

ABSTRACT

The schooling micro-system plays a critical role in a child's life at every stage of development. Children require a physical environment that presents rich opportunities to discover, explore, connect, and stimulate their senses. Research has demonstrated that attributes of such facilities are linked to critical developmental outcomes for students. This is especially true for those who have neurodiverse needs and will find the greatest opportunities for growth within inclusive environments.

It is recognized that children with disabilities are typically served in alternate classrooms from the general population. However, research has proven these students have greater chances to thrive when they remain in the same environment as their peers for most of their learning. This paper aims to help readers understand why this is true through a human-centered design approach.

SEARCH TERMS: Sensory, Neurodiversities, Stimulation, Inclusive, Children

ACKNOWLEDGMENTS

AUTUMN HOWARD

RIT INTERIOR DESIGN STUDENT

This capstone is a testament to the knowledge, skills, and growth cultivated over the last four years at Rochester Institute of Technology.

Bringing together design principles, research methods, and creative problem-solving strategies developed throughout the program into one comprehensive and meaningful work.

This project would not have been possible without the unwavering support of my professors, mentors, and peers who continually inspired and challenged me throughout this journey. I am especially thankful for my capstone committee for their invaluable guidance throughout this process, and my family and friends for their endless support and belief in me.

Lastly, to every neurodiverse student whose experiences motivated this work - you are the reason behind this project, and I hope that this project inspires more inclusive, empowering learning spaces in the future.



THE COMMITTEE



MARY GOLDEN

NCIDQ, M. ARCH
ASSOCIATE PROFESSOR
| INTERIOR DESIGN
PROGRAM DIRECTOR



BRENNA THERING

MANAGING PARTNER |
DESIGN SPACE STUDIOS



**NICOLE
KIRCHGRABER**

NCIDQ, IIDA
SENIOR INTERIOR
DESIGNER | CPL

TABLE OF CONTENTS

i.	ABSTRACT
ii.	ACKNOWLEDGEMENTS
iii.	THE COMMITTEE
iv.	TABLE OF CONTENTS
vi.	LIST OF FIGURES
01	LITERATURE REVIEW
25	RESEARCH AGENDA
38	CREATIVE AGENDA
68	CONCLUSION
70	APPENDIX

LIST OF FIGURES

1. Teaching Models	03
2. Steps of Design Theory Thinking	09
3. Corridor Activities	34
4. Sensory Station	
5. Sensory Room	
6. Library	
7. Dynamic Classroom Example	35
8. Structured Classroom Example	35
9. Front of Classroom	36
10. Teacher's Station	
11. Back of Classroom	37
12. Sensory Area	
13. Sketch Illustrations	39
14. Clara Barton Site Plan	41
15. Clara Barton Exterior - Front Entry	42
16. Entry Corridor	
17. Tile Corridor	
18. CMU Corridor	
19. Makerspace	
20. Classroom	
21. Clara Barton Level One Floor Plan	43
22. Clara Barton Level Two Floor Plan	

INTRODUCTION

23. Proposed Level One Floor Plan	46
24. Proposed Level Two Floor Plan	47
25. Proposed Level One Reflected Ceiling Plan	54
26. Proposed Level Two Reflected Ceiling Plan	55
27. Sensory Wing	58
28. Hyposensitive Relief	59
29. Hypersensitive Relief	60
30. Prototypical K-3 Classroom	61
31. Prototypical 4-6 Classroom	62
32. Learning Commons	63
33. Library	64
34. Makerspace Breakout Zone	65
35. Teacher's Lounge	66
36. Wayfinding Corridor Elevation	67

LIST OF TABLES

1. Co-Teaching Models	04
-----------------------------	----

The future of education looks much different post-pandemic. Spaces are now expected to deliver variety and vitality to support all types of work and learning styles. Creating a space for children ages 5 through 10 to learn and engage with their peers goes beyond the physical environment and influences psychological impacts as well. This capstone project aims to explore design methods and solutions that bring designers one step closer to creating conducive learning environments for users with neurodiverse characteristics.

Interior design strategies can produce a space that is not only physically adaptive and functional but one that will also evoke emotional or cognitive responses as well. Sensory well-being is important for everyone, whether neuro-typical or neuro-diverse, and the interior space has the capacity to enhance the quality of human experience through reduced environmental stress and empowerment (Park, Nanda and Adams). Giving individuals the flexible resources to support all needs is what the fundamental purpose of the built environment is (Gaines, Bourne and Pearson). Going beyond biophilia, elements like lighting,

furniture, organization, materiality, and color selections are all ways that interior design can cater to users across all marginalized groups.

The goal of this capstone is to investigate new methods of design that cater to children with exceptionalities in the classroom. The research activities conducted at local school district facilities, with teachers and administrative staff, furniture representatives, and educational leaders at CPL Architecture, Engineering, and Planning Firm will help to identify solutions and substantiate design strategies. These methods will be implemented within an interior environment that will encourage the empowerment, growth, and learning to create a school atmosphere which is inclusive to barrier-free design.

This project seeks to explore how elementary classrooms can better support neurodiverse students with autism spectrum disorder. Hypothesizing that implementing sensory inclusive design methods will enhance the experience for neurodiverse students.

REFERENCE APPENDIX A FOR THE ORIGINAL CAPSTONE PROSPECTUS

LITERATURE REVIEW

CHAPTER 1 | TEACHING STRATEGIES

Schools and classrooms of the 21st century represent some of the most diverse student populations educators have ever seen. This growing number includes students with disabilities who are now, more than ever, being supported within general education environments. As stated in an article by researcher Christine Walther-Thomas, "...more than 95% of all students with identified disabilities receive their education and related support services in the public schools" (Walther-Thomas). For many students, this does not mean separate classrooms within the same building as their peers, but instead a full-time integration within the general education classroom.

The emerging learning models that emphasize this inclusive special education have shown, in many cases, to improve the communication, efficiency, social skills, and self-confidence among students with disabilities. Some examples of these inclusive efforts include peer tutoring, curriculum-based assessments, cooperative learning, cognitive learning strategies, adaptive education strategies, and integrated curriculum (Walther-Thomas).

Most of these structures are based on the fundamental principles of collaboration and problem-solving, working to address the learning needs of low-achieving students. Traditional means of learning were often referred to as mainstreaming, which is "...when students with disabilities spend a portion of their school day in the general education program and a portion in a separate special education program" (Idol). While this effort does work towards a more inclusive classroom, it is not an ideal scenario for all disabled students who miss out on key interactions with peers and teachers through being in the general education environment.

The increasing appreciation for collaboration in modern schooling systems has led to a reconceptualization of how special education programs are currently utilizing it to support their children. Although it has long characterized instructional methods within these classrooms, instructors are working to gradually increase the acceptance of inclusive schooling and crossing the traditional boundaries between professionals.

In a research article done by colleagues at the University of Alabama, the authors stated "[i]n the classroom, paraprofessionals have assisted special educators in supporting students with disabilities..." (Friend, Cook and Hurley-Chamberlain). Other professionals include, speech-language therapists, school psychologists, counselors, and occupational and physical therapists who have likewise delivered their services working alongside special education teachers. These efforts allow students to receive the most rigorous curriculum taught by highly qualified teachers and paraprofessionals. These children will now have increasing access to a wider range of instructional options that will better cater to their varied needs. Allowing them to be more involved and motivated within general education environments.

Co-Teaching

Collaborative methods in the classroom have expanded beyond students and are being used by educators as they come together in the planning and delivering of

instruction to a diverse group of students. These efforts are reflected in the co-teaching model of learning. Defined by researchers as, "...the partnering of a general education teacher and a special education teacher or another specialist for the purpose of jointly delivering instruction to a diverse group of students, including those with disabilities or special needs, in a general education setting and in a way that flexibly and deliberately meets their learning needs (Friend, Cook and Hurley-Chamberlain). In other words, these educators carry a distinct set of skills, perspectives, and teaching philosophies which allow them to work collaboratively in the classroom. Therefore, providing these academically and behaviorally heterogeneous groups of

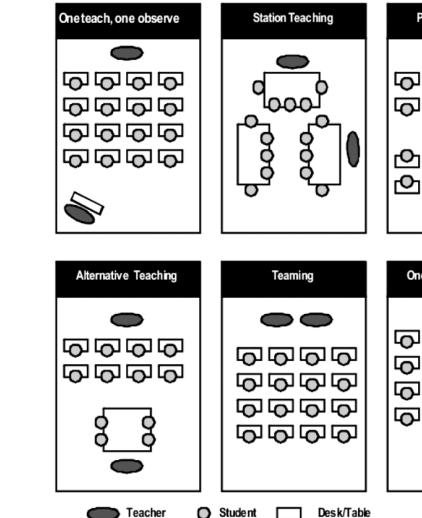


Figure 1: Teaching Models

students with a better education through integrated settings. Their settings may be structured in a variety of ways to be supportive of the learning methods at hand (see fig.1).

Healthy co-teaching situations are built upon a mutual trust and respect for one another's expertise in each respective field. This relationship is what enables students with disabilities to be more successful and have good experiences in the classroom. Ideally, these teachers work together an hour or two per day to plan their shared responsibilities in direct instruction, curriculum development, reteaching, and enrichment activities (Walther-Thomas). A time that for some elementary school teachers, who are responsible for the entire days' worth of curriculum, may not have the option to allocate a planning period within school hours. Therefore, the implementation of co-teaching will heavily depend on the work relationship between the teachers and what skills or teaching styles they may carry.

Studies have shown that some teams give the instructional leadership to the general education teacher, leaving the special education to act as more of an aid to the students throughout class and assisting those who might need extra help or who require adaptations. Others distribute equal ownership over the students and are consistent with rotating their activities to create a fair share of leading time that may be divided by subject (Mastropieri, Scruggs and Graetz). There are a variety of different means to conduct co-teaching (see table 1).

Table 2. Descriptions and examples of co-teaching models.

Co-teaching model	Description	Advantages	Example
One-teacher, one-observe	One teacher provides large group instruction while the other teacher collects observational data	Provides data which are difficult to gather when teaching solo. Provides objective data for decision-making	In a 7th grade science class, one teacher demonstrated a lab while the other systematically gathered on-task data on several students being referred for behavioural interventions
One teach-one assist	One teacher provides large group instruction while the other circulates to provide support to students, as needed	Provides preventative on-the-spot student support. Provides classroom management support for lead teacher	While the 12th grade social studies teacher lectured using guided notes, the co-teacher circulated to ensure students were taking accurate notes and attending to the lecture
Station	Students rotate among various learning stations or centres, often with one led by each teacher	Each teacher has instructional role. Students are exposed to many skills in short period of time. Adds variety for students	In a 9th grade math class, students rotated among different stations (each for 10 minutes) that reviewed various skills in preparation for an upcoming test. The special educator designed stations related to student IEPs
Parallel	Each teacher teaches half the class the same lesson	Each teacher has an instructional role. Can separate students who do not get along	In a 10th grade algebra class, each teacher took half the class to review solving basic equations
Alternative	One teacher provides large group instruction while the other pulls a few students aside for a short period of time to reteach, review, or differentiate instruction	Smaller teacher-student ratio. Can individualise or differentiate instruction. Can support students who were absent. Can individually conference with or assess students	During a 5th grade language arts class, while students were journal writing, one teacher debriefed with two students who were displaying signs of frustration
Teaming	Both teachers jointly provide instruction by presenting different examples, strategies, methods, or views	Each teacher has instructional role. Teachers can debate issues, provide different perspectives, and teach different ways of solving a problem or completing a skill	In a high school civics class, the co-teachers debated various sides of a social issue

Table 1: Co-Teaching Models

This component of co-teaching is what makes research data more difficult to attain. The method is defined differently for everyone, each teacher comes into the classroom with his/her own set of beliefs, and it is from there that these collaborative methods can be successful or create more harm.

This instructional leadership is also tied to a supporting faculty and administrative staff who have the attitudes and work ethic to make decisions in the best interest of their students. A lack of support systems throughout the district can result in negative outcomes for not only students but teachers as well. An article by author Lorna Idol states, "...instructional leadership [means] the principal [is] actively involved with teachers in making curricular decisions, and was spending time in classrooms as a leader in shaping the development of programs" (Idol). What happens within the classroom goes beyond the teacher's responsibilities and lies in the hands of the district's administration too. Almost all teachers have indicated a lack of planning time as an

obstacle of co-teaching. These efforts are crucial to successful classroom management and the alleviation of student confusion. Therefore, it is important administrative staff consider an allocated planning time during the school week for teachers to meet and review plan for upcoming classes outside of their standard parent conferences and IEP meetings. Doing this can ensure that the entire school staff are well versed and consistent in their method of learning, as well as understanding the role of others in the classroom. Thus, leading to a transformative educational system that is inclusive of all students.

Differentiation

There is an expansive list of subjects that teachers, elementary especially, are required to teach. As a result, these general education instructors are often not well enough prepared to vary instruction for students with disabilities or meet their unique needs effectively. An approach that can be utilized within collaborative

classroom environments is differentiation. Defined by authors Conderman and Hedin as, "...offering students choices, using flexible grouping systems, presenting content at various skill levels, offering a variety of meaningful activities or processes, designing different assessments or products, attending to student affect, and creating a conducive and respectful learning environment - all based on the student's unique learning characteristics, skill levels, and interests" (Conderman and Hedin).

This strategy is especially useful for students with emotional and behavioral difficulties (EBD) due to their struggles with math, reading, spelling, and poor social skills or lack of interpersonal relationships. Differentiation allows students to make choices and oversee their learning, to work with various peers and receive instruction at their skill level. Students with Autism heavily rely on a consistent schedule throughout their day and giving them autonomy over that can be very impactful.

Differentiating instruction can be carried out in a variety of ways: content, process, product, affect, and learning environment. It is based on planning curriculum that addresses students' unique strengths, interests, skills, and readiness. To understand these characteristics, teachers may use a variety of formal or informal assessments to better inform their decisions for classroom organization. These results help them in planning instruction, develop flexible groups, and choose appropriately levelled materials that are aligned with their interests.

When differentiating by content, "...they establish different learning outcomes for groups of students based on skill readiness or background knowledge" (Conderman and Hedin). By ensuring both teachers in the classroom instruct all groups of students, whether having disabilities or not, it allows the special educator to be more than an assistant to those who have limited background knowledge. This may also help to alleviate any anxious feelings from students with disabilities who

typically carry a label in general education. By utilizing smaller instructional groups, teachers can better understand each student, provide more immediate student assistance, and minimize student distraction. These groups also provide a transition for students until they are ready and feel confident enough to rejoin the larger group.

Overall, this method allows students to work with the same essential knowledge, understanding, and skill, but at different levels of difficulty that challenge them in their own ways. In contrary, teachers differ by process when, "...they develop various learning activities for groups of students based on interest or learning performance" (Conderman and Hedin). This method emphasizes heavily on student choice, offering them a variety of respectful and rigorous learning tasks. Some teachers may choose to utilize stations, games, or hands on activities. All of which relate to the unit of instruction, expand students' thinking, and offer a variety of choices

reflecting various student interests and learning preferences.

