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An analysis of green school facility management for children with special needs in inclusive early childhood education

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Abstract

This study analyses the management of child friendly facilities and infrastructure in inclusive early childhood education. The research uses a qualitative approach, data were collected through observations of school activities and interviews with principals, teachers, and parents. The purpose of this study is to analyse the management of green school facilities in inclusive early childhood education and to identify the problems and impacts related to their implementation for children with special needs. This study uses a qualitative approach to understand in depth the management of environmentally friendly school facilities for children with special needs in inclusive early childhood education. Collecting data by observation, interview. Data analysis techniques are triangulated data and literature review. The study analyses inclusive facility management requires not only physical adaptation but also an infrastructure, supporting facilities, tools and learning media, tools, Infrastructure management, parent participation management and technology. Inclusive and eco-friendly early childhood education. Good infrastructure, supportive facilities, engaging learning tools, strong management, active parents, and smart use of technology. Classrooms should be more than just accessible they need to be green, safe, and friendly for every child's growth. Facilities like quiet rooms, sensory spaces, and adaptive playgrounds are not luxuries but essentials for learning and healing. Teachers also need the right training to use assistive tech and eco-friendly resources effectively, while parents play a key role as partners in shaping schools. Inclusive education offers a fresh framework that supports global goals for quality education and sustainable communities.

Keywords: Analysis, Green School, Infrastructure, Special Needs Children, Inclusive School

INTRODUCTION

The growing number of children with special needs entering formal education in Indonesia underscores the urgency of creating learning environments that are both inclusive and sustainable.

In 2023 alone, the number of students with special needs reached 146,205, yet the availability of facilities designed to support them remains uneven. This study therefore seeks to develop a model for managing inclusive, eco-friendly facilities and infrastructure in early childhood education. Although the number of inclusive schools nationwide has increased to 44,477, the shortage of specialized support staff continues to present challenges. Current data reveal that only 14.83% of the 40,164 schools serving children with special needs are equipped with special guidance teachers. This imbalance highlights a critical gap between policy expansion and practical implementation on the ground.

Recent research increasingly emphasizes the benefits of ecological green spaces in school environments, particularly for children with developmental challenges. Transforming playgrounds into natural, eco-friendly areas has been shown to strengthen children's social behaviours by fostering sharing, empathy, and self-control. Beyond these social improvements, green school settings are closely linked with gains in cognitive functioning, improved attention, and better behavioural regulation. These effects are especially evident in children with ADHD and autism, for whom natural environments often provide both calming and stimulating experiences (Díaz Martínez and a. L., 2023). A school environment enriched with greenery also reduces stress and mental fatigue, which is particularly important for children with special needs who may be more sensitive to stressful stimuli. Learning outdoors, in natural and shaded spaces, helps children feel calmer, more focused, and more receptive to instruction (Amicone and Petruccelli, 2018). Nature-based education has further been shown to promote social inclusion by addressing children's innate "biophilic" need to connect with the natural world. For children with special needs, such experiences nurture self-esteem, a sense of belonging, and active participation in school life (Stavrianos, 2016). At the same time, they also cultivate values of responsibility, empathy, and care for the environment—skills that not only benefit personal growth but also support broader goals of lifelong learning and sustainable development (UNICEF, 2023).

In addition to social and emotional advantages, ecologically supportive environments enhance concentration, memory retention, and overall engagement in learning activities. These benefits are particularly important for children with learning disabilities, who may struggle to focus on overstimulating settings (Browning et al., 14). Natural school environments, by minimizing distractions, provide optimal conditions for children to grow and achieve according to their potential. Finally, the physical infrastructure of green schools plays a central role in supporting the development and wellbeing of children with special needs. Design features such as natural lighting, clean air circulation, easy access to outdoor green spaces, and the use of eco-friendly materials can significantly reduce sensory overload while enhancing cognitive performance. These considerations are especially critical for children with autism spectrum disorder or ADHD, who often face heightened sensory and attentional challenges (Smith, 2024). In this way, green school environments emerge not only as spaces for ecological education but also as inclusive, supportive settings where all children can thrive.

Green spaces in schools not only enrich the physical environment but also encourage positive social interactions and help reduce behavioural challenges. By providing calm and structured settings, such spaces promote cooperative play, exploration, and meaningful peer engagement (Rahman and, 2024). In addition, involving children with special needs in sustainability projects such as school gardening or recycling has been shown to build self-esteem and foster a strong sense of responsibility (Martinez, 2024). In this way, green infrastructure goes beyond environmental benefits; it actively supports educational success and contributes to the overall wellbeing of students with diverse needs. Inclusive schools serve as crucial spaces where children from a wide range of social, cultural, and economic backgrounds can learn side by side. This diversity not only strengthens social cohesion but also enriches the learning experience for all students. For children with special needs, inclusive education ensures their right to participate in mainstream schooling, where they are given opportunities to learn and grow alongside their peers (Fitriani, 2019). However, the success of inclusive education requires careful adaptation of curricula, facilities, infrastructure, and instructional systems to the

unique needs of each student (Roza, 2020). Adaptive learning practices, designed to address the diverse needs of personal knowledge, play a crucial role in fostering inclusive participation (Mihovska et al., 2021).

