

Design for Diversity: Sensory Processing Disorder and Classroom Adaptations

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Abstract: Sensory Processing Disorder (SPD) is a neurological condition affecting individuals' perception and reaction to sensory stimuli. For children with special needs, SPD significantly hinders their ability to engage in traditional educational settings. This paper underscores the importance of understanding SPD in the context of developing inclusive classrooms tailored to meet their unique sensory and educational needs. The initial sections delineate SPD's definition, symptoms, and prevalence, integrating relevant literature from the past decade to provide a comprehensive overview. Key aspects of creating sensory-friendly classrooms are explored, emphasising modifications such as adjustable lighting, reduced noise levels, and the incorporation of sensory tools, aimed at fostering focus, alleviating sensory overload, and improving educational outcomes. This paper is vital for guiding scholarly pursuit in underexplored areas related to inclusive education, presenting an exhaustive literature review that identifies significant contributions, trends, and gaps. By addressing these gaps, future research can enhance understanding and support for children with SPD in educational contexts. The study concludes by advocating for the significance of sensory-friendly classrooms, which bolster academic achievement, emotional regulation, and social inclusion among children with special needs. Recommendations include incorporating SPD training into teacher education programs, applying evidence-based adjustments in classroom settings, fostering parental collaboration in interventions, and leveraging technology to promote sensory-friendly education. By prioritising sensory processing needs, educators can ensure equitable access to learning opportunities for all students, culminating in calls for further research and policy initiatives to enrich inclusive educational practices.

Keywords: *Classroom Adaptations, Sensory Processing Disorder, Special Education, Special Needs Education*

1. Introduction

The concept of diversity in education encompasses a multitude of differences, including cultural, linguistic, socio-economic, and neurodiversity. Neurodiversity particularly calls attention to variations in sensory processing, which significantly affects learning. Sensory Processing Disorder (SPD) represents a neurological condition wherein individuals experience difficulties in perceiving and responding to sensory stimuli, subsequently affecting their learning experiences. This issue is increasingly becoming a focal point in educational research as awareness of neurodiversity rises. Almakrob, Alduais, and Mhone (2024) pointed out that within educational institutions, traditional teaching methods may not adequately meet diverse learning needs, thereby contributing to a phenomenon termed the "disability of instruction," where the learning environment itself can become a barrier to educational equity.

Among the diverse learning needs, Sensory Processing Disorder (SPD) presents unique challenges in educational settings. SPD is a neurological condition that affects how individuals perceive and respond to sensory stimuli, leading to overstimulation, under-stimulation, or difficulty integrating sensory information. Studies estimate that sensory processing disorders affect between 1 in 20 and 1 in 625 children in the general U.S. population, while a study in Finland found sensory abnormalities in 8.3% of 8-year-old children (Silva, Schalock, Gabrielsen, Budden, Buenrostro, & Horton, 2015).

In the context of Malaysia, studies estimate that around 20% of children experience some form of sensory processing difficulty, underscoring the necessity for inclusion in educational settings. Specific statistics regarding SPD prevalence appear limited, yet anecdotal evidence suggests a growing recognition of sensory issues among children, particularly among those diagnosed with conditions such as autism and ADHD (Bakar

et al., 2023). This recognition echoes global trends, reflecting concerns voiced by researchers who argue that the prevalence of learning difficulties associated with neurodiversity necessitates more inclusive approaches within educational frameworks (Almakrob et al., 2024). Understanding the implications of SPD in educational environments is vital. Research indicates that children with SPD can display significant challenges in mainstream classrooms, where overstimulation from sensory inputs such as bright lighting and loud noises can impair their ability to learn effectively (Gigliotti et al., 2024). Traditional classroom settings may not provide the necessary accommodation, leading to issues such as academic underachievement and difficulties in social interactions (Bradley et al., 2024). Addressing these sensory challenges is crucial for fostering inclusive environments that support both cognitive and emotional development among all learners.

The increasing prevalence of sensory processing difficulties calls for timely interventions that integrate evidence-based strategies within teacher training programs. Educators must be equipped with the knowledge and skills necessary to discern and respond to the unique sensory needs of their students, ultimately bridging the gap between standardised curricula and individualised learning requirements (Nair & Geetha, 2023; Erkek & ÇEKMECE, 2023). This paper emphasises the necessity for designing sensory-responsive classrooms to foster equitable learning experiences, encouraging schools to embrace inclusive practices that honor the diversity of sensory processing among students.

