JURNAL ILMU PENDIDIKAN INDONESIA
Website:http://ejournal.uncen.ac.id/index.php/JIPI
Jurnal Terakreditasi Nasional, Keputusan, No 225/E/KPT/2022

Jurnal Ilmu Pendidikan Indonesia

Vol 13, No 2, Halaman 123-132 Juni 2025
P – ISSN 2338-3402, E – ISSN 2623-226X

OPTIMIZING FACILITIES AND INFRASTRUCTURE IN SCIENCE LEARNING: CHALLENGES, OPPORTUNITIES, AND SOLUTIONS THROUGH EBOOKS, LEARNING VIDEOS, LABORATORIES, AND TEACHING AIDS

Nur Almi[1)]; Margaretha Dhera[2)]; Moh. Risqa[3)]; Febri Riansah[4)]; Marungkil Pasaribu[5)]

[1)] Science Education Master Program, Postgraduate, Universitas Tadulako, Indonesia; almiganing00@gmail.com
[2)] Science Education Master Program, Postgraduate, Universitas Tadulako, Indonesia; dheraphysics105@gmail.com
[3)] Science Education Master Program, Postgraduate, Universitas Tadulako, Indonesia; ikalkoko601@gmail.com
[4)] Science Education Master Program, Postgraduate, Universitas Tadulako, Indonesia; febri.nara14@gmail.com
[5)] Physics Education, Universitas Tadulako, Indonesia: pasaribumarungkil@gmail.com

Abstract: This study presents a literature-based analysis focusing on the procurement and optimization of educational facilities and infrastructure, particularly in the context of science education. To improve the efficiency and efficacy of the teaching and learning process, the research attempts to identify important issues and offer workable solutions pertaining to the use of eBooks, instructional videos, labs, and teaching aids. Even though infrastructure and facilities are essential to a quality education, science courses are not making the most of them due to issues like inadequate digital resources, subpar lab equipment, and a lack of instructional media. The results demonstrate that maximizing the infrastructure for science education necessitates a multipronged strategy that includes the incorporation of suitable educational technologies, the supply of practical teaching tools, and ongoing professional development for teachers. Furthermore, to guarantee fair access and the long-term viability of educational resources, government participation through encouraging policies and consistent investment is essential. By tackling these issues, science instruction can become more dynamic, captivating, and capable of generating students who are competent and scientifically literate.

Keywords: Optimization of Facilities and Infrastructure; Challenges; Opportunities and Solutions; Media Ebooks; Videos; Laboratories; Teaching Aids

1. INTRODUCTION

The availability of suitable educational infrastructure and facilities is crucial for a successful and efficient teaching and learning process. These resources are essential instruments that facilitate communication between educators and learners, allowing for the attainment of the best possible learning results. Without these kinds of support networks, learning goals might not be met and the educational process might become less effective. Every subject area has distinct qualities that call for teaching strategies and supplementary materials. Therefore, to maximize engagement and comprehension, learning facilities must be customized to meet the needs of each subject. (Firdianti, 2018) asserts that because every subject is unique, various learning resources and media must be used to support subject-specific educational objectives. This highlights the value of planning educational resources contextually, especially when it comes to science education, where interactive

platforms, multimedia aids, and experimental tools are crucial for creating engaging learning opportunities.

National policy has firmly established the importance of educational infrastructure and facilities in facilitating the learning process. The Law of the Republic of Indonesia Number 20 of 2003 concerning the National Education System states that "each formal and non-formal education unit is required to provide facilities and infrastructure that meet educational needs, in line with the development of students' physical potential, intellectual intelligence, emotional maturity, and sense of responsibility" (Malik Fadjar, 2003). This rule highlights that educational infrastructure is essential to attaining holistic student development and is not just supportive. Lembong et al., 2023 go on to say that having access to sufficient educational resources and media is crucial to the execution of successful learning activities. These facilities act as direct tools that make it easier to deliver content and allow students to engage meaningfully with the learning materials. Without this kind of assistance, learning becomes less interesting and might not produce the desired learning results.