Inclusive education is an approach that embraces diversity and prioritizes individual learning needs. It seeks not only to provide access but also to transform the school into a more welcoming and inclusive environment where every child can realize their full potential (Firli, 2020). The role of facilities and infrastructure is particularly significant in this process. Well-designed spaces and resources allow schools to create enjoyable and engaging learning experiences, helping maintain students' interest and reducing boredom during lessons. Furthermore, the completeness of school facilities serves as a key factor in nurturing social skills, offering children opportunities to interact, collaborate, and develop confidence in a supportive environment (Yunita, 2019). The provision of facilities and infrastructure is a crucial component of implementing inclusive education (Suvita and e., 2022). Inclusive education requires the availability of various facilities and infrastructure, as students with special needs have diverse needs that necessitate facilities and infrastructure that support their learning process (Azzahra, 2022). These facilities include textbooks in braille format, talking books for blind students, audiobooks, and special equipment to support students with special needs (Hidayat, 2022). The completeness of these facilities must comply with the standards set by the government. This guideline is a national reference in the field of education, which includes basic requirements for inclusive schools, such as classrooms, sports fields, places of worship, libraries, laboratories, play areas, creative spaces, and other learning facilities that are expected to support the learning process, including the use of information and communication technology (Hasanah, 2023). Inclusive education management in early childhood education still faces challenges in providing holistic and integrated services (Maemunah, 2021). This includes limitations in curriculum development, teacher training, and parent and community involvement. In addition, physical facilities that support inclusion are still inadequate, hindering the active participation of children with special needs in learning activities. This condition requires a more comprehensive and adaptive management approach to the needs of children with special needs. It is essential to develop strategies that prioritise academic aspects and the physical and social environment to support inclusion. Thus, early childhood education can be a friendly and supportive place for all children, including children with special needs. This effort requires collaboration between various stakeholders, including the government, educators, and the community. Without a holistic approach, achieving the goal of inclusion in early childhood education is challenging. Therefore, this study aims to identify and develop a management model for facilities and infrastructure that supports child-friendly green schools for children with special needs in early childhood education. Integrating physical, social, and pedagogical aspects can create an inclusive and sustainable learning environment.

Another key issue lies in the theoretical gap. Much of the existing literature on educational management and learning environment design is framed in universal terms but often fails to capture the specific needs of young children with disabilities. For instance, the Reggio Emilia approach highlights the environment as the "third teacher" (Strong-Wilson and, 2021). While valuable, this framework does not fully embrace the principles of universal accessibility and therefore overlooks the lived experiences of children with disabilities. This gap points to the need for a more inclusive and context-specific theory of educational facility management one that emphasizes building a truly inclusive community in the governance of early childhood learning environments. In this context, facilities and infrastructure for early childhood education must be designed with inclusion and sustainability in mind, especially for children with special needs. According to the OECD, 2023, inclusive education goes beyond curriculum design; it also requires facilities that meet children's diverse physical and cognitive needs. This means that classrooms and outdoor spaces should prioritize accessibility, comfort, and environmental sustainability. Evidence has shown that access to green spaces offers substantial psychological benefits, particularly for children who need calming and

positive sensory stimulation. For example, (Fernández, 2021) documents the importance of classroom designs that reduce stress levels in children with developmental disorders. This aligns with the broader concept of green school's environments that are simultaneously environmentally responsible and child-friendly—where design choices are especially critical for children with special needs.

The design of inclusive classrooms stands at the heart of this study, as the physical adaptation of learning spaces plays a critical role in determining the success of inclusive education (Schuelka, 2021). Flexible classroom layouts allow schools to respond to the diverse needs of all children, including those with disabilities. Adjustments to the physical environment are particularly vital in ensuring that inclusion is not only a principle but also a lived reality for children with special needs (Lau, 2021). For example, the use of child-friendly building materials and barrier-free access such as ramps, wheelchair-friendly pathways, or adjustable furniture can dramatically improve children's participation in learning. Similarly, classrooms with abundant natural lighting and proper ventilation help reduce anxiety while enhancing concentration and engagement. This study therefore focuses on developing a model of infrastructure management that supports inclusive education through a sustainable, environmentally conscious approach. Equally important is the role of community involvement in shaping child-friendly green schools. The educational community, particularly parents, holds a significant influence in driving meaningful changes within the school environment. The success of inclusive education cannot rest solely on schools but depends on the collective engagement of families, educators, and wider communities (Ainscow, 2019).

An inclusive pedagogical approach also requires educators to develop a deep understanding of children's diverse needs. Teachers who are trained in inclusive strategies are better equipped to adapt instructional methods to suit the unique characteristics of their students, including those with disabilities (Fox, 2021). Examples include the use of assistive technologies, individualized support, and curriculum modifications that ensure every child can actively participate in classroom activities. These practices resonate with the findings of Liu et al., 2023, who emphasize the centrality of pedagogical adaptation in making inclusive education effective. In the context of early childhood education, such pedagogical efforts are most successful when supported by both a responsive physical environment and the readiness of educators to implement inclusive strategies. Beyond their physical and psychological advantages, green spaces in schools play a vital role in supporting children's social development. Well-designed and safe outdoor environments encourage interaction, cooperation, and play, benefiting all children, including those with special needs (Fernández, 2021). For children with physical or developmental disabilities, open spaces provide opportunities to build friendships, practice communication, and engage in meaningful social experiences that might be more difficult in traditional classroom settings.

