

The Role of Evidence-Based Design in Developing the Interior Environment for Inclusion Classes for Autistic Students

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دور التصميم القائم على الأدلة في تطوير البيئة الداخلية لفصول الدمج لطلاب طيف التوحد

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Abstract

This research study aimed to develop a three-dimensional prototype based on a set of key Evidence Based Design of inclusion classes for students with autism spectrum disorder (ASD). The study employed a qualitative research approach through pictorial case study and content analysis. A literature review of the latest publications, case studies, and scientific reports was also done to seek evidence from previous work. The study was conducted, in the fall of 2022 semester, in the interior design department located at one of the South-eastern universities in the United States. The findings indicated that indirect lighting, bright and cool colors, and soft and colored flooring are significant in providing a safe and comfortable learning environment for students with ASD needs in inclusive classrooms. The findings have implications for policymakers, educators, concerned authorities and designers for building favourable learning environments for autistic students. However, certain limitations to estimating the cost of redesigning the classroom and investigating other classroom features need further research. Further research is needed to investigate the further issues in designing inclusive classroom design for university students.

الملخص

تهدف هذه الدراسة إلى عمل تصميم ثلاثي الأبعاد مقترح من خلال إيجاد الأدلة البحثية المرتبطة بتصميم فصول الدمج لطلاب طيف التوحد. تم استخدام المنهج الوصفي في هذه الدراسة من خلال عمل دراسة حالة والتحليل الوصفي. كما عُملت مراجعة بحثية لآخر الأبحاث والدراسات التي تمت على طلاب التوحد وفصول الدمج المرتبطة بهم. وعُملت هذه الدراسة في الفصل الأول من العام الدراسي 2022 في قسم التصميم الداخلي بإحدى الجامعات الواقعة في الجنوب الغربي في الولايات المتحدة الأمريكية. تظهر النتائج أن الإضاءة غير المباشرة، والألوان الهادئة والباردة، وخامات الأرضية الناعمة والملونة، تعتبر مهمة جدًا في تصميم الفصول الدمج لطلاب التوحد حيث تعتبر مريحة وآمنة لهم. قدم الباحث في نهاية البحث مجموعة من التوصيات للمعلمين وصناع القرار والمصممين الداخليين لعمل تصاميم فصول دراسية مناسبة لطلاب التوحد. تتلخص حدود البحث في عدم احتساب تكلفة إعادة تصميم الفصل الدراسي. والدراسات المستقبلية تتطلب عمل تقييم لنموذج الثلاثي الأبعاد الخاص بفصول الدمج، والكشف أيضًا عن تحديات أخرى تواجه طلاب التوحد في فصول الدمج.

Introduction

Autism is a developmental disability that persists throughout one's life and is defined by severe challenges with socializing, speech difficulties, recurrent and limited preferences and habits, and sensory sensitivity (Turk, 2021). There are several ways to comprehend autism, many of which use different terminology, which must be recognized. The significant trend toward autistic students receiving inclusive education demonstrates a rights-based perspective on disabilities (Liyanage, 2022). This strategy emphasizes that individuals cannot be deprived of an equal opportunity to schooling in compliance with global guidelines like the Universal Declaration of Human Rights and the United Nations Convention on the Rights of Persons with Disabilities (Veriava et al., 2020, Kanter & Arlene, 2019). Autistic students benefit from inclusive educational methods in a diverse range of ways, including exposure to more intellectually challenging instruction than they could probably acquire in isolated classrooms and improving their social interactions by engaging with other students (Beghin & Hannah, 2021). If implemented correctly with sufficient specialist assistance, including autistic students may also be helpful to all learners. However, individuals with autism can experience significant challenges in the regular classroom (Alshaigi et al., 2020). According to a study, autistic students are more likely to be bullied (Zhang et al., 2021) and more inclined to be isolated from school than any other category of students (Brain et al., 2019).