The government must give the provision of sufficient infrastructure and educational facilities careful consideration because their completeness is essential to promoting the achievement of learning objectives. According to (Nurbaiti, 2015), the best possible availability and use of infrastructure and facilities are directly related to the attainment of successful and goal-oriented learning. To establish a baseline for high-quality education, the government, through PERMENDIKNAS No. 24 of 2007, Article 1, specifies the minimal requirements for infrastructure and facilities that educational institutions at all levels, from primary (SD/MI) to secondary schools (SMP/MTs and SMA/MA), must meet (Badrudin et al., 2024). These standards emphasize the significance of fulfilling national standards for school facilities and are also crucial indicators in the school accreditation process. Therefore, to effectively support the learning process, schools are expected to align with these national standards. The ease with which teachers can conduct classroom activities and deliver instruction increases with the completeness and functionality of educational facilities. Simultaneously, infrastructure development needs to be planned to improve the efficacy and efficiency of the teaching and learning process, which will ultimately lead to better student outcomes.

The availability and sufficiency of educational facilities and infrastructure have a major impact on the implementation of the school-based educational process, and difficulties are not only attributable to teachers or students. Subpar learning outcomes can arise from ineffective teaching

and learning activities caused by a lack of resources. A thorough learning process needs to take into consideration several important elements, such as learning objectives, media, teaching strategies, instructional content, and assessment techniques. By lowering time constraints and improving instructional delivery, the integration of science and technology in education offers a chance to improve learning efficiency. Students are more likely to be interested and motivated to learn when appropriate teaching aids, useful tools, and interactive learning resources are used. In addition to promoting conceptual understanding, these resources pique students' interest and motivate them to take an active role in their education.

Teachers must establish an efficient teaching and learning environment that supports the growth of students' knowledge, attitudes, and abilities to fulfil the requirements of being a competent educator. Achieving educational goals requires maximizing learning outcomes and raising the standard of instruction. In this sense, the teaching and learning process often referred to as PBM or KBM in Indonesian is the main element involved in putting education into practice. According to (Megasari, 2020), having sufficient educational infrastructure and facilities can greatly improve the continuity and efficacy of teaching and learning activities. These materials must be in line with the most recent developments in science and technology in addition to meeting national education standards. A more dynamic and responsive learning environment that helps teachers and students achieve high-quality educational outcomes is made possible by making sure that facilities change in tandem with pedagogical and technological advancements.

Every educational institution must plan and oversee the acquisition of infrastructure and facilities in accordance with the guidelines established by the National Education Standards Agency (BSNP) to guarantee the successful and efficient execution of the teaching and learning process. In this sense, educational infrastructure and facilities are crucial to the effective execution of school-based learning, not just auxiliary components. Though, many schools still struggle to make the best use of their infrastructure, especially when it comes to teaching science. For example, there is still little integration of instructional aids, laboratories, learning videos, and eBooks. Poor use of available resources, inadequate equipment storage space, and a lack of suitable laboratory or practicum tools are some of the common challenges. The quality and interactivity of the learning process are directly impacted by these constraints. To support the enhancement of learning quality, this study intends to investigate the difficulties and provide workable solutions for the acquisition and administration of educational infrastructure and facilities. Schools must have sufficient and well-maintained resources because infrastructure and facilities are essential to creating a productive

teaching and learning environment.

2. RESEARCH METHODS

The literature study method used in this study entails a methodical process of reading, gathering, documenting, organizing, and evaluating previously published works that are pertinent to the research topic (Hanifah and Purbosari, 2022). By critically analyzing a variety of academic sources, the literature study approach is especially well-suited for finding trends, gaps, and answers. To develop a cohesive understanding of the issues discussed, the topics covered in this study are analyzed by combining and relating a variety of pertinent references (Mahanum, 2021). Peer-reviewed scientific articles from both domestic and foreign journals, especially those that address educational infrastructure and facilities, instructional media use, and the problems and solutions in science education, make up the data sources used. This approach enables a thorough conceptual investigation based on current scholarly discussions.