For this reason, the management of early childhood education (ECE) facilities must place strong emphasis on designing outdoor areas that are both child-friendly and inclusive. Such environments help children feel welcomed, accepted, and free to interact with their peers. Effective green space design also contributes to stress reduction and improved emotional wellbeing, offering children calming spaces that support resilience and positive behaviour. Accessibility is another central aspect of inclusive school design. Child-friendly facilities must ensure that every student, including those with motor or sensory impairments, can participate fully in school life. This requires the provision of ramps, accessible pathways, adaptive play equipment, and classroom layouts that accommodate wheelchairs, hearing aids, and other assistive technologies. By integrating these features into green school infrastructure, schools ensure that no child is excluded from the learning process. This study, therefore, seeks to explore how the design and management of green school infrastructure can strengthen accessibility for children with special needs in early childhood education. Despite the growing emphasis on inclusive education globally, research gaps remain. Challenges faced by teachers in adapting learning to the specific needs of children with developmental disabilities are rarely addressed in facility management strategies (Gunawan, 2023).

This study offers a fresh contribution by linking green school management with inclusive early childhood education, an intersection that has rarely been explored in previous research. Whereas most studies examine inclusion or sustainability in isolation, this research combines the two within a single management framework. By examining school facilities, assistive resources, and community involvement, the study provides not only practical strategies for strengthening inclusive early childhood education but also a theoretical lens for understanding how sustainability principles can be embedded into education management. In doing so, it illustrates how inclusive practices and environmental responsibility can work hand in hand to create supportive, child-friendly learning environments. The significance of this research also extends beyond the Indonesian context. Positioned within global discussions on inclusion and sustainable development, the findings offer insights that can inform both policy and practice internationally, highlighting education's potential to advance equity, participation, and sustainability at the same time.

MATERIALS AND METHODS

The Research Designs

This study uses a qualitative approach to understand in depth the management of environmentally friendly school facilities (green schools) for children with special needs in inclusive early childhood education. Qualitative methods were chosen because they can explore the meaning, perceptions, and managerial practices carried out by schools in real contexts (Creswell and Poth, 2016). Qualitative research is characterized by an inquiry into human experiences, social interactions, and cultural contexts. It allows researchers to understand how individuals make sense of the world around them (Tisdell, 2025). This study emphasizes the meaning, perspective of the subjects, and contextual dynamics that cannot be explained quantitatively. In addition, this approach allows researchers to examine management strategies holistically from the experiences of principals, teachers, and parents, thus providing a comprehensive understanding of inclusive green facility management practices. Thus, qualitative methods are very relevant to answer the research objectives that focus on exploring and understanding green facility management in the context of inclusive education (Miles et al., 2014).

Participant

The participants include the headmaster, Teachers, and parents. The number of participants includes approximately 5 headmasters, 10 teachers of inclusion and early childhood education, and 25 parents. The research was conducted on inclusive early childhood education in Surakarta.

Table 1. Research Subjects and Their Demographic Characteristics

Research Subject	Number of Participants	Education Background	Years of Experience	Role in Inclusive PAUD
Principals	5	Bachelor/Master in Education/Management	10–20+ years	School leadership, policy implementation, facilities management
Teachers	10	Bachelor in Early Childhood Education/Special Education	3–15 years	Classroom management, inclusive practices, daily facility use
Parents of Children with Special Needs	25	High School – Bachelor	Varies	Caregiver, collaborator in learning process, provide feedback on facilities

The Data Collection Techniques

In this research, the data collection techniques used are observation and interviews. Observations were conducted by researchers directly in the school, where they observed children participating in an activity using the infrastructure in a green school that is friendly to children with special needs.

Observations are made throughout the entire learning process, from its inception to its completion. Interviews were conducted directly by the researcher with the headmaster, teacher, and parents. Before conducting an interview, the researcher creates several questions related to the research topic to serve as an interview guide. Before conducting an interview, the researcher develops several interview questions related to the research topic to serve as a guide for the interview. The purpose of this interview guide is to provide an overview of the answers to this research topic. The guide also facilitates the research interview process.

Data Analysis Method

Data analysis techniques are triangulated data and literature review. In this research, the researchers will perform qualitative data analysis using the interactive analysis model proposed by Miles et al., 2014. The data analysis will be carried out in several stages, such as conditions and challenges of inclusive early childhood education are background of the Student, facilities and infrastructure, accessibility, room class. Analysing the problems and their impact are infrastructure, supporting facilities, supporting facilities, tools and learning media, infrastructure management, parent participation, management and technology innovation.

RESULT AND DISCUSSION

Analysis of Facilities and Infrastructure Management Needs for the Adiwiyata Early Childhood Education Pilot Project, Focusing on Children's Special Needs in Surakarta City

Field observations in an inclusive early childhood center in Surakarta revealed that while the school already has some basic green infrastructure, such as a small garden and classrooms with good ventilation and natural lighting, these facilities are not yet fully utilized for learning or therapeutic purposes. The garden, for instance, has the potential to serve as an eco-learning and calming space, but currently functions only as decoration. Accessibility also remains a serious issue. Although a ramp has been provided, its steep slope makes it difficult for children in wheelchairs to use, and toilets are not yet disability-friendly. The classrooms themselves are bright and airy, but the fixed layout of desks and chairs limits mobility for children with physical disabilities. In terms of learning media, teachers largely rely on conventional tools like paper, whiteboards, and posters, with very limited use of assistive technology or adaptive resources.