Global educational standards are confronted with difficulties in achieving better inclusion. Even though inclusive legislation and initiatives have been adopted in many countries worldwide, evidence indicates that enrolling students with autism in regular classrooms does not ensure their inclusiveness (Zakai-Mashiach, 2023). Instead,

various aspects may help or hinder effective transition and inclusiveness (Richter et al., 2019). Inclusive instructors can help realistic inclusion with the appropriate training. It is essential to adopt dynamic, personally designed instructional strategies. This implies that instructors have a variety of adaptations and resource alternatives that they might use within and beyond the lesson (Forlin et al., 2020).

Many academics have vented frustration that there is not enough information accessible to guide planners on how to make surroundings that is encouraging for autistic children. The study that occasionally emerges has methodological flaws, needs to be more rigorous and has subjective origins. Besides this, data can also be challenging for developers to access and is frequently dispersed and ambiguous. If further detailed evaluations on modelling classrooms for students with autism were performed, reported, and rendered open and accessible to developers, it might help them construct helpful learning spaces using actual data (Underhill et al., 2019; Williams et al., 2021).

Alfonsi et al. (2014) defined the EBD as "a scientific analysis methodology that emphasizes the use of data acquired in order to influence the design process" (p. 1). Roberts et al. (2022) asserted that if school administrators like to create an environment with a student-centered approach and adaptable assistance for autistic students, they must have accessibility to the academic literature on evidence-based practices. School heads should proactively encourage employees to use and evaluate these procedures regularly across the classroom and have knowledge of evidence-based practice for autistic students (Roberts et al., 2022).

Dean et al. (2022) also stated that as school professionals progress in devising

effective capabilities initiatives for autistic students in inclusionary educational environments, the acceptance of evidence-based practices utilized in school-based interpersonal capabilities measures, along with the categorization of monitoring guidelines and pertinent behavioral benefits, serves as a foundation for them to learn about. It has been demonstrated that evidence-based strategies aid in developing and applying interpersonal skills in educational settings (Dean et al., 2022).

Translating Research Evidence into Design Solutions

Evidence-based design (EBD) is a process of environmental design that utilizes credible research evidence and methodology to improve outcomes (The Center for Health Design, n.d.). EBD is an example of translational research that facilitates the application of research findings by creating design solutions and innovations that meet practical needs. It addresses the disconnect between research and design often observed in the environmental design field. The disconnect partially originates from the fact that peer-reviewed research journal articles published in medicine and other scientific disciplines are difficult for many design professionals to access and understand. To address this problem, many extensive literature reviews have been conducted in recent years on various EBD topics to make the research knowledge readily available to practitioners. Another type of effort is the development of prototypes for healthcare environments that visually demonstrate all relevant EBD features, which would effectively speed up the translational research. This research study is one step toward developing such a prototype of evidence-based inclusive classroom design appropriate for autistic students.

Aim of the Study

This research study aimed to develop a set of key EBD To design a friendly classroom environment for Autistic Students (see figure 1). It measures the physical and psychological effects of the built environment on its users. As the first step in developing the prototype, a literature review was conducted to update previous reviews by examining the most recent research on inclusive classroom environments.

Research Question

1. What are the main environmental design features (Lighting – colors) that reduce autistic students' stress in a classroom environment?
2. What are the types of lighting and appropriate color temperature?

Hypothesis

1. The current classroom environment is not appropriate for autistic students.
2. Developing a set of key EBD helps in creating an interior classroom environment that is friendly to autistic students.
3. Monitoring and documenting the requirements of autistic students with regard to appropriate lighting and colors supports and enhances the idea of a friendly classroom for autistic students

