Exploring the Impact of Learning Space Design at Home for Children with Autism

Fatemeh Marzban
Dr. Sharran Parkinson - Spring 2021

ABSTRACT

In 2020, the Centers for Disease Control and Prevention (CDC) reported that, in 11 states, 1 in 54 children age eight were diagnosed with Autism Spectrum Disorders (ASD), which is an increase from 1 in 68 in 2012 (Maenner, Shaw, Baio, et al., 2020). According to studies (Gaines et al., 2016; Mostafa, 2008, 2009, 2018; Khare & Mulick, 2009), the environment and surroundings significantly impact individuals with ASD. Providing a supportive physical environment helps these children better recognize and understand their surroundings and helps to prevent them from exhibiting negative behaviors (Gaines et al., 2014). The COVID-19 pandemic has resulted in unexpected effects on the daily lives of these children and their families. These changes are particularly challenging for children with autism spectrum disorder (ASD) because they depend and thrive on routine, coherence, and structure. The process of adopting remote learning that provides the same stability and structure as the classroom for these children and their families is an ongoing and difficult challenge. Families were not ready for this quick change, and many continue to need support and solutions. However, unlike classrooms and schools, there are no set guidelines that outline optimal design features for supportive home learning environments.

The aim of this study is to create a home learning space that improves e-Learning performance for children with Autism (ASD) and identifies design criteria that can help create a supportive home learning environment. Within this study, strong emphasis will be placed on identifying elements of the physical environment that influence students with ASD’s engagement when learning at home, whether through homeschooling or e-learning programs.

RESEARCH QUESTION

What design solutions can be implemented to improve performance in remote learning for children with ASD at home?

METHOD

The systematic literature review proved to be an effective method for gathering information related to school and classroom design for children with ASD. However, there is a limited amount of literature available on home design. This represents a gap and lack of research on physical learning environments in homes for children who are too sensitive to their environment. To address this, features of the physical environment in the school, classroom, and home were studied and then synthesized in order to create a toolkit that provides information regarding the design of home learning environments for children with ASD. Another way data was collected was through interviews with professionals and ABA analysts in the field of autism. After completing the proposed tool kit, an interview with a subject matter expert was conducted to ensure different aspects of supportive home learning environments were covered and to receive feedback on whether the proposed design strategies and recommendations were effective.

THEORETICAL FRAMEWORK

Two theories were used in this study to investigate relevant information and establish a design criteria for supportive home learning environments for children with ASD.

- **Sensory Integration Theory**

  Sensory integration theory was developed by Fisher, Murray, and Bundy (1991) to better understand how humans’ sensory input helps them interact with their environment (Sandri & Marcarini, 2018). Children with ASD have sensory integrative dysfunction, which means their brains do not organize and process the environmental information in the same ways that neurotypical (NT) people’s brains do. This theory can help designers create environments based on the user’s sensory information and help them better understand the environment. This theory emphasizes the use of sensory information to improve people’s interactions with the environment. Most existing literature on school and classroom design focuses on sensory design (Sandri & Marcarini, 2018).

- **Environmental Preference Theory**

  The environmental preference theory was developed by Kaplan & Kaplan (1989). Kaplan & Kaplan identified four characteristics of the environment (coherence, legibility, complexity, and mystery) that help create an environment that increases individuals’ engagement and comfortable living within the space (Sandri & Marcarini, 2018).

  - **Coherence**
    
    “Features in the environment that help organize and understand the space, including features that direct our attention” (Gaines et al., 2016, p. 48).

  - **Complexity**
    
    The degree of visual details available in the environment, the level of information detail, the scene’s diversity, and the environment’s richness (Gaines et al., 2016, p. 48). Essentially, in a given context, complexity represents how much is going on (Herzog and Leverich, 2003).

  - **Legibility**
    
    A space that is easy to understand and to remember. A legible space contains distinct features that aid in wayfinding, making it easy both to find the desired location and to return to the point of origin” (Gaines et al., 2016, p. 48).

  - **Mystery**
    
    “Features in the environment that invite or encourage further exploration of the environment with the promise that one could learn more” (Gaines et al., 2016, p.48).

AUTISM SPECTRUM DISORDERS (ASD)

According to the Autism Speaks organization (2020) “Autism, or Autism Spectrum Disorder (ASD), refers to a broad range of conditions characterized by challenges with social skills, repetitive behaviors, speech and nonverbal communication.”

AUTISM CHARACTERISTICS

Sensory processing is another characterization of individuals with ASD. They have deficiencies in sensory processing due to the failure to perceive input from many senses at once. It is difficult to quickly transfer focus between two different stimuli, and irregular sensory processing may cause odd behaviors to be exhibited. Several studies (Brooke, 2010; Shabah, & Gaines, 2012; Gelman, 2016; Nazi, & Ismail, 2016; Gaines et al., 2016) group this population into two categories, hypersensitive and hypersensitive, based on their response to environmental stimulus. Hyper-sensitive children are excessively sensitive to environmental stimulus (e.g., very sensitive to loud noises). Hyper-sensitive children do not exhibit responses to the environmental stimuli. These children have lack of sensitivity to noise, pain, and temperature. ASD is a neurological condition that affects the way a person experiences and interacts with the world.

