

Teachers' Perception of Inclusive Infrastructure Based on the Concept of Universal Design in Primary Special Education School in Malaysia

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To Link this Article: <http://dx.doi.org/10.6007/IJARPED/v14-i1/24695> DOI:10.6007/IJARPED/v14-i1/24695

Published Online: 18 February 2025

Abstract

A learning environment designed to meet the specific needs of these students reduces learning barriers and fosters an inclusive learning atmosphere. This study aims to explore teachers' perceptions of inclusive infrastructure based on the concept of Universal Design in primary special education schools. The study employs a descriptive qualitative research design and uses purposive sampling, selecting 10 special education teachers from 4 primary special education school in Klang Valley, Malaysia, with at least a minimum of 6 months of teaching experience in primary special education school. Data were collected through semi-structured interviews, where participants were interviewed on a one-to-one basis. The interviews were recorded, transcribed verbatim and translated, with the findings analysed using thematic analysis. Four main themes were identified and discussed. The study reveals that teachers' perceptions of infrastructure based on the Universal Design concept are positive in terms of functionality and physical aspects. However, the impact of inclusive infrastructure on social and emotional aspects has received less attention. Therefore, this study hopes that the policymakers will develop a standardised school design template based on the Universal Design concept to enhance the quality of infrastructure in primary special education school and improve the learning experiences of students with special educational needs (SEN).

Keywords: Inclusive Infrastructure, Universal Design, Special Education School

Introduction

Children's lives are greatly influenced and can be reformed through education, which serves as a platform to develop their minds and spirits. Education is no longer a privilege; it is a right for every child without prejudice. Marking its 30th year, UNESCO, through the Salamanca Statement in 1994, initiated efforts to normalise inclusive education for all children worldwide, including those with special educational needs (SEN). This recommendation aligns closely with the measures outlined in Sustainable Development Goal 4 (SDG 4) presented in 2015, which aims to guarantee quality and equity in education for all students, regardless of

their background, gender, race, religion, or diverse educational needs, by 2030. According to Norwich (2008), the concept of inclusive education is practiced differently depending on the context and educational culture of a particular place. The diversity of inclusive concepts, influenced by various factors, leads to different interpretations, which in turn shape differing inclusive educational practices among teachers. The varying approaches taken in developed countries, for example, are heavily influenced by their education systems and policies. According to Leifler (2022), most studies conducted on inclusion focus more on the theoretical aspects and ideologies of the inclusive concept, rather than deeply exploring the effective methods and strategies in practice and implementation. This issue is one of the reasons why it becomes challenging for teachers to implement inclusive approaches in schools without adjustments.

Inclusive architectural design for special education institutions remains an underexplored area, particularly in Malaysia. While existing studies have primarily focused on general accessibility standards—such as wheelchair ramps, tactile paving, and disabled toilet—there is limited research on how specific architectural elements, such as spatial layout, sensory-friendly materials, lighting, acoustics, and wayfinding systems, directly influence the cognitive, emotional, and behavioural responses of students with SEN. The built environment plays a crucial role in shaping the learning experiences of these students, yet empirical studies addressing this intersection between architecture and special education remain scarce. This study aims to bridge that gap by systematically examining how architectural design elements impact engagement, comfort, and overall academic performance in special education settings. Through teachers interviews this research seeks to provide evidence-based recommendations for designing more inclusive and supportive learning environments for students with diverse needs.

According to Sharma and Salend (2021), inclusive education not only focuses on the academic development of students but also on their social and emotional growth. Emotional and social support are crucial to ensure that students feel accepted, valued, and safe within the school environment. This includes providing inclusive infrastructure, a welcoming environment, and activities that encourage social interaction and collaboration among students. Inclusive education aims to create an environment where all students can develop holistically. Therefore, the inclusive approach is not merely about placing students with SEN in the same classroom as their typically developing peers, but it should also ensure that the academic, social, and emotional needs of students with SEN are met. In the implementation of special education, every aspect of teaching and learning should be examined, and strategies should be tailored to the needs of each student with SEN. Inclusivity also means reducing any barriers that might diminish the effectiveness of education for students with SEN, including providing inclusive environments and infrastructure to ensure learning can take place efficiently (Sánchez et al., 2019).