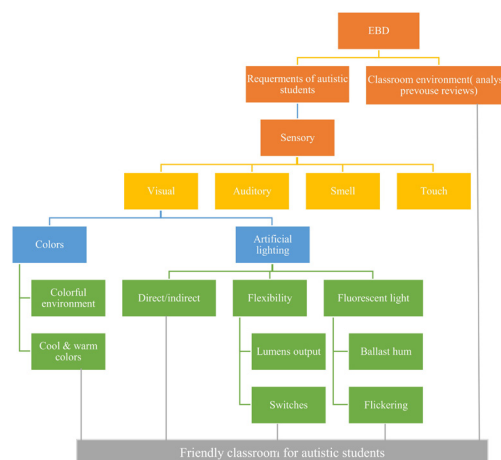


Figure 1: Conceptual framework of research problem

Literature Review

Inclusive Education and Students with ASD Needs

The motion for inclusive education has expanded internationally to help not only disabled students but to advance fair accessibility, engagement, and academic achievement for all learners (Roberts et al., 2022). Educators who work with autistic children in primary and secondary classes must have a deeper understanding of how to meet their students' academic, interpersonal, and psychological concerns. Without this information, there may be inadequate educational opportunities for all pupils as well as interruptions to the learning of a student who is on the autism spectrum due to decreased participation and retention, academic problems, marginalization, detachment, and stress on parents to discover substituted childcare provisions for their children (Roberts et al., 2022). All students benefit from inclusive education in terms of their educational performance, social development, and perceptions toward differences (Roberts et al., 2022).

Challenges Encountered by Students with ASD Needs during Transition Process

Autistic students can have trouble transitioning throughout school activities and can react by engaging in disruptive behaviors (Meindl et al., 2020). Many of these difficulties arise in transitioning from separate classrooms early. Several new obstacles could appear during the transitioning period, impacting the learner and their family as a whole. To achieve the objective of inclusivity, it is necessary to overcome the difficulties that come with departing the separate classroom during the transition stage (Richter et al., 2019).

Complications could arise even when learners move into general classrooms. Many

students who are placed in a supportive environment experience peer victimization. Learners may experience behavioral difficulties in a regular environment. The behavioral reactions of learners to transitional challenges span from resistance to complete reliance on help from the teacher. Due to the problems, autistic students could indulge in demanding behaviors such as angry outbursts, violence, and self-harm. Since most of these recently integrated students demand substantial services in schools, there is a greater demand for funding to assist the students in the classrooms (Zhang et al., 2019).

Understanding the Problems of Students with ASD Needs in Classroom

Teachers must provide an inclusive classroom as the number of autistic students in normal classes increases. Yet, sometimes there are no standards that specify how to accomplish this. Many instructors find it difficult to assist autistic students socially, intellectually, and interpersonally, even though several instructors believe that institutions should undertake strategies to encourage socializing in the classrooms and fulfill the student's requirements. Engaging with pupils who have autism without understanding autism and without knowing how to get help and guidance are among the most significant challenges experienced by teachers (Sulasmi et al., 2019).

Previous studies have shown that including autistic students benefit by allowing them to interact with their classmates. There are a few advantages like behavioral patterns and interpersonal development, consequently, parents and educators may establish a more challenging academic potential for such students. Students thrive from the assistance of teachers, and other education personnel, in understanding their social and psychological requirements and essential life competencies. Inclusion is most efficient

when all parties associated with the transition phase are willing to participate (Ekblom, 2020).

Cooperation between parents and schools is crucial for student achievement as more autistic students move to inclusive learning environments. Educators and families must keep aware and uphold open interaction channels throughout the home and the classroom to maintain this teamwork. Most trust and cooperation entail constant interactions, which include instructors' reporting of objectives and successes from the classroom and families' assessments and descriptions of behaviors and accomplishments from the homes (Abdollahi et al., 2023).

Offering relevant child-centered education that is competent of effectively teaching all students, especially children who suffer from substantial difficulties and impairments, is a major problem for regular classrooms. This is especially the case for autistic students when it comes to their distinctive abilities and challenges (Wang et al., 2019). Students usually present a consistent distinction between verbal and non-verbal cognition in addition to various intellectual and cognitive mental abilities. Furthermore, it is usual for autistic students to perform below their intellectual function or have significant difficulties in certain school courses (Hodges et al., 2020).