This study's data collection procedure was carried out in several methodical steps. First, pertinent articles about educational infrastructure and facilities in science learning more especially, subjects pertaining to the use of eBooks, instructional videos, labs, and teaching aids were found and gathered from a variety of scholarly databases and websites. Second, the gathered papers were sifted according to their applicability and the details needed to meet the study's goals. Third, to extract accurate and significant information, the chosen articles underwent critical review and validation. Lastly, descriptive analysis methods were used to examine the data. Descriptive analysis, according to (Hanifah and Purbosari, 2022), entails presenting the data obtained from the literature in an extensive, thorough, and detailed way. The researchers were able to synthesize findings from various sources and identify important patterns and solutions pertinent to the study because this process was conducted in a clear and informative manner (Sugiyono, 2016).

3. RESULTS AND DISCUSSIONS

Barriers to Accessibility in the Optimization of Educational Facilities and Infrastructure

One important factor that greatly affects the efficacy and efficiency of the teaching and learning process in Natural Science (IPA) education is the optimization of facilities and infrastructure (Ananda and Banurea, 2017). Sufficient educational resources, including labs, digital learning materials, and teaching aids, serve two purposes: they facilitate regular teaching activities and are important factors in determining students' achievement of learning objectives and scientific

proficiencies. In accordance with recent scientific and technological advancements, educators can deliver instruction in a contextual and interactive way when facilities that are pertinent, modern, and curriculum-aligned are available. Furthermore, incorporating digital resources like eBooks and instructional videos could help get around time and location restrictions and increase learning opportunities outside of the classroom (Yasin et al., 2024). Notwithstanding these possibilities, there are still several obstacles to overcome before facility and infrastructure optimization can be put into practice. These include a lack of standardized practicum tools that meet curriculum requirements, a lack of funding, and inadequate teacher training in educational technology. To address these problems, this study intends to investigate the fundamental difficulties and offer well-thought-out, empirically supported solutions for the acquisition and efficient use of science learning facilities. Technology integration and the encouragement of practice-oriented learning strategies are prioritized. Policymakers, school administrators, and educators can use the research's findings as a useful guide to improve the calibre and fairness of science instruction in a variety of educational contexts.

A summary of the main ideas concerning the optimization of facilities and infrastructure in Natural Science (IPA) education is presented in Table 1.

Table 1. Key Aspects of Facility and Infrastructure Optimization in Natural Science (IPA) Education

No	Aspect	Description
1.	Importance	Optimization of facilities and infrastructure enhances the efficacy and efficiency of the teaching-learning process
2.	Educational Resources	Labs, digital learning materials (eBooks, videos), and teaching aids serve to: • Support teaching activities • Improve student outcomes and scientific skills
3.	Modern Facilities Benefits	Enable contextual and interactive instruction aligned with curriculum and technological developments
4.	Digital Resource Advantages	• Overcome time and location constraints • Extend learning beyond classroom settings
5.	Challenges	• Lack of standardized practicum tools • Limited funding • Insufficient teacher training in educational technology
6.	Study Goals	Identify core challenges and propose evidence-based solutions for acquiring and using science learning facilities effectively

7.	Focus Areas	• Integration of technology • Promotion of practice-oriented learning strategies
8.	Target Audience	Policymakers, school administrators, educators
9.	Expected Impact	Enhance the quality and equity of science education across various educational settings

A. Technology and Interactive Learning Media as Strategic Tools for Educational Innovation

Limited access to sufficient resources, both in terms of quantity and quality, is one of the primary obstacles to optimizing educational infrastructure and facilities. The implementation of various policies aimed at enhancing physical facilities, including classrooms, laboratories, and learning aids, has not been dispersed equally throughout Indonesia. Although some schools have seen improvements, Makruf (2023) claims that many educational institutions particularly those in 3T (underdeveloped, frontier, and outermost) areas continue to face significant infrastructure issues. These issues include not just the actual structure but also the completeness of the lab apparatus and the limitations of the digital learning materials required for education in the twenty-first century.