In addition to the educational aspects conducted during teaching and learning sessions in classroom, factors such as infrastructure and facilities also contribute to create an inclusive environment. Design without the considerations of the students with SEN, contradicted UNESCO's recommendation of advocating for quality education opportunities for all. A study by Simorangkir (2021) found that many schools still lack inclusive infrastructure for students with SEN that meets the required specifications. This situation can affect the

quality of education experienced by students with SEN. According to Nur Rohazirah Roslan & Mohd Mokhtar Tahar (2022), the physical environment can influence students' comfort levels during learning sessions overall. Non-inclusive infrastructure and environments can hinder and reduce the quality of education received by students with SEN. For example, for students with neurological developmental disorders, the environment plays a crucial role in helping them self-regulate. According to Goodall et al. (2022), classrooms specifically designed for neurodivergent students, such as those with attention deficit hyperactivity disorder (ADHD) or autism spectrum disorder (ASD), can help reduce behavioural challenges. In efforts to empower self-regulation skills for students with SEN, infrastructure and the environment must be strategically designed to enhance social participation, particularly in terms of the physical aspects and functional infrastructure, as well as creating a conducive environment that considers emotional and sociological factors. Building infrastructure that only meets the minimum requirement of students with SEN will negatively impact their learning environment and overall academic and social participation.

According to UNESCO (2020) in the Global Education Monitoring Report Team, inclusive educational infrastructure includes basic facilities such as wide entryways, ramps, toilets with handrails, and easily accessible outdoor environments like well-maintained walkways extending a certain distance from the school. Integrating accessibility into the design of schools not only benefits students but also the broader community. Creating inclusive infrastructure in special education schools involves designing physical spaces that are accessible, flexible, and supportive of students with special needs, with the goal of promoting participation, freedom, and equality. This report also highlights that an inclusive school environment must prioritize accessibility, appropriate resources, and adaptable spaces to meet a range of learning and mobility needs. For example, special facilities such as sensory rooms, wheelchair-accessible pathways, and visual aids support students with various needs in ways that standard environments might not.

This study aims to examine through studying teachers' perceptions of the infrastructure and design aspects of special education schools in Klang Valley, Malaysia, that support the principles of Universal Design. The concept of Universal Design emphasizes not only facilitating access to physical school environments, water facilities, sanitation, and safety elements in emergencies, but also giving attention to sociological and emotional factors. The design aims to ensure the optimal use of space and facilities for all groups, including those with physical, sensory, and intellectual disabilities. The inclusive approach is not only applied during teaching and learning sessions, but the environment also plays an important role in building a fully inclusive learning culture. Primary special education schools are the chosen population for this study, as they are the pioneering institutions that have designed systems and implemented special education. With their extensive experience, primary special education schools should serve as a benchmark and standard for the implementation of special education in Malaysia. Primary special education schools serve students with a wide range of SEN and abilities, both physically and cognitively. Teaching practices and the environment in primary special education schools can be considered inclusive in the context of strategies and learning methods that are implemented to meet the diverse needs of students with SEN. Primary special education schools in Klang Valley were selected as the population because they are in urban areas. With better resources and facilities compared to rural schools, the inclusive approach should be easier to implement. Their views serve as a benchmark for

understanding the extent of their awareness of a learning environment that supports the Universal Design concept.

Universal Design for Inclusive Infrastructure

Goldsmith (1997) states that the concept of disability in architectural literature is defined as individuals who face barriers due to the lack of appropriate facilities to use buildings designed for general purposes because of physical limitations. This view suggests that an individual is defined as disabled when buildings or facilities and infrastructure are designed and constructed in ways that make it difficult for them to use them like typical individuals. The concept of Universal Design infrastructure in schools refers to the construction of schools and infrastructure that support inclusive education from various perspectives. Şenyiğit and Yılmaz (2021) argue that in the context of inclusive education, Universal Design emphasizes the concept of empathy to incorporate emotional and social aspects for students with SEN in its design, not just focusing on technical aspects. Understanding the physical, mental, and emotional needs of individuals plays a crucial role in shaping an inclusive environment where all types of needs are considered. Three aspects will be examined in greater depth in this study: functional and physical aspects, social aspects, and emotional aspects.

According to Şenyiğit and Yılmaz (2021), individuals can be disabled either permanently or temporarily, such as pregnant women, the elderly, parents pushing strollers, and others. They argue that these groups should also be considered as potential users of a building. In the context of primary special education school, basic facilities such as disabled-friendly restrooms and ramps are among the infrastructure designs that enhance the positive experience for students with SEN at school. The physical aspect of Universal Design involves the design of buildings and spaces that are accessible to all students. This includes providing ramps for wheelchairs, disability-friendly toilets, clear and obstacle-free pathways, and flexible furniture arrangements in classrooms. By providing sufficient physical access, students with SEN can move freely and participate in all school activities without barriers. A study by Widiastuti et al. (2020) emphasizes that classroom layout, ventilation, and lighting are important factors in improving students' learning comfort. Inclusive physical design helps reduce physical barriers and improves accessibility for all students. This research also highlights that providing such facilities not only helps students with SEN but also benefits other students who may face temporary challenges, such as physical injuries.