Designing an Inclusive Classroom Environment Meets Students with ASD Needs

About forty percent (40%) of students with autism also have co-occurring anxiety symptoms (Yerys et al., 2019). Autistic students may also display co-morbid mental health issues like eating or sleeping abnormalities (Lugo-Marin et al., 2019). Other problems include hyperactivity and concentration issues, executive functioning deficiencies,

problems with socialization, self-harming tendencies, stereotypical attitudes, and intense psychological vulnerability (Llanes et al., 2020). In a nationwide survey, autistic students identified the categories wherein they encountered the greatest difficulties. These included executive functioning, interpersonal coordination, and fine motor functions as. However, they also mentioned that academics and perceptual impairments affect them at school (Anderson, 2020). Moreover, autistic students are more susceptible to bullying than learners who are typically developing or have certain known difficulties. As a consequence, even while instructors could have strong educational demands for students with autism, the related traits of autism and comorbidities can render the classroom experience extremely difficult for such learners, leading to the frequent effort of institutions to meet their requirements (Roberts et al., 2022).

Schools must be designed to enhance students' intellectual capacity in a way that suits their requirements. The American law mandates that disabled children attend the same schools as those without impairments if these satisfy their requirements (Wehmeye et al., 2021). Since they are often taught alongside their classmates who do not have autism, several autistic children attend the same schools however, most school settings are not created to accommodate the sensory difficulties that several children with autism encounter (Larcombe et al., 2019).

Methodology

A qualitative research approach was implemented in the study. A pictorial case study was conducted to determine the issues related to visual distraction in terms of lighting and colors in one of the interior design classroom studios at one of the Southeastern universities in the United States in the fall of 2022 semester. Content

analysis of the classroom was conducted to determine the issues related to artificial lighting, such as glare and lighting intensity. Also, the lumens output of the lighting was investigated by using a lighting meter. Content analysis is defined as "research technique for the objective, systematic, and quantitative description of the manifest content of communication" (Murphy et al., 2005, p193).

The researcher retrieved the needed information regarding the effects of artificial lighting and colors on Autistic students in the built environment through a literature review. Also, two semi-structured interviews were conducted using a purposive sampling technique to get the experts' ideas about inclusive classroom design. Two experts from one of the southeastern universities in the United States were retrieved based on their expertise of designing and dealing with autistic students. Participants identity was eliminated for confidentiality and replaced with codes. The first interviewee is coded with (A), she is the director of the transition academy for Autism Education and Research at the university. The second participant is coded with (B), she is specialized in designing and researching for students with autism. Participant (A) was interviewed to gain in-depth information about autistic students. Then, the researcher developed the prototype, proposed, design of the inclusive classroom. After that, the researcher interviewed participant (B) to gain insights about the redesign of the classroom. The proposed design model was built using Autodesk Revit.

Literature Research

The researcher reviewed the literature and scientific publications of the last twenty-four years (2000 to 2023). The researcher employed key terms like ASD, autism, autistic students, inclusive education, inclusive classroom design criteria, recommendations,

education for all, etc. The researcher used OR and AND features with key terms to extract relevant information from the literature. These key terms were used to access research published in top journals. The inclusion and exclusion criteria were also applied to eliminate duplicated, irrelevant and unnecessary research. The exclusion and inclusion criteria are as follows:

- Peer-reviewed journals
- English language
- Publications from 2000 to 2023
- Evidence-based research

Data Extraction and Synthesis

It was observed that almost fifty-five research papers were published on the design of inclusive classrooms for students with autism. After applying exclusion and inclusion standards, twenty researchers were filtered and reviewed, and their results were analyzed.

Results

The latest literature, case studies, scientific reports and other evidence for reviewed to extract evidence-based recommendations for designing inclusive classroom environments for students with ASD needs (see table 1). The recommendations based on the results of the literature review were summarized as follows.

Table 1: Recommendations for designing inclusive classrooms for ASD students.

Assessment Domain	Criteria	Design Recommendation
Floorings	Types, color, material, etc.	<ul style="list-style-type: none"> • Plain tiles should be used on floors. • Floors should be covered with rugs or carpets. • Floor materials should not reflect light. • The floor should not be slippery. • Vinyl flooring should be used to make the floors safe. • Soft materials should be used in place of hardwood on the floor. • Floor material should be comfortable and safe for students with ASD needs.
Artificial Lightening	Types, color, availability, etc.	<ul style="list-style-type: none"> • Colorful interior increases students' productivity in class. • Cool colors like blues, greens, and pink give the child a sense of calm and relaxation. • Hot colors like red, yellow, and orange create excitement, anger, and disturbance. • There should be wide windows in the classroom for sunlight. • Cold and bright colors should be used to calm the nerves of students with autism. • Indirect lighting that alleviates glare is recommended for an inclusive classroom environment. • Direct ambient lighting design has several disadvantages, such as glare and visual triggers for ASD students. • Over head fluorescent lighting is not appropriate for ASD students. • Sunlight has a productive and healthy impact on students with ASD needs. • Natural daylight is advantageous for students with ASD needs. • The warmth of sunlight should be maintained in the classroom since it benefits the psychological health of students with ASD.