It is important to offer students multiple ways of demonstrating what they know and can do with the content they have learned. Similar to the previous method, differentiating by product encourages teachers to develop various assessments based on student's master of content or skills (Conderman and Hedin). When considering students with EBD it is important to recognize the shyness or anxiety some may have over particular types of tests. Offering alternative approaches allows students time to think and organize their learning, promoting self-regulation. They may also find meaning through their choice and active engagement, increasing motivation and improving overall school attendance and graduation rates. When tackling instruction by affect, teachers are "...purposefully consider[ing] the socio-emotional factors of the classroom and student's feelings" (Conderman and Hedin). Just as these emotions

are considering for assessments, it is crucial that students feel welcome, accepted, valued, and safe for learning to occur. Therefore, being mindful of individual triggers, stressors, and sources of frustration can encourage planning for intervention beforehand.

Lastly, the most thoroughly examined method for this capstone is differentiating by learning environment. This is when teachers design their classrooms to be flexible, considering the amount of time for instruction, materials, rules, and procedures (Conderman and Hedin). While each of the previous methods have been proven to see academic improvements, and remains crucial to research, they would not be possible without a successful classroom setting to learn in. The classroom influences the learning mood and can support or deter student's need for affirmation, contribution, power, purpose, and instructional challenge. As will be touched on later, an environment is what allows students to feel accepted and valued for not only themselves but to their peers as well. It is more than four white walls with a whiteboard at the

front of the room. It is a space that encourages flexibility and collaboration, allowing students to learn at their full potential.

STEAM Learning

The term "STEAM" and its variations have gained a lot of interest across educational settings the last few years. In the classroom, STEAM activities incorporate science, technology, engineering, art, and math concepts to create an education that applies real-life strategies. As authors Wade, Koc, et al stated, "[t]he research on STE[A]M education has gained attention as a result of the poor performance of children from the United States...as well as the low number of students choosing careers in these STE[A]M fields" (Wade, Koc and Searcy). This method of teaching has demonstrated effectiveness in promoting engagement, persistence, problem-solving, and active learning. Students are exposed to more creative and strategic thinking skills through exploration, observation, and discovery.

Like the co-teaching method of learning, this requires the support of administrative staff and faculty to be successful. Given that there are more varieties of dense topics a teacher may need to cover, it can become challenging to remain proficient in all areas. Furthermore, researchers stated "[i]n the past it was rare for university teacher preparation programs to offer courses integrating multiple disciplines" (Johnson, Byrd and Allison). Consequently, it was found that the highest quality of integrated STEAM instruction occurred through co-teaching. It allows for each teacher to teach the subject they are most confident with and offer their own expertise. Some teachers may follow the design thinking process, that is "an inquiry-based pedagogical approach to student learning and engagement, curricula that specifies how to create, implement, and assess [what] is needed" (Cook and Bush). These steps help students and teachers navigate within a creative classroom (see fig. 2). As a result, creating classroom culture that challenges the way students think about creative problem-solving and teamwork.

STEAM learning supports the belief that the early stages of life are fundamentally important for establishing children's interests and passions. These young learners can obtain firsthand experience with science and technological skills as early as possible. Early exposure to any subject can develop positive attitudes and better understanding of formal concepts in subsequent years. Furthermore, through equitable access to STEAM activities children with disabilities can participate in these learning environments alongside their peers. This may involve teachers planning for their needs and allowing additional one-on-one instructional time but nonetheless allows them to get the same access to these resources.

As outlined by researchers in their exploration of inclusive classrooms they state, "[o]ne framework that is well suited to support the implementation of STEAM

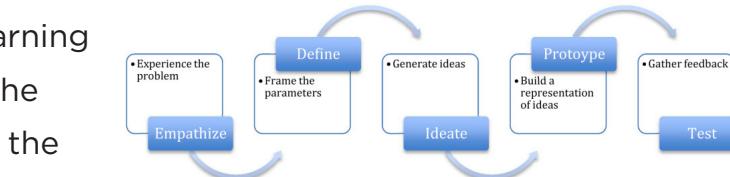


Figure 2: Steps of Design Theory Thinking

CHAPTER 2 | SENSORY NEEDS

pedagogy within inclusive settings to meet the individual needs of learners is the universal design for learning (UDL). The three principles within the UDL framework include (a) providing multiple means of representation, (b) providing multiple means of engagement, and (c) providing multiple means of action and expression" (Wade, Koc and Searcy). When referring to universal design, we often are not applying it in the context of a classroom, however it is just as important that students are being universally catered to in the learning environment. Instruction that is intentionally designed to promote active engagement of all students is what creates the optimal learning experience.

Until recently, academic environments have only ever been designed exclusively to meet the needs of neurotypical populations, however there is an increasing recognition of the need to make built environments more accommodating for neurodiverse populations. The spaces within a school are fundamental aspects of a child's developmental process, and therefore it carries a responsibility to support children and the activities they engage in. Making changes to the interiors of schools to create more inclusive and friendly environments for everyone can happen in a multitude of ways. Elements include simple spatial layouts, compartmentalizing, zoning spaces into specific activity sections, and providing retreat spaces for easily overstimulated users (Black, McGarry and Churchill). Overall, it is recommended that designers and architects begin to make the built environment adaptable and flexible to accommodate the unique needs of each student.

Considering the diversity of human abilities at the beginning of the design process not only helps designers

to better understand the experiences and perspectives of neurodiverse individuals, but also allows barrier-free design to be used as a tool for inclusivity throughout; benefitting not only the intended few but also others who have not been identified or observed (Patel, Doff and Baker). When designing an accessible space, the spectrum of users is often narrowed to a standard audience - those with physical impairments. However, there is minimal impact on environmental accessibility issues for those with intellectual disabilities. Neurotypical students may share classrooms with students who have diverse needs, thus the psychological and physical well-being of these users must also be accounted for through design. Environments that foster independence, autonomy, and a sense of self-worth through holistic and non-pharmaceutical methods to achieve an optimal quality of life is what the design world strives to achieve (Gaines, Bourne and Pearson).

To increase the recognition of the need for society to embrace the concept of accessible design in both

physical and psychological terms, minimum standards will need to be set through building regulations, codes and policies to create solutions that make the end design truly as inclusive as possible. The current application of design through the Americans with Disabilities Act (ADA) is not enough to be fully supportive of all users, as it focuses on individuals with physical disabilities and disregards those with 'invisible' conditions. Ultimately, the academic environment is ideally built in a way that is flexible enough for everyone to have the ability to modify it according to their personal preferences and maximize their skills at full potential.

Developmental Disabilities

The World Health Organization estimates that "1 in 160 children worldwide have autism spectrum disorder (ASD) and the Centers for Disease Control and Prevention updates that number to 1 in 59 within the U.S." (Park, Nanda and Adams). Furthermore, about 2/3 of individuals with ASD are cognitively impaired. These

statistics emphasize the relevance of considering the impact that learning environments have on children in just one developmental disorder category. ASD is a common neurodevelopmental disorder that affects a person's ability to socially interact with other people and act in accepted ways. These individuals often face unique sensory challenges that affect their behavior and ability to learn.

Developmental disabilities is an overarching term for impairments that begin in early stages of human development, including language disorders, autism spectrum disorders, cerebral palsy, and motor disorders (Park, Nanda and Adams). Individuals with these impairments often have difficulties with daily activities such as learning, something a child must face every day. Children with an "Intellectual Disability (ID) have below average intellectual functioning which affects logical thinking, problem solving, planning, abstract thinking, and adverse effect on the child's educational performance" (Patel, Dorff and Baker). Consequently,

this leads to an inability to be independent and take on responsibilities, a trait that most children are eager to achieve as they get older. This leaves them in a pervasive feeling of unhappiness or depression over circumstances that are beyond their control and can even instill fears associated with these problems. Despite previous beliefs due to a lack of research, the interior space can offer these children autonomy over their routines if flexibility is emphasized in the design stages.

Hyposensitivity vs. Hypersensitivity

One of the most prevalent features of an environment that creates stress is sound. Noise can significantly interfere with neurotypical students' cognitive functioning in learning environments, and this feeling is amplified for students with higher sensitivity to sound. Sensory Integration theory, "expresses the proper integration of the development of language, attention, organization, motor abilities, interpersonal relationships, and academic learning" (Black, McGarry and Churchill).

It is imperative in a physical setting where real life neurodiverse learners are in one space, to be aware of their sensory needs and provide an environment that responds accordingly. Sensory integration proposes a flexible and adaptable concept that creates a range of stimulation zones which respond to varied activities and skill levels of its users. It addresses the generalization of skills by employing progressive sensory spaces that can be highly adaptive, using sensory cues to convey meaning and messages to users which help to facilitate individual use of the space.

Children that are hypersensitive react to external stimuli like smell, noise, and texture that children without ASD may not notice (Patel, Dorff and Baker). They have a lower threshold for registration and are often easily overstimulated by sensory information in the environment. The difficulty to filter stimuli from the environment may also cause them to retreat into themselves and not respond to teachers or classmates. Thus, altering environmental characteristics such as

space organization, illumination, and ceiling height can assist children with ASD to accept greater variation in the environment. These users also emphasize the importance of including respite spaces within a classroom to provide a comfortable space where they can willingly relieve themselves of the stimulation that the classroom may have.

Furthermore, it is crucial that spaces are designed to help users gradually develop a tolerance to sensory stimuli, "through minimizing baseline stimulation levels and incrementally adding stimuli" (Park, Nanda and Adams). This means creating thresholds between spaces that allows for a period of transition to adjust and avoid overstimulation. Whether that be implemented from corridors to classrooms or within classroom zones, it is a previously overlooked element that remains crucial to a child's everyday interaction with the space. Children can also be hyposensitive and not react to external stimuli that someone without ASD normally would. They carry a higher threshold to register stimuli and therefore are

more likely to miss salient cues or need a longer time to respond that neurotypical populations (Patel, Dorff and Baker). Like hypersensitive users, these students would also benefit from incremental transitions to re-engage themselves with their environments.

Children with disabilities are typically served in a different classroom than neurotypical users which often contain makeshift arrangements that have no significant consideration to the sensory needs. When designing an "inclusive classroom that is structured to address the needs of all children, the best learning results (greater communication skills, higher academic success, larger social networks, fewer behavior issues, meaningful employment as adults) for all students occurs" (Patel, Dorff and Baker). The future of design lies in creating spaces that allows for the needs of neurodiverse students to be served in the same environment as their peers. By manipulating spaces to assist specific functions and elicit desired behaviors through interior design, this goal can be made possible.

Spatial Sequencing

Physical attributes within a space include space planning, furniture shape and form, lighting, color, materiality, and acoustics. The relevance of adding sensory considerations to the design process goes beyond just accessibility considerations but instead provides tunable and adaptable solutions that replace underutilized interventions, thus optimizing users' sensory experience. Sensory well-being is important for everyone whether neurotypical or neurodiverse as it can contribute to human well-being by reducing environmental stress and empowering people with adjustable features that cater to their needs (Park, Nanda and Adams).

Recently, "a surge of multisensory research has resulted in new environments for sensory respite and stimulation" (Park, Nanda and Adams). These spaces are known as Snoezelen rooms and are adaptable, scalable, and modular sensory well-being hubs which allow neurodiverse learners to be integrated within typical

learning spaces. They may contain a variety of zones within their footprint such as respite zones that house calming sensory interventions, an active zone that includes stimulating instruments for physical movement, and a transitional zone which allows the user to adjust themselves to the atmosphere as needed. They are durable, easy to maintain, and are a more cost-efficient solution to renovating a pre-existing condition.

Many changes required to better suit the needs of neurodiverse students may be unrealistic or infeasible due to prohibitive costs or the age of the building. To combat this, policy change must be recognized and implemented to balance environmental costs with the impact on individual functioning (Back, McGarry and Churchill). While cost will always remain as one of the most relevant features of a construction job, as designers it is our responsibility to recognize that greater values lies in the health of our occupants. As a failure to recognize the holistic nature of design might have undesirable consequences on the functionality and inclusivity of

spaces long term.

Creating successful classroom experiences for students begins with space planning. Large wide-open areas can be difficult for students with developmental disorders like ASD to understand because the environment is not segmented or sequenced functionally (Patel, Dorff and Baker). All spaces need to be well-defined, and areas should be provided for independent work, group work, and leisure. Screens, bookcases, and other movable partitions can be used to divide the classroom. Materiality in the flooring pattern may also be utilized to delineate different zones within a space and help with wayfinding strategies. Students with ASD or Emotional Disturbances (ED) experience sensory overloads more often than the neurotypical individual. Therefore, clear functioning of designated areas and visual boundaries will help these students understand where each area begins and ends, meeting both the vestibular and visual needs (Patel, Dorff and Baker). This logical organization can also be based on the typical scheduled use, allowing

them to regulate emotions independently and decide internally what intervention is best without disturbing other classmates. Furthermore, flexible furniture arrangements will allow movement within a space to permit a variety of teaching strategies. Teachers have shared their value in utilizing horseshoe tables with sliding panels for writing surfaces as an area for group work and individual desks with an organization system for task cues (Patel, Dorff and Baker).

Research has shown that “illuminating the space with natural light has proven to increase students’ performance in school” (Patel, Dorff and Baker). The traditional method of using fluorescent lighting is appealing neither visually nor functionally. They create flickers and hums from the ballast used in their design, which in turn creates visual hypersensitivity and repetitive behaviors in students who are bothered by bright lights and easily distracted. Utilizing windows, clerestories, or skylights increases exposure to nature which has also been beneficial in restoring attention and

enhancing concentration for users with attention deficit hyperactivity disorder (ADHD). Incorporating daylighting strategies has a great number of advantages for improving the well-being of students in learning environments.

Color and materiality preference tends to be empirical, as all disabilities are unique to each individual person. Therefore, it lies in the hands of designers to make educated decisions on what palette will best fit the needs of a broad audience. A study noted that, “color stimulation in the learning environment improves attention and motor processes, resulting in general increased academic performances” (Patel, Dorff and Baker). This can be done through subdued color schemes in warm neutral colors that have a low reflectance value such as blues and purples. An encouragement of low contrasting colors in the walls and flooring colors, along with avoiding complex shapes or patterns is necessary to prevent overstimulation. Utilizing saturated colors or dense textural changes can be applied to designate

different functional zones and acquire the attention of children with hypersensitivities (Thi Tam, Joneurairatana and Sirivesmas).

Areas like building entrances, waiting areas, circulation spaces, and destination spaces can be confirmed and accented to enrich the experience. Additionally, “integrating symmetrical elements that are similar in proportion and scale like forms, shapes, textures, patterns, and color reinforce a sense of unity and harmony through careful application and juxtaposition” (Thi Tam, Joneurairatana and Sirivesmas). Using simple shapes is preferred for body awareness and creating visual boundaries for walking throughout a space. Whereas diagonal lines may present skewed perspectives and confuse neurodiverse users who can be easily distracted.

Studies have shown that, “attention spans, response times, and behavioral temperament, as assessed by occurrences of self-stimulating behavior.

CHAPTER 3 | BUILT ENVIRONMENT

are all enhanced when noise levels and echo are reduced in educational environments" (Patel, Dorff and Baker). These statistics also show a doubling of attention span, a 60% reduction in reaction time, and a 60% reduction in self-stimulatory behaviors. Activities that require higher focus tend to require a higher level of acoustical control to keep background noise, echo, and reverberation to a minimum. This can be achieved through the active use of sound absorbing materials like acoustic ceiling tiles, minimal hard surfaces, and wall structures that reduce sound transmission such as double-layered drywall or staggered stud walls (Park, Nanda and Adams). It is recommended by research professionals that, "average sound level to be kept at a 50dB or below" (Black, McGarry and Churchill).

