Designing for Children
- With focus on 'Play + Learn'

Touch + Space: Active Learning for Visually Impaired Children

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Abstract: The manipulation of objects is an essential part of learning. Children with visual impairment have a paradoxical relationship with touch; many are hesitant, even fearful to reach out and explore their surrounding; yet they have much to gain by engaging their sense of touch. The lack of one sense increases the importance of the remaining ones. This project has involved looking at existing systems that encourage exploratory behavior in blind children, researching early childhood education, and observing in classrooms for the blind and multiply disabled. The research led to prototypes aimed at engaging visually impaired children in active play. The goal for the designs is to create a system of activity mats that empower children to participate actively in their environment while building cognitive, social, and physical skills.

Key words: Vision Impairment, Children, Toys, Active Learning, Play, Disabilities.

1. Introduction

Touch and Space began with vague notions of the challenges faced by the blind and only hazy ideas of possible design interventions. While the initial interest was in vision impairment general, the project began by investigating all age groups and abilities of the visually impaired. Research and observations revealed many opportunities in designing for blind children. The design could make an impact over a longer period of time and be introduced more seamlessly into the educational environment. Having discovered through research the prevalence of passive behavior in blind children, the question arose, "how can designed objects engage visually impaired children productively and actively in their environment?"

To learn more about vision impairment and its impact on early education, I created relationships with schools. At the Perkins School for the Blind, which focuses on the education of the visually impaired from infancy through high school, I spent time building and modifying equipment in the assistive device center and observing children in the preschool program. There was a free exchange of ideas and knowledge amongst myself, the teachers, and occupational and physical therapists. I also worked with a teacher of visual impairment at Meeting Street, a school that educates children of all abilities. While it was important to the project that the schools taught children with vision

impairment, I found the integrated classrooms and varied abilities of the students to be an important inspiration.

As the project progressed, discoveries made during research and decisions that came out of my explorations informed the development of a set of goals and criteria for evaluation:

Encourage object based learning.

Enable proficiencies in skills that would allow the child to function at the highest level possible.

Give children a sense of accomplishment, independence, and self-confidence that can transfer to real world situations.

Create an environment that encourages exploration and active learning for blind children.

2. Blindness

A person is considered legally blind if "visual acuity is not greater than 20/200 in the better eye with correction or a field not subtending an angle greater than 20 degrees."[1] This is only a medical definition, but understanding the condition is much more complex. There are many causes of blindness—age, disease, nutrition, trauma—which can occur at birth or later in life. Each person affected by vision impairment has a unique deficiency and severity of sight loss. Vision impairment is a very individual experience; no two people will see, interpret, or use their vision the same way. What remains the same with every totally blind, legally blind, or low vision person is the need for coping mechanisms to deal with their impairment and its impact on daily life. For individuals born with vision impairment and adults dealing with vision loss for the first time, there are many ways to deal with the obstacles presented by the impairment in daily life. The solutions to these problems should be specific to the individual, meeting their needs and wants and be focused on independence, productivity, and safety.

3. Observational Research

The most valuable research and background information for Touch + Space was gathered by observing preschool and kindergarten classrooms and interviewing teachers and physical and occupational therapists. Creating connections with teachers and students resulted in a design process that was responsive to the needs of the children and the realities of the classroom environment. The observations revealed individual abilities and characteristics of each student. It was obvious which activities the children enjoyed and how the teachers guided the play activities to teach concepts and skills. The teachers provided expertise regarding skill acquisition, free and directed play, and learning toys.

The Meeting Street School follows an integrated classroom approach where part of the class has special physical, cognitive, or emotional needs and the students have an individualized education plans. The other part of the class is on a regular track of education. All activities are part of a routine creating a stable environment where the children learn through repetition and experimentation.

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[1] P. 81, "Who Is Blind?" by Kenneth Jernigan, If Blindness Comes

The Perkins School for the Blind educates children with visual impairment from infancy through high school. I volunteered at the school's assistive device center. The center is run by an occupational therapist, where she and a team of volunteers, parents, and therapists build and modify equipment. Most of the modified equipment is furniture and games. Everything is low-tech, home grown adaptations focused on the needs of the blind students. Adapting games for the blind involves adding tactile components, textures, and changing printed information into auditory or three dimensional equivalents.

Also at the Perkins School, I observed preschool classes. The children range widely in their vision impairment and their cognitive and physical abilities. The children work individually with a variety of therapists—speech and language, physical, and occupational. Because many of the children have a lot of medical needs the teachers place extra importance on not having the therapy sessions seem like therapy in a medical sense. This is done by giving fun names to the activities such as finger fun for occupational therapy and giving work in the form of games and play.

