the use of existing infrastructure for scientific writing learning. Teachers at SMAN 10 Surabaya act not only as instructors but also as facilitators and mentors, guiding students through the complex stages of scientific writing, including topic selection, research design, data analysis, and reporting. Teachers provide structured support that enables learners to achieve higher levels of competence. Scientific writing is a cognitively demanding task requiring iterative learning, feedback, and social interaction. The present study demonstrates that teachers provide essential scaffolding through both face-to-face mentoring and digital guidance.

The integration of digital tools such as Google Scholar, Mendeley, and WhatsApp discussion groups further illustrates teachers' innovative adaptation to 21st-century learning demands. The modern education requires digital literacy integration, particularly for developing higher-order academic skills. The findings show that teachers' use of online platforms compensates for limited physical resources, enabling continuous academic support. Educators increasingly rely on ICT tools to maintain learning continuity and enhance student engagement, particularly after the global shift toward digital learning practices. However, unlike contexts where technology adoption is hindered by low teacher readiness [42]SMAN 10 Surabaya demonstrates relatively high teacher adaptability, suggesting that professional commitment plays a key role in facility optimization.

**D. Student Engagement and Constructivist Learning Practices**

The study further reveals that students are active participants in scientific writing learning, utilizing facilities such as libraries, computer labs, and online resources to construct knowledge through exploration and collaboration. Students engage in peer discussions, group-based research, and iterative writing revisions, reflecting constructivist principles that emphasize learning through experience and social interaction [27], [28].

These findings support prior research indicating that academic writing skills develop most effectively when students are actively involved in authentic writing practices rather than passive instruction [43]. Moreover, the study suggests that facilities serve as learning spaces that enable students to engage in inquiry-based and collaborative learning processes.

Inadequate learning facilities often reduce student motivation and satisfaction. In contrast, SMAN 10 Surabaya illustrates that student engagement remains strong despite infrastructure limitations, largely due to teacher facilitation and a collaborative learning culture. This divergence suggests that motivation and learning quality depend not only on physical resources but also on the social and instructional environment that supports resource utilization. Thus, this study contributes by demonstrating the interplay between facilities, teacher scaffolding, and student agency in shaping scientific writing learning outcomes.

**E. Collaboration and Shared Responsibility in Facility Management**

Another key contribution of this study is the identification of collaborative facility management strategies involving teachers, students, school leadership, school committees, and the broader community. Facility governance at SMAN 10 Surabaya is not centralized solely at the administrative level but distributed across stakeholders through participatory planning, procurement support, maintenance involvement, and evaluation processes.

This aligns with contemporary educational management perspectives, emphasizing shared leadership and community involvement as essential for sustainable school improvement [44]. Collaborative approaches foster ownership and accountability, ensuring that facilities remain functional and aligned with learning needs. Schools with strong stakeholder engagement tend to achieve better outcomes in resource utilization and learning quality. The present study reinforces this argument, showing that collaborative facility governance strengthens both infrastructure sustainability and student motivation. Unlike schools where facility management is often constrained by bureaucratic inefficiencies, SMAN 10 Surabaya demonstrates adaptive capacity through stakeholder synergy. This suggests that collaboration can serve as a mitigating factor against structural limitations.

**F. Continuous Evaluation and Adaptation to Technological Change**

The study also underscores the importance of periodic evaluation in facility management. SMAN 10 Surabaya conducts regular assessments of facility effectiveness, identifies gaps, and adjusts strategies such as improving access schedules or enhancing digital resource subscriptions. This reflects quality assurance principles emphasizing continuous improvement rather than one-time provision of resources [29]. Sustainable educational development requires ongoing monitoring and adaptation of learning environments to evolving needs. The adaptive nature of facility management at SMAN 10 Surabaya is particularly relevant in the context of rapid technological advancement. Schools must integrate technology strategically to remain responsive to contemporary learning demands. The present study provides empirical evidence that facility management must remain dynamic, ensuring that infrastructure supports evolving academic literacy and scientific writing requirements.

## Conclusion

This study explored how facility and infrastructure management supports scientific writing learning at SMAN 10 Surabaya. The findings reveal that educational infrastructure functions not only as a physical resource but also as a strategic element that shapes the quality of academic learning when managed systematically. Scientific writing requires critical thinking, academic literacy, and structured

inquiry; therefore, it depends on a supportive learning environment with accessible resources and effective infrastructure governance. The study shows that the school has established several foundational facilities, including a library, computer laboratories, internet connectivity, and digital learning resources. These facilities enable students to access references, draft research reports, revise academic work, and participate in collaborative inquiry-based learning. However, limitations such as restricted computer availability, outdated scientific references, and occasional digital access constraints indicate that infrastructure adequacy remains an ongoing challenge. An important finding is the pivotal role of teachers in optimizing facility utilization. Teachers extend beyond traditional instruction by providing scaffolding throughout the scientific writing process while integrating digital academic tools such as Google Scholar and Mendeley to expand students' access to scholarly sources. At the same time, students actively engage in exploratory learning, peer collaboration, and iterative writing practices. Furthermore, infrastructure management is implemented through collaborative governance involving school leaders, teachers, students, and the broader community. This participatory approach strengthens accountability and sustainability in facility planning, procurement, maintenance, and evaluation. Overall, the study demonstrates that strategic infrastructure management, combined with teacher innovation and student engagement, plays a crucial role in strengthening academic literacy and supporting effective scientific writing learning.