Ceiling height is also a notable factor in sound reduction as it can also affect lighting, acoustics, reflectance, and a sense of enclosure within the room. Using the previously mentioned techniques in space planning which compartmentalize a space can reduce visual distractions

and keep sound to a minimum as well. Through these design strategies there is a reinforced belief that many students can be included with their typical peers for all or at least part of their school day. Sound acts as a baseline for the sensory considerations that must be accounted for within an environment, but it does not stop here.

Over the last two decades there was a significant transformation for education models around the globe to enable a student-centric approach to teaching and learning. Learning environments play a pivotal role in supporting the educational process through "pedagogical practices, spatial design, and configuration of classrooms, as well as digital affordances" (Vijapur, Candido and Gocer). This student-centric approach has led classrooms to move away from the traditional static atmosphere to a dynamic and interactive learning environment.

Learning within spaces has been defined by the Holistic Evidence and Design Project (HEAD) to be "facilitated by three separate principles of naturalness, individualization, and level of stimulation" (Barrett, Davies and Zhang). Meaning that the broad functioning of our brains that respond to multi-sensory inputs are carried out through these three principles. This project has researched ways that surrounding environments influence the ability of children to utilize these concepts at their full potential.

Naturalness refers to lighting levels, acoustics, learning temperature, and air quality levels. This principle has been shown to improve cognitive function and is measured based on the ability of a child to concentrate on learning within a classroom. Natural elements and views of nature, whether it is direct access to a learning zone outside or simply views from a window, lower levels of stress and greater self-discipline has been shown as a result (Barrett, Davies and Zhang).

Individualization refers to "how much the room is designed for both the class as a whole and for each pupil" (Barrett, Davies and Zhang). Flexibility is one element that addresses this principle, and it also considers width and orienting features of clear navigation paths within the school. Lastly, level of stimulation aims to create measures that put a scale on the visual stimulation of a classroom. It can be applied through color and complexity, which may be visual impact from both the architectural structure and display elements within the classroom.

As mentioned in the previous chapter, sensory is a critical component to the classroom environment as it can affect children's moods, mental clarity, and energy levels. This project reported that, "pupils from the age of 5 years spend over 6 hours every day of the week within the school environment" (Barrett, Davies and Zhang). Meaning, they spend more time in the classroom than anywhere else in their early childhood years, taking them from vulnerable infants to independent learners and thinkers. Therefore, they need to materially cater them over their journey and create opportunities to grow.

Indoor Environmental Quality (IEQ)

Flexible learning environments arose as enablers for the implementation of student-centric classrooms by providing the physical infrastructure needed for students to engage on several learning activities from individual to group work; all of which take place in a variety of zones. Physical design plays a crucial role in classroom management as well as mediating the teaching and

learning process. Physical configuration has become a key classroom resource for meeting desired learning outcomes. The teaching and learning practices that occur within flexible learning environments gives students an opportunity to move from one zone to another, finding which location best suits their learning activity and interactions with teachers, peers, and technology (Vijapur, Candido and Gocer). Design is shifting towards a more dynamic model that is guided by flexibility, openness, and teamwork. These environments offer increased autonomy for students and support the idea of a blended classroom, where both physical and digital resources are being used.

Existing literature has established that flexibility means more than just removing desks and chairs to provide more informal furnishings. Future focused environments instead create different learning settings compromised of spatial typologies like general learning areas, breakout areas, individual pods, respite spaces, and presentation zones (Vijapur, Candido and Gocer). Furthermore, there

is an emphasis on removing the 'front of the classroom'; an idea that breaks free of the conventional classroom with its four walls, whiteboard, and linear arrangement. Traditional layouts are oversimplified and inflexible in design, being found to work against learner-centered approaches that stress diversity and multiplicity. Flexibility is also measured on how well designed a classroom is for the age of students it houses. Complex room shapes might be more ideal for younger students to enable an increased variety of learning zones.

Whereas larger more open spaces might be suitable for older students to enable group work or whole class learning (Vijapur, Candido and Gocer). Alongside the built environment, teachers play the most important role in maintaining the indoor environmental quality in classrooms by taking actions to control the conditions and adjust them accordingly.

As previously mentioned, the acoustical levels within a space are one of the most overlooked elements of a learning environment. With the implementation of these

new open-plan layouts there is an inevitable increase in unpredictable background noise that will follow. A study showed that, "speech perception of young children is less effective in open-plan classrooms unless appropriate measures are taken to reduce problems" (Vijapur, Candido and Gocer). Semi-open plans are an acoustically considerate solution to open-plans as they still allow for the flexibility in space by removing walls but are intentional in layout to stagger partitions or furniture in a meaningful way that prevents extreme noise levels.

The indoor air quality and thermal comfort of a building is a background factor in the success of a space and has become important to the sustainability component of construction. It has been identified that more attention should be paid to local source control and to the cleaning of flooring surfaces and components of building surfaces (Vijapur, Candido and Gocer). Children are more susceptible to air pollutants than adults because of their immature lung growth and metabolic defense mechanisms. Low ventilation rates in classrooms have

been found to reduce attention span and negatively impact memory and concentration (Vijapur, Candido and Gocer). While this element of the built environment might be an invisible one, it still remains crucial to the health and well-being of students. Additionally, children carry a greater sensitivity to temperature within a space due to the previous limitations in adaptive opportunities. Typically, the only options to adjust a space are through opening windows or turning on the air conditioning; something that not all schools have.

Furniture

In order to facilitate both individual and collaborative learning, designers must use a variety of furniture options that are lightweight, proportionally scaled, and reconfigurable. This may be compromised of modular versions of conventional elements of a classroom such as seats and tables, or less traditional furniture such as couches, bean bags, ottomans, standing desks, or partitions (Vijapur, Candido and Gocer). This variety

supports students' choice of seating, location, comfort, and learning style.

Life as a student may be the most sedentary phases of a child's life where permanent habits of poor sitting develop (Castellucci, Arezes and Molenbroek). These habits acquired during childhood are difficult to change in adolescence or adulthood but can be addressed early on through the selection of furniture within the classroom. In educational settings children are required to maintain a prolonged sedentary position, creating a conflict between children's natural impulses towards physical movement. It is not often a child can remain comfortable in one spot for long durations of time, whether they are neurotypical or neurodiverse. This upright position forced onto students has required their sitting to have joints of their hips, knees, and ankles at right angles. This posture can also cause bio-mechanical problems because "a seated person has a hip joint flexion of about 60 degrees" (Castellucci, Arezes and Molenbroek). Beyond the numerical measurements that

remain only relevant in case studies or research, it is important to have knowledge on the anthropometric dimensions of students to plan accordingly when specifying design features of school furniture. Until recently, there has always been a clear mismatch between children's characteristics and the dimensions of furniture because they have traditionally been supplied only as fixed options. These pieces have little to no opportunity for adaptability to suit the changing bodies of children and consequently make these bio-mechanical problems worse. Physical responses include discomfort or pain, energy expenditure, and poor posture, whether it be a component of the entire body or as a specific body segment (Castellucci, Arezes and Molenbroek). While this may seem very minimal to impacting students in their learning environments, research has shown that "abnormal and awkward postures may affect their academic performance and learning because uncomfortable body postures can decrease students' interest in learning" (Castellucci, Arezes and Molenbroek).

At such a young age, elementary school children are growing much more rapidly than older students. Keeping this demographic engaged for long periods of time is already a challenge as they have the natural urge to be mobile and fidgety. Therefore, it is crucial for designers to plan accordingly when making selections for the types of furniture to support sedentary learning if creating zones is not a feasible option. Lastly, it is important to note that students do not automatically sit properly in ergonomically designed furniture and will require proper instructions or adjustments. Functionally, this remains the best option however scalability is a more realistic and cheaper solution.

RESEARCH AGENDA

CONCLUSION

In conclusion, designing elementary classrooms for neurodiverse students requires a thoughtful consideration of both the built environment and biophilic strategies. By integrating sensory-friendly elements, flexible spatial arrangements, and nature-inspired design, educators and designers can create spaces that foster inclusivity, reduce overstimulation, and enhance learning for all students. Incorporating daylighting, calming color palettes, modular furniture, and compartmentalizing spaces not only supports neurodiverse individuals but also benefits the broader student population.

Beyond the design, it is what efforts teachers are making to successfully use the space to its full potential. Thus, through uniting two professionals with different educational backgrounds, and perhaps different views on teaching or classroom management, they can enhance the learning of all students. Research in this capstone will explore the design interventions for a range of neurodiverse conditions, ensuring that educational spaces will meet the diverse needs of all learners.

INTRODUCTION

The research agenda plans to utilize a variety of instruments to gain a thorough understanding about how neurodiverse students currently utilize and place themselves within a learning environment. Areas for intervention will help to better support children's needs and defend the capstone question, "How can elementary classrooms better support neurodiverse students with autism spectrum disorder".

Interviews, tours of local Rochester schools and observational studies provide a contextual analysis for how neurodiverse children are currently being supported in their everyday lives. They also reflect what elements of design could still use further improvement within the academic environment. These discoveries will aid in an increased comprehension of the design elements needed to inform design thinking and the Creative Agenda portion of this project.

Interviews with K-12 design professionals, teachers, furniture dealers, educational leaders, and parents of this

demographic will establish a concrete baseline of classrooms dynamics and how educational environments can support both students and teachers. The first-hand experience of this population will be crucial to the outcome of this project and support the findings discovered in the literature review.

Following the approval of the school principal, interviews with teachers and administrators were set up over email and conducted over Zoom or in person; giving opportunities for site visits and observations simultaneously. Given the sensitivity of the project's targeted demographics, all student information remains anonymous and is only referenced in a general manner.

Observational analysis' are another important element in this investigation, as they provide numerous precedent approaches to educational design. Considerations were made to the above-mentioned variables and a close examination of how they may or may not have been successful was noted in terms of overall academic

INSTRUMENT STRUCTURE

INTERVIEWS

success and growth of students.

Initial explorations found in the literature review validates the results of this research agenda. Learning environments must be transformed to create blended, flexible, and supportive atmospheres. The qualitative and quantitative research discovered design problems and solutions that will better support a positive environment which fosters growth and collaboration among every student.

REFERENCE APPENDIX B & C FOR INTERVIEW AND OBSERVATION ANALYSIS TEMPLATES

One-to-one interviews were conducted with teachers, administrators, and design professionals who have first-hand experience of working with the targeted demographic. To maintain consistency across all individuals who were interviewed, the questions were divided into three groups as follows:

- Teachers
- Administrators
- Design Professionals

All three populations were asked questions regarding classroom environments, sensory considerations, and common challenges. Full documentation of these interview questions can be found in Appendix B.

Observational Analysis

Gaining personal exposure to educational settings will be vital in the manner which the creative agenda is organized and developed. A template was created to maintain consistency across each observation and documentation of it can be found in Appendix C.

Some key elements that were noted during each analysis were sensory and furniture design, daylighting, spatial organization, and the relationship between spaces. Each observation was conducted outside of school hours to keep student confidentiality a top priority.

Participant's Rights

Prior to each interview an informed consent form was emailed to each individual with a request that they sign and send it back before the meeting. This form clearly outlines what is involved in the interview and states that there are no incentives, monetary awards, gifts, and known risks connected to participating. The documentation of this form can be found in Appendix D.

As mentioned above, all responses will remain anonymous unless permission was otherwise noted. Any statements regarding students will always remain unidentifiable and quoted in a generalized manner. Data is stored in a multi-authenticated, password-protected drive, only accessible to the research team and within the HSRO Department. Once the capstone is complete, it will then be archived to the RIT Interior Design program.

INTERVIEW FINDINGS

GROUP 01: TEACHERS - SUMMARY

All 5 interviewees teach the 2nd grade level, most of which do so in co-taught environments. Individuals stated their class sizes are about 20 students each year, with around 3-5 of those students possessing neurodiverse traits. Given the larger classroom ratio, most of them often had an aid or secondary teacher, special education or other, to assist them in daily routines.

Each teacher carries their own values within the classroom, something that is heavily influenced by the district as well. As such, interview findings reflect a variety of responses that will help to better inform the design outcome.

General Classroom Environments

This section of responses pertains to questions regarding the general classroom environments. Considerations such as class structure, inclusivity or accessibility, color palettes, and decoration were all elements covered.

Classrooms that are co-taught notably carried different

routines and organization. Oftentimes these teachers would hold an all class presentation period for the teacher to give their lesson, then small group or individual work would follow. However, some teachers opted for the parallel teaching method, dividing the class into two, if they found their classes became too chaotic with a larger amount of students.

Individualized education programs (IEP) are another determining factor in how the classroom is structured. These programs provide students who are classified as disabled, whether that be a health impairment, autism, or speech and language diagnosis, to get the resources they need. Teachers are given a state mandated minutes requirement that must be met each year prior the annual review.

Another commonality among those interviewed was the emphasis on structure for students with autism. Whether this be within the curriculum, class routines, seating arrangements, or transitional methods. Although

flexibility has become a valued component in educational settings, it is important to remember that not all students benefit from changing pace.

Sensory Considerations

Across all teachers interviewed, each one had some sort of sensory station or area(s) within their classroom for students to use throughout the school day. Some teachers allowed them to use it at any point, and others were more strict on regulating periods for them to use the tools so that they didn't become a distraction.

Integrated sensory methods act as proactive measures for regulating sensory input. Whether these strategies are located within the classroom or as ancillary spaces across the building, they remain a crucial resource to students with neurodivergent needs in all districts.

One teacher stated "students will get their feelings and emotions out regardless, so letting them do it on their

own terms and helping them to understand it is normal." That it will create a culture that is aware of these diversities and help students to better connect with each other.

Design Elements

Furniture is a tool that can be utilized in classrooms to optimize student learning and teaching efficiency. However, can only do so when purposefully selected and used correctly. Some common pieces referenced by interviewees include: horseshoe tables, hokki stools, rocking and cube chairs, floor cushions, standing desks, bean bags, and carpets.

Across all interviews, teachers mentioned some sort of struggle with getting these resources in all of their classrooms. One even said, "it is a act of Congress to get just one piece of broken furniture replaced. This leaves most teachers to find these resources themselves or apply to programs that will hopefully help.

INTERVIEW FINDINGS

While this problem differs between districts and their funding values, it is common knowledge that public schools don't have the resources or even knowledge to make decisions for a fully inclusive school. An occupational therapist hopes that we can make "classroom spaces universal for all". That often she has to figure things out on a student need basis and is stuck scrambling each year. However, through having these opportunities and tools built into their school, inclusivity will never have to be a question.

Students spend most of their day sitting, so many teachers try to promote movement throughout the day. Having moveable or adjustable furniture would assist in this dynamic environment, enabling students to make decisions that benefit their learning.

While having smaller amounts of furniture in a greater variety could be thought to create conflict in children, all interviewees stated otherwise. They too are pleasantly surprised by the amount of respect and understanding

towards neurodiverse students and their needs.

Summary

Overall, there were a lot of similarities in responses across all teachers interviewed. While values and strategies may vary between districts, the belief that these students deserve just as equal and inclusive of a learning experience as their neurotypical peers remained consistent.

When asked what they would change within their classroom or school with an infinite amount of resources, nearly everyone said they'd use it to ensure all students had access to these tools. Other responses included larger classroom spaces or more flexible seating options within their classrooms.