2. Literature Review

Sensory Processing Disorder

Sensory Processing Disorder (SPD) is a condition in which the brain struggles to receive and respond appropriately to sensory information. According to Schaaf, Benevides, Mailloux, Faller, Hunt, Van Hooydonk, and Kelly (2014), children with SPD experience sensory input differently, which can impact their ability to interact with their surroundings and participate in daily activities. These sensory differences often manifest in various behaviors, such as avoiding noisy environments, seeking strong tactile sensations, or experiencing challenges in coordinating movements. A fundamental framework for understanding SPD is Dunn's Model of Sensory Processing, which categorises sensory responses into four (4) distinct patterns: sensory seeking, sensory avoiding, sensory sensitivity, and low registration (Dunn, 2014).

Dunn's Model of Sensory Processing helps explain the diverse ways in which children with SPD respond to sensory stimuli. For instance, sensory seekers actively pursue intense sensory experiences, while sensory avoiders tend to withdraw from environments they perceive as overwhelming. SPD is frequently associated with other developmental disorders, including autism spectrum disorder (ASD) and attention-deficit/hyperactivity disorder (ADHD). Miller, Anzalone, Lane, Cermak, and Osten (2007) estimate that SPD affects between 5% and 16% of children, highlighting the importance of addressing sensory needs within educational settings. Therefore, by recognising and accommodating these sensory challenges, educators can create supportive learning environments that enhance both academic engagement and overall well-being.

Designing the Classroom for Students with Special Educational Needs

Creating a sensory-friendly classroom is essential for accommodating children with Sensory Processing Disorder (SPD), as it enhances their ability to focus, self-regulate, and participate effectively in learning activities. Moore et al. (2014) emphasise that a well-designed sensory-friendly classroom should minimise sensory triggers while providing appropriate tools for self-regulation.

Next, one crucial aspect of classroom design is lighting. Using natural light or dimmable LED lights instead of fluorescent lighting helps reduce visual overstimulation, thus creating a more comfortable learning environment (Yuen, Wood, Krentel, Oster, Cunningham, & Jenkins, 2023). Additionally, acoustics play a significant role in sensory regulation. Installing acoustic panels and carpeting can help dampen noise levels, whereby this can reduce auditory distractions and promote a quieter atmosphere (Wilson, Harper-Hill, Ashburner, Downing, Armstrong, & Perrykkad, 2019).

Subsequently, providing flexible seating options is another effective strategy for accommodating diverse sensory needs. Seating alternatives such as wobble chairs, bean bags, and standing desks allow students to engage in movement while learning, which can help with focus and self-regulation (Rollo, Crutchlow, Nagpal,

Sui, & Prapavessis, 2019). Furthermore, incorporating sensory zones within the classroom, such as quiet corners or sensory stations, provides children with designated spaces where they can either calm down or engage in sensory activities as needed (Marwati, Dewi, Wiguna, & Aisyah, 2023).

Research by Schaaf et al. (2015) highlights that sensory-friendly classrooms not only benefit children with SPD but also create a more inclusive and supportive learning environment for their peers. By making thoughtful adjustments to the physical environment and integrating sensory-friendly teaching strategies, educators can foster a classroom atmosphere that meets the diverse needs of all learners.

Importance of Understanding SPD among Educators

Educators play a critical role in identifying and addressing sensory needs in the classroom. However, Miller-Kuhaneck, and Watling (2018) emphasise a significant gap in teachers' knowledge of SPD, which often leads to misinterpretation of sensory-driven behaviours. For example, a child experiencing sensory overload might exhibit aggression or withdrawal, which can be mistakenly viewed as defiance or inattentiveness. Therefore, teacher training in sensory processing and its impact on learning is essential. A study by Case-Smith et al. (2015) found that professional development programs focusing on sensory strategies significantly improved teachers' ability to manage classrooms and support children with SPD. These programs equip educators with skills to (i) identify sensory triggers in the classroom, (ii) implement sensory interventions such as sensory breaks or calming strategies, and (iii) adapt lesson plans to align with sensory needs.

Furthermore, collaboration with occupational therapists is also critical. Dunn et al. (2016) emphasise the importance of a multidisciplinary approach in designing Individualised Education Plans (IEPs) that incorporate sensory accommodations. Educators who understand SPD can better advocate for resources and policies that promote inclusion. Moreover, fostering an empathetic understanding of sensory needs among all students can reduce stigma and promote peer support. A study conducted by Robertson et al. (2017) found that inclusive environments where sensory differences are openly addressed foster a culture of acceptance and collaboration, benefiting the entire classroom community.