The function of Universal Design infrastructure also includes the provision of tools and architectural technology that support inclusive learning. This includes the use of assistive technology such as screen reader software, augmentative and alternative communication devices, as well as adapted learning applications in the building design to meet individual students' needs. Inclusive technological infrastructure ensures that all students have equal access to spaces and can engage in the learning process. According to Moraiti et al. (2021) emphasizes that the use of assistive technology in special education enhances learning effectiveness, supports educational integration, and improves cognitive abilities and self-regulation. By providing appropriate technology, schools can ensure that all students can access spaces and learning materials and communicate more effectively.

Steinfeld and Danford (1999) state that Universal Design is designed for person with disabilities (PWD) to use the same objects and spaces as able-bodied individuals, and to

increase the ubiquity of accessibility and improve opportunities for PWD participation in society. The design of schools that promote equality enhances the social inclusion of PWD alongside others in a more natural environment. An inclusive environment ultimately helps to form a society that has normalised the participation of all kinds of people, regardless of their needs, without prejudice or discrimination. According to Steinfeld and Maisel (2012), Universal Design is a process that enables and empowers all layers of society with limitations, enhancing their abilities, health, well-being, and social participation. Furthermore, Universal Design also provides support for individuals to become more independent in social involvement (Maisel & Ranahan, n.d.).

The social aspect of the Universal Design concept refers to strategies and designs that encourage social interaction, active participation, and a sense of belonging within the school community. Inclusive social design ensures that all students feel accepted and valued in the school environment (Hall, Meyer & Rose, 2012). This includes providing collaborative activities, comfortable interaction spaces, and teaching approaches that promote cooperation and mutual respect. The design of comfortable and welcoming spaces is important for fostering social interaction. Areas such as reading corners, play areas, and recreation rooms provide spaces for students to gather, chat, and interact in a relaxed atmosphere. Such inclusive and welcoming designs help students feel accepted and comfortable, which is essential for their social and emotional development. Infrastructure designed according to the principles of Universal Design ensures that students with SEN can move freely and participate in all school activities. By reducing physical barriers, students can interact more easily with their peers, which is crucial for their social development. Moreover, an inclusive and accessible environment helps reduce stigma and discrimination against students with SEN. When all students have equal access to facilities and activities, they are more likely to view differences as normal rather than as obstacles. This helps foster attitudes of mutual respect and appreciation for diversity.

Watson (1930) believed that an individual's traits and behaviours are influenced by external factors and the environment. The key principles of Behaviorism Theory in the context of inclusive education, according to Harold and Corcoran (2013), state that individuals learn behaviours influenced by the learning and teaching environment, and such learning can lead to changes in behaviour. These behavioural changes indirectly trigger actions. School infrastructure and environments designed based on Universal Design principles can provide positive stimuli and rewards to encourage good learning behaviour. For example, an inclusive and supportive environment can provide social rewards for students, such as praise and recognition from teachers and peers. Furthermore, the emotional aspect is a critical element in the learning of students with SEN. A learning environment designed based on Universal Design principles helps reduce stress and anxiety, as well as enhance their emotional well-being. An inclusive environment that supports the emotional needs of students with SEN provides a comfortable and safe space where they feel accepted and valued. Universal Design ensures that the school environment is inclusive and supports the emotional well-being of students (Collins & Halverson, 2018). This includes providing quiet rest areas, calming wall colours, proper lighting, and appropriate classroom acoustics. A comfortable atmosphere helps students with SEN feel calm and focused on their learning.

In addition to the design of SEN-friendly infrastructure, such as special restrooms and textured pathways, specific design elements such as colour selection, lighting, and the layout of pathways can affect the mental and emotional well-being of students with SEN, especially those with neurological disorders like ASD and ADHD. A study conducted by Mostafa (2014) on sensory responses in individuals with ASD highlights the importance of acoustic aspects of space, ventilation, colour, orientation, and enclosure, as these are sensory inputs from the physical environment. These elements are translated into design to have a positive impact on individuals with ASD. A well-designed environment can reduce stress and anxiety in students. For example, a classroom space that is not overcrowded, access to private spaces, and flexible furniture arrangements help students feel more comfortable (Basham et al., 2016). Research by Sokal and Katz (2020) shows that a positive school atmosphere can reduce stress levels among students and improve their emotional well-being.

Methodology

This study is qualitative research aimed at examining the perspectives of teachers in primary special education school regarding the inclusive approach from the aspects of infrastructure and an inclusive environment aligned with the Universal Design concept. This study employs a data collection method through semi-structured interviews. These interviews were conducted with 10 teachers from 4 primary special education school in Klang Valley. The study adopts a descriptive qualitative research design, allowing the researcher to gather rich data on the perspectives of special education teachers concerning the infrastructure and design of primary special education school based on the Universal Design concept. This approach is suitable for exploring complex and contextual phenomena, such as the provision of inclusive infrastructure based on the Universal Design concept.