GROUP 02: ADMINISTRATORS - SUMMARY

The two interviewees for this group consisted of a principal and an assistant superintendent for curriculum; one residing in a more resourceful district than the other. Resources refer to the financial capacity for securing the assets needed to provide extra support for neurodiverse students without grants or other funding programs.

Both individuals have state mandated ratios within their self-contained special education classrooms through IEP's. Through sensory rooms, furniture typologies, and easier access to funding for teachers - they emphasized a value in establishing a community that accepts others.

General School Environments

Across both districts, individuals noted mixed feedback from parents and staff about co-teaching strategies utilized within their schools. Some prefer more traditional methods of learning, while others find this method beneficial for building a respectful community. It was often stated that each learning scenario will always

remain different as each student possesses their own needs. So providing universal tools and experiences that can be utilized by and influence all of their students was most ideal.

Each administrator mentioned some sort of sensory intervention that was included within each classroom of their school. One utilized rugs, stating "they may seem like a necessity but are really expensive and hard to attain". That each one ranges from \$600-\$1000 and needs to be purchased for around 20 classrooms schoolwide. The other administrator provides different types of furniture, such as chairs that rock, wiggles tools, or cube chairs. As well as a sensory room and bins filled with fidgets within each classroom.

Budgetary Decisions

State funding is provided to public schools based on their financial needs, demographic, population, and poverty levels. Grants are another resource that may

INTERVIEW FINDINGS

GROUP 03: DESIGN PROFESSIONALS - SUMMARY

be applied for as an additional resource as well. Some common tools administrators often prioritized funds for were such as pencil grips or sensory bins, and teacher budgets.

One administrator emphasized her desire to keep students that are normally sent away to BOCES programs to better support their needs. She said it is costly either way, but having all of the students together brings a sense of empathy in understanding that not everyone is like them. Creating a powerful community that not only prioritizes academic skills but social skills as well.

The individual chosen for an interview under this group is a K-12 practice leader and vice president at a local Rochester firm. With over 20 years of experience, he has seen a variety of projects and clients within this sector of design.

Overall, discussions focused on how designers can create a space that provides users with the tools to utilize it in the right way. This involves choosing clients that have a forward thinking vision and believe the investments made to their schools are not only beneficial for students but to sustaining educators in bringing in talent. These educators are what drives the designs beyond their initial implementation.

Design Process & Philosophy

With enrollment declining, it has become more important than ever to create spaces that attract different learners. Decisions were also made in consideration to sustainable efforts and cost savings long term.

Factors such as temperature regulation, daylighting, acoustical separations, and air quality concerns are all thought about in some manner for each project. He said that often they strive to create outcomes that don't just renovate what is existing, but strive to improve the space and its community that utilizes it.

From an architectural standpoint, exterior design was considered just as much as the interiors. Whether that be through connecting the standard classroom to an outdoor space, or the overall design - the building envelope plays heavily into the sustainability of a project.

A notable design statement from the interview was the architect's decision to create exterior facades that contained wall mounted whiteboards to make most efficient use of space. Windows framed in these boards and digital screens as a reminder that "there is another world out there". Meaningful connections like this are what makes a design thrive.

Challenges

The challenges predominantly went back to the client in this question. He stated, "we as designers may possess a bunch of ideas for how to revolutionize a space, but if there isn't a strong leadership team to follow through on it long term then these ideas may never be received".

He also mentioned the struggle of designing within old buildings, that more often than not school projects are a renovation. With this comes hazardous materials as walls are open and floors are demolished, or at least the potential for them. So it is important to remain mindful of the age of these buildings and what limitations may come as a result of this.

Lastly, the topic of funding was discussed. While New York has been shown to invest in its education more than any other state, it is ultimately the taxpayers who are funding the project. Therefore, it vital designers make sure these projects cater to the community.

OBSERVATIONAL ANALYSIS

OBSERVATION 01: ELIZABETH A. BARCLAY ELEMENTARY SCHOOL

This observation followed an interview with a 2nd grade teacher at the school. Which included the opportunity before school hours to tour the building and explore some common spaces neurodiverse students interact with throughout their daily routines.

Key elements observed include: sensory and fitness rooms, flexible furniture options, corridor activities, spatial adjacencies, bathroom accessibility, and acoustical concerns.

Overall, there were many diverse opportunities for students to utilize tools that optimize their daily learning routines. Classroom designs obviously varied between teachers, but corridor spaces remained minimal in design and free of overstimulating graphics besides the interactive floor decals.

Sensory and resource rooms were conveniently located at the end of each corridor for easy access throughout the day. Large windows lined hallways and classrooms for ample daylighting, encouraging

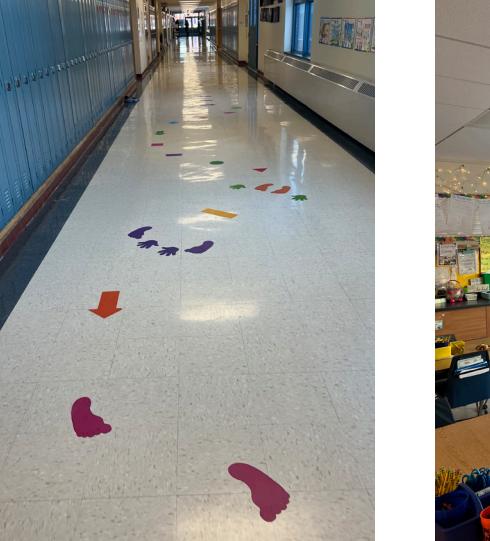


Figure 3: Corridor Activities



Figure 4: Sensory Station

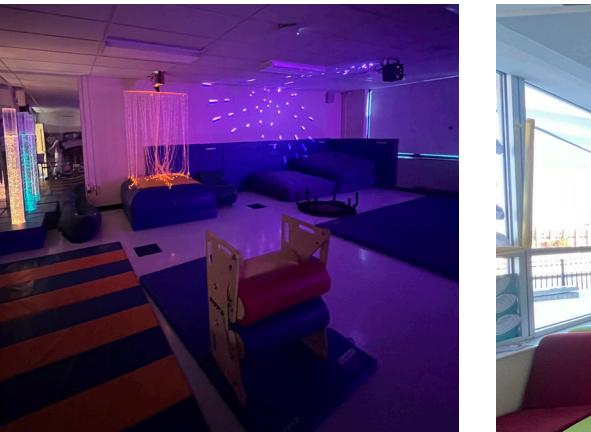


Figure 5: Sensory Room



Figure 6: Library

teachers to turn off artificial lights for a more calm environment. Bathrooms located within each classroom required renovation and ADA updates.

As seen in (fig. 7) and (fig. 8), classrooms are relatively small and contain lighting that produces glare and creates a straining environment. Teachers decorate their walls with things their students can actually reference and utilize, assuring it doesn't become too overstimulating.

Table and chairs are often what is utilized in lower grade level classrooms for groupwork and social opportunities. However, as referenced in (fig. 8) desks are still an option for teachers. Regardless, zones are created within all classroom environments through other items such as a carpet, bookshelf, or table.

Teachers made note of their sensory stations, whether that be through toys and fidgets or a separate nook inside a tent, each one understood the value of providing these tools within their classroom.



Figure 7: Dynamic Classroom Example



Figure 8: Structured Classroom Example

OBSERVATION 02: KENDALL ELEMENTARY SCHOOL

This observation was another opportunity provided through an interview with a second grade teacher of the classroom observed.

This particular learning space is catered towards students with neurodiverse needs, making up the only completely inclusive classroom in the school. Given this circumstance, it made a great resource for this capstone.

Overall, this classroom contains the most sensory inclusive tools observed as part of this research agenda. There were sensory stations, flexible furniture typologies, fidget toys, dimmable lighting options, and integrated stimulation release activities within the daily class schedule.

The teacher noted that within each cluster of desks, there was at least one high-needs student that required a particular curriculum modification to achieve an optimal learning experience. This arrangement allowed students to better understand the diversity among their peers.

The stark VCT flooring pattern was the most stimulating feature of the space. This pattern among the large array of furniture and color created a very overwhelming environment.



Figure 9: Front of Classroom



Figure 10: Teacher's Station

As illustrated in (fig. 11), there are a variety of furniture provided to students within the classroom. The teacher indicated that students have two opportunities through the day to select their seat for the day, allowing autonomy and sharing of resources. Access to these items throughout the day allows for a consistency in routine for students who rely on that, but enables them to make independent decisions that help them learn.

While sensory resources were scattered throughout the classroom, (fig. 12) indicates the main area designated within the classroom for stimulation regulating resources. Books are clearly indicated and color coded, toys include soft and hard objects for a variety of children. This allows students to rely on this area regardless of the sensory experience they may be having.

It can also be recognized that this corner is spatially partitioned from the rest of the classroom with stand-alone book shelves. This further emphasizes the value in utilizing flexible furniture throughout a classroom environment.



Figure 11: Back of Classroom



Figure 12: Sensory Area

CREATIVE AGENDA

INTRODUCTION

The goal of this creative agenda is to design a prototypical learning environment which optimizes the academic success of students who have neurodiverse needs, such as autism. Spaces include classrooms, corridors, a sensory room, resource centers, library, an outdoor courtyard, and other ancillary spaces for transitional considerations.

Variables from the research agenda proven to be significant are: space planning, furniture selections, color, lighting, acoustics, technology, and biophilic strategies.

This conceptualized project emphasizes that sensory inclusive needs are no longer an alternate option and instead integrated into the typical design standards of learning environments. These needs require elements such as: designated sensory or respite zones, meaningful spatial and furniture organization, adjustable illumination options, acoustical barriers, and distinct wayfinding strategies.

CONCEPT DEVELOPMENT

The fundamental purpose of the built environment is to support the people and activities they engage in while using the space. This is especially important when

designing for those with Autism Spectrum Disorder (ASD), as they have differentiated sensory sensitivities and cognitive awareness (Bourne, Pearson, and Kleibrink).

While each case of ASD is unique to the individual, research has shown that they tend to thrive in spaces that are straightforward and easy to navigate. Spaces that are compartmentalized can limit the sensory inputs that a child needs to process and encourage individualized learning. These routines are enforced through purposeful spacial adjacencies and clearly defined wayfinding strategies.

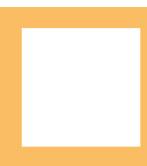
Building materials, finishes, textures, patterns, and colors provide meaning within a space and serve as a learning tool that can empower students with ASD to be more independent and find increased opportunities for growth.

An optimized school environment can be accomplished through the flexible implementation of adaptable furniture and lighting, low-stimulating color selections, acoustical tools to assist with transitional zones, and biophilic strategies. These spaces not only improve student success but can also increase teacher's efficiency in the classroom as well.

DESIGN DRIVERS

ASPECTSS Design Index

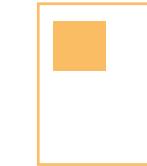
Published in 2013, ASPECTSS is a research-based framework of 7 design concepts facilitative of architecture for autism. This tool was thoughtfully considered throughout the design process to ensure the environment provides autonomy through choice and a variety of physical resources.



ACOUSTICS



SPATIAL
SEQUENCING



ESCAPE
SPACE



COMPARTMENTALIZATION

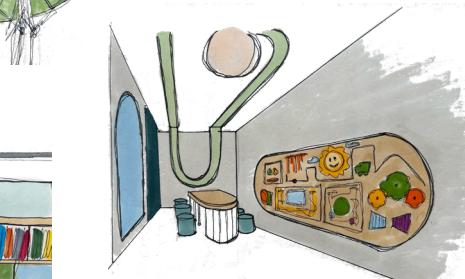
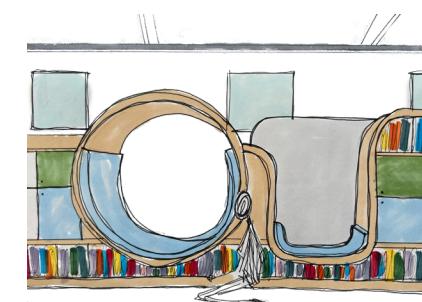


TRANSITIONS



SENSORY
ZONING

SKETCH ILLUSTRATIONS

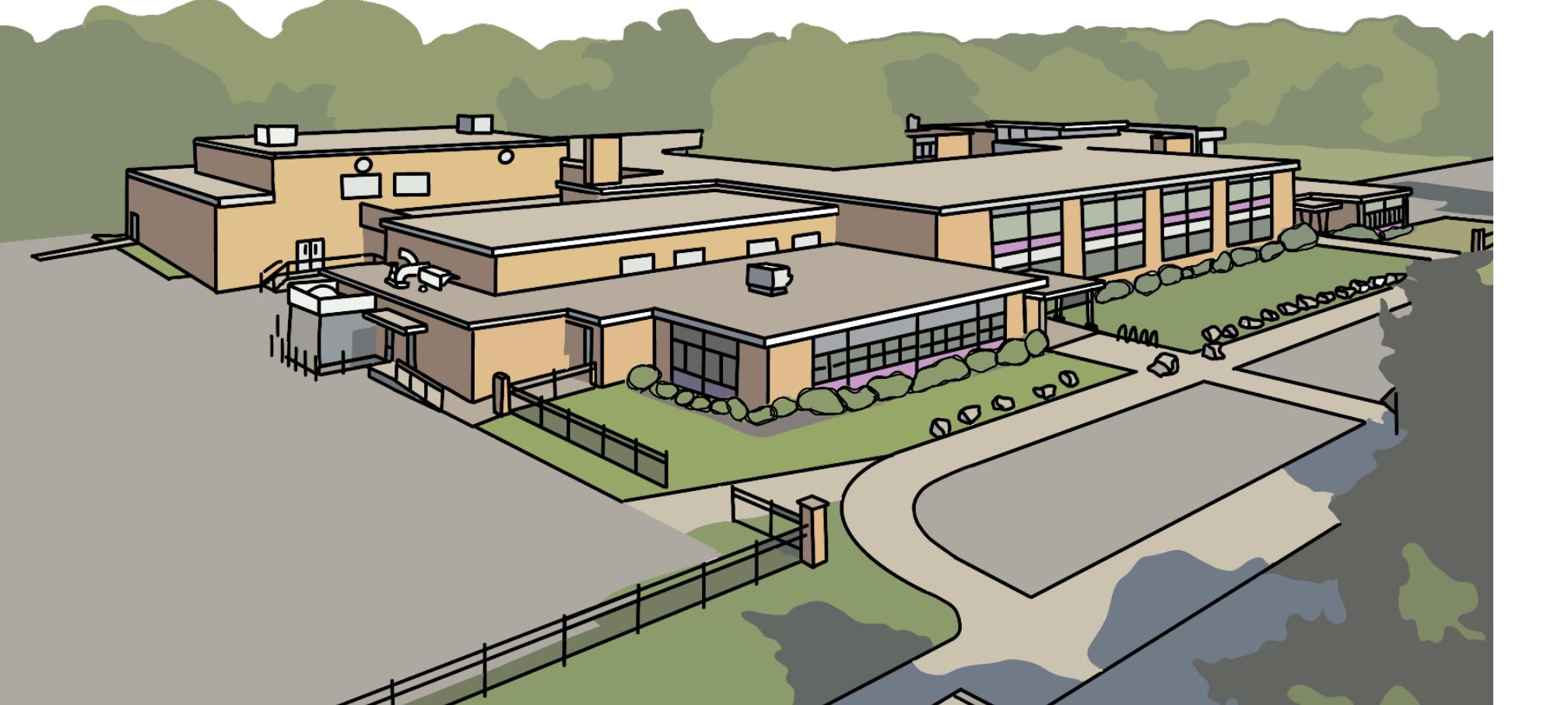


PROPOSED SITE

CLARA BARTON SCHOOL NO. 2

190 Reynolds St. Rochester, NY 14608

78,000 SQ. FT.