Interviews with teachers further highlight these gaps. One class teacher explained that children with autism often become calmer when taken outside into the garden, but the absence of sensory tools or a dedicated calming room forces teachers to improvise with whatever materials are available. A special assistant teacher echoed this concern, pointing out that although the school has made efforts to improve accessibility, the facilities do not yet meet universal design standards. Parents also expressed similar challenges. A parent of a child with physical disabilities shared that the path to the classroom was not wheelchair-friendly, often requiring them to physically carry their child into class. Another parent of a child with ADHD emphasized the urgent need for a sensory or quiet room, explaining that without it, their child frequently becomes overwhelmed and must be taken home early. This table is a based condition of school.

Table 2. Conditions and Challenges of Inclusive Early Childhood Education

No	Aspect	Condition	Challenge
1	Background of the Student	Students with special needs	The learning approach is very individual yet optimal because of limitations in means and infrastructure.
2	Facilities and Infrastructure	Limited special aids	There is an imbalance between the number of students and the availability of infrastructure.
3	Accessibility	Strategic and easy location, accessible	Track chair wheel, toilet, and play area are not yet disability-friendly.

No	Aspect	Condition	Challenge
4	Room Class	Ventilation and lighting are enough	Layout and room location do not yet support mobility and special needs.

Inclusive early childhood education embraces children with diverse special needs, school support them by learning approaches must be tailored to each child's unique abilities and challenges. Yet, in practice, the lack of adequate facilities and infrastructure often makes this difficult (Kurniawati and, 2017). In Indonesia, inclusive education still struggles to provide proper services for every child who needs them. Essential facilities such as braille boards, hearing aids, and sensory areas play a vital role in helping children learn, but many early childhood institutions still have limited access to these resources (Margiyanto, 2023). The way facilities are managed significantly affects how successful inclusive programs can be, particularly in meeting the developmental needs of children with disabilities. While the location of schools can make education more accessible, challenges remain in creating truly disability-friendly environments. Wheelchair ramps, accessible toilets, and inclusive play spaces are often missing or inadequate. Developing proper accessibility is not just about compliance; it is key to sustaining inclusive education. Although classrooms typically provide good ventilation and lighting, their layouts often do not support the mobility of children with special needs. A thoughtful arrangement of space designed to be safe, open, and easy to navigate ensures that every child can move freely, learn comfortably, and develop independence within their learning environment.

Table 3. Analysis the Problem, Literature Result and Article Contribution

Dimension	Literature Result	Synthesis and Article Contribution
Infrastructure	1. Exposure to green spaces enhances cognitive function and working memory (Dadvand and N., 2015). 2. Green spaces support equity for disadvantaged communities (Van Velzen et al., 2023) 3. Natural lighting and healthy ventilation reduce sensory stress in children with autism and ADHD (Smith, 2024) 4. Disability-friendly design is essential (UNICEF, 2023). 5. Natural environments reduce mental fatigue (Amicone and Petruccelli, 2018). 6. Green design improves behavioral regulation in children with ADHD (Díaz Martínez and a. L., 2023). 7. Flexible classrooms support mobility for children with special needs (Lau, 2021).	This article brings together two areas of research that are usually discussed separately: green schools, which focus on health and cognitive benefits, and inclusive education, which stresses physical accessibility. By integrating these perspectives, it proposes a model of early childhood education that combines equity and sustainability through inclusive green infrastructure. Yet, in practice, many ECE institutions still lack ramps, accessible toilets, and adaptive green spaces—leaving children with special needs limited mobility and fewer opportunities to learn in safe, stimulating environments.
Supporting Facilities	1. School gardens enhance psychological well-being (Fernández, 2021). 2. Gardening improves empathy and social skills in autistic children (Martinez, 2024). 3. Green play areas foster social interaction among children with special needs (Rahman, 2024). 4. Sensory therapy rooms support motor development (Lau, 2021). 5. Inclusive facilities prevent social isolation (Ainscow, 2019). 6. Inclusive play environments support motor and social development (Dadvand and N., 2015).	This article shows that eco-friendly supporting facilities are not just extra spaces but vital tools for learning and therapy. Yet, the lack of sensory rooms and green areas leaves many children with special needs without proper support to manage emotions, recover, and build social skills.