The findings of Ramadhani et al. (2021), who stressed that an effective learning design should consider the availability of digital learning media and visual aids in accordance with the characteristics of the subject, support this condition. To develop a solid conceptual understanding and boost active student participation in science classes, instructional aids, instructional videos, and experimental simulations are crucial. The learning process tends to become passive and less interactive when these resources are unavailable or inaccessible, which could potentially lower students' motivation to learn. In addition, these physical barriers to access also have a connection to the growing digital divide, particularly between urban and rural schools. Using technology-based learning resources like eBooks, online learning videos, or other digital learning platforms is challenging for schools in places with poor internet infrastructure. This technology ought to be a way to get around the physical constraints of lab space and instructional aids.

Therefore, a sustainable and equitable accessibility improvement strategy must be implemented in tandem with efforts to maximize learning facilities and infrastructure. For educators to fully utilize technology in the classroom, this entails equitable budgetary distribution, proportionate facility distribution, and capacity building. This strategy can greatly and fairly raise the standard of education across all subject areas, particularly in science education.

B. Strengthening Teacher Competence through Educational Policy Innovation

Technology integration is one of the strategic solutions that can be used to improve the quality of education, particularly in learning the natural sciences (IPA), when faced with various

challenges in optimizing learning facilities and infrastructure. The limitations of physical infrastructure, which are still commonly present in many schools, can be overcome by using technology-based learning resources like eBooks and instructional videos. Technology not only offers flexibility in material delivery, but it also makes it possible to present learning content in a way that is more contextual, interactive, and visual. According to research by Ferdiansyah (2023), students' critical and creative thinking abilities-two crucial skills for learning science in the twenty-first century can be greatly enhanced by incorporating digital media into the classroom. In addition to being a tool, technology also drives changes in how students learn and how teachers instruct. Students can actively engage in the learning process, conduct independent research, and gain a more concrete understanding of abstract concepts when they have access to the appropriate digital resources.

Additionally, in the context of practice-based science learning, the use of teaching aids as traditional learning tools is still relevant and significant. Students' comprehension of abstract scientific concepts can be improved with the use of tangible props. According to Seprianty (2018), students' comprehension of science was greatly enhanced using teaching aids, as evidenced by an increase in learning completeness from 53.6% to 85.8%. This demonstrates how the teaching and learning process can benefit from a constructive synergy created by combining traditional and contemporary learning media approaches. summarizes the key points regarding the relevance of teaching aids in practice-based science learning.

Table 2. Role of Teaching Aids in Practice-Based Science Learning

No	Aspect	Description
1.	Relevance of Teaching Aids	Traditional teaching aids remain significant in practice-based science learning
2.	Function	Help students better understand abstract scientific concepts through tangible, hands-on experience.
3.	Effectiveness	Use of teaching aids improved learning completeness from 53.6% to 85.8%.
4.	Learning Strategy	Combines traditional and modern media to create a constructive synergy in the teaching process.

Therefore, one dependable way to increase the efficacy of science learning is to integrate digital technology and instructional aids into a practice-based learning strategy. The implementation of this strategy requires ongoing training for educators in creating and utilizing educational materials, as well as government policy support for the acquisition of infrastructure and facilities in line with curriculum requirements and technological advancements.

The absence of professional training and mentorship for teachers to make the most of the facilities available is one of the major obstacles to optimizing science learning infrastructure and facilities. Despite the availability of a variety of learning resources, both digital and tangible, the efficiency of their application greatly depends on how well teachers can incorporate them into the teaching and learning process. Sugianto (2023) highlights the necessity of providing teachers with ongoing training so they can adopt cutting-edge teaching strategies in line with the advancement of educational technology.

