Inclusive Learning Spaces: Evaluating the Impact of Architectural Design Approaches on Neurodivergent Students

ABSTRACT

Learning environments function as active spatial systems that influence cognitive engagement, sensory regulation, and social interaction. This study evaluated the impact of architectural design on the learning experiences, well-being, and inclusion of neurodivergent students in Philippine primary schools. Despite inclusive education policies, limited evidence-based research examines how architectural design addresses sensory and cognitive needs. The study utilized a mixed-method approach integrating systematic observation of SPED schools, survey questionnaires, and semi-structured interviews. It was structured around two objectives: developing criteria for evaluating SPED schools and assessing five key architectural elements affecting student experience, with data analyzed using weighted mean, descriptive statistics, and thematic analysis. Findings indicate that environments with controlled sensory conditions, clear spatial organization, and adaptable features improved comfort, focus, and engagement, while poorly regulated settings led to overstimulation and reduced participation. The study underscores inclusive architectural design as essential to equitable, context-sensitive learning environments.

KEYWORDS:
Neurodivergent, Neurodiversity Paradigm, Sensory Processing Sensitivities, Universal Design Principles, Multisensory School Environments

INTRODUCTION

Inclusive education seeks to ensure that all students can meaningfully engage in educational environments, regardless of cognitive, sensory, or developmental differences. For neurodivergent students—such as those with Autism Spectrum Disorder (ASD), Attention-deficit/hyperactivity disorder (ADHD), and dyslexia—the physical learning environment plays a decisive role in how sensory information is perceived, processed, and regulated. Architectural factors such as lighting, acoustics, spatial organization, and materiality directly influence learning engagement, emotional regulation, and social interaction; when these environments are designed primarily for neurotypical users, they may unintentionally hinder the participation and well-being of neurodivergent users (Mostafa, 2021).

Recent studies have shown that standardized school design approaches often insufficiently address sensory diversity, contributing to sensory overload, reduced concentration, and heightened anxiety among neurodivergent learners (Mostafa, 2021; Hay & Fleming, 2024). These findings underscore the built environment as an active determinant of learning experiences rather than a neutral backdrop.

In the Philippine context, inclusive education is institutionally supported through the K to 12 Basic Education Program and Special Education (SPED) initiatives. However, many

public and private school facilities continue to reflect conventional, neurotypical design standards, with limited provision for sensory regulation, spatial predictability, and environmental flexibility (Llego, 2022; Lauengco, 2023). This disconnect suggests that architectural design has not been fully integrated into inclusive education strategies, despite its direct impact on learner experience.

Universal Design Theory and the Neurodiversity Paradigm advocate learning environments that inherently accommodate diverse users without reliance on specialized or retroactive modifications (Mace, 1985; Singer, 1998). Empirical evidence indicates that carefully calibrated multisensory design strategies can enhance comfort, engagement, and independence among neurodivergent students (Mostafa, 2021).

Accordingly, the objectives of this study was to evaluate five (5) architectural design approaches for inclusive learning environments by examining how these key five architectural elements—(1)lighting and (2)color, (3)tactile and material sensations, (4)acoustics, visual and spatial organization, and (5) adaptive features—affect the learning experiences of neurodivergent students in school settings. The study aimed to generate evidence-based insights to inform the design of more responsive and inclusive educational spaces within the Philippine context.

METHODOLOGY

The study utilized a mixed-method, qualitative and quantitative method, to investigate what architectural design approaches influence the learning experience of the neurodivergent student in primary schools. It will mainly focus on how existing architectural design approaches support the well-being of these students and aims to provide practical insight for inclusive architectural practices on children with neurodevelopmental needs.

The methodology is divided into two components: **Criteria for Evaluating SPED Schools, and Data Collection Tools for assessing Five Architectural Elements.** Each discusses the research methods' data gathering tools, data analysis, treatment of data, locale and population, sample size, and ethical considerations.