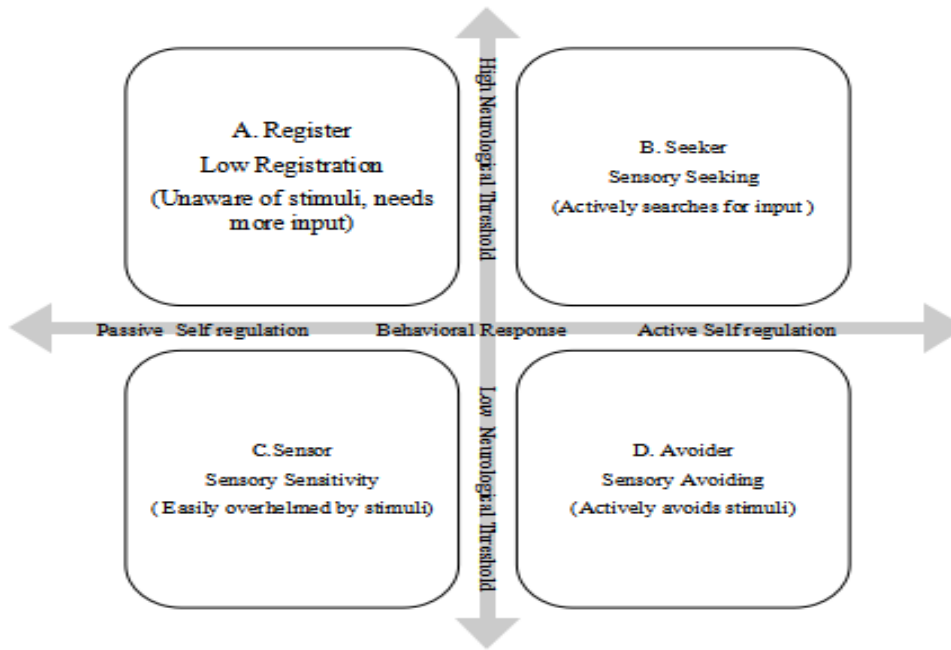
Model of Sensory Processing

Dunn's Model: Designing for Diversity in the Classroom Adaptation

Dunn's Model of Sensory Processing was introduced by Dr. Winnie Dunn in 1997. The framework explains how individuals perceive and react to sensory stimuli in their surroundings. The model is commonly used in occupational therapy, education, and psychology to comprehend sensory processing patterns and the impact they have on behaviour, learning, and daily functioning. Figure 1 is the overview of Dunn's Model of Sensory Processing, which consists of four (4) subtypes of sensory functioning, such as register, seeker, sensor, and avoider. These fall at a unique point between two spectrums of neurological threshold and self-regulation.

In addition, the model is specifically beneficial for designing modifications and adaptations for individuals with SPD or other sensory-related difficulties. Utilising Dunn's Model of Sensory Processing to inform classroom adaptation for diversity provides a systematic framework for categorising instructors and students according to their methods of acquiring, processing, and applying knowledge. By mastering these patterns, educators can optimise teaching strategies and learning environments to accommodate the diverse sensory and learning needs of all children.

Figure 1: Dunn's Model of Sensory Processing



Understanding Dunn's Model

Dunn's model proposes that individuals process sensory information based on two (2) main constructs: neurological threshold and self-regulation. Besides, Dunn's model of sensory processing proposes that individuals have different patterns of responding to sensory input, which are influenced by neurological thresholds and self-regulation. Dunn's model categorises sensory processing into four (4) patterns such as low registration, sensory seeking, sensory sensitivity, and sensory avoiding. This framework allows educators to tailor their teaching methods to better meet the sensory needs of each student, thereby promoting engagement and participation.

People with low registration have a high neurological threshold, meaning they need strong or intense sensory input to notice it. However, because they use a passive self-regulation strategy, they do not actively seek extra stimulation. For example, a student with low registration may not notice when the school bell rings or may be slow to respond to their name being called. They often seem "tuned out" or unresponsive, not because they are uninterested, but because the sensory input is too weak for them to detect easily. Next, sensory seeking is when people with a high threshold actively seek out sensory input to meet their needs. They enjoy and crave sensory-rich experiences and may go out of their way to stimulate their senses. For example, a child who constantly touches objects, moves around, or makes loud noises is likely a sensory seeker. They may love climbing, spinning, or engaging in messy play because these activities give them the intense input they need.