SITE ANALYSIS

INTRODUCTION

The proposed site for this project is a local Rochester City School - Clara Barton School No. 2. The selection of this building lies in the districts current priorities to create environments where neurodiverse students can thrive. The school's central courtyard, diverse student demographic, and newly constructed makerspace were crucial factors in the decision as well.

As demonstrated in (fig. 14), the surrounding community consists mostly of neighborhoods and minor businesses or parks. The houses that encompass the school create a safe environment within the larger city. Enstilling a sense of comfort within parents as they send their children to school for the day.

Alongside the ample green space that surrounds the building, the building has a central courtyard as well. Its location allows students to freely make use of the area, providing easier sightlines for teachers within the classrooms facing the space.

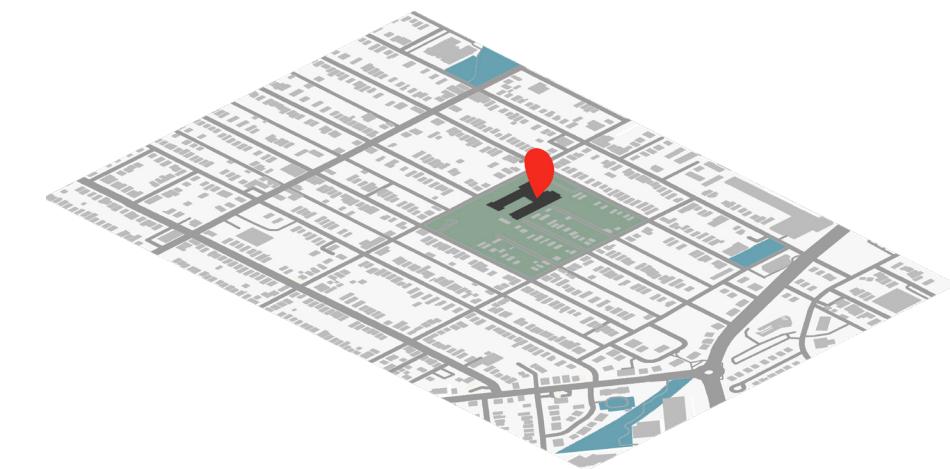


Figure 14: Clara Barton Site Plan



Figure 15: Clara Barton Exterior - Front Entry

SITE ANALYSIS

EXISTING CONDITIONS

Throughout the tour of the proposed site for this project, I meticulously analyzed elements such as sensory and furniture design, daylighting, spatial organization, and the adjacencies that currently exist.

In (fig. 16, 17, and 18) you will see the typical interactions users currently have with corridor spaces. Depending on access to daylight, they often felt short, dark, and narrow; especially when entering the classroom thresholds.

Consistent designs in the terrazzo flooring at large intersections was a current wayfinding methodology in place, but it didn't appear to be very successful. In addition, there are tile details on some walls, as seen in (fig. 17). However, most corridors are faced with the traditional concrete masonry units and painted to match school colors.

Classroom spaces, as depicted in (fig. 19 and 20) felt crowded and not purposeful in their design or layout. Furniture was very crowded and seemed to be pushed together in order to make room for other activities.

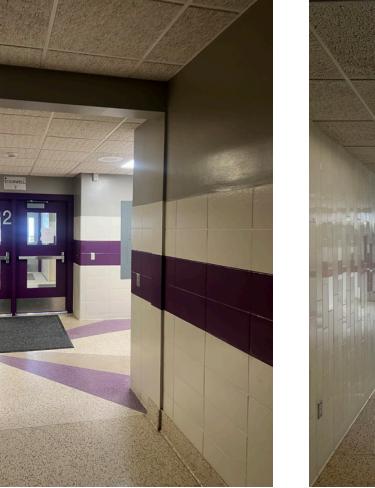


Figure 16: Entry Corridor



Figure 17: Tile Corridor



Figure 18: CMU Corridor



Figure 19: Makerspace



Figure 20: Classroom

FLOOR PLANS

As demonstrated in (fig. 21 and 22), the school currently has designated OT/PT classrooms, a sensory space, and an entire Hillside suite on the second floor dedicated to aiding students with neurodiverse needs.

The first floor is currently made up of 3 Pre-K. and (4) K-2 classrooms, the gymnasium, cafeteria, art and music classrooms, and administrative offices. Resources such as the nurse, social workers, resource teachers, and occupational or physical therapists are all located on this floor as well.

As the floor plan currently sits, spaces feel static and separate. There is no intentional considerations made to students who may have neurodiverse needs in terms of wayfinding, materiality selections, or spacial adjacencies.

The second floor is currently made up of (4) 3-6 classrooms, speech therapist, teachers lounge, and the previously mentioned Hillside suite. The major difference from the previous plan is the lack of in-class toilet rooms, which are now within the corridor.

However, the plan follows the same traditional box-like layout as the first floor. Leaving no room for flexible learning or collaboration among classes.



Figure 21: Clara Barton Level One Floor Plan



Figure 22: Clara Barton Level Two Floor Plan

DEMOGRAPHIC

USER PROFILES



JORDAN (ADHD & SENSORY SENSITIVITIES)

AGE: 8 | GRADE: 03

NEEDS:

- Focus Support
- Sensory Regulation

CHALLENGES:

- Distracted Easily
- Overwhelmed by Group Work

DESIGN FEATURES:

- Flexible Seating
- Calming Features
- Visual Cues



MS. GARCIA (GEN ED TEACHER)

EXPERIENCE: 10 YEARS | GRADE: 02

NEEDS:

- Simple, Inclusive Systems
- Visual Routines for Student Independence

CHALLENGES:

- Overwhelmed with Varied Needs



LEAH (AUTISTIC, NON-SPEAKING)

AGE: 10 | GRADE: 05

NEEDS:

- Visual Communication
- Calm Spaces

CHALLENGES:

- Loud Noises
- Transitional Anxiety

DESIGN FEATURES:

- AAC Device Access Points
- Visual Routines & Storytelling
- Soft Quiet Zones



MR. JOHNSON (SCHOOL OT)

EXPERIENCE: 5 YEARS | GRADE: 3-6

NEEDS:

- Flexible, Accessible Design to Support Therapy Methods

CHALLENGES:

- Limited Time in Classrooms



FLOOR PLANS

OVERALL - FURNITURE LAYOUT | LEVEL ONE



Figure 23: Proposed Level One Floor Plan

OVERALL - FURNITURE LAYOUT | LEVEL TWO



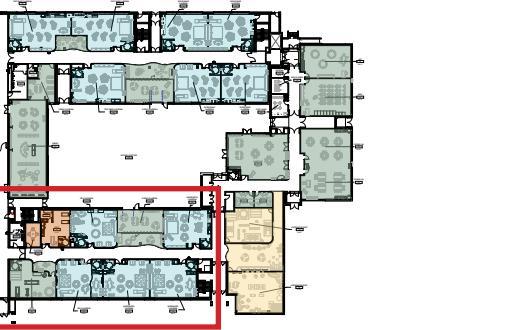
Figure 24: Proposed Level Two Floor Plan

ENLARGED - AREA A | LEVEL ONE



This area of the level one floor plan resembles a proposed layout for the Pre-K and Kindergarten classrooms, as well as an easily accessible OT/PT space. The nurse's office remains in its original location, only removing a designated office space to free up space for a conference room right off the main entry of the building. This space allows for quick parent-teacher meetings or after school PTA assemblies.

Given the young demographic that will occupy these classrooms, **table typologies** were selected and **dramatic play** elements were highly emphasized.

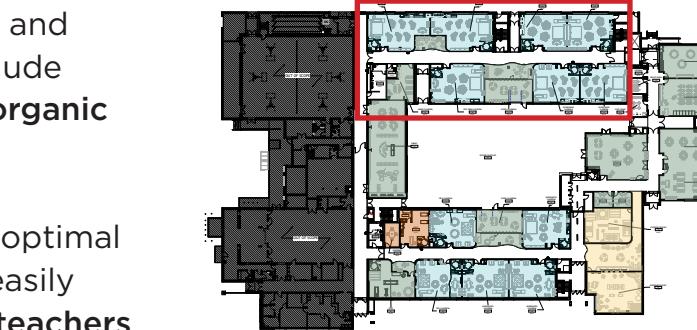


ENLARGED - AREA B | LEVEL ONE

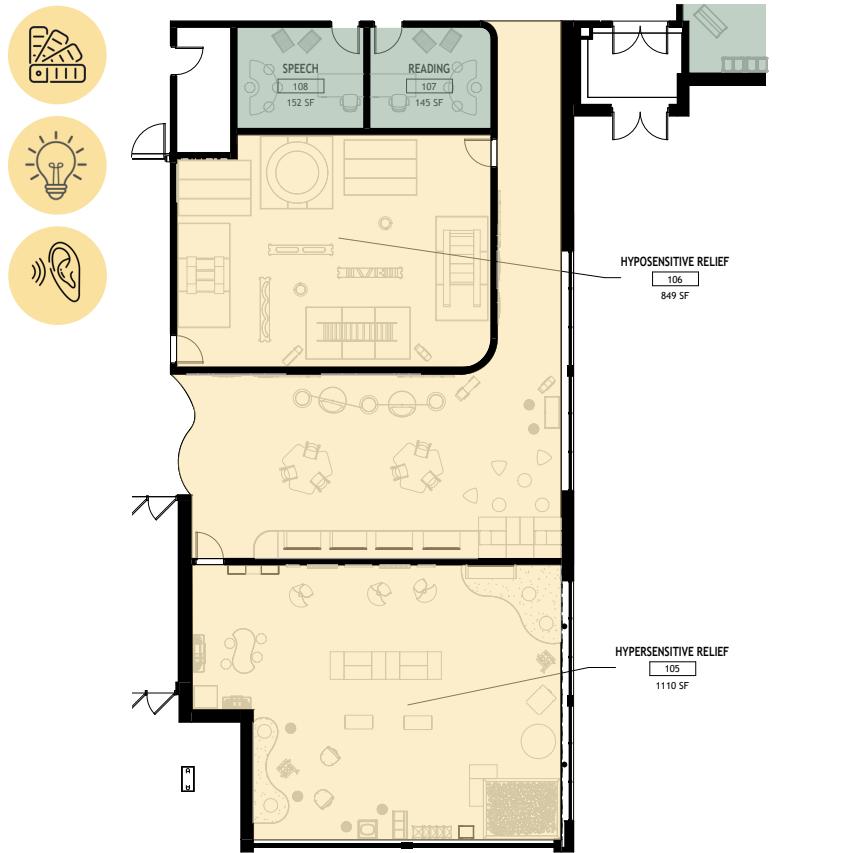


The illustrated enlarged plan demonstrates a proposed design for the first and second grade classrooms on level one. Some notable design elements include **individual desk seating**, **more extensive breakout spaces**, and continued **organic forms** throughout the **corridors** and **rounded wall intersections**.

These classrooms allow for **active-learning**, ensuring **faculty mobility** and optimal **student engagement**. The **modular** and **light-weight** furniture creates an easily **adaptable learning environment** which values the **needs of students and teachers**.

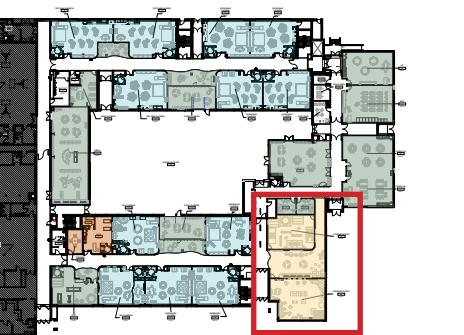


ENLARGED - AREA C | LEVEL ONE



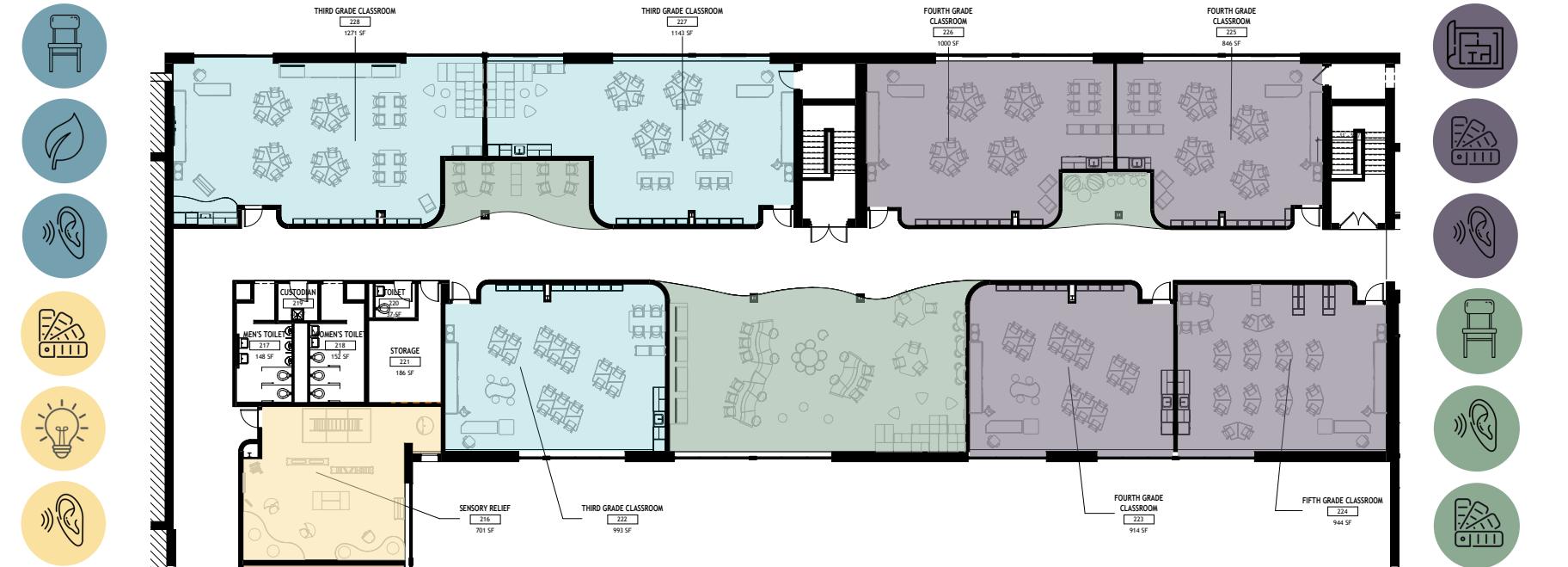
The sensory resources were **intentionally** placed within their own section of the school, adjacent to the maker's wing. This location ensures that **noise** in the **active sensory** space (**hyposensitive**) does not hinder learning. Whereas the **calm sensory** room (**hypersensitive**) lies on the exterior facade to have access to the outdoors and remains **secluded** for maximum **sound reduction**.

The **curve** along the interior wall allows for a **smooth path of transition** while traveling through the space. A **variety** of seating options allows children to utilize the space in a way that best fits their needs.



