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Facilities and Infrastructure Management: Ergonomic Analysis of Inclusive Schools

Nur Baety Habibah Jannah*, Ummi Alfiyyatur Rohmaniyyah
Islamic Education Management, Faculty of Islamic Education and Teacher Training, UIN Sunan Kalijaga
Jl. Tel. +62-274-540971, Fax. +62-274-519739.

Corresponding author*
baetyhabibah@gmail.com

Abstract: Management of facilities and infrastructure can be interpreted as a process of cooperation in utilizing all educational facilities and infrastructure effectively and efficiently. Management of facilities and infrastructure in inclusive schools is very important as a support for learning and meeting the needs of all students. This study uses a literature study method by reviewing various related studies and publications. The focus of this study is on the application of ergonomic analysis in the management of educational facilities and infrastructure in inclusive schools. The purpose of this analysis is to create safe, comfortable, and effective interactions between users and existing facilities. An effective management process includes planning, organizing, implementing, and supervising school facilities and infrastructure, which aims to minimize disruptions in the learning process and increase the efficiency of resource use. Ergonomic analysis in inclusive schools includes adjusting facilities for comfort, accessibility, safety, and flexibility, which allows students to learn with good posture, reduce the risk of health problems, and increase learning focus. The results of this study indicate the importance of ergonomic-focused facility and infrastructure management in inclusive schools. This study analyzes how ergonomic learning environments can improve comfort, safety, and accessibility, thereby supporting optimal learning for all students. The study also highlights relevant regulations, such as the Law on Persons with Disabilities and the Regulation of the Minister of Education on Inclusive Education, which mandate appropriate inclusive education facilities. The study also provides evidence-based recommendations for policymakers and school administrators to improve the effectiveness of inclusive school facilities worldwide. Thus, the management of facilities and infrastructure that pays attention to ergonomic needs contributes to the successful implementation of inclusive education, increasing overall student engagement and achievement.

Keywords: facilities, infrastructure, inclusive, ergonomic.

Introduction

Educational facilities and infrastructure are one of the supporting tools in achieving learning goals. Adequate learning facilities are very important for national schools or inclusive schools at all levels (Laswandi & Mularsih, 2019) . Currently, many inclusive schools face problems with a lack of attention to the design and management of ergonomic facilities. This has an impact on the quality of education for students with special needs, as well as limited accessibility and comfort. Research shows that an unergonomic learning environment can reduce student participation and cause long-term health problems (Horne et al., 2020) . Although many schools are trying to implement the principles of inclusion, there are still challenges in providing adequate facilities, especially related to the implementation of good ergonomics in inclusive schools (Buli-Holmberg, J. & Jeyaprathaban, S., 2016) . Therefore, it is important to conduct an analysis of the management of inclusive school facilities and infrastructure to ensure that all students can learn optimally.

Inclusive schools are designed to meet the diverse learning needs of all students, including those with disabilities (García, A., et al., 2020) . To ensure that all students receive the best learning experience, it is essential to evaluate how inclusive schools manage their facilities and infrastructure. Inclusive schools accept students with a variety of

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needs, including those with physical or cognitive disabilities. By considering and modifying facilities such as chairs, tables, and classroom accessibility, schools can create a comfortable and supportive classroom environment for all students. (Wiggins, S., & Damodaran, P., 2019) . Ergonomic analysis is essential to ensure that the physical environment of the school promotes comfort, safety, and accessibility for all users (García, A., et al., 2020)

Various international and national regulations including the United Nations Convention on the Rights of Persons with Disabilities (CRPD), which emphasizes the importance of access to inclusive education for all without discrimination (United Nations, 2006) . The legal basis for inclusive education in Indonesia is regulated in Law Number 8 of 2016 concerning Persons with Disabilities (Government of Indonesia, 2016) . And also in the Regulation of the Minister of Education and Culture Number 70 of 2009 concerning Inclusive Education (Ministry of Education and Culture, 2019) . Both regulations mandate that schools must provide adequate facilities and full accessibility for students with special needs. Thus, an ergonomic analysis of inclusive school facilities is important to ensure that the principle of inclusion can be implemented properly.