## Limitation and Future Research

This study provides important insights into the role of facility and infrastructure management in supporting scientific writing learning at SMAN 10 Surabaya; however, several limitations should be acknowledged. First, the research employed a qualitative case study design focused on a single school context. While this approach enabled in-depth exploration of facility management practices, the findings may not be fully generalizable to schools with different socio-economic conditions, resource availability, or organizational cultures. Future studies should therefore conduct multi-site comparative research to enhance external validity and provide broader contextual understanding.

Second, the study relied primarily on qualitative data from interviews, observations, and document analysis. Although triangulation was applied to strengthen credibility, the research did not include quantitative indicators of learning outcomes, such as measurable improvements in students' scientific writing performance or facility utilization rates. Mixed-method approaches integrating qualitative insights with quantitative assessments would provide a more comprehensive evaluation of the relationship between infrastructure management and academic outcomes.

Third, the study focused mainly on facility availability, utilization, and collaborative governance, with limited examination of financial and policy factors influencing infrastructure management. Future research should explore budget allocation mechanisms, funding disparities, and long-term infrastructure planning that shape facility sustainability.

Finally, the research was conducted within a limited timeframe and did not deeply analyze variations in teacher digital competence or student socio-cultural backgrounds. Longitudinal and multi-

perspective studies are therefore recommended to better understand how infrastructure management, teacher capacity, and student engagement interact in supporting scientific writing development.



## Acknowledgment

The author would like to express sincere gratitude to SMAN 10 Surabaya for granting institutional support and access during the data collection process. Appreciation is also extended to all school stakeholders who contributed to the implementation of this research through their cooperation and assistance.

## Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

## References

[1] L. Barrett, P., Davies, F., Zhang, Y., & Barrett, "The Impact of Classroom Design on Pupils' Learning: New Evidence from Holistic Environmental Factors.," *Build. Environ.*, vol. 195, p. 107750, 2021.

[2] J. Gao, N., & Lafortune, "School Facility Conditions and Student Outcomes: Evidence from Policy and Funding Disparities," *Educ. Financ. Policy*, vol. 15, no. 4, pp. 682–710, 2020, [Online]. Available: https://doi.org/10.1162/edfp_a_00293%0A

[3] S. Vincent, J. M., Jain, M., & Lin, "Facility Conditions, Maintenance Investment, and Student Opportunity: Evidence for Equity-Focused Infrastructure Planning," *Educ. Adm. Q.*, vol. 58, no. 5, pp. 789–825, 2022, [Online]. Available: https://doi.org/10.1177/0013161X221098765

[4] X. Zhang, D., Zhang, H., & Wang, "School Infrastructure and Student Learning Outcomes: Evidence from Large-Scale Assessment Data.," *Int. J. Educ. Dev.*, vol. 91, p. 102576, 2022, [Online]. Available: https://doi.org/10.1016/j.ijedudev.2022.102576

[5] R. Ariyanti, A., & Fitriana, "Students' Difficulties in Writing Scientific Papers: A Review of Academic Literacy Challenges.," *Heliyon*, vol. 7, no. 12, p. 408540, 2021.

[6] A. Lu, J., Zaidi, S. F. A., & Tarhini, "M-learning Service Quality and Student Satisfaction: A Meta-analytic Review," *Comput. Educ.*, vol. 204, p. 104874, 2024.

[7] D. Luo, N., Zhang, M., & Qi, "Digital Learning Environments and Student Engagement: A Systematic Review," *Comput. Educ.*, vol. 166, p. 104154, 2021.

[8] J. Kim, Y., & Kim, "AI-enhanced Scaffolding and Student Writing Outcomes: Evidence from Classroom Interventions," *Comput. Educ.*, vol. 191, p. 104639, 2022.