Population and Sample of the Study

In this study, the sample consists of teachers teaching in primary special education school in Klang Valley. The research sample is a subset of the population selected for data collection and analysis purposes (Etikan et al., 2016). This sample represents the overall study population and is used to make inferences about the population. In the context of this study, the population refers to special education teachers in 4 primary special education school in Klang Valley. This population is crucial to ensuring that the data obtained is relevant and can be generalised to the entire population under study.

The sampling technique used is purposive sampling. This technique was chosen because the sample criteria were determined before conducting the interviews. Special education teachers in primary special education school with at least six months of teaching experience in special education were selected as they, being new educators in special education, tend to have fresh perspectives and are not yet influenced by specific school cultures or practices. This allows them to provide a more objective perspective on inclusive infrastructure, as they may be more critical in assessing its effectiveness and shortcomings. According to Creswell and Plano Clark (2018), a sample selected based on experience and their unique position can provide richer data in a qualitative context. By selecting novice teachers, researchers can diversify views among teachers with different levels of experience, rather than solely relying on the opinions of more experienced teachers. This provides a more comprehensive picture of how inclusive infrastructure functions from various perspectives.

This study focuses on primary special education school in Klang Valley, which includes primary special education school located in Selangor and the Federal Territory of Kuala Lumpur. Klang Valley is an urban area with better access to infrastructure. The involved schools have classrooms for student with hearing impairment, student with vision impairment, student with learning disabilities, and student with multiple disabilities. Through interviews with teachers who teach various types of special education needs, more comprehensive data on infrastructure requirements for all types of students can be obtained.

Research Instrument

The semi-structured interview protocol, utilising the Responsive Interviewing Model, was designed based on research questions. The formulated questions were also derived from findings reviewed in the literature review. Semi-structured interviews are an instrument used to collect data through directed but flexible conversations between researchers and respondents (Adams, 2015). In this type of interview, researchers prepare a list of questions or topic guides for discussion, but respondents are given the freedom to expand on their answers and steer the conversation in a direction they find relevant. This allows researchers to obtain more in-depth information and richer context on the topic being studied. There are three sections of interview questions developed using the Responsive Interviewing Model pioneered by Rubin and Rubin (2011): a) Section A: Respondent Background, b) Section B: School Infrastructure and Environment Supporting Universal Design, and c) Section C: Summary and Conclusion.

Data Collection and Analysis Procedure

Interviews were conducted face-to-face at 4 primary special education school schools with 10 teachers. Teachers were interviewed individually in a one-to-one format to ensure their views and experiences were not influenced by other respondents. This helped generate a greater variation of responses with deeper and more specific insights. The interviews lasted between 15 to 40 minutes and were recorded using the Voice Memos application on a mobile phone. At the beginning of the interview, an introduction session was conducted to facilitate the interview process. A brief explanation of the study's objectives and purpose was also provided to give respondents context regarding the questions asked in the interview.

In Section A, questions focused more on respondents' demographics, such as their background and years of teaching experience in special education. Moving into Section B, teachers were asked about their understanding and views on infrastructure and environments based on the Universal Design concept. They were also asked about challenges or improvements in infrastructure that could be suggested to help them conduct more inclusive learning sessions. At the end of the interview, in Section C, teachers were also asked about their expectations and conclusions they could summarise.

All interview audio recordings were transcribed verbatim and translated, and analysed using thematic analysis method, where the process involved several key steps. The first step was data familiarisation, where the researcher repeatedly read and reviewed the data to deeply understand its content. The second step was data coding, where important or relevant data segments were identified and assigned meaningful codes. The third step was theme identification, where similar or related codes were grouped together to form broader themes. The fourth step was theme review, where identified themes were reassessed and determined

for their relevance to the overall data. The fifth step was theme naming, where each theme was given a clear and descriptive name. The final step involved documenting the identified themes along with relevant data examples.

Results

A total of 10 special education teachers serving in primary special education school around Klang Valley, specifically in 4 primary special education schools—Anggerik School, School Dahlia School, Kenanga School, and Mawar School—were selected for interviews. The participating respondents were SEN teachers for students with Hearing Impairment (HI), Visual Impairment (VI), and Learning Disabilities (LD). The respondents were assigned the code names Alis, Aina, Aisyah, Dila, Darshini, Kamila, Kasih, Kyra, Melur, and Mira. The selection of these respondents enabled the researcher to obtain a variety of experiences, approaches, and perspectives in the field of special education, particularly in addressing various challenges and effective teaching strategies within the context of inclusive education.