Part 1: Criteria for Evaluating SPED Schools

The first component of this study is to evaluate schools for neurodivergent students. To achieve this, the methodology began with a systematic observation conducted across three schools in Dagupan City, Pangasinan. These schools are named West Central I Elementary School, North Central Elementary School, and Oakridge International School. The evaluation criteria were established based on Mostafa's ASPECTSS Design Index (2015) *(acoustics, spatial sequencing, escape spaces, compartmentalization, transition zones, sensory zoning, and safety)* for autism and modified to relate to the architectural design elements that address and support the needs of neurodivergent students. The descriptions of the criteria were modified to relate to the architectural design elements that address and support the needs of neurodivergent students. Five evaluators rated the schools using a Likert-scale ranging from 1 (Not Implemented), 2 (Limited Implementation), 3 (Partially Implemented), 4 (Largely Implemented), and 5 (Fully Implemented). Each score has a description relating to the

category on Mostafa's ASPECTSS Design Index Framework. Descriptive evaluations were then carried out to explain how the observations correspond to the ratings obtained.

Part 2: Data Collection tools for assessing Five Architectural Elements

For this component, the quantitative tool, survey questionnaire, and qualitative tool, semi-structured interview are based on Lasafer's Multisensory Design Framework (2025) **(***Lighting and Color, Acoustics, Tactile and Material, Acoustics, Visual and Spatial Organization, Adaptive and Interactive)*. Both have two versions, one for the parents and guardians and one for the teachers and allied professionals. All items on the survey questionnaire and semi-structured interview were answered using a likert-scale starting from 1 (Never) to 5 (Always), and descriptive statistics, specifically the mean and weighted mean, were utilized to determine the respondents' level of agreement regarding the five key architectural elements that influence neurodivergent students. The semi-structured interview made use of thematic analysis to interpret the responses. These two instruments have two versions, one physical copy and a digital copy.

The questionnaires and interview guide were validated by seven qualified experts using a Likert scale (1 = not relevant, 2 = somewhat relevant, 3 = quite relevant, 4 = highly relevant, 5 = perfectly relevant). After the validation process, a statistician computed the validity index V value, resulting in at least 0.75, considering 7 expert evaluators using a 5-point scale. The evaluation using Aiken's V coefficient was utilized to account for varying importance or emphasis that certain items may carry within the instrument, ensuring that items with higher significance influenced the overall validity rating appropriately. Together, these measures provided a more accurate and reliable assessment of the instrument's psychometric soundness. The content validity certificate was issued after the required procedures (see Appendix G, page 60).

Locale and Population

Table 10. Research Methodology - SPED Student Population in West Central 1 Elementary School, North Central 1 Elementary School, and Oakridge International School

Schools	Students	SPED Teachers
West Central 1 Elementary School	156	10
North Central Elementary School	51	2
Oakridge International School	13	13
Total	**220**	**25**

The population gathered by the researchers represents the total number of students and teachers in the identified SPED schools. However, the count does not directly reflect the actual number of parents/guardians of neurodivergent students who are also the intended respondents for the study.

Sampling Design

Purposive sampling is used in the study and only participants and institutions that met specific characteristics relevant to neurodivergent students were intentionally selected. First, the schools in Dagupan City, inclusion required being geographically within the city, have enrolled neurodivergent students and offer SPED or inclusion programs. Second, the parents or guardians of neurodivergent children studying in Dagupan. Third, the professionals, such as developmental pediatricians, pediatric neurologists, child psychiatrists, and SPED teachers, were purposely selected based on their direct expertise with neurodivergent children and active practice within Dagupan. Fourth, the therapy centers within Dagupan that catered to neurodivergent children were also included to access additional professionals.

Cochran's formula was used to compute the sample size and the recommended sample size is **150 respondents**.

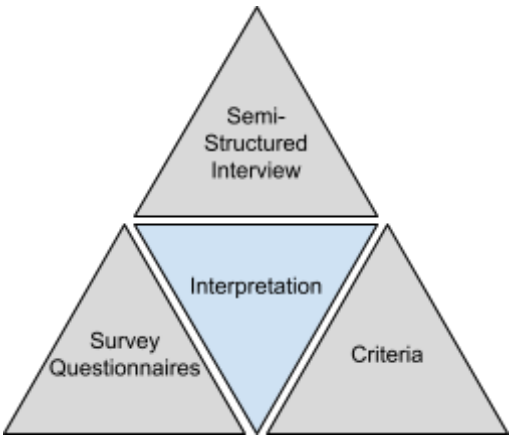
$$(n = \frac{n_0}{1+\frac{(n_0-1)}{N}}) \qquad n = \frac{384.16}{1+\frac{(384.16-1)}{245}} = 149.83 \approx 150$$

Triangular Process of Data Triangulation

In this study, the triangular process of data triangulation consists of three complementary components: semi-structured interviews, survey questionnaires, and a structured set of evaluative criteria (See Fig. 2). The systematic integration of these components enables a clearer and more coherent interpretation of participants' responses.