[9] K. Dhar, P., & Lee, "Service Quality and Institutional trust in Digitally Transformed Education Services: A Systematic Synthesis," *Educ. Res. Rev.*, vol. 42, p. 100564, 2024, [Online]. Available: https://doi.org/10.1016/j.edurev.2024.100564

[10] A. K. Teeroovengadum, V., Kamalanabhan, T. J., & Seebaluck, "Rethinking Service Quality Measurement in Education Services: A Systematic Synthesis and Future Agenda.," *Qual. Assur. Educ.*, vol. 31, no. 4, pp. 456–475, 2023, [Online]. Available: https://doi.org/10.1108/QAE-01-2023-0012

[11] T. K. F. Chiu, "School Digital Learning Policies and Teachers' Digital Competence Development: A Multi-level Perspective," *Comput. Educ.*, vol. 182, p. 104463, 2022.

[12] K. Hathaway, J., Guglielmo, S., & Kwon, "Internet Access Equity and Digital Learning Readiness: Implications for School Systems," *Comput. Educ.*, vol. 207, p. 104913, 2024, [Online]. Available: https://doi.org/10.1016/j.compedu.2023.104913

[13] A. Aslan, "Problem-based Learning in Live Online Class: Learning Achievement, Problem-solving Skill, Communication Skill, and Interaction," *Comput. Educ.*, vol. 171, p. 104237, 2021, [Online]. Available: https://doi.org/10.1016/j.compedu.2021.104237

[14] J. Andrade-Arenas, L., Corzo-Zavaleta, J. I., Alvarado-Páucar, A., Baldeón-Vilca, C., Segovia-Fernández, L., Reyes-Vilca, N., López-Tolentino, G., Villarreal-Chumbes, V., & Canturín-Narrea, "Design of an Educational Platform Based on an Innovative Model of Research in Secondary School Students.," *Int. J. Electr. Comput. Eng.*, vol. 15, no. 2, pp.

2000–2021, 2025, [Online]. Available: https://doi.org/10.11591/ijece.v15i2.pp2000-2021
[15] P. Magasi, C., Mashenene, R., & Kihwelo, "Service Quality Dimensions and Student Satisfaction in Higher Education: Evidence from Emerging Economies," *Qual. Assur. Educ.*, vol. 30, no. 3, pp. 295–312, 2022.
[16] K. Dangaiso, A., Seo, Y., & Um, "Blended Service Quality and Student Satisfaction in Digitally Supported Higher Education," *Internet High. Educ.*, vol. 57, p. 100882, 2023, [Online]. Available: https://doi.org/10.1016/j.iheduc.2023.100882
[17] N. A. Ali, F., Zhou, Y., Hussain, K., Nair, P. K., & Ragavan, "Does Higher Education Service Quality Influence Student Satisfaction? Evidence from a Developing Country," *J. Hosp. Leis. Sport Tour. Educ.*, vol. 28, p. 100272, 2021.
[18] M. Ban, K., Alterkait, M., & Alduaij, "Perceived Service Quality and Student Satisfaction in Higher Education Under Digital Integration: Evidence and Implications," *Front. Educ.*, vol. 9, p. 1492432, 2024.
[19] M. J. Bobkina, J., Domínguez Romero, E., & Gómez Ortiz, "Kinesic Communication in Traditional and Digital Contexts: An Exploratory Study of ESP Undergraduate Students," *System*, vol. 115, p. 103034, 2023, [Online]. Available: https://doi.org/10.1016/j.system.2023.103034%0A
[20] Z. Yeh, H.-C., & Yu, "Academic Writing Development in Digital Contexts: Trends and Pedagogical Implications.," *System*, vol. 115, p. 103034, 2023, [Online]. Available: https://doi.org/10.1016/j.system.2023.103034
[21] J. Marr, "Information Literacy Gaps in Secondary Students' Academic Work: Implications for Writing Pedagogy," *J. Inf. Lit.*, vol. 16, no. 2, pp. 28–45, 2022.
[22] M. Sumi, R., & Kabir, "Website Design, Information Quality, and E-learning Service Quality: Effects on Student Satisfaction," *Internet High. Educ.*, vol. 50, p. 100790, 2021, [Online]. Available: https://doi.org/10.1016/j.iheduc.2021.100790
[23] L. V. Flavián, C., Pérez-Rueda, A., Belanche, D., & Casaló, "Intention to use Analytical Artificial Intelligence (AI) in Services: The Effect of Technology Readiness and Awareness," *J. Serv. Manag.*, vol. 33, no. 2, pp. 293–320, 2022, [Online]. Available: https://doi.org/10.1108/JOSM-10-2020-0378
[24] J. W. Creswell and C. N. Poth, *Qualitative Inquiry and Research Design: Choosing Among Five Approaches*, 4th ed. Thousand Oaks, CA, USA: Sage Publications, 2016.
[25] I. Bafadal, *Manajemen Perlengkapan Sekolah*, Bumi Aksara, 2014.
[26] T. Bush, *Theories of Educational Leadership and Management*, Thousand Oaks, CA, USA: Sage Publications, 2019.
[27] J. Piaget, *The Psychology of the Child*, Basic Books, 1972.
[28] L. S. Vygotsky, *Mind in Society*, Harvard Univ. Press, 1978.
[29] E. Sallis, *Total Quality Management in Education*, Routledge, 2012.
[30] OECD, *Education Policy Outlook*, OECD Publ., 2020.
[31] F. R. David, F. R. David, and M. E. David, *Strategic Management: Concepts and Cases: A Competitive Advantage Approach*. Upper Saddle River, NJ, USA: Pearson, 2017.
[32] B. Trilling and C. Fadel, *21st Century Skills: Learning for Life in Our Times*. San Francisco, CA, USA: Jossey-Bass, 2009.
[33] UNESCO, *Education for Sustainable Development Goals*, OECD Publ., 2017.
[34] H. Kallio, A. M. Pietilä, M. Johnson, and M. Kangasniemi, "Systematic methodological review: Developing a framework for a qualitative semi-structured interview guide," *Journal of Advanced Nursing*, vol. 72, no. 12, pp. 2954–2965, 2016.
[35] Fadilaturrahman, "Strategi Pengelolaan Sarana dalam Meningkatkan Mutu Pendidikan di Sekolah Dasar Negeri 61 Pekanbaru," Universitas Islam Negeri Sultan Syarif Kasim Riau Pekanbaru, 2025.
[36] G. B. Marshall, C., & Rossman, *Designing Qualitative Research*, Sage Publ., 2016.
[37] G. A. Bowen, "Document analysis as a qualitative research method," *Qualitative Research Journal*, vol. 9, no. 2, pp. 27–40, 2009.
[38] V. Braun and V. Clarke, "Using thematic analysis in psychology," *Qualitative Research in Psychology*, vol. 3, no. 2, pp. 77–101, 2006.
[39] E. G. Lincoln, Y. S., & Guba, *Naturalistic Inquiry*, Sage Publication, 1985.
[40] R. N. Amanchukwu, G. J. Stanley, and N. P. Ololube, "A review of leadership theories, principles and styles and their relevance to educational management," *Management*,