Wall Color	Types, color, material, etc.	<ul style="list-style-type: none"> • Cold and relaxing colors should be used in the architecture of walls. • Direct fluorescent lighting should not be applied in the inclusive classroom. • A sunspace should be retained in classroom walls since it helps filter external noises. • Color should be applied in the classroom to keep students optimistic, comfortable, and relaxed. • Wall materials should not reflect light. • No more than three colors are used within the interior environment of • inclusive classroom • The colors are harmonious and no contrast.
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Many researchers have conducted numerous studies to comprehend the standards and specifications for creating an inclusive learning environment for students with ASD needs. Below is a summary of the findings:

Artificial lighting

Artificial lighting has a strong impact on building users negatively and positively. Several challenges that students with ASD in the classroom environment have regarding artificial lighting, such as glare, lighting flickering, and ballast hum, as well as direct ambient lighting. Henry (2011) found that students with ASD show more sensitivity to direct fluorescent lighting. In their study, Mcallister and Maguire (2012) argue that designing indirect lighting that alleviates glare is recommended for an inclusive classroom environment. Thus, direct ambient lighting design has several disadvantages, such as glare and visual triggers for ASD students. Moreover, using overhead fluorescent lighting is not appropriate for the neurodiverse population. Kluth (2009) found that fluorescent lighting may be challenging if it is of poor quality and can be both a negative visual and auditory trigger.

Thus, it is significant to try to eliminate the use of fluorescent lighting in educational

classrooms designed for autistic students. In her study, Long (2010) found that fluorescent lighting is not recommended for a neurodiverse classroom environment due to humming noise and flickering. Several health issues might be involved when using fluorescent lighting fixtures. Individuals with ASD may experience anxiety and stress levels in ordinary classrooms because of the effects of fluorescent lighting (Wilkins & Craven, 1987). In their study, Shabha and Gaines (2013) indicated that fluorescent lighting causes visual and auditory issues for students with autism. Noises from cycling flickering and ballast hum are distractions for autistic students. Therefore, fluorescent lighting in the classroom addressing ASD students is not recommended.

Wall colors

Color should be carefully selected in a classroom environment because it affects students' reactions and outcomes. Choosing an appropriate color in a learning environment would influence the students with ASD to feel more comfortable and relaxed, encouraging them to engage more with their classmates (Mcallister & Maguire, 2012). As a result of this study, ASD-friendly classrooms are worth looking at and should be generalized throughout schools. Several autistic children are talented in practicing the semantic aspect of motivations, such as simple pictorial forms, color words, and numeric characters (Bryson, 1983). This explains that using colorful words in a classroom environment motivates autistic children to be more cooperative, and this would improve their performance and grades. Another study has shown that certain colors and color contrast were each selected by 15% of the teachers in a survey group as having a negative effect on the behavior of students with ASD. Patterned fabrics were selected by 13.1% of the teachers (Gaines et al., 2011).

Selecting an inapplicable color in a classroom environment may negatively affect ASD students' outcomes, affecting their attitudes and behavior. Moreover, a colorful interior of educational environments stimulates ASD students to be less stressed and more productive, whereas colorless interior spaces can be stressful and nonproductive (Gaines & Curry, 2011). This expresses that a colorful interior stimulates ASD students to be more positive, active, and productive in the classroom, whereas a colorless interior would reduce this energy and productivity. In addition, Maria Lapiana expressed that cool colors like blues, greens, and pink give the child a sense of calm and relaxation. In contrast, hot colors like red, yellow, and orange create excitement, anger, and disturbance. People are mostly affected by the saturation and brightness of the color hue, which impacts their feelings (Lapiana, 2013). This explains that people differ in their sensory level toward color, which puts more effort on designers to study color theory to select the appropriate colors for the appropriate environment.