The **Semi-Structured Interview** provided context and meaning to the numerical trends identified in the quantitative method. Thematic analysis was used to identify and interpret the themes and patterns from the respondents' narratives. For the **Survey Questionnaire**, the numerical data complemented and validated the data from the semi-structured interview. Descriptive statistical tools such as mean and weighted mean were used. While the **Criteria** served as a structured framework that enabled the researchers to analyze architectural design features from multiple perspectives, ensuring the reliability, consistency, and accuracy of findings. A rating system was used alongside which was supported by descriptive evaluations per category. At the center of the model lies the **Interpretation**, the point where the findings from semi-structured interviews, questionnaires, and criteria are integrated. The convergence ensured that the numerical data and personal experiences were aligned to create a cohesive and evidence-based understanding.

Figure 2. Triangular Model of Methodological Triangulation



Ethical Considerations

1) Respect for the Dignity of Persons and People
2) Competent Caring for the Well-Being of Persons and Peoples
3) Integrity
4) Professional and Scientific Responsibilities to Society

RESULTS AND FINDINGS

Systematic Observation - Evaluation

This study examined how the built environments of selected SPED schools in Dagupan City—West Central I Elementary School, North Central I Elementary School, and Oakridge International School—support neurodivergent students, using Mostafa's ASPECTSS Design Index (2015) as the guide. The evaluation used a five-point observational rating scale to measure how well each school environment follows the design principles from Mostafa's ASPECTSS Design Index. The ratings considered the level of presence, effectiveness, and quality of architectural implementation seen in the physical environment, rating the facilities on a scale of 1 (lowest) to 5 (highest). 1

Structured Interviews

This section presents the interview data from the interview and identifies themes that are identified by the participants according to their experience and observations. These themes are sensory-related architectural features experiences in learning environments for children with neurodevelopmental needs.

Lighting and Colors

Participants often identified the themes under lighting, which are the dim light, dark spaces, and bright light. Controllable lighting was repeatedly mentioned during interviews, indicating the importance of adjustable illumination to enhance comfort and reduce sensory overload in learning spaces. Dim lighting was commonly associated with calming or sensory-regulation spaces, while bright lights that are evenly distributed and glare-free were identified as helpful for visual clarity and focused activities.

For color, the two primary themes identified were light colors and bright colors. Light colors were frequently mentioned in contributing to comfort, calm, and safety for neurodivergent students. In contrast, bright colors function as irritation and sensory discomfort among students.

Acoustic Environment

According to the interviews, themes under Acoustics, such as sound proofing and sound absorption reveals that sound is one of the primary sources of distraction and behavioral distress to neurodivergent students. Quiet environments were identified by the respondents as comfortable for the students, as loud noise affects their concentration, discomfort, and anxiety.

Visual and Spatial Organization

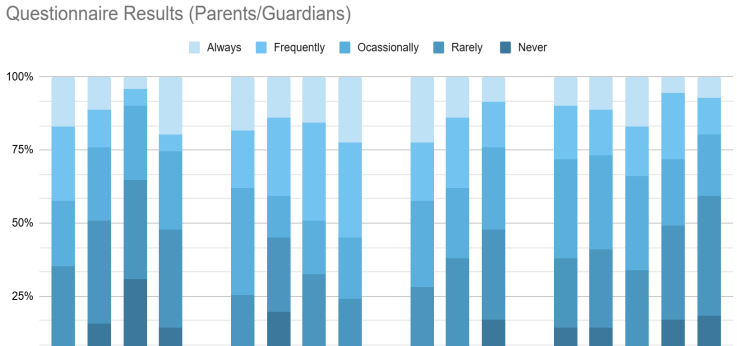
In terms of visuals, several themes were identified, such as plain walls, mixed-color decoration, wall-mounted decorations, minimal color, and colored walls. The results show that the use of plain walls and a limited color palette helps students to calm, focus, and better sense control. While mixed-color decorations and wall-mounted decorations increase their visual complexity, the more they are exposed, the more it results in distraction. Furthermore, minimal color helps students focus in the classroom.