Table 1

Research Demography

Respondent	School	Qualification	Teaching Experience	Teaching Experience in primary special education school	Type Student	SEN
Alis	Anggerik	Master	5 years	5 years	HI & LD	
Aina	Anggerik	Degree	4 years	4 years	HI & LD	
Aisyah	Anggerik	Degree	16 years	16 years	HI & LD	
Dila	Dahlia	Degree	13 years	13 years	HI & LD	
Darshini	Dahlia	Master	7 years	7 years	HI & LD	
Kamila	Kenanga	Degree	17 years	17 years	HI & LD	
Kasih	Kenanga	Master	8 years	6 years	HI & LD	
Kyra	Kenanga	Degree	24 years	24 years	HI & LD	
Melur	Mawar	Degree	6 months	6 months	VI & LD	
Mira	Mawar	Degree	16 years	1 years	VI	

The study findings reveal both positive aspects and significant constraints that influence student learning, accessibility, social integration, and emotional well-being. Based on the interviews conducted, four key themes emerged. The first theme is accessibility and spatial suitability, which focuses on basic infrastructure for ease of access within the school environment. The second theme highlights the need for specialised facilities, such as sensory rooms and lifts. The third theme addresses the impact of resource shortages in inclusive practices, including the lack of specific teaching-learning materials (TLM) for students with SEN and assistive technology, which is not provided in all primary special education schools.

The final theme explores the relationship between infrastructure, socialisation, and emotional well-being, emphasising the effects of non-inclusive infrastructure on the social and emotional skills of students with SEN.

Accessibility and Spatial Suitability

For respondents Aisyah and Kasih, the basic inclusive features provided, such as ramps for wheelchair users and fully equipped accessible toilets, have helped enhance students' learning experience at school.

"Everything is okay. All the toilets have been upgraded. I feel like a lot of upgrades have been made this year to accommodate students who use wheelchairs..." (Kasih, 34)

"There's nothing to complain about. Everything looks great. The toilets are even nicer than those in regular schools." (Aisyah, 40)

Several respondents, such as Alis and Melur, also agreed that the size of the classrooms provided is adequate for the current number of students. They also mentioned that overly large classrooms could make it more challenging to manage students.

"If we go by the current situation, the school size is already sufficient for the number of students we have." (Aina, 27)

"Okay, in terms of the classroom, there's no issue. The space is fine. People say it's very conducive—not too cramped, but also not too large for the small number of students." (Melur, 28)

However, Alis believes that the classroom size is already at its maximum capacity, and comfort may decrease if the number of students increases. This is because the school area is also very limited and cannot accommodate additional classrooms.

"I think it's comfortable now because there aren't many students. But if the number increases, it won't be comfortable anymore." (Alis, 28)

Similarly, respondent Kyra also feels that the classroom size is at its maximum capacity, and comfort may be affected if more students are added.

"..the size of the classrooms for students with learning difficulties is a bit cramped with the number of students and everything. When they want to do activities, it's quite limited. You know, students with learning difficulties need a lot of movement..." (Kyra, 47)

Need for Special Facilities

The interview also highlighted that respondent Aina felt the need to provide special facilities, such as sensory rooms. However, the limited school space and lack of financial allocation hindered the school from providing such an important room, especially for students with ASD, ADHD and multiple disabilities.

“..in my class, I have students with learning difficulties who are deaf. Then, there are those with Down Syndrome and Autism. Sometimes, autistic children like dark rooms with lights. So, if there was space, maybe we could have one. But because the school (space) is limited...” (Aina, 27 years old)

Respondent Darshini also believes that air-conditioning facilities in the LD classrooms help teachers manage students' emotions, especially when dealing with behavioural challenges during hot weather.

“In terms of their behaviour, because when it’s hot, when they sweat, they become very uncomfortable. So, their emotional regulation is affected. When the environment is very cooling and calming for them, they calm down. And you can definitely see the difference between students who have air-conditioning and those who don’t.” (Darshini, 31 years old)

Good emotional management can enhance the effectiveness of learning in the classroom. An uncomfortable and hot environment disrupts students with SEN, especially in managing the impact of excessive stimulation. This factor will affect their ability to stay focused in the classroom. Suitable classroom with adequate and proper design, aid teacher to manage classroom better.

The Impact of Resource Shortages on Inclusive Practices

According to respondents Kamila and Kyra, there are limitations in providing specific teaching resources or TLM for students with SEN. For student with HI, the available TLM are not tailored to their needs, which require more visual materials accompanied by sign language codes. Most of the existing TLM are aligned with the mainstream curriculum, which is slightly advanced for student with HI.