Technology plays an important role in developing the Interior Design field. Several design software are used by researchers to validate and test their hypothesis, others are used to examine the accuracy of the proposed design of the built environment. Also, since sustainability is a major consideration for both interior designers and architects, several computer programs and software have been developed to address this study area. Moreover, measuring the lighting intensity and lumens output is one of the advanced aspects of the technology. Therefore, the researchers of this study will use the Autodesk Revit computer program to produce the proposed design. This software will aid the researchers in choosing the appropriate lighting and colors recommended by the literature and the study participants. This design aims to approach

the EBD concept by forming a suitable learning environment that would satisfy ASD and normal students' needs.

Many researchers have carried out numerous studies to comprehend the standards and specifications for creating an inclusive learning environment for students with ASD needs. Below is a summary of the findings:

Floorings

Wu et al. (2020) stated that the typical seating arrangements for healthier students and the use of inconvenient elements, particularly the components of floors, are just a few of the various poor designs in conventional school classrooms. Most classrooms have plain tiles not covered by rugs or other surfaces, which is incompatible with the case of individuals with cognitive disabilities. It causes intellectually challenged students to be tired and unhappy (Wu et al., 2020).

In this regard, Black et al. (2022) asserted that moving around on the floor must be more pleasant and safe. It is observed that vinyl flooring is consequently preferable since it is protected and secure. For healthy students, a variety of flooring may be utilized in schools. Convenient flooring must be used, like carpeting or softer flooring made of vinyl for students with ASD (Jebrilet al., 2021).

In a study by Cable (2022), some parents emphasized the value of interior areas with soft flooring to reduce their children's bumps and bruises. In addition, a parent of a child with severe autism reported that their child would enter the area if secured into a stroller since some floors are difficult for them to move on. According to the findings, autistic students do not like it when hard flooring materials like hardwoods are employed as the flooring layer in the architectural surroundings they engage with

(Cable, 2022).

In contrast, Ibrahimi (2021) argued that flat, non-slip surfaces are ideal for dry and damp environments. However, certain flooring types and materials can help specific students while hindering others. In light of this, employing carpet as a flooring material in schools might not be suitable for students using wheelchairs (Ibrahimi, 2021).

Discussion

Findings of Literature Review

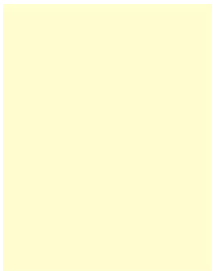

A comprehensive literature review has outlined several recommendations for students with autism spectrum in inclusive learning settings. The literature review has clearly stated that traditional classrooms are not favorable for the learning of students with ASD needs (Alshaigiet al., 2020, Zakai–Mashiach, 2023). The conventional educational settings pose serious challenges to autistic students in their learning processes. These can affect their performance in the classroom and reduce their cognitive efficiency. These facts suggested the significant need for a change in strategies in designing inclusive classrooms for students who have any disability or mental impairment. The recommendations listed above (table 1) can help in making a dynamic and convenient environment for students with ASD needs. These can help make them comfortable in class and prevent physical or mental injury or damage.

Findings of Case Study

There were several issues investigated in the case study that the designers have considered in their proposed design. First, the level of lighting in the current classroom design has 80–90 Foot Candles, measured by lighting meter, which is low and needs to be increased to make this space more appropriate for ASD students. Second, the use of

lighting fixtures in the current classroom design needs flexibility and functionality due to the absence of a dimming switch that helps control classroom lighting levels. Third, the use of direct fluorescent lighting fixtures is a big issue for students in the current classroom design because it causes glare on drafting tables and flooring tile, making students uncomfortable while working or studying in the classroom. Fourth, no light flickering, and ballast hum was found, which are needed especially for presentations. Fifth, the current classroom wall is painted with a neutral color (cream color), where ASD students prefer cool colors because it makes them feel more relaxed and comfortable and stimulates them to get more engaged with their classmates (see table 2).