E-ISSN 2962-1674
P-ISSN 2962-5742



vol. 5, no. 1, pp. 6–14, 2015.
[41] R. I. Asiyai, "Assessing School Facilities in Developing Countries," *Educ. Res. J.*, vol. 5, no. 2, pp. 45–56, 2012.
[42] W. Li, X., Zhang, Y., & Liu, "Technology Integration in Resource-constrained Schools: A Systematic Review," *Educ. Technol. Res. Dev.*, vol. 72, no. 1, pp. 1–25, 2024.
[43] N. A. Ali, F., Zhou, Y., Hussain, K., Nair, P. K., & Ragavan, "Does Higher Education Service Quality Influence Student Satisfaction?," *J. Hosp. Leis. Sport Tour. Educ.*, vol. 28, pp. 100–105, 2021.
[44] M. Fullan, *The New Meaning of Educational Change*, Teach. Coll. Press., 2016.

## Authors



**Nuphanudin** is a lecturer at Universitas Negeri Surabaya, Indonesia. He serves as the Publication Chair for a national conference, where he coordinates publication processes and ensures that research dissemination activities run smoothly and according to plan. His professional interests include web design, online marketing consulting, and technical support for digital platforms, particularly in supporting academic communication and conference management. (email: nuphanudinnuphanudin@unesa.ac.id).



**Nayla Dea Adelia** is a student at Universitas Negeri Surabaya majoring in Educational Management. She is known as a diligent, friendly, and responsible person, both in her studies and daily life. She has a number of hobbies, such as reading, writing, and trying new things to broaden her horizons. She actively participates in various campus activities that help her develop her teamwork, time management, and communication skills. In her studies and organizations, she always maintains discipline and consistency to achieve the best results. (email: 25010714021@mhs.unesa.ac.id).



**Raya Naila Feisya** is a student of Educational Management at Universitas Negeri Surabaya who is known for being active and enthusiastic in various campus activities, both academic and non-academic. She believes that involvement in campus organizations and communities helps improve interpersonal and leadership skills. She gets along easily with friends from various backgrounds and always strives to build positive relationships. (email: 25010714105@mhs.unesa.ac.id).



**Zulfa Sekar Arum** is an Education Management student at Universitas Negeri Surabaya who has a high level of adaptability and a strong passion for developing her potential. She actively participates in leadership training, educational seminars, and social projects that give her practical experience in program management. She is accustomed to working independently and in teams, and strives to be a good listener and effective communicator. In her first semester, she also actively participated in Student Activity Units (UKM) to develop her interests and talents. (email: 25010714209@mhs.unesa.ac.id).