DEFINITION OF LEARNING SPACE

Learning space refers to the physical settings in which learning occurs and learners accomplish their work.

The physical characteristics of learning spaces play a strong role in the effectiveness of student learning. In his paper titled “The Psychology of Learning Environments,” Graetz (2006) indicated, “In any learning environment, physical characteristics that cause discomfort can be expected to interfere with learning; environments that produce positive emotional states can be expected to facilitate learning and the development of place attachment” (p. 62). The space and its physical characteristics can help to generate or create positive feelings. The more these positive feelings occur, the stronger the learner’s positive association with that space, a process which ultimately leads to the physical space transforming into a place.
SUMMARY OF LITERATURE REVIEW

Relative literature was conducted on the classroom learning environment for students with Autism diagnoses, as well as studies related to the effects of the physical environment and its features on the learning for children with ASD. Also, literature review reviewed on homeschooling and e-Learning for these children.

There are two main streams that force researchers to pay attention to this subject including homeschooling and e-learning as two styles of education, which also grabbed attention during the COVID-19 pandemic. And the results of research on Homeschooling and e-Learning indicated that both have benefit for children with ASD.

Furthermore, there are different educational interventions for children with ASD and one of the most important and effective intervention is Applied Behavior Analysis (ABA) approach. These educational interventions indicated that environment and surroundings are significantly impacts on children with ASD AND their learning process. Therefore, educational interventions, homeschooling, e-learning and research during this pandemic, ALL, suggest creating learning space as a strategy to help children do their schoolwork.

The point is that there is a great deal of information about accommodating these children within a school setting, however, there is no research devoted to designing and creating learning spaces/environments at home.

- **Homeschooling**
  - Reduce anxiety (children with ASD and parents)
  - Improve academic performance
  - Foster positive social interactions

- **e-Learning**
  - Increasing learning experience for children with autism
  - Enjoy repetition
  - Children with autism preference for visual stimuli
  - Predictable, rule-based structures with repeated patterns

**Design elements** for learning environments and spaces for ASD from literature:

- Noise
- Sight (light, color, visual stimuli)
- Touch
- Space organization (zoning, spatial sequencing)
- Break/Quiet space (Planned Escape)

**E-Learning**

- Predictability
- Flexibility
- Safety
- Controllability

**Sensory Integration**

- Visual and Auditory
- Tactile and Kinesthetic
- Proprioceptive and vestibular

There are Seven well-known design guidelines for designing schools and classrooms. Each of them was studied and analyzed through a cross-examination method to understand communities among them and how those guidelines can be applied to home learning environments. This illustration provides a breakdown of these existing design guidelines and shows the categories the design elements were placed into.

**REFERENCES**

These interviews were conducted with Applied Behavioral Analysis OR ABA analysts which provided valuable insights into this issue. Design strategies were extracted from these interviews, including the idea that design should be flexible so it can match with different styles of intervention for different families. Providing an environment that gives children different choices, relies on children’s preference, and is clutter and distraction free were also important and takeaways. Here, Clutter refers to organization and distraction refers to high preferred items.

**SUBJECT MATTER EXPERT INTERVIEWS**
**PROPOSED HOME LEARNING ENVIRONMENT TOOLKIT**

### 01 NOISE

Noise is the first important issue for children with ASD. Acoustical treatment is a strong strategy to minimize sounds.

**DESIGN STRATEGIES:**
- Acoustic Wall tiles/ cork wall padding
- Carpet tiles/ Cork flooring (absorb sound)
- Rugs
- Covering windows with heavy curtains to prevent sound from outside
- Separating the "loud" spaces and "quiet" spaces within the home

### 02 NATURAL LIGHT

The goal of Natural light is to achieve evenness and clarity through the space. Natural light should provide indirect and minimize glare. Studies recommend that both natural light and artificial light used in the space. Artificial light should not produce sound like fluorescent lighting and it is recommended that the light source should be invisible.

**DESIGN STRATEGIES:**
- Natural lighting
- Using natural light in all rooms as much as possible (indirect).
- Artificial lighting (General Lighting): Task Lighting
  - Opaque windows
  - Uplight
  - Task light

### 03 SIGHT

Individuals with ASD have hard time filtering background information, therefore, spaces should be as legible as possible. Eliminating unnecessary information around the child like posters, books is important. Storage space is the good strategy for decluttering spaces.

**DESIGN STRATEGIES:**
- Minimizing details (Minimal visual wall decorations, visual stimuli)
- Prevent glare
- Avoid surfaces that reflect light
- Provide visual cues
- Visual signage
- Clutter and distraction free (visual stimuli)
- Storage space
- Spring loaded curtain rod

### 04 COLOR

Colors is another important issue in designing environment for these children. Studies indicated that color is powerful tool to promote calming environments for these children and help them reach a level of comfort necessary for task completion.