The quality of education is directly impacted by this competency gap, particularly when it comes to cultivating 21st century abilities like digital literacy, problem solving, critical thinking, and teamwork. Technology and project-based learning strategies have the potential to boost student engagement and improve mastery of these competencies, according to Sari et al., 2024 findings. This approach, however, necessitates that teacher be prepared in terms of method mastery, technology use, and the capacity to oversee a more transparent and exploratory learning process.

The government's and educational institutions' roles become crucial in this situation. In addition to providing infrastructure and facilities, they also must make sure that policies are in place to support the professional development of teachers. According to Widhanarto (2024), the availability and caliber of educational facilities have a significant impact on learning outcomes. These facilities also need to be regularly maintained and support the development of teaching staff members' capacity. Efforts to acquire comprehensive and contemporary facilities run the risk of not having a major effect on the caliber of education in the absence of integrated policy support.

Consequently, a systemic strategy with two key pillars is required: (1) the establishment of infrastructure and facilities that are pertinent, flexible, and curriculum-appropriate; and (2) enhancing teachers' abilities through workshops, professional development, and training. Working together, schools, local governments, and private partners can increase access to resources and expedite the completion of infrastructure projects for education.

Overall, there are several intricate obstacles to overcome to maximize science learning infrastructure and facilities. But these difficulties also create opportunities for creative, cooperative solutions that can be applied piecemeal. The science learning process can be carried out more successfully and efficiently and influence raising student competency in science by leveraging relevant technology, offering contextual teaching aids, and enhancing teacher capacity through ongoing training.

4. CONLUSIONS AND SUGGESTIONS

CONLUSIONS

Optimizing science education infrastructure and facilities, including digital media and physical resources, is essential to support interactive learning and develop 21st-century skills such as scientific literacy and critical thinking. However, constraints such as limited funding, lack of standard equipment, uneven access, and inadequate teacher training hinder the maximum utilization of these facilities. Therefore, a systemic approach is needed that includes professional teacher development, provision of relevant infrastructure, and policy support and inter-institutional cooperation to ensure the availability and equity of educational science. With this step, science education can be more effective, efficient, and equitable, so that students are able to become competent and scientifically literate.

SUGGESTIONS

Based on the study's findings, future efforts should focus on researching the long-term effects of educational resources and technology, developing training programs for teachers to integrate technology effectively, and standardizing practicum supplies for equal access. Collaboration with policymakers is needed to secure funding for teacher training and infrastructure, while partnerships between businesses, academia, and schools can enhance resource sharing. Establishing community centers for science resources, evaluating educational technologies' effectiveness, and ensuring equitable access to quality science materials-especially for underrepresented students-are also essential priorities.

5. ACKNOWLEDGMENTS

The authors would like to thank the postgraduate program of Universitas Tadulako for facilitating this study.

BIBLIOGRAPHY

Ananda, R., dan Banurea, O. K. (2017). *Manajemen sarana dan prasarana pendidikan*.

Badrudin, B., Setiana, R., Fauziyyah, S., dan Ramdani, S. (2024). Standarisasi Pendidikan Nasional. *JIIP-Jurnal Ilmiah Ilmu Pendidikan*, 7(2), 1797–1808.

Ferdiansyah, E. A. (2023). Improved Capabilities Think Critically and Creatively in Learning Natural Science With Media Base HOTS in the Era Society 5.0. Social Humanities and Educational Studies (Shes) Conference Series, 6(3). https://doi.org/10.20961/shes.v6i3.82329

Firdianti, A. (2018). *Implementasi manajemen berbasis sekolah dalam meningkatkan prestasi belajar siswa*. Gre Publishing.