Tools & Learning Media	1. Assistive technology (AT) increases participation among children with special needs (Navas Bonilla et al., 2025). 2. Teachers' readiness remains limited (Fox, 2021). 3. Eco-friendly interactive visual media is effective for dyslexic children (Rahman, 2024). 4. Ecology-based digital applications increase motivation among children with special needs (Sakti, 2020). 5. UDL emphasizes multisensory media ((Strong-Wilson T. , 2021). 6. Eco-friendly media supports inclusion (Yang, 2025).	Limited teacher training and rare use of adaptive eco-media mean children with special needs often miss full participation and early ecological awareness. By involving communities, inclusive media can become both a tool for learning and a way to nurture children's connection to the environment.
Infrastructure Management	1. Accessibility audits are required (Roski, 2024). 2. Green maintenance enhances school quality (Van Velzen et al., 2023). 3. Failures of inclusion in Turkey are attributed to poor facility management (UNICEF, 2023). 4. OECD, 2023 emphasizes inclusive facility management. 5. Inclusive leadership is crucial (Ainscow, 2019). 6. Standards for inclusive facility management in Indonesia remain low (Hasanah, 2023). 7. Limited funding constrains facility management (Ayibah, 2022).	This article advances the literature by proposing a participatory governance-based model of facility management. Traditionally, management has been overly technical and top-down, with limited community involvement. As a result, inclusive green facilities are difficult to sustain and remain highly dependent on school-level policies.
Parent Participation	1. Parental involvement improves children's attendance (Herath and Herath, 2024). 2. Parents act as partners in inclusive school culture (Ainscow, 2019). 3. AT training for parents increases children's engagement (Fox, 2021). 4. Families promote environmental awareness (Ainscow, 2019). 5. Parental involvement is linked to early learning outcomes (Herath and Herath, 2024). 6. Inclusive facilities require parental support (Roza, 2020).	This article highlights the importance of involving parents not just as supporters but as co-designers of inclusive green facilities. Currently, parental participation in inclusive ECE is limited, often driven by financial or advocacy issues, resulting in programs that may not meet the needs of children with special needs. By integrating parents into school management strategies, this study broadens their role beyond their traditional function in children's learning.
Management & Technology Innovation	1. Learning analytics helps map learning barriers (Roski, 2024). 2. AI and NLP support accessibility (Navas Bonilla et al., 2025). 3. Environmental monitoring is crucial for children with special needs (Lau, 2021) 4. Adaptive software supports engagement of children with special needs (Fox, 2021). 5. Student information dashboards assist evaluation (Schuelka, 2021). 6. Environmental sensors support inclusive green schools (Smith, 2024). 7. Digital innovation must be adapted to sociocultural contexts (Tisdell, 2025).	This article expands the discussion on technology in inclusive ECE by introducing a green, data-driven management model. Unlike traditional use of technology solely for learning, this approach monitors both children's development and environmental factors like air quality, lighting, and green facility usage. The lack of such digital monitoring in inclusive schools has made it hard to systematically track children's progress and facility conditions. By framing technology as a strategic management tool, the study highlights its potential beyond learning, supporting more effective governance of inclusive green schools.

Infrastructure

Early childhood education infrastructure plays a crucial role in fostering children's cognitive, social, emotional, and in inclusive education, children's physical development is closely tied to the environments where they learn. Green and disability-friendly infrastructure is especially important because it brings together two key goals: environmental sustainability and universal accessibility for children with special needs. Research shows that exposure to green spaces can boost cognitive function, support equity for disadvantaged groups (Van Velzen et al., 2023), and provide therapeutic

benefits by reducing fatigue and improving behavior in children with ADHD (Díaz Martínez and a. L., 2023). School-led greening initiatives have also been shown to improve children's mental, social, and physical well-being (Lau, 2021), while natural environments in rural schools help students regulate their emotions more effectively (Fuentes Vilugrón et al., 2025). Simple design elements like natural lighting and good ventilation can reduce sensory stress for children with autism and ADHD (Smith, 2024). At the same time, sensory-supportive environments both indoors and outdoors are essential for helping neurodivergent learners thrive. Accessibility features such as ramps, adaptive toilets, and barrier-free pathways remain critical (UNICEF, 2023), yet many inclusive early childhood institutions still lack these basic supports. Teachers themselves have highlighted the importance of universal design, noting how crucial inclusive infrastructure is for learning (Azmi Khairuddin, 2025). Beyond infrastructure, flexible classroom layouts also play a vital role, enabling children with special needs to move freely, engage actively, and feel more included in daily learning activities (Lau, 2021)

Supporting Facilities

Creating a truly inclusive and environmentally friendly early childhood school goes far beyond simply providing ramps or accessible classrooms. It requires supportive spaces that nurture children's well-being and development, it places where they can calm down, explore, and connect with others in meaningful ways. Facilities such as sensory gardens, quiet rooms, and adaptive play areas serve as both learning and healing environments. They help children with special needs regulate emotions, build empathy, and develop essential motor and social skills. Studies show that green schoolyards and garden-based activities can significantly improve children's mental health, engagement, and self-regulation (van Dijk-Wesselius, 2020); (Díaz Martínez and a. L., 2023). Similarly, sensory gardens and multi-sensory spaces have been proven to reduce stress and support better behaviour among children with developmental differences (Fan, 2023). Research on outdoor learning also reveals that nature-based settings, such as forest schools, encourage autistic children to participate more confidently and socially, offering them low-pressure opportunities for growth and connection (Friedman, 2022). These findings remind us that facilities like quiet rooms, green play areas, and therapeutic gardens are not just "extras", they are essential parts of an inclusive, sustainable school environment where every child can learn, heal, and thrive together.