At both schools classroom activities must be adapted to different levels of ability to accommodate all children in the integrated classrooms. One example is how children sign-in every morning. Some children can copy their names, some trace over or connect the dots, and others are using stamp letters with the assistance of a teacher. A few of the children work unsupervised while with other the teacher uses a hand-over-hand method to guide the movements of the child's hand. The goal is the same, but the method is adjusted for each child.

4. Educational Assessments

The teachers were continually emphasizing a child's need to learn skills and concepts. The ability of the child to demonstrate these skills is how success can be judged and it is what enables the child to move on with their education through completion of assessment evaluations. The teachers were interested in tools that engaged the child in actively learning a concept or skill.

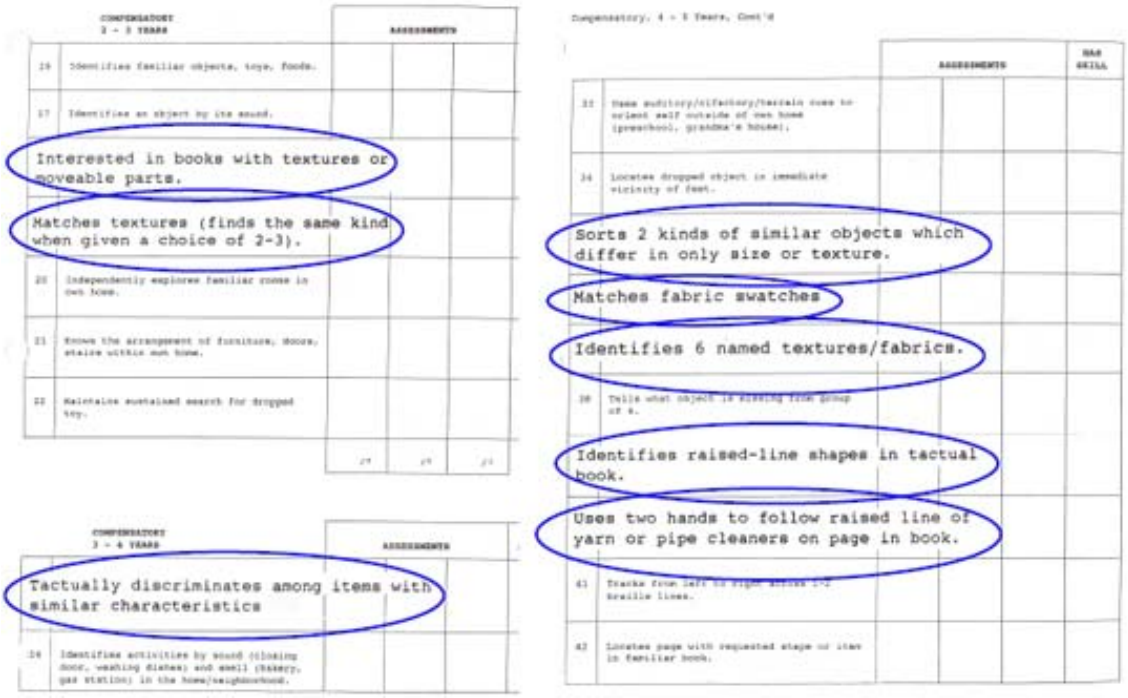

Figure 1. Perkins Preschool assessment documents

Using the assessment evaluations and meetings with teachers and occupational therapists, lists were compiled of skills and activities. Working with the two lists links between possible activities and skills on the assessments were explored.

The skills listed on the assessment pages were very specific. Initially, two categories were created to divide the skills into, academic and motor. As the skills were further evaluated, the distinction between the two categories decreased. The skills investigated included cognitive concepts, motor skills, tactile skills, sensory integration, spatial skills, and self-care skills. Motor skills include all the skills and planning to effectively manipulate objects and understand space. The majority of self-care skills fall under the motor skills category. In general, self-care skills are considered any function or task an individual performs to live independently. For young children most self-care skills concern dressing, which requires finger dexterity and strength along with motor coordination and planning.