Hanifah, M., dan Purbosari, P. P. (2022). Studi Literatur: Pengaruh Penerapan Model Pembelajaran Guided Inquiry (GI) terhadap Hasil Belajar Kognitif, Afektif, dan Psikomotor Siswa Sekolah Menengah pada Materi Biologi. Biodik, 8(2), 38–46. https://doi.org/10.22437/bio.v8i2.14791

Lembong, J. M., Lumapow, H. R., dan Rotty, V. N. J. (2023). Implementasi merdeka belajar sebagai transformasi kebijakan pendidikan. *Jurnal Educatio Fkip Unma*, 9(2), 765–777.

Mahanum, M. (2021). Tinjauan Kepustakaan. ALACRITY: *Journal of Education*, 1–12.

Makruf, A. (2023). Daya Dukung Sarana Sekolah Dalam Pembelajaran Ilmu Pengetahuan Alam Sekolah Dasar Di Papua Barat Daya. Search, 1(2), 58–64. https://doi.org/10.47945/search.v1i2.1252

Malik Fadjar, A. (2003). Undang-Undang RI No. 20 Tahun 2003: Tentang Pendidikan Nasional. Jakarta: Mendiknas.

Megasari, R. (2020). Peningkatan pengelolaan sarana dan prasarana pendidikan untuk meningkatan kualitas pembelajaran di SMPN 5 Bukittinggi. *Jurnal Bahana Manajemen Pendidikan*, 2(1), 636–648.

Nurbaiti, N. (2015). Manajemen sarana dan prasarana sekolah. *Manajer Pendidikan: Jurnal Ilmiah Manajemen Pendidikan Program Pascasarjana*, 9(4).

Ramadhani, S. P., Ms, Z., dan Fahrurrozi, F. (2021). Analisis Kebutuhan Desain Pengembangan Model IPA Berbasis Project Based Learning Untuk Meningkatkan Berpikir Kritis Siswa Di Sekolah Dasar. Jurnal Basicedu, 5(4), 1819–1824. https://doi.org/10.31004/basicedu.v5i4.1047

Sari, F., Sesmiarni, Z., dan Febriani, S. (2024). Implementasi pembelajaran berbasis proyek untuk meningkatkan mutu pendidikan di SMAN 5 Payakumbuh. *Al-I'tibar: Jurnal Pendidikan Islam*, 11(3), 281–288.

Seprianty, S. (2018). Penggunaan Alat Peraga Pada Mata Pelajaran IPA Sebagai Upaya Meningkatkan Hasil Belajar Siswa Kelas IV SD Negeri 06 Karang Tinggi. *Jurnal PGSD Jurnal Ilmiah Pendidikan Guru Sekolah Dasar*, 11(2), 128–134. https://doi.org/10.33369/pgsd.11.2.128-134

Sugianto, F. (2023). Motivasi Belajar Dan Hasil Belajar Siswa Pada Pembelajaran IPA Materi Pencemaran Lingkungan Menggunakan Model Pembelajaran Reqol (Real Quest Outdoor Learning). Bio-Cons *Jurnal Biologi Dan Konservasi*, 5(2), 321–328. https://doi.org/10.31537/biocons.v5i2.1490

Sugiyono, S. (2016). *Metode penelitian kuantitatif, kualitatif, R&D*. Bandung: Alfabeta, 1(11).

Widhanarto, G. P. (2024). Optimalisisai Potensi Peserta Didik: Tantangan Pendidik Indonesia Dalam Pendidikan Berbasis Kompetensi. *Pedagogi Jurnal Ilmu Pendidikan*, 24(1), 27–37. https://doi.org/10.24036/pedagogi.v24i1.1857

Yasin, M., Judijanto, L., Andrini, V. S., Patriasih, R., Hutami, T. S., Hasni, H., Arisa, M. F., Asriningsih, T. M., Saifuddin, M., dan Hariyono, H. (2024). *Model Pembelajaran Berbasis Teknologi: Teori dan Implementasi*. PT. Green Pustaka Indonesia.