The principles of ergonomics in inclusive schools in this study include several important aspects to create a comfortable, safe learning environment that supports the participation of all students. The principles of facility and infrastructure management in ergonomic analysis in inclusive schools include several important aspects to create a comfortable, safe learning environment that supports the participation of all students. Accessibility is the main principle, where facilities must be designed to be accessible to students with special needs, such as ramps and lifts for wheelchair users (Smith, J., 2020) . Ergonomics is also an important factor, where equipment and furniture, such as tables and chairs, must be adjusted to the posture and comfort of students, in order to prevent health problems such as musculoskeletal disorders (Straker, L & Mathiassen, SE, 2017) . In addition, flexibility in space arrangement and assistive technology must be considered so that all students, including those with disabilities, can learn independently and actively (Rouse, M, 2020) . Compliance with inclusive education regulations ensures that all students have the right to learn in an equal and disability-friendly environment (Johnson, T. & Brown, K., 2018) . These principles as a whole aim to create inclusive schools that support optimal learning for all students.

This research is very important to improve the learning environment in inclusive schools, so this research is needed. In addition, it is very important to create an ergonomic environment to improve the comfort and effectiveness of student learning. According to recent research, it shows that if the facilities used by students with special needs do not meet ergonomic standards, they are more susceptible to discomfort, fatigue, and musculoskeletal injuries (Castellucci, H. I et al., 2016) . Therefore, inclusive schools are the right place for this research because the various needs of students in their environment allow for a more in-depth analysis of how effective the design and management of infrastructure are. In addition, there is a need to provide recommendations based on scientific evidence to educational policy makers and inclusive school managers (Mulcahy, D. et al., 2015) . By studying directly how ergonomic factors affect the learning experiences of students with disabilities, this research is expected to help improve the design and management of inclusive schools around the world and help build better education for students with disabilities (Barrett et al., 2017) .

Method

To find the relevance of ergonomics in the management of facilities and infrastructure in inclusive schools, this study uses a literature study method. By doing this, researchers can analyze and synthesize previous research findings to gain a comprehensive and in-depth understanding of the research topic (Hannah Snyder, 2019) . This method was chosen because it can provide a comprehensive picture of various academic perspectives on the design of inclusive education facilities, as well as ergonomic aspects that affect

the comfort of students with special needs (Xiao Yu & Maria Watson, 2019) .

The initial step in this study was data collection through regular searches in academic databases such as Google Scholar, Scopus, Sinta, etc. By limiting it to articles published in the last 10 years to ensure the relevance of the data used to the current context (Booth, A. et al., 2016) . Furthermore, the articles found were evaluated based on their methodological quality, relevance to the subject, and their influence on the management of inclusive school facilities and infrastructure (Okoli, C., 2015) . Then, each selected article was analyzed thoroughly. This analysis includes an evaluation of the research methodology, results, and conclusions generated from the study. The purpose of this study is to develop a broader perspective on how ergonomics is used in the creation and management of inclusive school facilities (Zhu, Y. et al., 2019) . The researcher also identified existing research gaps and formulated recommendations for improving more inclusive and ergonomic facility management (Pang, Z. et al., 2018) .

Results and Discussion

Management of facilities and infrastructure is very important in supporting the success of the teaching and learning process in schools, especially in the context of inclusive schools. Well-managed facilities and infrastructure not only provide a comfortable and safe learning environment, but also enable all students, including those with special needs, to learn optimally (Nurliah, A. & Amir, M., 2020) . Good management ensures that facilities, such as classrooms, learning equipment, and physical accessibility, are always ready to use and in accordance with applicable education standards.

In addition, effective management of facilities and infrastructure also increases the efficiency of resource use and ongoing maintenance of facilities. When school facilities are updated and maintained regularly, potential disruptions to the teaching and learning process can be minimized. With adequate accessibility and ergonomic design, students are more likely to feel comfortable and focused, so that their academic results can also improve (Wiggins, S., & Damodaran, P., 2019) .

Facilities and Infrastructure Management

Management of facilities and infrastructure as stated by George R. Terry in the book Principles of Management has the function of Planning, Organizing, Actuating, Controlling. Principles are the basis for carrying out an idea, from concept to implementation (Ilmi et al., 2023) . The management of these facilities aims to maximize the effectiveness of the use of facilities and infrastructure to support an efficient and safe learning process (Fletcher, T. & Hesketh, AJ, 2019) .

Planning is a basic step in facility management that ensures that all school facility and infrastructure needs are clearly identified from the start (Al-Harthi, AS & Al-Zyoudi, M., 2017) . Through good planning, educational institutions can allocate resources efficiently to meet the standards needed to support the learning environment (Johnson, P. & , & Orr, R., 2018) . Mulford and Fuchs (2021) emphasize that good planning must consider the needs of students, especially in the context of inclusive education, so that facilities are accessible to all students, including those with special needs.