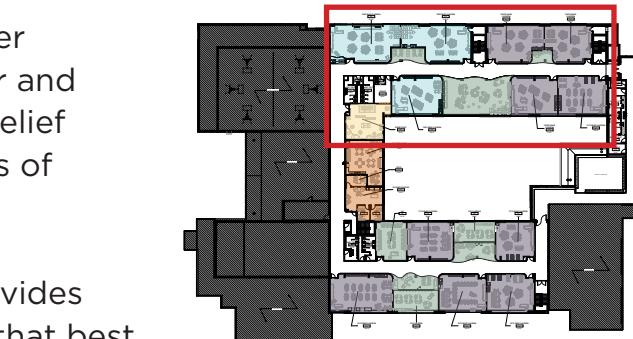
50

ENLARGED - AREA A | LEVEL TWO



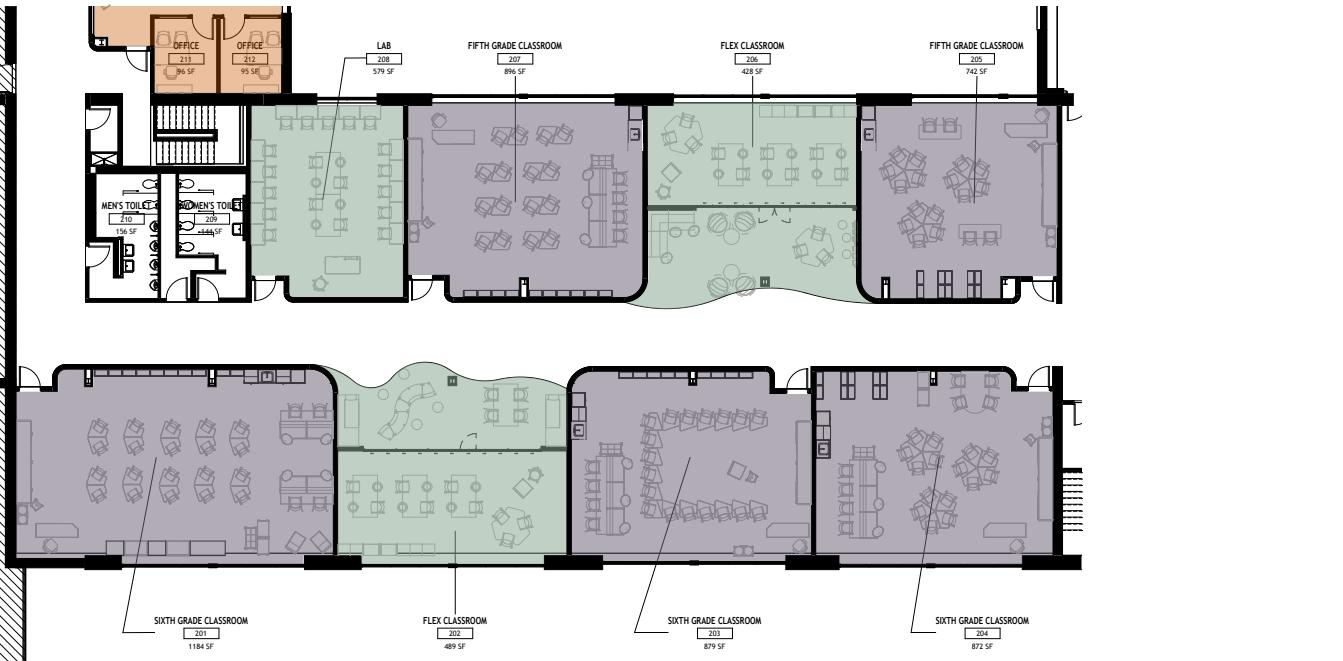
Level two was purposefully designed to cater towards the needs of the older students (grades 3-6). With this in mind, **breakout spaces** were made larger and provided more **collaborative opportunities**. There is an additional sensory relief space provided on this floor as well. This encourages routine use, regardless of location within the building.

The main **learning commons** is located right off of the north stairway, it provides vast opportunities for students to work outside the classroom in a manner that best suites their learning style.



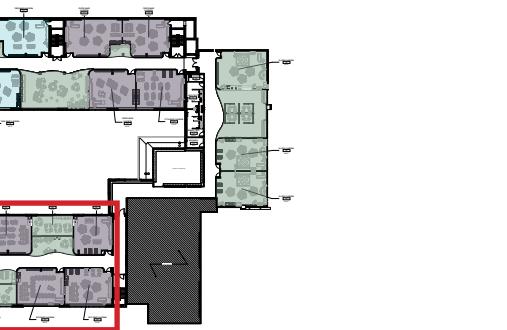
51

ENLARGED - AREA B | LEVEL TWO

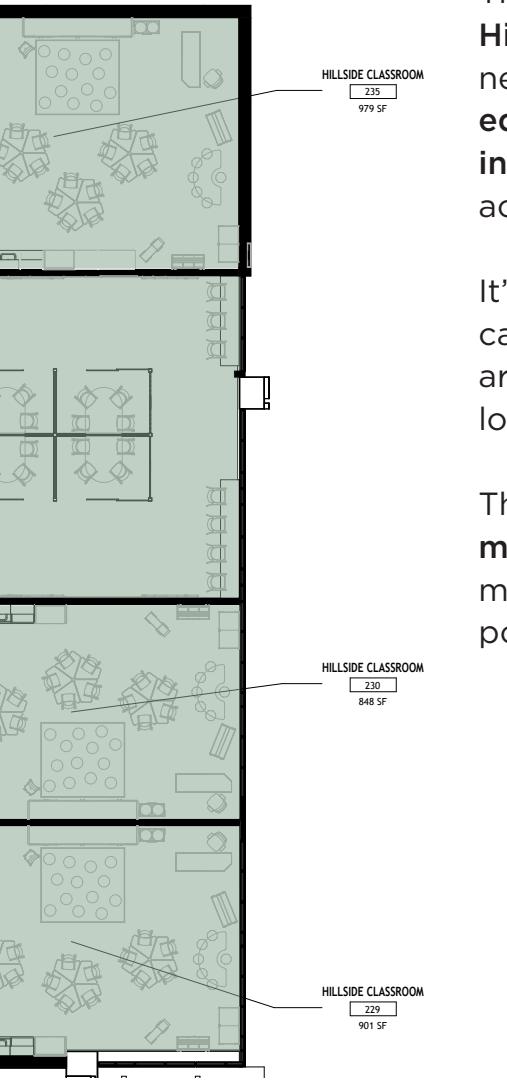
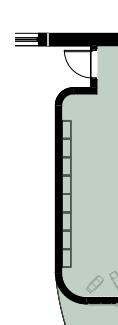


Similar to the northern corridor, these classroom groupings are designed for students in **grades five through six**. There is an additional **computer lab** space and two **flexible classrooms** that are open for teacher's to utilize for STEAM oriented activities.

Furniture was selected and **scaled** according to the typical demographic needs, including **sit-to-stand desking units**, **high-top tables**, and **high-density foam seating**. Bathrooms on this level are only located in corridors to support student **privacy** and encourage a sense of **individuality**.



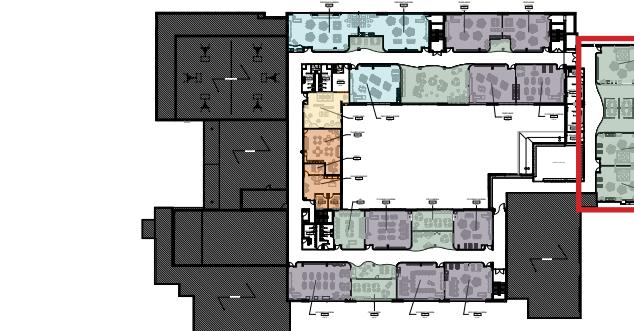
ENLARGED - AREA C | LEVEL TWO



The existing school where this project is located has an **integrated Hillside suite** which provides **specialized education** to students in need. These facilities work with teachers to provide **individualized education services**, **mental health support**, and **behavioral interventions**. The program focuses on helping students stay in school, achieve academic success, and prepare for life after high school.

It's dedication to student success aligns well with the goal of this capstone, so it became an integral part of the design. Hillside services are geared towards students going into middle and high school, so its location on the second floor is accessible to this demographic.

The designated classroom spaces provide a space for **state mandated ratios** of students to meet **IEP's** and support those with more **hands-on needs**. While the central space acts as an easy meeting point for one-one student-teacher help or a private testing center.



REFLECTED CEILING PLANS

LEVEL ONE

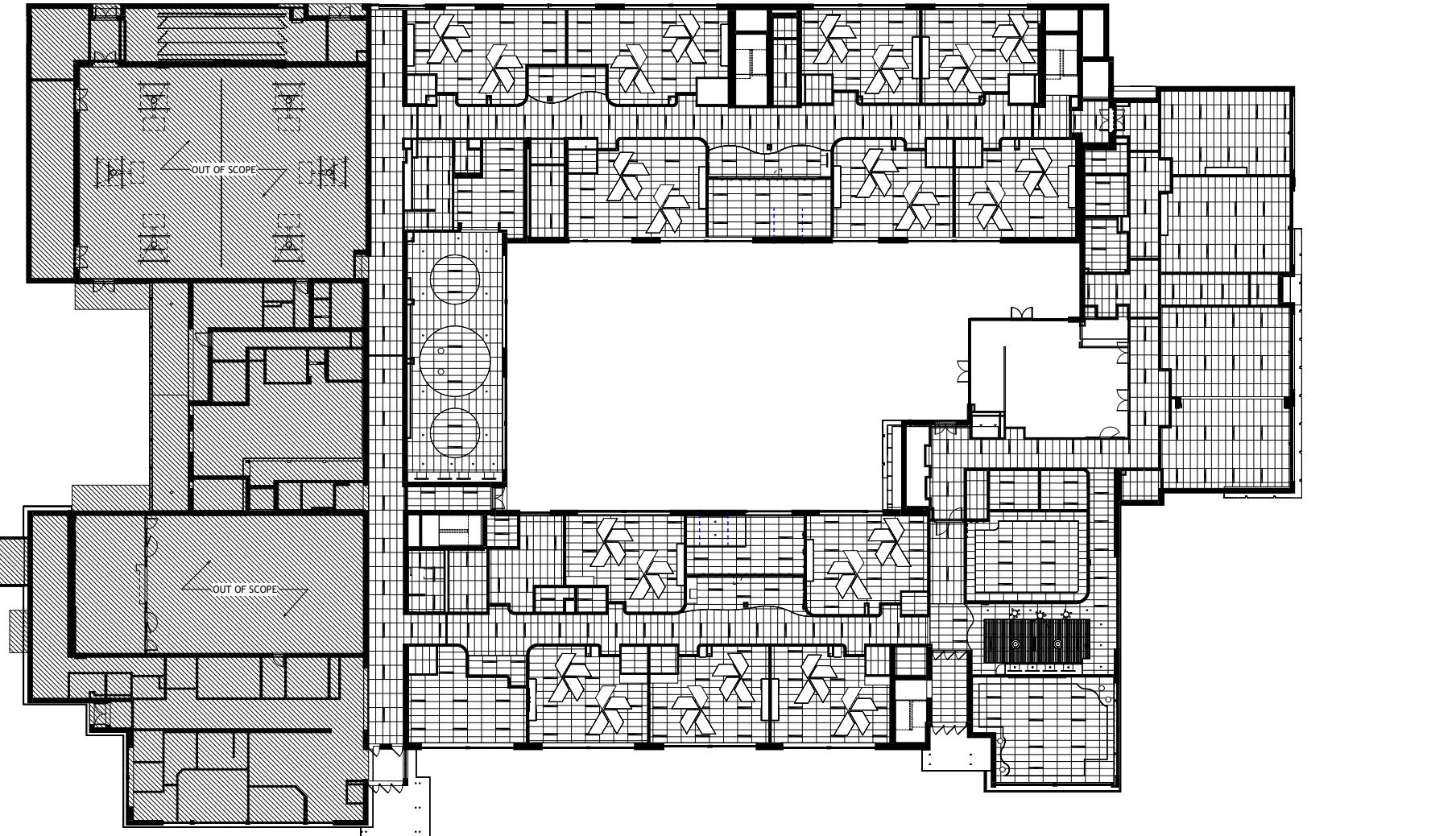


Figure 25: Proposed Level One Reflected Ceiling Plan

LEVEL TWO

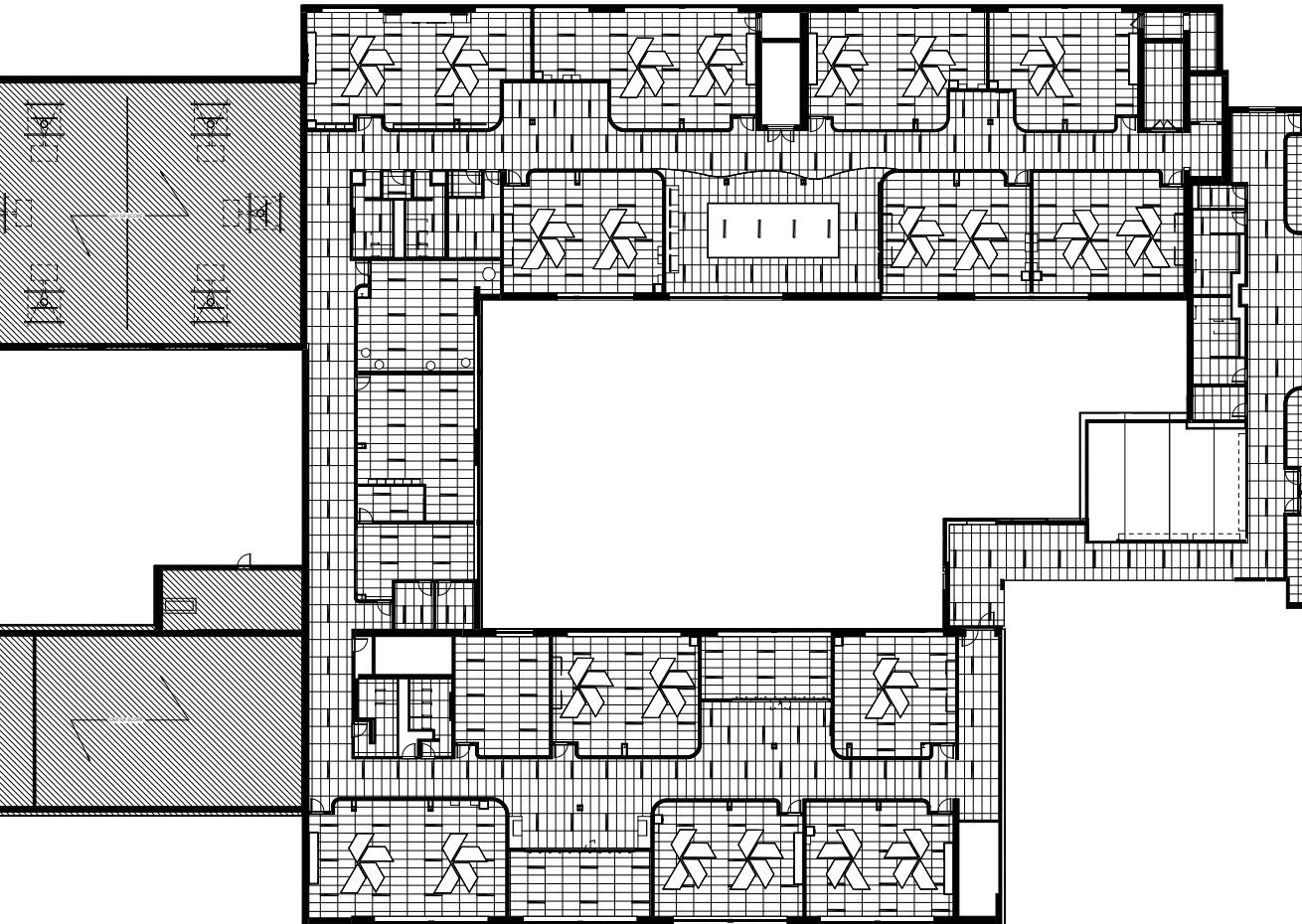


Figure 26: Proposed Level Two Reflected Ceiling Plan

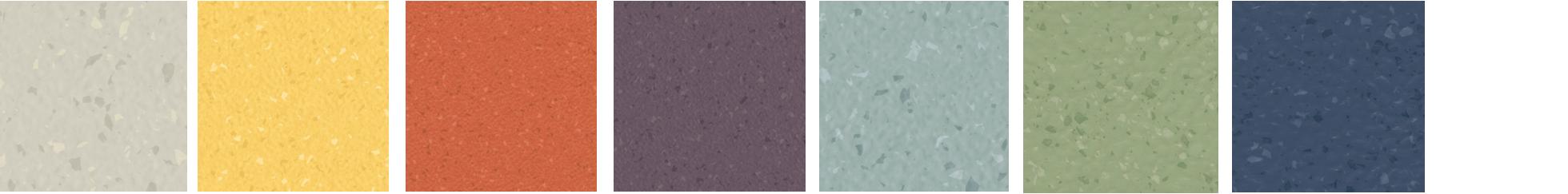
MATERIALS

MATERIAL SELECTIONS

PAINT



FLOORING - RUBBER



FLOORING - CARPET



SOLID SURFACE & LAMINATE



UPHOLSTERY



VISUALIZATIONS

SENSORY SPACES | TRANSITIONAL ZONE

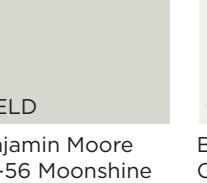
This visualization represents the central space between the hypo and hyper-sensitive resource rooms. It acts as a **neutral** area to provide students with a quick **de-escalation zone**, whether they are just walking through or need to stop for a few minutes to regulate.