Tools and Learning Media

Digital innovation is making the connection between inclusion and sustainability in early childhood education even stronger. Take ecology-based digital applications, for example. These tools not only make lessons more interactive but also weave environmental themes into the learning process, which has been shown to boost both motivation and cognitive development in children with special needs (Sakti, 2020). In other words, children are not just learning core skills, they are also developing an early awareness of ecological issues in a way that feels natural and engaging (Hidayat, 2022) points out, At the same time, traditional tools such as Braille and audio-based learning remain essential for children with visual impairments. These tools do more than provide access to literacy; they also nurture a sense of independence and confidence. When combined with eco-friendly and digital innovations, these more established resources help build a richer, more inclusive ecosystem of learning media. Still, progress is uneven. Many inclusive ECE institutions continue to depend on conventional learning media that don't adequately serve children with diverse needs. Eco-friendly and adaptive media, though promising, are often underdeveloped and rarely integrated into daily classroom practices. As a result, children with special needs miss out on meaningful opportunities not only to participate fully in learning but also to build ecological awareness from an early age. On top of that, a lack of teacher training in both assistive technology and adaptive digital media remains a persistent barrier, limiting the potential of these innovations to truly transform inclusive education.

Infrastructure Management in Inclusive Green Early Childhood Education

Managing infrastructure in inclusive green early childhood education (ECE) is critical for creating

schools that are both sustainable and equitable, yet it is often overlooked. Effective management goes beyond technical upkeep, it requires attention to accessibility, inclusivity, and environmental sustainability simultaneously. Conducting accessibility audits, for example, helps schools identify barriers such as ramps, adaptive toilets, classroom layouts, lighting, and ventilation, ensuring compliance with universal design standards (Roski, 2024). Unfortunately, many schools perform these audits irregularly, resulting in inconsistent implementation of inclusive practices. Sustainability also depends on ongoing facility maintenance. Green practices like energy-efficient lighting, water recycling, and biodiversity-friendly gardens improve both environmental quality and student well-being (Van Velzen et al., 2023). Without systematic management, however, these features often fail to deliver long-term benefits, especially in inclusive ECE settings where infrastructure supports both therapeutic and educational needs for children with special needs.

Global evidence shows that poor facility management undermines inclusion: UNICEF, 2023 reported schools in Turkey struggled due to inaccessible classrooms and lack of maintenance protocols, the inclusive management is an ongoing process of adaptation, not just upkeep. Leadership is key, inclusive leadership fosters school cultures valuing equity, participation, and community involvement (Ainscow, 2019). In Indonesia, challenges persist: standards for inclusive facility management remain low due to weak policy enforcement, limited expertise, and uneven funding (Hasanah, 2023), with financial constraints further limiting regular audits and eco-friendly retrofits (Ayibah, 2022). As a result, many schools prioritize short-term operational needs over long-term strategies for inclusive and green infrastructure.

Parent Participation

Parental involvement has long been recognized as one of the strongest factors influencing children's educational success. Yet, its role in shaping inclusive and environmentally sustainable early childhood education is often overlooked. Research consistently shows that when parents are engaged, children benefit not only through improved attendance but also through stronger readiness for learning. The children whose parents participate actively in school activities are more likely to attend regularly and demonstrate better learning outcomes (Herath and Herath, 2024). This becomes even more significant for children with special needs, who require consistent collaboration between home and school to support their development. Despite this, in many contexts parental involvement is still limited to financial support or occasional volunteering, rather than being recognized as a strategic partnership. This narrow view underestimates the critical role parents can play in shaping inclusive school cultures and contributing to sustainable practices. Truly effective parental participation depends on strong and open communication between schools and families. The importance of two-way communication dialogue that goes beyond one-sided teacher reporting and instead builds mutual trust. Such exchanges allow teachers to better understand a child's strengths, challenges, and preferred learning strategies, while giving parents insight into how the school supports their child's growth. In inclusive classrooms, this is particularly important: without input from parents, interventions often risk being misaligned with the real needs of children with disabilities.

Management and Technology Innovation

The integration of management and technological innovation in inclusive green early childhood education (ECE) offers a powerful yet often overlooked opportunity to transform learning environments. Advances in educational technology are showing that data-driven approaches can do more than streamline processes. They can actively enhance both teaching and infrastructure management in inclusive schools. It illustrates how learning analytics can identify the specific barriers faced by children with special needs, whether in literacy, numeracy, or social interaction (Roski, 2024). By making these challenges visible, educators are better equipped to tailor instruction and design interventions that truly respond to each child's developmental profile. At the same time, tools like student information dashboards give teachers and administrators a clearer picture of progress, not only for individual learners but also for the institution as a whole. This supports more evidence-based

decision-making and ensures that inclusion is consistently evaluated and improved (Schuelka, 2021). Beyond data systems, artificial intelligence (AI) and natural language processing (NLP) are opening new possibilities for accessibility. AI-driven tools can assist children with speech and language impairments, allowing them to participate more actively in classroom activities (Navas Bonilla et al., 2025).

The green school movement and inclusive early childhood education for children with special needs. While most studies on green schools emphasize ecological and health benefits, and research on inclusion tends to focus on accessibility, parental involvement, or assistive technology, few have explored how these two perspectives can be integrated into a single management model. This study fills that gap by offering a comprehensive framework built on six interconnected dimensions: infrastructure, supporting facilities, learning tools and media, infrastructure management, parental participation, and technological innovation in school management. By connecting these elements, the study expands the concept of inclusive education management into what we call a green-inclusive governance perspective a vision where green facilities are not just physical assets but also function as learning tools, therapeutic spaces, and social enablers that support the holistic development of children with special needs.