Spatial Organization themes, such as tight spaces, wide and spacious form, and the same arrangement layout, show a need for support for neurodivergent students, particularly in indoor learning areas and therapeutic environments. Participants mentioned that wide and spacious forms in areas like classrooms, playrooms, and therapy rooms suggest the need for improvement as these environments promote focus, comfort, and a functional learning experience for students. While organization of furniture contributes to spatial clarity by being able to identify activity zones and unobstructed circulations to reduce cognitive demand and anxiety.

Adaptive and Interactive Features

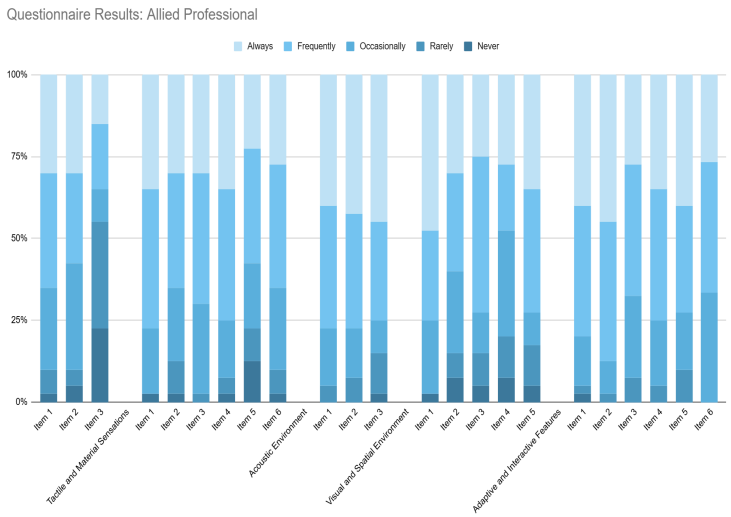
Professionals in this field provided responses which identified a need for adaptive and interactive features, such as Isolation rooms, new classroom features, cool rooms, calm rooms, activity rooms, quiet zones, and play rooms. The data provided shows that these features help support children with neurodevelopmental needs, enhancing their focus, promotes roleplaying, encourages social interactions, and provides a safe space to exploration.

SURVEY QUESTIONNAIRE



The chart shows the results of two different respondents. The questionnaire for parents consisted of 16 different questions, categorized into five categories:

Lighting and Color (4), Tactile and Material (4), Acoustic and Environment (3), and Visual and Spatial Organization (5). Meanwhile, the questionnaire for allied professionals consisted of 23 different questions, categorized into five categories: Lighting and Color (3), Tactile and Material (6), Acoustic and Environment (3), Visual and Spatial Organization (5), and Adaptive and Interactive Features (6).



The survey included 111 participants from three different schools in Dagupan City that cater to neurodivergent students: West Central Elementary School, North Central Elementary School, and Oakridge International School. The response was calculated by dividing the number of responses for each scale category (Always, Frequently, Occasionally, Rarely, Never) by the total number of respondents in both Parents/Guardians (71) and Allied Professionals (40), and multiplying by 100.

DISCUSSION

This study evaluates how the built environments of selected SPED schools accommodate the sensory, spatial, and developmental needs of neurodivergent students. Through on-site observations, surveys, and thematic analysis, the findings are interpreted using established architectural criteria and sensory-based design principles. The built environments of three observed SPED schools Oakridge International School, North Central Elementary School, and West Central Elementary School fall short in supporting neurodivergent learners, earning consistently low scores across sensory-sensitive design criteria. Despite differences in institutional context and capacity, all three schools recorded generally low performance in the seven evaluated categories, indicating that their spaces are not adequately structured to meet the sensory, spatial, and self-regulatory needs of these students. These findings suggest that current SPED school designs rely on fragmented or minimal applications of inclusive design principles rather than a holistic sensory-sensitive approach.

Quantitative results revealed low scores across all criteria in the three schools, with deficiencies in one area frequently coinciding with weaknesses in related aspects. For instance, poor transition spaces are consistently paired with fragmented spatial sequencing, as effective transitions rely on clear sequencing for predictability, orientation, and ease of movement otherwise leading to confusion and sensory stress. Similar overlaps appeared in sensory zoning, compartmentalization, and escape spaces, where the absence of one element undermined the environment's overall capacity for sensory regulation.