“..I think it’s because the students, they need more materials to learn. Right now, the materials are limited for hearing-impaired students. For hearing-impaired students, they provide reference books, they provide TLM, but there aren’t many specifically for them. I mean, for the specific needs of the children. Sometimes, when we want to buy materials, we rely on our own committees, and even then, the materials are sometimes limited. We use what we have. Also, when it comes to textbooks or anything, the level is a bit higher for hearing-impaired students. The syllabus we have, we make adjustments. Adjustments are only made for Malay Language and Religious Studies for hearing impairments. Everything else follows the mainstream.” (Kyra, 47)

“So, there aren’t many resources in the market for students like ours, who need, if there’s a picture, it must have a code. A hand code. Like in storybooks.” (Kyra, 47)

“If we consider what’s enough, it never is, we always have to add more. If we think about it, we don’t get TLM resources specifically for us to teach like this. So, it depends on the teacher on how we explain things to the students. So, it’s up to us, our own creativity. We have to prepare it ourselves.” (Kamila, 42)

Additionally, the inconsistency in the provision of assistive technology for students with SEN also impacts student learning. According to respondent Kasih, Kenanga School is equipped with a smart board that helps teachers reduce the time spent preparing visual teaching materials for student with HI specifically. However, this facility is not available at Anggerik School, Dahlia School, and Mawar School.

"If we look at the hearing-impaired class, one thing I like about the classes above is that every class has a smart board. So, for hearing-impaired students, their medium of understanding is through visuals, right? So, that really helps. Because if we had to get the teacher to draw everything, it would be quite difficult, right? It would take time, in terms of preparing the materials." (Kasih, 34)

According to respondent Kasih, the use of smart board technology has provided her with an advantage in varying the learning mediums, especially for student with HI. The use of assistive technology can support teachers in preparing more engaging teaching materials for students. Teachers can quickly change medium and TLM according to students' interest with less time as the smart board can be connected to the internet.

The Relationship Between Infrastructure, Socialisation, and Emotional Well-being

Constraints in the provision of infrastructure can negatively impact opportunities for social interaction and play, which are crucial for a child's development. Comprehensive infrastructure enhances opportunities for social interaction and play, both of which are essential elements in a holistic and inclusive learning environment. According to Aisyah, the absence of a functioning canteen and limited access to outdoor play areas restrict students' opportunities to engage in unstructured social interactions, develop social skills, and foster a sense of belonging within the school community. Similarly, respondent Kasih feels that the lack of common areas for students with SEN to gather diminishes their experience of a social atmosphere like that of mainstream schools.

"They don't get to interact with others. They don't experience buying food at the canteen. They are not used to handling change and so on. They become dependent—meals are already prepared for them." (Aisyah, 40)

"I feel that the students in this school are quite rigid. For example, when they arrive, they have to sit at the front, near the bus stop. Yes, they do socialise there, but in a mainstream school, you'd see students running around the school grounds. But here, they just sit there." (Kasih, 34)

The impact of infrastructure on students' emotional well-being is also a concern. For instance, respondent Kyra highlights the issue of inadequate ventilation and excessive heat, particularly after lunchtime, which negatively affects students' behaviour and ability to focus in class. This observation underscores the need to provide a comfortable learning environment with proper temperature control to support students' emotional regulation and enhance their ability to actively engage in the learning process.

"In terms of space, the size is fine, but the ventilation is an issue. This is an old building. The windows—some are missing, and some can be opened. But now, with the hot weather, it's uncomfortable." (Kyra, 47)

"Lighting is also a concern because the space feels a bit enclosed. For example, the classroom only has a door. The windows are positioned higher up, and there's a corridor blocking airflow from entering the classroom." (Kyra, 47)

Additionally, the vibrancy of classrooms and the school environment has an impact on students' emotions. According to respondent Darshini, a classroom with a cheerful atmosphere and calming wall colours plays an important role in capturing students' attention and maintaining their focus. Soft and bright colours can provide a soothing sensation, particularly for students with ASD and ADHD.

"Classroom wall colours actually serve a purpose. We can't use colours that are too dark for them (the students). They are very drawn to colourful things. So, when you make your classroom vibrant, they enjoy it more. Previously, I decorated my classroom with wallpaper and animal-themed wall stickers, and the students were really engaged. They enjoyed looking at them. In a way, it attracted their attention. They prefer a lively classroom environment." (Darshini, 31)

Findings from this study indicate that inclusive infrastructure has numerous positive impacts on students with SEN. Students' motivation to learn is not solely influenced by what happens inside the classroom; the overall school infrastructure also plays a crucial role in fostering their holistic development, encompassing both academic and non-academic aspects.