Table 2: current and recommended color palette for designing inclusive classrooms for ASD students.

Current classroom wall color	Recommended color palette
	 <p data-bbox="866 1301 1334 1335">(Source: Author, based on Asirelli, 2010)</p>

Findings of Interviews

A face-to-face interview with participants (A) was conducted before developing the proposed design. The findings of the interview revealed that there are at least 120 ASD students who are registered at the University, which is a big number that needs to be considered. Also, ASD students are distracted by fluorescent lighting and warm colors because it irritates their senses and makes them feel more stressed and less productive. In contrast, LED lighting, direct-indirect lighting, flexibility in light control, and cool colors would give ASD students the sense of being calm, relaxed, and more

productive.

The interviewee was also questioned about the appropriate path that ASD students would follow to reduce the severity of their level of autism. The interviewee believes it is: intervention, speech occupation therapy, physical therapy, and social skills. The interviewee also mentioned several preferences that ASD students look for in their lives, for example:

- Creating a visual schedule by listing the things that will be done in time.
- Notifying them of the events that will be done ahead of time and not surprising them.
- Treating them according to their back history.
- Determining territories.

Moreover, the interviewee was asked about the levels of autism, and she said there are 3 levels of autism: severe, medium, and low. The participant was also asked what would be a suitable environment that ASD students look for in their learning environment. The response was that structured and predictable environments help stimulate ASD students to express their thoughts and feelings.

A face-to-face interview was conducted with participant (B) after the proposed design was developed to solicit her opinions and thoughts about the proposed project. The interview findings revealed that the proposed design with the blue color wall is more satisfying and suitable for ASD students because it makes them more relaxed and comfortable. Also, she was asked which design had the least visual and auditory distractions to ASD and neuro-typical students regarding lighting issues, such as glare. She responded that the proposed design is more suitable since it alleviates glare due

to the use of LED lighting instead of fluorescent lighting used in the current design. Moreover, the participant was asked which design would improve ASD and neuro-typical students' satisfaction in a classroom environment, the answer was: the proposed design because the glare is the biggest issues in the current design that dissatisfies ASD as well as neuro-typical students. In addition, participant (B) was asked if the flexibility aspect applied in the lighting design is more appropriate for designing an inclusive classroom. She answered that it is appropriate because dimming in the proposed design is more applicable. Also, using three switches instead of two helps to control the lighting level in the space much better. Finally, the interviewee added one suggestion to the proposed design: switching the artificial lighting fixtures from horizontal to vertical and placing them directly on top of the drafting tables.

Implications

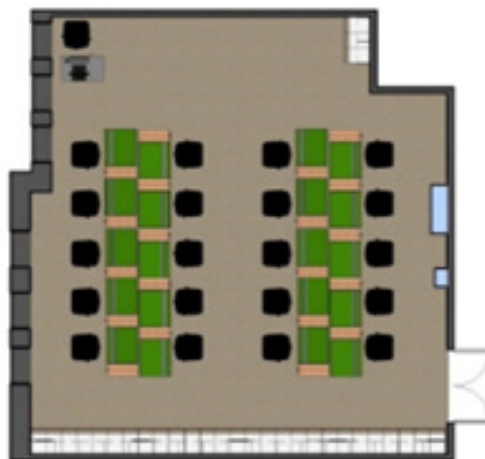


Figure 2: class plan (Source: Author).

The designer made several changes in the proposed design to make the classroom environment more suitable and comfortable for ASD students (see design features as annotations in Figures 2 to 6). The classroom walls were painted blue, and the green color

was added to the drafting tables because previous research studies had mentioned that cool colors like blues and greens give ASD students a sense of calm and relaxation (see figure 4). Also, a colorful interior for educational environments stimulates ASD students to be less stressed and more productive. Moreover, a wooden texture was added to the cabinets and landscape pictures were placed on the pin boards, making the classroom environment more pleasant and welcoming for ASD students (see figure 8). Furthermore, the fluorescent lighting fixtures were replaced with LED lighting fixtures which alleviate glare and reduce the visual and auditory distractions of ASD students (see figures 9 and 10). Also, adding dimming and using three switches instead of two helps to control the lighting level in the space much better.