Category	Skill
Cognitive Concepts	beginning, middle, and end concepts, same and opposite, sorting, matching, patterns, design copy, identifying, and categorizing, pre-Braille skills (finger following and texture matching), math concepts (one to one relationships, short and long concepts, measurement, counting, and fractions)
Motor skills	bilateral coordination (two handed coordination), fine motor skills (coordination of small muscle movements in the fingers), finger strength
Sensory integration skills	body awareness, motor planning (understanding of the steps required to execute a given task and perform them in the correct order)
Spatial concepts	near, far, up, down, top, bottom and the language to describe location

Table 1. Skill categories

5. Design Development

Throughout the research and observation process quick brainstorms were generated that expressed the design possibilities. Ideas ranged form plush toys to therapeutic and tactile clothing to group and individual play spaces. Some ideas used the sensory stimulation of water or wind while others sought to encourage a child's understanding of spatial relationships. The direction that the project ended up taking followed very closely to the skills assessment and focused on skill acquisition and creative play geared toward children with visual impairment. The final design, intended for children from three to six years of age with visual impairment, is a set of five activity mats designed to develop key skills was tested with four children with visual impairment. Because of the varying abilities of the children, the mats were designed to function at many levels of ability and can be used as part of a focused lesson or by the child independently as free play.

6. Designed Activity Mats and Observational Testing

The designs were tested with four visually impaired children. Instead of presenting the designs of the activity mats as independent of the interactions of the children with the product, the skill and design components of the individual mats will be listed in conjunction with the observational testing process. Also, potential refinements based on the observations will be discussed with each mat.

All the tested subjects are visually impaired. Two are legally blind, Hailey, age 4, has no other disabilities and Michelle, age 6, has additional cognitive and physical impairments. Josh and Justin, both age 5, have low vision with additional physical and cognitive disabilities. Josh and Justin use wheelchairs, and Justin has low muscle tone and limited fine motor skills.

To test the mats, the children worked with their teacher. The teacher gave verbal and physical guidance when needed and encouraged the children to perform the tasks independently.

Figure 2. Josh and Justin playing with several activity mats.

6.1 Finger Following Mat

Figure 3. Finger Following Mat in use at Meeting Street School.

Primary Skills:

Cognitive concepts, fine motor skills, spatial concepts, pre Braille line following, trailing, marking location, tactile exploration, tactile discrimination, tolerating textures

Design Components:

Stacked fleece to create raised line for activity, hidden texture rewards for following the line

Observations:

Each child used the finger following mat in a different way. Some children did an overall tactile search of the mat, feeling the raised line and searching out the tactile reward areas. Michelle was very focused on following the line which she called, "the road." At first, when following the road, she would use only one hand, but was motivated to use both hands when she found the rubbery texture. Surprising the teacher, she figured out how to turn the worm like pieces into a musical instrument, stretching them out and plucking them. Initially this was done with assistance. The teacher would stretch the piece out, and Michelle would pluck it. Michelle then figured out how to use both her hands to control the activity. According to her teacher she does not use her sub-dominant hand unless very motivated.

Refinements:

The overall design of the mat worked well. Areas of possible refinement would be the individual tactile reward areas. An occupational therapist at the Perkins School was interested in having interchangeable tactile areas to increase texture tolerance in sensitive children. A simple Velcro or zip system could be developed which would allow teacher, therapists, and children to use textures or materials of their choice.

6.2 Drawing Mat

Figure 4. Hailey playing with the drawing mat.

Primary Skills:

Creative play, making patterns, design copy, math concepts, cognitive concepts, fine motor skills, finger strength, spatial concepts, pre Braille line following, tactile exploration

Design Components:

Tactile grid, four lengths of drawing sticks determined by grid spacing and one curved drawing stick each in a different color, Velcro-like connection between drawing sticks and mat, compartment with color and size matching compartments

Observations:

Using the grid mat with Hailey demonstrated the use of textures and materials in the piece. She eagerly arranged the drawing sticks on the grid of the mat, drawing a circle with teacher assistance. Flipping the mat upside down and shaking, the teacher explained the sticky properties of the material. Hailey mimicked her teacher's movements testing the strength of the material for herself. She is at the beginning states of learning to sort and match. While she has enough sight to see colors, she still does not know color names. She struggled with putting the pieces away in the pocket on the back of the mat. And while it is not the goal to have each child be proficient with the task the first time they used it, it would have been more intuitive for her to match textures in addition to color and length.

With Josh, the teacher used the activity to identify colors. It started by him picking up a piece and the teacher telling him the color. Then she began asking him to find specific colors. He drew a few shapes, but also traced letters and shapes that were put down for him. A few times the teacher drew his hand along the drawing sticks surface, making a finger following game which was not anticipated.

Refinements:

The addition of varied textures and materials to the drawing sticks and the insides of the compartments would make the activity mat accessible to children without sight and more engaging for children of all abilities. The child would be able to sort and put away the drawing sticks by length, color, and texture. The textured drawing sticks would also engage pre-Braille texture matching skills and create another way to use the mat.