Subsequently, sensory sensitivity is when people have a low neurological threshold and easily notice even minor sensory input. However, they passively regulate their responses, meaning they do not take action to reduce or avoid stimuli. For example, a person who is easily distracted by background noise, such as the hum of a fluorescent light or the tapping of a pencil, may have sensory sensitivity. They may feel overwhelmed, but they endure the discomfort rather than trying to change the environment. Lastly, individuals with sensory avoidance tendencies have a low threshold and actively try to manage their sensory environment by avoiding stimuli. They are highly sensitive and take steps to reduce or escape from sensory input that feels overwhelming. For example, a person who wears headphones in noisy places, avoids crowded events, or refuses certain clothing due to texture issues may be a sensory avoider. They deliberately control their environment to prevent discomfort.

Understanding these patterns helps educators create supportive environments. For example, a sensory-

seeking child might benefit from fidget toys or movement breaks, while a sensory-avoiding adult may need a quiet workspace with minimal visual or auditory distractions. Besides that, Dunn's Model empowers educators to better understand the "why" behind student behaviours and respond with compassion, flexibility, and informed strategies. This not only enhances educational outcomes but also fosters a more inclusive, respectful, and supportive learning environment where all students can thrive.

Application for Classroom Adaptations

To effectively support students with diverse sensory processing needs, educators must begin with an assessment of individual needs. Utilising tools such as Dunn's Sensory Profile allows teachers to evaluate each student's sensory processing patterns and tailor classroom adaptations accordingly (Dunn, 2008). One key adaptation involves modifying the classroom environment to accommodate different sensory preferences. For instance, flexible seating options, such as exercise balls or standing desks, can benefit sensation seekers, enabling them to regulate their sensory input without disrupting the class (Al-Eisa et al., 2013; Schilling et al., 2003).

Research indicates that these types of seating arrangements can enhance attention and engagement, particularly for students with attention deficit hyperactivity disorder (ADHD) (Wu et al., 2012). Meanwhile, quiet spaces provide a low-stimulation retreat for sensory avoiders who may become overwhelmed in a traditional classroom setting (Dydia et al., 2022). The importance of creating a sensory-friendly environment is highlighted by studies showing that sensory-based interventions can significantly improve academic performance and behavioural outcomes in diverse classroom settings (Worthen, 2010).

In terms of teaching strategies, incorporating movement breaks can help sensation seekers maintain focus by integrating short, structured physical activities into the learning process. Research indicates that such movement breaks can enhance attention and reduce sedentary behaviour among students, therefore improving overall engagement in the classroom (Lynch et al., 2022). Similarly, students with low sensory registration may benefit from visual schedules, which provide clear, structured guidance on tasks and expectations, facilitating better understanding and task completion (Case-Smith et al., 2014).

By thoughtfully adapting classroom environments and teaching strategies, educators can foster a more inclusive and supportive learning experience for all students, ultimately enhancing their academic performance and social interactions (Donnelly et al., 2016). In summary, the integration of sensory assessments and tailored classroom adaptations is crucial for meeting the diverse needs of students. By implementing flexible seating and designated quiet areas, educators can create an inclusive environment that fosters learning and engagement for all students, particularly those with sensory processing challenges (Halidane et al., 2023).

Supporting Diversity

Supporting diversity in the classroom is essential for fostering an inclusive educational environment that accommodates the varied sensory processing needs of all students. By understanding and applying Dunn's Model of Sensory Processing, educators can create strategies that not only support students with SPD but also enhance the overall learning experience for all students by recognising and respecting individual differences. Implementing strategies based on Dunn's Model can significantly improve classroom dynamics.

For instance, incorporating sensory-friendly classroom designs, such as quiet zones for sensory avoiders or active learning spaces for sensation seekers, can help students feel more comfortable and focused. Additionally, the use of visual schedules and structured routines can benefit students with low sensory registration by providing clear expectations and reducing anxiety (Tuck, Chow, Kim, Malone, & Smith, 2024). Furthermore, by integrating Universal Design for Learning (UDL) principles, educators can ensure that all students have multiple means of engagement representation, and action, thus fostering a truly inclusive learning environment (Mallory & Keehn, 2021).

Framework for Interactive Classrooms Supporting Sensory Processing Disorder (SPD)

The development of interactive classroom frameworks specifically designed for students with Sensory Processing Disorder (SPD) is crucial for addressing the distinctive challenges these children encounter in

conventional educational environments. Such classrooms aim to cultivate a sensory-responsive space that enhances engagement and learning outcomes for students with SPD. A comprehensive and effective framework integrates several critical elements, including flexible seating arrangements, ambient noise management, and opportunities for sensory modulation, each aiming to mitigate sensory overload while promoting emotional regulation and social interaction.