CONCLUCION

This study shows that inclusive and environmentally friendly early childhood education can only succeed when six key elements work hand in hand: infrastructure, supporting facilities, learning tools and media, infrastructure management, parental involvement, and technological innovation. Inclusive infrastructure must go beyond ramps and accessible toilets. It should also provide green, sensory-friendly spaces that nurture children's overall development. Supporting facilities such as quiet rooms, therapeutic gardens, sensory rooms, and adaptive playgrounds are not optional extras but essential spaces that help children learn, heal, and grow. Assistive technology, eco-friendly media, and Universal Design for Learning (UDL) approaches can make lessons more engaging and inclusive, although many teachers still need better preparation to use them effectively. Strong management through accessibility audits, sustainable maintenance, and participatory decision-making ensures that inclusive and green practices last, while meaningful parental involvement turns families into true partners in shaping school environments. Technology also plays a vital role, with tools like learning analytics, adaptive software, and environmental monitoring enabling schools to track children's progress and ecological health at the same time. The unique contribution of this study lies in bringing together two areas that are usually studied separately green school initiatives and inclusive education into one unified framework. By doing so, it offers both fresh theoretical insights and practical guidance for creating schools that are not only inclusive and sustainable but also aligned with global goals such as SDG 4 (quality education) and SDG 11 (sustainable, child-friendly communities).

AUTHOR CONTRIBUTION STATEMENT

S.K. conducted research, formulated problems, and analysed the results of interviews with selected sources. J.D.W. assisted in evaluating research methods. I.B.H. assisted in assessing the results that had been obtained. T.A. assisted in developing the theoretical framework and determining gaps in the research. Q.F.F. assisted in refining this article. All authors have contributed to writing this article.

DECLARATION

The authors of this study certify that they have no affiliations or involvement with any organization or entity that has a financial interest in the subject matter of this manuscript. This includes, but is not limited to, honoraria, educational grants, participation in speakers' bureaus, membership, employment, consultancies, stock ownership, or other equity interests, as well as expert testimony

or patent licensing arrangements. Additionally, the authors have no non-financial interests, such as personal or professional relationships, affiliations, knowledge, or beliefs related to the materials discussed in this manuscript.

DATA AVAILABILITY

The dataset generated or analysed during this study is available from the corresponding author upon reasonable request.

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REFERENCES

Ainscow, M. (2019). Developing inclusive education systems: The role of organisational cultures and leadership. *International Journal of Inclusive Education*, *23*(7-8), 755–769.

Amicone, G., & Petruccelli, I. (2018). Green breaks: The restorative effect of the school environment's green areas on children's cognitive performance. *National Library of Medicine*.

Ayibah, G. (2022). Manajemen sarana dan prasarana sekolah inklusi di sekolah dasar negeri gayungan. *Jurnal Inspirasi Manajemen Pendidikan*, *10*(3), 2.

Azzahra, I. M. (2022). Learning facilities and infrastructure based on the characteristics of children with special needs in inclusive education. *Al-Athfaal: Jurnal Ilmiah Pendidikan Anak Usia Dini*, *5*(2), 169–190.

Browning, W. D., Ryan, C. O., & Clancy, J. O. (14). Patterns of biophilic design. *New York: Terrapin Bright Green, LLC*, 3–4.

Creswell, J. W., & Poth, C. N. (2016). *Qualitative inquiry and research design: Choosing among five approaches*. Sage publications.

Dadvand, P., & N. (2015). Green spaces and cognitive development in primary schoolchildren. *Proceedings of the National Academy of Sciences*, *112*, 937–7942.

Díaz Martínez, F., & a. L. (2023). Systematic review: Neurodevelopmental benefits of active/passive school exposure to green and/or blue spaces in children and adolescents. *International Journal of Environmental Research and Public Health*, *20*(5), 3958.

Fan, M. S. (2023). Nature-based interventions for autistic children: A systematic review and meta-analysis. *JAMA Network Open*, *6*(12). https://doi.org/10.1001/jamanetworkopen.2023.46715

Fernández, M. E. (2021). Green spaces and childhood development: A study of the psychological and social benefits of school gardens. *Environmental Psychology Review*, *36*(4), 478–495.

Firli, I. W. (2020). Analisis kesiapan guru terhadap program inklusi. *BEST Journal (Biology Education, Sains and Technology)*, *3*(1), 127–132.

Fitriani, L. (2019). Manajemen pembelajaran inklusi di tk laboratori pedagogia uny yogyakarta. *Annual Conference on Islamic Early Childhood*. http://conference.uinsuka.ac.id/index.php/aciece/article/view/136

Fox, L. E. (2021). Adaptive teaching strategies for children with disabilities: Approaches for inclusive classrooms. *Educational Psychology Review*, *33*(3), 223–243.

Friedman, S. (2022). "a new adventure": A case study of autistic children at forest school. *Journal of Outdoor and Environmental Education*, *25*(3). https://doi.org/10.1080/14729679.2022.2115522

Gunawan, I. I. (2023). Inclusive education for early childhood: Challenges faced by kindergarten teachers in indonesia. *Education Sciences*, *13*(4), 420.

Hasanah, F. M. (2023). Manajemen sarana dan prasarana untuk meningkatkan mutu pendidikan sekolah inklusif. *Jurnal Ilmu Manajemen dan Pendidikan*, *3*, 161–166.