The **acoustical baffles**, egg-shaped swings, **nooked seating**, **interactive spinning columns**, and miscellaneous **sensory-oriented toys** make this a great resource for students at any age.



Figure 27: Sensory Wing

PAINT



FIELD

Benjamin Moore OC-56 Moonshine



CEILING

Benjamin Moore OC-57 White Heron



TRIM

Benjamin Moore CC-548 Asphalt



ACCENT

Benjamin Moore CC-214 Golden Honey



ACCENT

Benjamin Moore HC-129 Southfield Green

CARPET



Shaw Contract In Common - Together Color

UPHOLSTERIES



Design Tex Swift - Mesa



CF Stinson Loophole - Matcha



Design Tex Silicone Level - Light Lilac



Design Tex Beguiled By The Wild - Minke

SENSORY SPACES | HYPOSENSITIVE RELIEF

This **active relief** space supports those who are **under stimulated**. A variety of sensory furniture allows for movements that offer a mix of **proprioceptive** and **vestibular** input to **regulate** the nervous system and organize the body.

These **joint compression** activities improve **motor planning skills**, **body awareness**, and **calm** the body down to a level where students can **focus** and **learn**.

Acoustical wall panels were installed to provide **cushion**, **absorb sound**, and **create visual/tactile interest**.

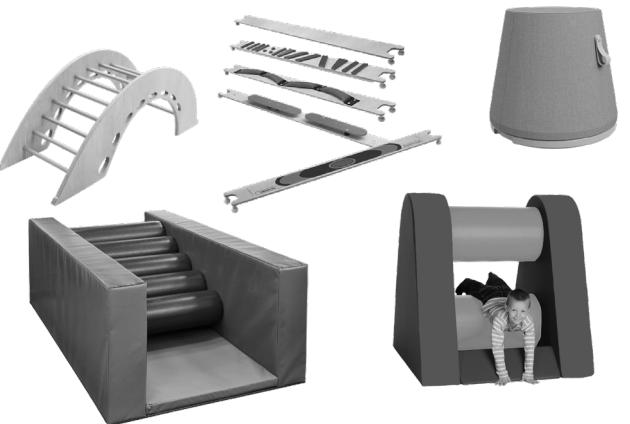


Figure 28: Hyposensitive Relief

PAINT



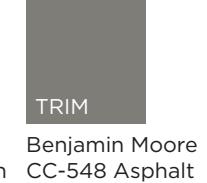
FIELD

Benjamin Moore OC-56 Moonshine



CEILING

Benjamin Moore OC-57 White Heron



TRIM

Benjamin Moore CC-548 Asphalt



ACCENT

Benjamin Moore HC-152 WhippleBlue

RUBBER



Noramont Satura - Orion

UPHOLSTERIES



Design Tex Tilt - Grove



CF Stinson Silicone Avail - Maize



Design Tex Silicone Level - Light Lilac

SENSORY SPACES | HYPERSENSITIVE RELIEF

The **calm respite** space supports children who are **easily overstimulated** and need a break from sensory stimulation. Elements such as **soothing white noise, essential oils, fiber optic lighting, weighted blankets and pillows, or sand/water tables** are some resources integrated within the space.

The installed **linear troffer lighting**, which is utilized throughout the entire school, is **dimmable** with **RGB color** options. **Blackout curtains** are also provided to reduce daylighting as needed.

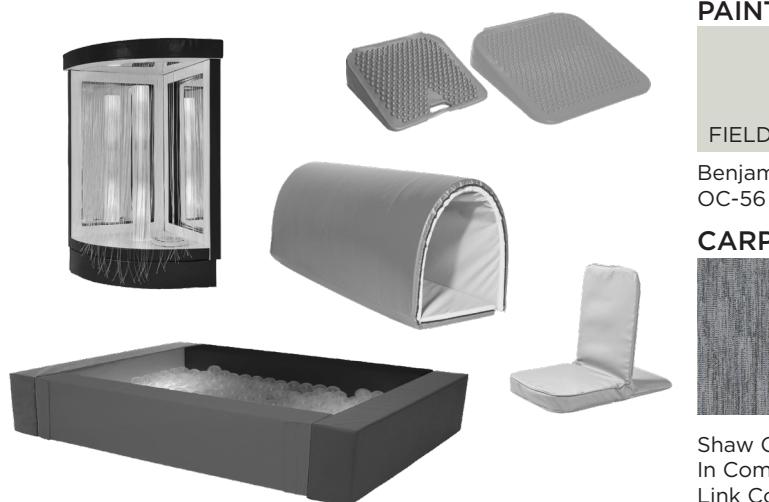
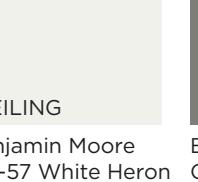
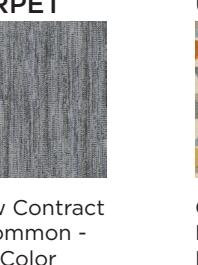


Figure 29: Hypersensitive Relief

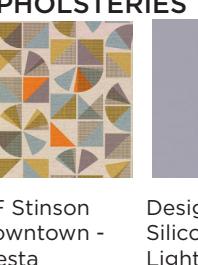
PAINT



CARPET



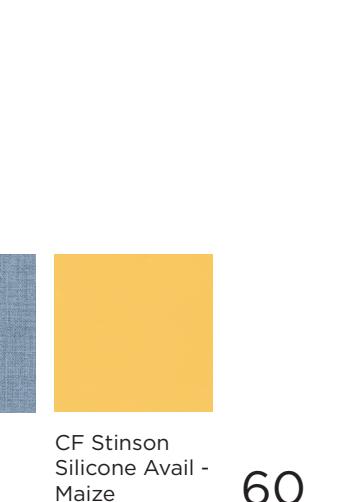
UPHOLSTERIES



CARPET



UPHOLSTERIES



PROTOTYPICAL CLASSROOM | PRE-K - THIRD GRADE

The layout within these classrooms emphasizes **predictability** and **flexibility** by incorporating **clear visual cues**, **defined zones** for different types of activities, and **calming color palettes**.

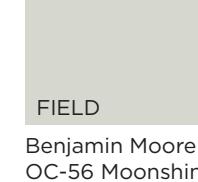
Sensory-friendly features include **dimmable RGB lighting**, **acoustical treatments**, and **cozy retreat areas**.

These elements create a supportive environment that helps **reduce overstimulation**. Working together to **foster engagement, comfort**, and a **sense of belonging** for every student.



Figure 30: Prototypical K-3 Classroom

PAINT



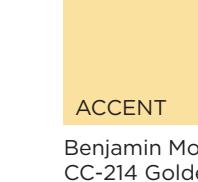
CARPET



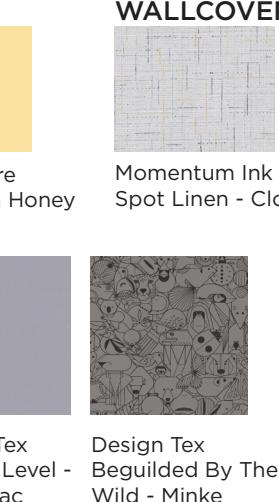
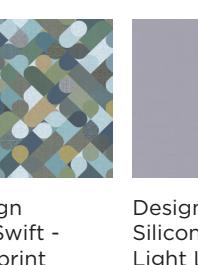
RESILIENT



UPHOLSTERIES



CARPET



PROTOTYPICAL CLASSROOM | THIRD - FIFTH GRADE

The upper-grade classrooms are purposefully located on the second level of the building to **promote a sense of independence and maturity** among students. This strategic placement also allows for the integration of expanded breakout zones along the corridors.

A **cool and refreshing** material palette paired with **modular desks, high-top tables, and soft seating** offers a **calm, adaptable** environment. These design choices **empower** students to take ownership of their learning by giving them the freedom to choose how and where they work best.



Figure 31: Prototypical 4-6 Classroom

PAINT



FIELD
Benjamin Moore
OC-56 Moonshine



CEILING
Benjamin Moore
OC-57 White Heron



TRIM
Benjamin Moore
CC-548 Asphalt



ACCENT
Benjamin Moore
CC-38 Nightfall Sky

CARPET



Shaw Contract
In Common -
Link Color



Design Tex
Swift - Mesa



Design Tex
Silicone Level -
Light Lilac



CF Stinson
Loophole -
Coast



Design Tex
Swift -
Blueprint



Momentum
Twill EPU -
Jade

UPHOLSTERIES



Shaw Contract
In Common -
Link Color



Design Tex
Swift - Mesa



Design Tex
Silicone Level -
Light Lilac



CF Stinson
Loophole -
Coast



Design Tex
Swift -
Blueprint



Momentum
Twill EPU -
Jade

ANCILLARY SPACES | LEARNING COMMONS

The learning commons, located along the second-level corridor, serves as a **dynamic extension** of the classroom for older students. Designed with **flexibility** in mind, this **open, collaborative space** features a variety of **moveable seating** options to support different learning preferences and activities.

The space **encourages movement, sparks curiosity**, and invites students to engage with their peers in a setting outside of the typical classroom.



Figure 32: Learning Commons

PAINT



FIELD
Benjamin Moore
OC-56 Moonshine



CEILING
Benjamin Moore
OC-57 White Heron



TRIM
Benjamin Moore
CC-548 Asphalt



ACCENT
Benjamin Moore
HC-152 Whipple Blue

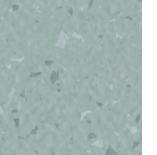


WALL COVERING
Momentum Olma -
Natural Sprig

RUBBER



Noram
ent Satura -
Orion



Noram
ent Satura -
Delphinus



CF Stinson
Downtown -
Fiesta



Wolf Gordon
Nova -
Emberglow



CF Stinson
Loophole -
Matcha



Design Tex
Silicone Level -
Light Lilac

ANCILLARY SPACES | LIBRARY

This re-designed library space enhances student learning through **thoughtfully integrated** features like **acoustically treated nooks**, **soft seating**, **markerboard surfaces**, and **versatile tables**.

Centered around student needs, the space **supports diverse learning styles** and encourages both **independent** and **collaborative engagement**.

Modular bookshelf units define distinct zones without disrupting the open layout and provide integrated spaces for functional bench seating.



Figure 33: Library

PAINT



FIELD
Benjamin Moore
OC-56 Moonshine



CEILING
Benjamin Moore
OC-57 White Heron



TRIM
Benjamin Moore
CC-548 Asphalt



ACCENT
Benjamin Moore
CC-38 Nightfall Sky

CARPET



Shaw Contract
In Common -
Link Color

UPHOLSTERIES



CF Stinson
Downtown -
Fiesta



Design Tex
Silicone Level -
Light Lilac



CF Stinson
Loophole -
Coast



Wolf Gordon
Nova -
Emberglow

ANCILLARY SPACES | MAKERSPACE BREAKOUT

The breakout spaces located just outside the flexible classrooms are designed to **extend learning beyond traditional boundaries**. A retractable **nano wall** allows the space to open up, enhancing **flexibility** and **promoting movement**.

Featuring **soft seating**, **markerboard tables**, and **biophilic elements**. These areas offer a **calming, collaborative environment** for small-group work or other creative ideas.



Figure 34: Makerspace Breakout Zone

PAINT



FIELD
Benjamin Moore
OC-56 Moonshine



CEILING
Benjamin Moore
OC-57 White Heron



TRIM
Benjamin Moore
CC-548 Asphalt



ACCENT
Benjamin Moore
CC-214 Golden Honey



RUBBER



Noram
ent
Satura -
Orion



Noram
ent
Satura -
Aquila



CF Stinson
Downtown -
Fiesta



Wolf Gordon
Nova -
Emberglow



Design Tex
Tilt -
Grove



Design Tex
Beguiled By
The Wild Mirk

ANCILLARY SPACES | TEACHER'S LOUNGE

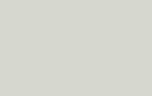
The teacher's lounge is a thoughtfully designed, multifunctional space that supports the success of the **co-teaching** model by providing educators with a **designated area to reflect, connect, and collaborate**.

With comfortable seating, calming design elements, and functional planning stations, the lounge encourages **meaningful dialogue, professional relationship-building**. Providing educators with a space to **co-develop curriculum plans** in a **supportive, low-stress environment**.

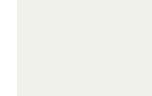


Figure 35: Teacher's Lounge

PAINT



FIELD
Benjamin Moore
OC-56 Moonshine



CEILING
Benjamin Moore
OC-57 White Heron



TRIM
Benjamin Moore
CC-548 Asphalt



ACCENT
Benjamin Moore
CC-38 Nightfall Sky

FLOORING



Bolon Botanic -
Spearmint



CF Stinson
Loophole -
Misto



Design Tex
Silicone Level -
Light Lilac



Momentum
Dome CV -
Nordic

UPHOLSTERIES



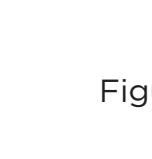
Bolon Botanic -
Spearmint



CF Stinson
Loophole -
Misto



Design Tex
Silicone Level -
Light Lilac



Momentum
Dome CV -
Nordic

WAYFINDING | CORRIDOR ELEVATION

The path of travel within a school day is particularly important for a student with neuro-diverse needs. Heavy considerations were made to **transitions, adjacencies, and the delineation of spaces**.