In addition, facility planning should include an analysis of long-term needs based on projected student numbers and technological developments, such as space for computer labs or classrooms that support digital learning (Tondeur, J., 2019) . Johnson and Orr (2018) noted that schools that have long-term planning for their facility development are better able to face the challenges of changing student numbers and evolving facility needs.

Next there is organization, where in the management of facilities and infrastructure involves the arrangement of structures and division of responsibilities so that each school unit can utilize the facilities effectively (Zhu, W. & Devine, E., 2015) . Effective organization allows schools to carry out maintenance and arrangement of facilities in a structured manner so that all elements function optimally and students can access them easily (Wheeler, T. & Shaw, D., 2016) .

The division of responsibilities in organizing includes assigning specific staff who are responsible for the maintenance, cleanliness, and arrangement of the use of facilities. It also involves coordination between staff to maintain the quality of facilities in the long term (Mulford, J. & Fuchs, D., 2021) . Good organization will ensure that facilities, such as libraries and laboratories, can be used alternately and in a safe and comfortable condition (Fletcher, T. & Hesketh, AJ, 2019) .

Then, the implementation includes daily use activities of facilities and infrastructure that have been planned and organized well. Implementation that pays attention to ergonomic aspects can increase student comfort during learning activities, so that they can learn in an environment that supports good posture and reduces the risk of health problems (Straker, L. & Mathiassen, SE, 2017) . In the context of inclusive schools, the implementation of facilities and infrastructure must consider the accessibility of students with various needs, such as wheelchair ramps and accessible toilets (Mulford, J. & Fuchs, D., 2021) . Al-Harthi and Al-Zyoudi (2017) emphasized that good implementation also requires routine maintenance of frequently used facilities to keep them in a proper and safe condition for all users, so that every student has an equal opportunity to learn.

Finally, supervision is the final stage that aims to ensure that all facilities are functioning according to standards and remain in good condition. Johnson and Orr (2018) stated that regular supervision is essential to detect damage or the need for repairs to existing facilities. Consistent supervision also helps ensure that schools comply with applicable safety regulations and standards, especially for inclusive environments (Wheeler, T. & Shaw, D., 2016) .

In addition, Fletcher and Hesketh (2019) showed that regular monitoring of school facilities can identify areas that need repair or quality improvement, so that the facilities remain in good condition to support the learning process. Mulford and Fuchs (2021) added that monitoring is not only important to keep facilities in good condition, but also to extend the life of the facility and avoid greater repair costs in the future.

Ergonomic Analysis of Inclusive Schools

Ergonomics comes from the Greek words ergon (work) and nomos (rule). The definition of ergonomics is the science, technology and art of harmonizing tools, work methods and the environment with human capabilities, abilities and limitations so that healthy, safe, comfortable and efficient working conditions and environments are obtained so that the highest productivity is achieved (I Made Sutajaya & Pande Wayan Mustika, 2016) . Humans need tools that are designed to facilitate and speed up their work in the work process. Tool development from an ergonomic perspective is a method that must be applied by considering the capabilities and limitations of the human body so that the designed products truly suit human needs (Azizah & Isnaini, 2023) . Ergonomic analysis in interior design is not only about creating an aesthetically pleasing space, but also about creating a comfortable, functional, and useful environment for its occupants. This involves holistic consideration of various factors, including physical, psychological, social, cultural, economic, and environmental aspects (Joko Wirja, tt) .

There are three general ergonomic objectives, namely first improving physical and mental well-being by preventing injuries, accidents, and occupational diseases, reducing physical and mental workloads, and striving for job promotion and satisfaction, second improving social welfare by improving the quality of social contact, managing and coordinating appropriately, and improving social security during the productive and post-productive age period, and third to create a rational balance between various aspects, namely economic, technical, anthropological, and cultural aspects of each work system carried out, so as to create high quality work and quality of life (Hadi et al., 2020) . Meanwhile, the main objective of ergonomic analysis in inclusive schools is to create a learning space that is physically and cognitively accessible to all students, so as to improve the learning experience and prevent health problems caused by inappropriate posture or environment (Straker, L. & Mathiassen, SE, 2017) .