Herath, K., & Herath, K. (2024). The role of parental involvement in early childhood education. *Cardiff School of Sport & Health Sciences Cardiff Metropolitan University, UK*.

Hidayat, Y. A. (2022). Optimalisasi pelayanan pada pemustaka penyandang disabilitas tunanetra di perpustakaan nasional republik indonesia. *Nautical: Jurnal Ilmiah Multidisiplin Indonesia*, *1*(5), 367–378.

Kurniawati, L., &. (2017). Pembelajaran pendidikan inklusi pada sekolah dasar. *Edutech*, *16*(2).

Lau, M. E. (2021). Environmental factors affecting children with special needs: A comprehensive review. *Journal of Special Education*, *55*(3), 193–205.

Liu, X., Lau, N., Chuin, A., Leung, W. K. R., Ho, A. H. S., Das, M., Liu, M., & Kwok, C. L. (2023). Understanding students' perspectives, practices, and challenges of designing with ai in special schools. *Proceedings of the Eleventh International Symposium of Chinese CHI*, 197–209.

Maemunah, S. (2021). The management of inclusive early childhood education (earlychildhood education) based on holistic integrative. *International Conference on Science, Education and Technology (ISET 2020)*, 528–534.

Margiyanto. (2023). Implementasi pengelolaan earlychildhood education inklusi di kelompok bermain. *Edukatif: Jurnal Ilmu Pendidikan*, *4*(5), 6956–6962.
Martinez, L. (2024). *Co-inclusive education: Engaging children with special needs in sustainable practices*. Green Learning Press.
Mihovska, A., Prevedourou, D., Tsankova, J., Manolova, A., & Poulkov, V. (2021). Building adaptive and inclusive education readiness through digital technologies. *2021 Joint International Conference on Digital Arts, Media and Technology with ECTI Northern Section Conference on Electrical, Electronics, Computer and Telecommunication Engineering*, 384–388.
Miles, M. B., Huberman, A. M., & Saldaña, J. (2014). *Qualitative data analysis: A methods sourcebook* (3rd). SAGE Publications.
Navas Bonilla, C. d. R., Viñan Carrasco, L. M., Gaibor Pupiales, J. C., & Murillo Noriega, D. E. (2025). The future of education: A systematic literature review of self-directed learning with ai. *Future Internet*, *17*(8), 366.
OECD. (2023). *Equity and inclusion*. https://doi.org/10.1787/e9072e21-en
Rahman, A. (2024). Designing nature-based school environments for inclusive learning. *Journal of Environmental Education and Inclusion*, *??*(??), 45–59. https://doi.org/??
Rahman, A., &. (2024). Designing nature-based school environments for inclusive learning. *Journal of Environmental Education and Inclusion*, 45–59.
Roski, M. (2024). Using learning analytics for investigating learning processes in inclusive chemistry classrooms using the universal design for learning.
Roza, A. (2020). Perencanaan pembelajaran anak berkebutuhan khusus dalam majamen sekolah inklusif. *JKPD (Jurnal Kajian Pendidikan Dasar)*, *5*(1), 61–69.
Sakti, S. A. (2020). Implementasi pendidikan inklusif pada lembaga pendidikan anak usia dini di indonesia. *Jurnal Golden Age Universitas Hamzanwadi*, *4*(2), 238–249.
Schuelka, M. J. (2021). Leadership in inclusive education: Supporting inclusive practices in early childhood education settings. *International Journal of Leadership in Education*, *24*(3), 327–345.
Smith, J. (2024). The cognitive and sensory impacts of green school design on children with autism and adhd. *International Journal of Special Needs Education*, 12–28.
Stavrianos, A. (2016). Green inclusion: Biophilia as a necessity. *British Journal of Special Education*, *43*(4), 416–429.
Strong-Wilson, T., &. (2021). Children, teachers and spaces: Reimagining early childhood education through the lens of place. *Contemporary Issues in Early Childhood*, *22*(2), 109–122.
Suvita, Y., & e. (2022). Kelengkapan sarana dan prasarana dalam mendukung penyelenggaraan pendidikan inklusif. *Jurnal Pendidikan Kebutuhan Khusus*, *6*(2), 155–164.
Tisdell, E. J.-P. (2025). *Qualitative research: A guide to design and implementation*. John Wiley & Sons.
UNICEF. (2023). Project on inclusive early childhood education for children with disabilities starts in 90 schools [Turki].
Van Velzen, E., Oosterhoff, M., & Haaijer, L. (2023). Green spaces for social equity: Ensuring access for disadvantaged children. *Journal of Environmental Equity*, *12*(3), 145–162.
van Dijk-Wesselius, J. E. (2020). Green schoolyards as outdoor learning environments: Barriers and solutions as experienced by primary school teachers. *Frontiers in Psychology*, *10*, 2919. https://doi.org/10.3389/fpsyg.2019.02919
Yang, L. (2025). Eco-friendly media and inclusive education: Sustainable approaches to early learning for children with diverse needs. *Journal of Green Education and Inclusion*, *??*(??), 58–72. https://doi.org/??
Yunita, E. I. (2019). Manajemen pendidikan inklusi dalam proses pembelajaran dan penanganan guru terhadap anak berkebutuhan khusus. *International Journal of Elementary Education*, *3*(3), 267.