Key components of this framework include the utilisation of sensory tools and resources. For instance, adjustable lighting and sound control tools serve to alleviate sensory overload, consistent with findings that excess stimuli can adversely affect children's engagement (Ouellet, Carreau, Dion, Rouat, Tremblay, & Voisin, 2018). Furthermore, creating a classroom environment that incorporates sensory breaks and designated quiet areas can help students better process sensory information and regain focus, which aligns with research emphasising the essential role of sensory integration in achieving positive educational outcomes (Ouellet et al., 2018).

Moreover, training educators in collaborative methods with occupational therapists is crucial for enhancing their ability to recognise and respond to sensory-related challenges in students. Research suggests that professional support significantly augments the success of sensory interventions within educational settings, thereby fostering a more inclusive and accommodating atmosphere for those with sensory processing difficulties (Araújo et al., 2021; Lane et al., 2022). This collaboration underscores the necessity for ongoing professional development and a team-oriented approach to crafting tailored educational strategies for children with SPD.

Relevant Theoretical Application

The Theory of Planned Behaviour (TPB) is particularly relevant in this context, as it provides a framework for understanding the adoption and implementation of sensory-friendly strategies within classrooms. This theory posits that an individual's intention to engage in specific behaviour is influenced by their attitudes, subjective norms, and perceived behavioural control (Ajzen, 1991). In educational settings, teachers' attitudes toward utilising sensory modifications, their understanding of available support systems, and the prevailing norms within their institution influence their readiness to adopt these strategies effectively.

Research highlights that misunderstandings surrounding sensory processing disorders can skew educators' perceptions, limiting their willingness to incorporate necessary modifications in the classroom (Jones, 2021). By fostering a deeper understanding of SPD among educators, it is possible to reshape these attitudes, encouraging the integration of innovative teaching strategies. The core assumption of the TPB is that improving educators' competency in sensory processing will enhance their confidence in implementing such practices, ultimately leading to a more inclusive learning environment for students with SPD (Ward, 2018).

The Ayres Sensory Integration Theory further supports this understanding by elucidating how sensory processing significantly influences behaviour, learning, and development in children with sensory integration challenges. Creating sensory-rich educational environments can enhance learning experiences for all students, highlighting the integral relationship between sensory interactions and cognitive processing, as recommended by various studies focused on sensory experiences and their impact on developmental coordination (Ringold et al., 2022).

3. Conclusion

This study significantly contributes to the targeted group of children with Sensory Processing Disorder (SPD) by elucidating the importance of understanding and accommodating diverse sensory needs within educational settings. By leveraging Dunn's Model of Sensory Processing, the research provides educators with a robust theoretical framework to identify, understand, and effectively respond to the specific sensory processing patterns exhibited by their students, namely Sensation Seeking, Sensory Avoiding, Sensory Sensitivity, and Low Registration.

The insights gleaned from this study advocate for the implementation of tailored strategies that not only cater specifically to students diagnosed with SPD but also enhance the overall classroom experience for all learners.

By utilising assessment tools such as the Sensory Profile, teachers can identify individual sensory needs, thereby facilitating the design of personalised classroom environments. Proposed adaptations include the incorporation of flexible seating arrangements, the establishment of quiet zones, scheduled movement breaks, the use of visual schedules, and differentiated instruction, each fostering a supportive learning atmosphere conducive to all students' success.

To ensure the successful adoption of these inclusive practices in classrooms, multiple parties must collaborate effectively. Specifically, school administrators play a crucial role in facilitating the necessary training and resources for teachers, ensuring that they are equipped to implement sensory-responsive strategies. Additionally, occupational therapists can contribute their expertise by guiding educators in understanding sensory profiles and programming sensory interventions tailored to individual students. Furthermore, parents and caregivers must be engaged as active collaborators in the educational process, providing insights and advocating for their children's unique needs.

This multifaceted approach enhances the likelihood of creating not only inclusive classrooms but also a supportive educational ecosystem that recognises and respects neurodiversity as an integral aspect of educational equity. The recommendations derived from this research underscore the necessity of a concerted effort among educators, administrators, therapists, and parents to cultivate learning environments that prioritise the sensory processing needs of all children, thereby promoting their academic achievement, emotional well-being, and social inclusion.

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