Discussion

Thematic analysis from teacher interviews reveals that while teachers perceive inclusive infrastructure positively in terms of functionality and physical aspects, there are shortcomings in the social and emotional aspects. Although teachers demonstrate strong commitment to inclusive practices and strive to implement Universal Design for Learning (UDL) principles, they are still constrained by infrastructure limitations based on Universal Design concepts. These constraints, including inflexible classroom sizes, the absence of specialised facilities, and a lack of teaching materials and assistive technology, directly impact teachers' ability to meet individual needs, provide differentiated instruction, and create an inclusive learning environment that supports all students. The teachers' perspectives highlight the importance of viewing infrastructure not merely as physical buildings but as a crucial component that shapes learning experiences and influences students' social, emotional, and academic development.

Functional & Physical Aspects

Overall, majority of teachers agree that schools have successfully provided good and inclusive physical infrastructure for students with SEN. Basic facilities such as classroom size and layout, ramps, accessible toilets, handrails, and other facilities have been made available in every school. According to teachers, these infrastructures benefit not only students with SEN but also teachers and teacher assistant (TA) in handling students within the school environment. However, a common issue is that the provision of these facilities is inconsistent and

incomplete across schools. For instance, wheelchair users can only access the ground floor since schools are not equipped with lifts. Special classrooms located on upper floors, such as resource centres, are therefore inaccessible to wheelchair users. Additionally, some classrooms lack ramps, making it difficult for wheelchair-bound students to enter (Ulfa et al., 2018). Consequently, their independent mobility remains limited, requiring teachers' assistance to access different rooms.

Infrastructure management should be integrated into the overall school planning, including budget allocation for specific adaptive resources and continuous training for staff on the effective use of these facilities. According to Reni Azhari et al. (2024), effective infrastructure management in inclusive schools is crucial for achieving educational goals, enhancing accessibility, and ensuring equal opportunities for all students. A successful inclusive environment often involves continuous professional development for teachers and staff to align the physical layout of schools with inclusive teaching practices, ensuring that all students, regardless of their specific needs, can access quality learning experiences.

Classroom size also plays a significant role in ensuring smooth teaching and learning sessions. This factor is particularly crucial for LD students, who require designated spaces to help them regulate their emotions. According to Zwillling & Levy (2020), ASD students need isolation spaces that act as sensory break areas, allowing them to calm themselves from excessive external stimuli. This is essential in helping teachers manage students' emotions while also capturing their attention and interest during lessons. However, classroom sizes are inconsistent across schools due to the constraints of school designs built on limited land and the repurposing of old buildings. According to Page et al. (2024), flexible spatial design allows students with SEN to choose spaces that suit their needs, thereby reducing feelings of isolation. Features such as adaptable furniture arrangements, open spaces, and designated adaptation zones can enhance student engagement during lessons. Teachers can also conduct a wider variety of inclusive activities for students with SEN when classrooms have flexible layouts. However, excessively large classrooms may pose challenges in managing students. Therefore, classroom sizes should be adaptable and maintain an optimal student-to-teacher ratio to allow designated spaces for specific needs.

Beyond classroom design, weather conditions also play a crucial role in ensuring a comfortable and conducive learning environment. Classroom design should maintain a comfortable indoor temperature for students. Baafi (2020) states that an optimal classroom temperature ranges between 20°C and 24°C to ensure students' comfort and concentration. While air conditioning is uncommon in mainstream schools, it is widely used in primary special education school, where it has proven effective in reducing behavioural issues, particularly during hot weather after recess. Studies have shown that extreme heat influences students' emotions and behaviour, leading to frequent tantrums and decreased attention spans in classrooms with poor ventilation (Amoatey et al., 2023). A study by Jouflin et al. (2022) on classroom improvements suggests that comfort can be enhanced by factors such as furniture, learning space, student-to-teacher ratio, lighting, air quality, and the colour of the classroom walls.

Learning & Social Integration Aspects

Inclusive infrastructure can also be examined through the lens of learning and social integration. In terms of classroom learning, the use of assistive technology enables teachers to adapt teaching methods and strategies according to the specific needs of students with SEN. Research findings indicate that the use of smart boards in classrooms has reduced the time teachers spend preparing teaching materials, as this technology provides a more efficient way of delivering lessons. Smart boards allow teaching content to be displayed visually, audibly, and even sourced from the internet, offering a variety of teaching materials. Additionally, they can project real objects onto the whiteboard, making content clearer and more accessible for all students. According to Genc et al. (2021), assistive technology enhances learning efficiency in classrooms and provides personalised learning experiences tailored to individual needs, ultimately improving student achievement. Assistive technology is effective in enhancing and supporting skills like comprehension (Schiavo et al., 2021) and communication (Johnson et al., 2020).

However, financial constraints remain a major barrier to the implementation of assistive technology. This issue is evident as only one primary special education school is equipped with this facility. Effective financial management is crucial to ensuring the provision of quality education, particularly for student with SEN (Walton & Engelbrecht, 2022). Furthermore, teachers must receive comprehensive training to optimise the use of assistive technology. Technical support should also be available to ensure regular maintenance, prolonging the lifespan of these tools. The complexity of this process may also hinder schools from providing such facilities in every classroom. Inadequate maintenance of assistive technology hindering efforts to promote equal participation in learning (Khairuddin et al. 2018).