The findings have implications for policymakers, educators, concerned authorities and designers for building favourable learning environments for students with ASD needs. The research's insights have implications for overall operational processes and improvements in the learning environment of autistic students.



Figure 3: current classroom design (Source: Author).



Figure 4: proposed classroom design (Source: Author).



Figure 5: current classroom design (Source: Author).



Figure 6: proposed classroom design (Source: Author).



Figure 7: current classroom design (Source: Author).



Figure 8: proposed classroom design (Source: Author).

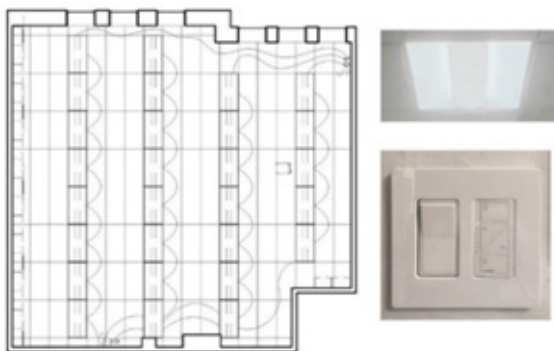


Figure 9: current RCP, lighting fixture and switch (Source: Author).

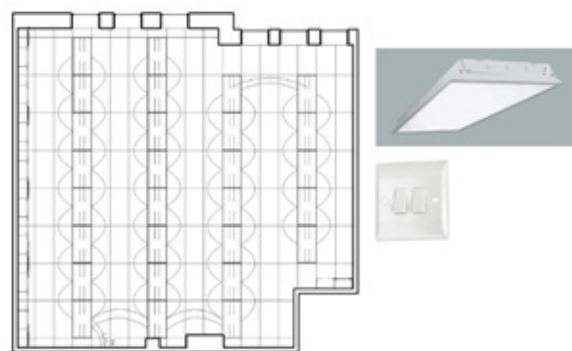


Figure 10: Proposed RCP, lighting fixture and switch (Source: Author).

Limitations

This study has few limitations. The study is limited to artificial lighting and colors in a classroom setting, no other sensory triggers in the classroom are considered. The budget for redesigning the classroom is not considered.

Research recommendations

Based on the findings of this study, the researcher has proposed several **recommendations:**

1. The state government in the United States should prioritize the development of inclusive classrooms that cater to the needs of students with special needs in primary and higher education settings.
2. Autistic students should receive more attention from school administration, especially in higher education, to ensure they receive the necessary support for success.
3. Policymakers in the United States and other countries should explore implementing inclusive classroom strategies that consider the unique needs of autistic students. By designing classrooms with appropriate lighting and colors, all students, regardless of their abilities, can receive the same level of education.
4. Interior designers and architects should incorporate the EBD approach when designing school buildings to create an environment conducive to learning and supports the needs of students with special needs.
5. Implementing inclusion classroom settings in all primary and higher education institutions is necessary to reduce distractions for students with different disorders, including autism spectrum disorder, adult attention-deficit/hyperactivity disorder (ADHD), and attention deficit disorder (ADD).

Future Research

There are several aspects that need further investigation. First, researchers and scholars should examine sensory triggers other than artificial lighting and colors in further studies. This would help to assess the impact of other elements of the inclusive classroom on the students with ASD needs. These elements may include auditory, ceiling, furniture, gardening, and music in the classroom environment. Second, research should be conducted to estimate the budget for redesigning inclusive classrooms for students with ASD needs.

Conclusion

Lighting and color are essential elements in a classroom environment and should be well-selected to create a healthy and productive learning environment. The designers had considered these issues in the proposed design by having more flexibility in controlling the lighting level in the classroom by including three-way switches and a dimmer. Also, direct-indirect LED lighting eliminates visual and auditory distractions and helps to provide a more suitable, inclusive classroom environment. Moreover, the designers used cool colors in the proposed design, which are perceived to be more appropriate for ASD and neuro-typical students and make them more calm, relaxed, and productive.

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