**DESIGN STRATEGIES:**
- **Green**
- **Brown**
- **Blue**
- Avoid warm color (red and yellow)
- Using cool colors
- Using neutral colors
- Preference of the child

### 05 TOUCH

Another main issue according literature is the tactile nature of the environment. Some children with ASD refuse to touch specific textures. It is recommended that soft surfaces are provided for these children and tactile tools are available to help them improve their touch sensory.

**DESIGN STRATEGIES:**
- Texture (Soft surfaces)
- Soft stimuli
- Temperature (cold and heat)
- Tactile tool (sensory wall, sensory walk)
- Textural Rug/Carpet (add tactility to space)

### 06 SPACE ORGANIZATION

Spatial sequencing is another important design elements. Areas should flow as seamlessly as possible from one activity to the next through one-way circulation with minimal disruption and distraction.

**DESIGN STRATEGIES:**
- Space sequencing
- Create separate learning zones and spaces of various sizes, compartmentalize space
- One-way circulation within room
- Routine and schedule
- Creation of a clear separation between areas of the home, dividing them by their function and purpose
- Color-coded

---

*Exploring the Impact of Learning Space Design at Home for Children with Autism*

**Fatemeh Marzban**

Dr. Sharran Parkinson - Spring 2021

---

**THEME: SENSORY COMFORT**

**THEME: SENSORY RATIONALITY**

**THEME: SENSORY SAFETY**

**THEME: PREDICTABILITY CONTROLLABILITY**

**COMPATIBLE COMPONENTS**

- 02 MATERIAL
- 04 FURNITURE
- 09 TRANSITION

---

*The Covering windows with heavy curtains to prevent sound from outside can help reduce noise.*

*Artificial lighting with moderation can help create a calming environment.*

*Colors should be chosen to promote calmness and comfort.*

*Touch elements should be integrated into the design to enhance sensory experiences.*

*Space organization is crucial to create a conducive learning environment.*

---

*Image credits: madisonhouseautism.org*
Exploring the Impact of Learning Space Design at Home for Children with Autism

Fatemeh Marzban
Dr. Sharran Parkinson - Spring 2021

PROPOSED HOME LEARNING ENVIRONMENT TOOLKIT

07 FURNITURE
Furniture is another design element in the tool kit that can provide flexible, predictable, and controllable environments. The important design strategy is to provide different choices in the environment to motivate the children. One example is to provide different seating area to help them release their energy and stay seated during work.

DESIGN STRATEGIES:
• Different seating areas is about the power of choice
• Modular seating
• Movable furniture
• Arrangement of furniture
• Transparent acoustic panel/partition

09 TRANSITION
Individuals with ASD have a hard time changing activities, shifting from one activity to another, and changing environments. Clear transitions are necessary to overcome these challenges. Transitions can be formed by different strategies including level changes, floor coverings or creating landmarks to indicate separate functional areas.

DESIGN STRATEGIES:
• Use visual cues to give her/him sense of entering another activity zone; visual timer, visual schedules (Hume, 2008)
• Anticipate the surrounding
• Trying to use of multiple senses for transitions like color, tactile experience, picture, and written structure.

08 ESCAPE SPACE BREAK ROOM
The goal of an escape space is to provide an alternative to the over stimulation found in other environments for children with ASD. Empirical research has shown the positive effects of such space, specifically in learning environments.

DESIGN STRATEGIES:
• Sensory corner
• Tent
• Soft stimuli
• Tactile and Visual Sensory Tool

05 TOUCH TOOLKIT
The design features should be comprised of Natural and durable materials.

DESIGN STRATEGIES:
• Natural material (nature colors are soothing, like green and brown)
• Soft surface
• Avoid materials with toxic
• Durability

03 SIGHT

06 SPACE ORGANIZATION

10 MATERIAL

THEME: SENSORY

COMPATIBLE COMPONENTS
02 LIGHTING
04 COLOR
06 SPACE ORGANIZATION

SAMPLES BASED ON PROPOSED TOOLKIT

An example of a home with extra room dedicated to a learning environment. Visual cues are provided for the child in her/his daily schedule for routine and predictability.

This is a sample of a transition space for children at home. Parents can help their child to shift from play and fun environment at home to learning environment at home. As these children think home is not place for learning.

This is a sample of a home that does not have extra room and the child’s bedroom is used for learning activities. The Partition used in this space covers the bedroom and other high preference items to help child concentrate on activity.

CONCLUSION

The main concept of this tool kit is flexibility. When discussing flexibility, two factors are of great importance and should be considered at all times; the child’s preference and skill level.

This study is meant to serve as a foundation for further research into home learning environments tailored for those with ASD. Future research should consider a variety of different factors and variables.