Furthermore, to ensure a truly inclusive schooling experience for students with SEN, schools should provide accessible basic facilities such as canteens, halls, fields, or playgrounds that cater to all students with SEN. While these facilities may not directly impact students' academic development, Etale et al. (2020) argue that facilities beyond the classroom enhance students' overall learning experience at school. A fun and welcoming environment can boost students' confidence and engagement. Shared facilities such as canteens and assembly halls serve as communal spaces where students gather, providing students with SEN with real-world social simulation. For instance, an operational canteen offers student's opportunities to practise social skills, such as queuing and communicating with canteen vendors when purchasing food and drinks. Various scenarios in these settings can serve as valuable out-of-class learning experiences that support students' social development. Due to their disabilities and differences, students with SEN often have limited exposure to society and the outside world. Interaction with peers in such settings allows them to experience social engagement in a meaningful way. According to Bølling et al. (2023), learning experiences beyond the classroom positively influence students' social relationships, well-being, and intrinsic motivation for learning.

Emotional Aspects

An inclusive school design based on Universal Design principles can have a significant impact on the emotional well-being of special education students by fostering a sense of acceptance, security, and freedom in their learning. According to Rozki et al. (2021), research indicates

that a school environment that meets Universal Design criteria—such as physical accessibility (ramps, wheelchair-friendly toilets), appropriate lighting, and flexible classroom spaces—not only supports students' physical needs but also enhances their self-confidence.

Special education teachers perceive the emotional aspect as the least prioritised area in primary special education school since it is difficult to measure. The diverse needs of students with SEN make it challenging to determine specific designs and infrastructure that can help them regulate emotions or trigger positive emotional responses. However, certain factors can be considered to create an inclusive atmosphere that prevents negative emotions. For example, a vibrant classroom environment with calming wall colours can encourage student participation during learning sessions. The use of appropriate colours, such as bright and cool-toned shades, can create an environment that enhances cognitive engagement and emotional well-being (Hussein et al., 2021).

Additionally, external noise, such as traffic sounds, can reduce learning quality (Gheller et al., 2023), particularly for students with HI, as such noise becomes more disruptive when using Assistive Listening Devices (ALDs). However, sounds like white noise can have a positive impact. According to Gheller et al. (2023), white noise helps students with ADHD stay focused during learning sessions. Therefore, classroom acoustics are crucial in ensuring a controlled auditory environment that minimises negative effects on students. Students with ASD, ADHD, and HI are especially sensitive to poor classroom acoustics (Mogas-Recalde et al., 2021). While dedicated sensory rooms may not be necessary, every classroom should be equipped with good acoustics, calming colours, sensory-friendly walls and spaces, as well as effective ventilation and lighting. These elements help students build positive emotions in school while making learning spaces more accessible for all students during lessons.

Thus, building inclusive infrastructure should not only focus on classrooms but should extend to the entire school environment while integrating Universal Design principles. The learning experience for students with SEN begins at the school entrance and continues into the classroom. Activities both inside and outside the classroom significantly impact their overall performance. Policymakers should place greater emphasis on developing inclusive infrastructure, not just in primary special education school but across all schools. A positive and enjoyable school experience will nurture students who appreciate their learning process and enhance their self-motivation.

Conclusion

Providing infrastructure that is inclusive for all should be one of the main aims of the national education goal, especially for students with SEN who have diverse special requirements. This is in line with the SDG 4 target to improve school facility. Beyond ensuring continuous refinement in the learning aspect, inclusive infrastructure plays a crucial role in reducing educational barriers. A well-designed inclusive infrastructure fosters a more holistic educational environment. Therefore, this study contributes to the field by providing empirical insights into the relationship between architectural design and learning outcomes for students with SEN. The findings offer practical guidelines for architects and educators to create more inclusive learning environments. Future research can build upon these insights to develop standardized frameworks for special needs-friendly school designs. The ministry and policymakers should establish a standardised school design template for special

education institutions, grounded in the principles of Universal Design. The features identified through the direct experiences of special education teachers working with students with SEN can serve as a guideline for school design and infrastructure development, ensuring that the Universal Design concept aligns with the national education system. An inclusive school infrastructure enhances the efficiency of teaching and learning for students while supporting teachers' efforts to create a more inclusive education system—ensuring that no student is left behind in accessing high quality education.

Acknowledgement

The researchers wish to express deepest gratitude to Universiti Kebangsaan Malaysia for the research grant GG-2024-051 and all respondents for their participations.

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