Ergonomic analysis in inclusive schools is the process of assessing and adapting the learning

environment to ensure comfort, safety, and accessibility for all students, including those with special needs. Here are some of the main ergonomic principles applied in inclusive schools (Straker, L. & Mathiassen, SE, 2017) , namely:

1. Comfort

The principle of comfort requires furniture and facilities that are appropriate to the needs and posture of students to support their learning activities. Height-adjustable tables and chairs, for example, allow students of different heights and sizes to sit with good posture, reducing muscle tension and the risk of musculoskeletal disorders. This comfort in the school environment creates a more pleasant learning atmosphere and can improve student concentration.

2. **Accessibility**

Inclusive schools must ensure that facilities are accessible to all students, including those with disabilities or special needs. This includes barrier-free wheelchair ramps, doorways that are wide enough, and handrails on stairs and toilets to make it easier for students with disabilities. Accessibility also includes assistive technology, such as magnifying screens or audio devices that help students with visual and hearing impairments, so that all students can participate in lessons on an equal basis.

3. Safety

In an inclusive learning environment means that furniture and facilities should be designed to minimize the risk of injury. For example, tables and chairs should be stable and free of sharp edges to avoid injury to students. A safe classroom environment also means a space that is free from distractions such as cables lying on the floor or other hazardous materials, so that students can move freely without risk . In addition, classroom safety also includes adequate lighting to avoid eye strain and provide good visibility for all students.

4. Flexibility

Flexibility is an important ergonomic principle in inclusive school design because facilities must be able to be adapted to the individual needs of students. For example, height-adjustable desks, comfortable chairs, and classrooms that can be rearranged to suit specific lesson needs make the learning environment more responsive to the needs of all students . This flexibility provides equal access for students with different learning needs and allows them to fully participate in activities.

There are several main components in the ergonomic analysis of an inclusive school:

1. Flexible Facility Design
   Facilities in inclusive schools must be designed with high flexibility to accommodate students with different physical needs. For example, height-adjustable tables and chairs allow students with different body sizes or those using wheelchairs to study comfortably (Davison, J. & Hornby, G., 2020) .
2. Furniture and Classroom Arrangement Classrooms
   in inclusive schools need to be arranged in such a way that students with mobility limitations can move easily. Sufficient space for wheelchairs, accessibility to desks, and disability-friendly door designs are important aspects of ergonomics (Wheeler, T. & Shaw, D., 2016) .
3. Use of Assistive Technology Assistive technology
   such as hearing aids, special visual devices, or adaptive learning software also play an important role in supporting students with special needs to learn independently and effectively (Fletcher, T. & Hesketh, AJ, 2019)
4. Health and Safety Aspects
   In addition to comfort, ergonomics also includes aspects of students' health and safety. Unergonomic desks and chairs, for example, can cause health problems such as back pain or poor posture. Straker and Mathiassen (2017) emphasize that good ergonomic design can reduce the risk of musculoskeletal disorders, which is important for students during their growth period. (Straker, L & Mathiassen, SE, 2017) .
5. Optimal Lighting and Acoustics
   Good lighting and a friendly acoustic environment are important components for students with visual and hearing impairments. Ergonomic analysis in inclusive schools

considers natural and artificial light sources, room color arrangements, and sound insulation to reduce external disturbances (Mulford, J. & Fuchs, D., 2021) .

The application of ergonomic analysis in inclusive schools provides significant benefits for the learning experience of students, especially those with special needs. With an ergonomic environment, students can learn more comfortably, improve concentration, and reduce the risk of long-term health problems. Good ergonomics also improves accessibility, meaning that each student can use school facilities independently and without obstacles (Al-Harthi, AS & Al-Zyoudi, M., 2017) .

Conclusion

This study shows that the management of facilities and infrastructure that pays attention to ergonomic principles is very important to support the success of the learning process in inclusive schools. Ergonomically designed facilities can improve comfort, safety, and accessibility for all students, including those with special needs. Ergonomic principles, such as comfort, accessibility, safety, and flexibility, provide long-term benefits by preventing health problems, improving student concentration, and supporting active participation in learning activities. Therefore, the implementation of ergonomic-based facility and infrastructure management in inclusive schools not only fulfills regulatory obligations but also creates an inclusive, comfortable, and healthy learning environment for all students. This study is expected to be a reference for policy makers and school administrators in improving the quality of inclusive education that is responsive to the needs of each student.

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