Thematic analysis of interviews with parents, teachers, and allied professionals reinforced these patterns. Key concerns included excessive noise, visual distractions,

inadequate calming spaces, poor spatial organization, and undefined transitions directly aligning with low scores in acoustics, sensory zoning, escape spaces, and spatial sequencing. Participants reported that unmanaged sensory stimuli and unintuitive layouts heighten anxiety, disrupt attention, trigger dysregulation, disorientation, and stress. Notably, while parents viewed these responses as occasional, allied professionals observed them as frequent in school settings, suggesting poor design amplifies challenges and calling for expert-informed, context-specific architectural interventions over behavioral adjustments alone.

Organizing qualitative codes and themes under Lasafer's five architectural elements, Lighting and Color, Acoustics, Tactile and Material, Visual and Spatial Organization, and Adaptive and Interactive provided a coherent analytical framework that aligned qualitative insights with quantitative measures. The consistently low to partial implementation scores across these elements reinforce qualitative accounts describing sensory overload, lack of spatial clarity, insufficient quiet or escape spaces, and limited environmental adaptability. Notably, themes under the Adaptive and Interactive elements point to a critical need for flexible and responsive environments capable of accommodating varying sensory thresholds and supporting self-regulation. The limited presence of such features, reflected in low scores for escape spaces, transitions, and sensory zoning, suggests that existing designs fall short of promoting emotional well-being, focus, and engagement.

Overall, the combined findings indicate that the observed shortcomings are not isolated deficiencies but manifestations of a broader lack of integrated sensory-sensitive design. The built environment functions as an interconnected system in which weaknesses in one criterion cascade into others. Addressing these gaps therefore requires a coordinated architectural approach that simultaneously enhances spatial sequencing, transitions, sensory zoning, compartmentalization, and adaptability. The alignment between qualitative themes and quantitative results strengthens the study's recommendation for targeted, evidence-based architectural interventions, reinforcing the critical role of holistic sensory-sensitive design in creating inclusive, supportive, and equitable learning environments for neurodivergent students.
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CONCLUSION

Inclusive learning environments must address the diverse needs of neurodivergent students, yet many schools still lack design solutions that directly respond to these challenges. Using systematic observation, semi-structured interviews, and surveys, the study identified key deficiencies such as inadequate sensory zoning, escape and transition areas, acoustic control, spatial sequencing, compartmentalization, and safety measures that negatively affect learning and development. Parents, teachers, and allied professionals proved these findings through the tools, emphasizing the importance of sensory-responsive architecture through lighting, color, tactile materials, acoustics, spatial clarity, and adaptive zones. Results showed that students react differently to their surroundings, with design either fostering comfort or causing distress. Importantly, the study demonstrated how **Mostafa's ASPECTSS Design Index** and **Lasafer's Multisensory Design Framework (2025)**—both emphasizing lighting, tactile sensations, acoustics, spatial organization, and adaptive features that positively contribute to the learning and well-being of neurodivergent students. Based on the findings, the study seeks to guide parents, teachers, allied professionals, and the wider educational community by translating research into practical architectural strategies tailored

to neurodivergent needs. Grounded in both observation and lived experiences, these underscores how design influences sensory regulation, emotional well-being, social interaction, and learning outcomes. The results suggest moving beyond uniform, one-size-fits all classrooms toward flexible, adaptive environments that place neurodiversity at the core of inclusive education. More importantly, the research envisions schools that not only accommodate but also empower neurodivergent learners promoting comfort, engagement, independence, and academic success.

Grounded by evidence, the design recommendations developed in this study enhance the effectiveness of inclusive schools for neurodivergent learners by integrating insights from parents, guardians, and allied professionals. Five key architectural elements were emphasized—color and environment, tactile and material qualities, acoustics, spatial and visual organization, and adaptive features that support regulation, comfort, and engagement. Practical strategies include replacing fluorescent lighting with recessed LED panels for glare-free illumination, using pastel or neutral color palettes to reduce sensory overload, and selecting consistent materials that provide stable tactile input. In addition, noise control through careful site placement and sound-absorbing finishes, along with spacious, well-organized activity zones and safe, soft-edged furniture, were also identified as essential. Adaptable features such as sensory rooms, quiet zones, and calm spaces further help manage distress and promote focus. These strategies aim to transform schools into sensory-responsive environments that actively support the comfort, focus, and well-being of neurodivergent students.

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ADDENDUM