The most notable design feature throughout this capstone project is the **curved wall corners** that **guide users** into spaces such as breakout zones or classrooms. This rounded edge helps **decrease blind spots** and **ease transitions** for students with Autism.

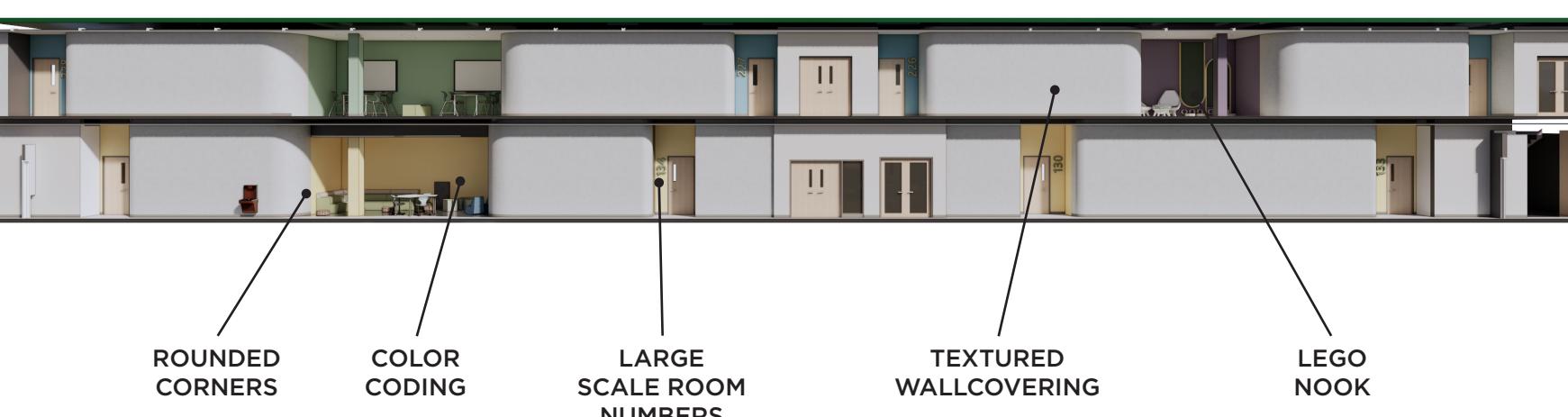


Figure 36: Wayfinding Corridor Elevation

CONCLUSION

This capstone brings together the profound impact that thoughtful environments can have on neurodiverse students. Through the integration of sensory design, flexible furniture, spacial adjacency considerations, and daylighting strategies. We move closer to creating inclusive spaces that support every child's ability to learn, grow, and thrive.

This project not only highlights the potential of design to address diverse neurological needs but also calls for a broader shift in how we approach educational environments—where empathy meets functionality, and every student feels seen, supported, and empowered.

As someone who has navigated the challenges of ADHD throughout my own educational journey, I understand how critical the environment can be in shaping a student's confidence, communication, and sense of belonging.

WORKS CITED

This capstone is more than a theoretical design proposal—it's an act of advocacy. It reflects my hope that through purposeful design, we can create classrooms that don't just accommodate physical or invisible disabilities, but embrace them.

Barrett, Peter, et al. "The Holistic Impact of Classroom Spaces on Learning in Specific Subjects." *Environment and Behavior* (2017): 425-451.

Black, Melissa Heather, et al. "Considerations of the Built Environment for Autistic Individuals: A Review of the Literature." *Autism* (2022): 1904-1915.

Castellucci, H. I., et al. "The Influence of School Furniture on Students' Performance and Physical Responses: Results of a Systematic Review." *Ergonomics* (2017): 93-110.

Gaines, Kristi, et al. "Part 3 Designing Realistic Environments." Gaines, Kristi. *Designing for Autism Spectrum Disorders*. Taylor & Francis Group, 2016. 95-198.

Park, Giyoung, et al. "Creating and Testing a Sensory Well-Being Hub for Adolescents with Developmental Disabilities." *Journal of Interior Design* (2020): 13-32.

Patel, Tina, Juliann Dorc and Allison Baker. "Development of special needs classroom prototypes to respond to the sensory needs of students with exceptionalities." *Journal of Architectural Research* 16 (2022): 339-358.

Thi Tam, An Nguyen, Eakachat Joneurairatana and Veerawat Sirivesmas. "The Relationship Between Spatial Form of Interior Learning Space and Children Behavior." *Solving Environmental Problems in the Construction Industry* (2023).

Vijapur, Diksha, et al. "A Ten-Year Review of Primary School Flexible Learning Environments: Interior Design and IEQ Performance." *Buildings* (2021).

Zakarya Habbak, Aya Lotfy and Laila Khodeir. "Multi-sensory Interactive Interior Design for Enhancing Skills in Children with Autism." *Ain Shams Engineering Journal* (2022).

APPENDIX

APPENDIX A - CAPSTONE PROSPECTUS

Interior Design Capstone Prospectus

Capstone Candidate: Autumn Howard, Senior Interior Design Student

School: College of Art and Design, School of Design | Rochester Institute of Technology

Program: Interior Design

Capstone Topic: Responding to Neurodiversity: Revolutionizing the Elementary Classroom

The Issue

The future of education looks much different post-pandemic. Spaces are now expected to deliver variety and vitality to support all work and all learning styles. Creating a space for children ages 6 through 10 to learn and engage with their peers goes beyond the physical environment and lies in psychological experiences as well. This capstone project aims to discover design methods and solutions that bring designers one step closer to creating conducive learning environments for users with neuro-diverse characteristics.

Capstone Justification

Interior design can create a space that is not only physically adaptive and functional but will also evoke emotional or cognitive responses as well. Sensory well-being is important for everyone, whether neuro-typical or neuro-diverse, and the interior space has the capacity to enhance the quality of human experience through reduced environmental stress and empowerment (Park). Giving individuals the flexible resources to support all needs is what the fundamental purpose of the built environment is (Gaines). Going beyond biophilia, elements like lighting, furniture organization, materiality, and color selections are all ways that interior designers can cater to the various needs of users across all marginalized groups.

Literature Review

Neurodiverse students are frequently marginalized and implementing new design strategies may help them to meet their maximum potential, support their well-being, establish a sense of self-empowerment, and create an inclusive environment simultaneously. Initial explorations focus on current trends and problem areas in elementary classroom design. Research thus far has proven learning environments must be transformed to create blended, flexible, and encouraging atmospheres that have the capacity to support all children. Developmental disabilities, as defined by Giyoung Park, "is an overarching term for impairments that begin in early stages of human development, including language disorders, autism spectrum disorders (ASD), cerebral palsy, and motor disorders. (Park). In most public schools, these students are often served in different classrooms from their peers. Efforts will be made to determine the current recognition of a more holistic sensory design approach that aims to bridge this gap between neuro-diverse and neuro-typical students.

The sensory thresholds that are created within a space are perceived much differently for neuro-diverse users and it has been understood that there is a value in helping create a tolerance to sensory stimuli to alleviate overstimulation. Hypersensitivity and hyposensitivity are terms that have been recurring in literature analyzed up to this point, meaning there is a recognized value in creating a space which can adapt for both ends of the spectrum. Majority of design information available to designers who work with the neuro-diverse population focuses on the physical needs of people with disabilities and do not tend to acknowledge the necessity of providing opportunities for individuals with neuro-diversities to express their full potential as well (Gaines). Thus, further research will inform what specific design elements and spatial organization methods that may benefit neuro-diverse individuals and not impose distractions for others. In addition, exploring relevant case studies and conducting an observational analysis in spaces that have already begun to create these interventions will help bring clarification as to why this topic is so important for future generations.

Research Agenda

The research agenda plans to utilize a variety of instruments to gain a thorough understanding about how neurodiverse students currently utilize and place themselves within a learning environment and determine in what ways we can make changes to better support their needs. Interviews with K-12 design professionals, furniture

dealers, educational leaders, and parents of this demographic will establish a concrete baseline for how the early childhood age group is often overlooked in environmental design. Going beyond literature and conducting tours of local Rochester schools as well as the Golisano Autism Center will provide a contextual analysis of how spaces are currently being used to support neuro-diverse children and discover how they still could use further assistance within the academic environment. The qualitative and quantitative research aims to discover design problems and solutions that will better support a positive environment which fosters growth and collaboration among every student.

Creative Agenda

The expected output will be a theoretical proposal for an inclusive elementary classroom and related spaces which considers all user needs from the beginning of the design development phase. It will have the ability to accommodate diverse learners who may have developmental disabilities and provide an adaptable environment that can serve a broader population of students. Current research has demonstrated the many ways teachers are trying to adapt their spaces to be more inclusive to sensory needs among students in their classrooms. However, this capstone will conceptualize a design where these needs are no longer an alternate option and instead integrated into the typical design standards of learning environments. It is expected that a project which conceptualizes a transformative classroom will include elements such as sensory zones, meaningful spatial and furniture organization, adjustable illumination options, acoustical barriers, and distinct wayfinding strategies.

Summary

The aim of this capstone is to investigate new methods of design that cater to children with exceptionalities in the classroom. The research activities conducted at and with the Golisano Institute Center, local school district members, furniture representatives, and educational leaders at CPL Architecture, Engineering, and Planning Firm will help to identify solutions and substantiate design strategies. These strategies will be implemented within an interior environment that will encourage the empowerment, growth, and learning to create a school atmosphere which is inclusive to barrier-free design.

APPENDIX B - INTERVIEW QUESTIONS

Research Agenda Instruments

Primary Source of Data Collection: Interviews

Group #1: Teachers

General Classroom Environment

- How do you currently structure your classroom? Could you describe any specific strategies, features, or setups you use?
- What do you think makes a classroom feel inclusive and accessible for all students?
- How do you approach the use of colors, textures, and displays, to make the space comfortable but not overwhelming?

Sensory Considerations

- How do you address sensory problems in your classroom? I.e. lighting, noise levels, seating arrangements
- Do you use flexible seating arrangements? If so, how do you decide where students sit, are there any special considerations for neurodiverse students?
- How do you manage the classroom when students are feeling overstimulated? Are there sensory tool or respite spaces available?
- How do you ensure students with different sensory needs can coexist within the same space?

Instructional Strategies

- What teaching methods or materials have you found most effective for neurodiverse students?
- How do you adapt lessons to cater to different learning styles or needs? Are there any subjects/curricula that require increased level of consideration?
- Do you have methods for both individual and group learning styles?

Classroom Routines and Transitions

- How do you help neurodiverse students transition between activities or spaces?
- What strategies do you have to create a predictable yet flexible routine for your class?

Communication and Social Interactions

- How do you encourage positive interactions among neurodiverse students and their peers?

Collaboration and Support

- How do you work with parents, specialists, or aides to support neurodiverse students?
- Do you gather feedback from neurodiverse students or their parents to adjust your teaching approach?

Challenges and Improvements

- What challenges do you face when trying to make your classroom feel more inclusive?
- If you could redesign your classroom environment, what changes would you make to better support neurodiverse learners?

Group #2: Administrators

General School Environment

- What are the school's overarching goals or policies regarding the inclusion of neurodiverse students?
- How does the school balance the needs of neurodiverse students with the general population when considering allocating resources?

Sensory Consideration

- What school-wide strategies are in place to address sensory needs? I.e. quiet areas, lighting, noise control in common areas like hallways or cafeterias
- Are there any school provided resources such as tools, furniture, or technology that are available to teachers?
- What trainings or guidance is provided to help staff understand and implement sensory accommodations?

Budget and Resources

- How are budgetary decisions made regarding investments in classroom modifications?
- Are there any grants, partnerships, or external funding opportunities the school has pursued?

Challenges and Improvements

- What are some of the biggest challenges the administration faces when creating inclusive environments?
- If you had unlimited resources, what would you implement school-wide to support neurodiversity?

Group #3: Design Professionals

Design Process and Philosophy

- Can you describe your general approach in starting education projects? What are your first considerations or priorities?
- How do you balance aesthetics with functionality when designing inclusive spaces?

Sensory Considerations

- How do you incorporate sensory-friendly features like lighting, acoustics, or textures?
- What are some of the most common challenges you address when designing K-12 spaces?

Specific Design Elements

- How do you approach classroom or building layouts to create flexible, adaptable spaces for all learning styles and student needs?
- What roles do materials play in creating inclusive spaces such as flooring, wallcoverings, furniture, or partitions?
- How do you incorporate technology? Are schools using more individually assigned devices or computer lab typologies?

Communication and Social Interactions

- What are some of the biggest design challenges you've encountered when designing for neurodiverse students? What are some solutions you have come up with accordingly?
- How do you design spaces that evolve over time and adapt to changing needs of students? Is it possible?
- How do you keep up on emerging design trends and implement them in ways that still support the needs of neurodiverse individuals?

APPENDIX C - SITE OBSERVATION CHECKLIST

School Observation Checklist

Date:

Teacher/Administrator: _____

School Name: _____

Grade Level(s) Observed: _____

1. Sensory Design

Noise Levels 1 2 3 4 5

- Quiet zones available for students
- Acoustic treatment in classrooms (e.g., sound-absorbing panels)
- Impact of external noise (traffic, playground, etc.)

Visual Environment 1 2 3 4 5

- Color scheme (calm vs. overstimulating)
- Wall displays (cluttered vs. intentional)
- Accessibility of visual cues (e.g., posters, signs, labels)

Sensory Accessibility 1 2 3 4 5

- Fidgets, cushions, or sensory tools provided
- Designated sensory break areas

2. Furniture Design

Flexibility 1 2 3 4 5

- Adjustable furniture for different body types and needs
- Modular desks and chairs for collaborative work

Ergonomics 1 2 3 4 5

- Comfortable seating for extended use
- Correct desk height for age groups

Inclusivity 1 2 3 4 5

- Accessible furniture for students with mobility challenges
- Only located in dedicated special education classrooms?

3. Biophilic Connection

Natural Light 1 2 3 4 5

- Presence of windows in learning spaces
- Glare management (blinds, curtains, coatings)

Artificial Light 1 2 3 4 5

- Adjustable lighting (dimmers, task lights)
- Warm vs. cold light impact on the environment

Balance 1 2 3 4 5

- Strategic combination of natural and artificial lighting

4. Spatial Organization

Flow and Navigation 1 2 3 4 5

- Clear paths for movement
- Logical organization of spaces (classrooms, breakout areas, restrooms)

Classroom Layouts 1 2 3 4 5

- Zoning within classrooms (e.g., reading corners, activity spaces)
- Open spaces vs. confined areas
- Ways the classroom is divided (e.g., furniture, structural partitions, materiality differences)

Accessibility 1 2 3 4 5

- Ease of access for students and staff (e.g., ramps, wide hallways)

If there are numerous floors, how are each laid out

5. Relationship Between Spaces\

Proximity 1 2 3 4 5

- Relationship between noisy areas (e.g., gym, cafeteria) and quiet spaces
- Placement of breakout rooms or specialized spaces
- Distance between those spaces (e.g., numerous floors)

Cohesion 1 2 3 4 5

- Continuity in design elements across the school
- Integration of indoor and outdoor spaces
- Common color palette or use of color organization

Inclusivity of Space Usage 1 2 3 4 5

- Flexible spaces usable for various activities
- Availability of private areas for students needing breaks
- Transitional strategies currently used between spaces

Additional Observations