6.3 Snap Mat

Figure 5. Hailey exploring buttons on the Snap Mat.

Primary Skills:

Self care skills, fine motor skills, finger strength, bilateral coordination, motor planning, spatial concepts, marking location, tactile exploration, tactile discrimination, texture matching

Design Components:

Four fastening tasks each with different textured fabric for beginning matching skills, fastening tasks are ordered in level of difficulty, contrasting fabric, hidden reward pocket

Observations

The snap mat was productively used by children of different abilities. Justin used the mat to feel textures and turn the pages of fabric. While experiencing the tactile qualities of the fabrics, he practiced large arm movements and controled of his left and right side independently. Hailey felt all the textures on the mat, but only fastened the top two layers. The snaps required a lot of finger strength after lining up the top and bottom parts of the snap. The buttons used fine motor skills and bilateral coordination. Hailey had an easy time matching up the button with button hole through matching color. She felt success when finishing the last button on the top of the mat. The teacher praised her, and she held the mat up with pride.

Refinements

The snap mat had the broadest appeal to children and teachers. The snaps used in the mat were very stiff and required excessive strength. The material containing the snaps caught between the snaps. A simple interfacing could be added making the material flat and stiff to prevent its interference with the activity. The fastening activities are lined up directly over each other which created an uneven working surface for the children. The fastening activities could be staggered across the mat creating a flat area for each to be manipulated.

7. Conclusion

The activity mats were enthusiastically received by teachers and children. They were able to quickly figure out how to use the mats at the appropriate level. The various layers of skills and information presented on each mat did not interfere with the children's ability to use the mats at their own pace. The activity mats provide multiple experiences for exploration, learning, and strengthening visual, tactile, and motor skills in original and imaginative ways. The mats are also a way to encourage exploration with little or no frustration. The child uses the mats to explore for the sake of their own enjoyment and sense of accomplishment.

The process of testing the activity mats with children presented many opportunities for further designs and modifications. Educational material can be developed to present the mats as activities with beginner, intermediate, and advanced options.

While all the testing took place in the classroom settings, the mats could be used in home environments giving parents the opportunity for directed instructional play. The activity mats could be a crossover toy, encouraging siblings of different abilities to play and learn together.

The mats do not have a medical quality, which is often evident in toys for children with disabilities. The absence of the medical model creates a more universal product, appealing to children and adults of all abilities. The market opportunity exists for universal toys which appeal to children of all abilities, but the qualities of this product could be expanded into other markets. Self-care skills could be taught to young adults with disabilities with an expanded set of activity mats.

By having a research and observation based project, a much richer experience is created for designer and user. By working with teachers and occupational therapists, the design explorations received direct feedback. The feedback was used to problem solve and resulted in much richer designs. The layers of information evident in the designs would not have been possible without understanding the complexity of early education for the visually impaired. The addition of highly visually elements to a largely tactile design benefited low vision students and opened up the possible user groups to children with

varying abilities. The aim of the project was general at the beginning, specific during the design development phase, and in testing was opened up to include a diverse population of children. Further adaptations of the mats to include the aging population and rehabilitation patients would be possible with additional research and observation.

References

"All We See Is Possibility." Watertown, MA: Perkins School for the Blind, 2006.

Dunnett, Jenefer. "Use of Activity Boxes with Young Children Who Are Blind, Deaf-Blind or Have Severe Learning Disabilities and Visual Impairments," Journal of Visual Impairment & Blindness, 93 no. 4, (April 1999): 225-233.

Lear, Roma. *Look at it This Way: Toys and Activities for Children with a Visual Impairment*. London: Butterworth-Heinemann, 1998.

Maurer, Marc, ed. *If Blindness Comes*. Washington, DC: National Federation of the Blind, 2001.

National Eye Institute. "Eye Disease Simulations." Available from http://www.nei.nh.gov /photo/sims/index.asp; Intranet.

National Eye Institute. "Prevalence and Causes of Visual Impairment and Blindness."Available from http://www.nei.nh.gov/eyedata/; Intranet.

Interviews

Allen, Beth. Teacher, Perkins Preschool. Multiple interviews by author, 2007, Watertown, MA.

Catrozola, Mike. Perkins School for the Blind. Interview by author, 11 October 2006, Watertown, MA.

Charlson, Brian. Director of Technology, Carroll Center for the Blind. Interview by author, 5 September 2006, Newton, MA

Driscol, Norma. Director, Perkins School for the Blind Preschool Program. Interview by author, 5 February 2007, Watertown, MA.

Foley, Brendan. Teacher of Visual Impairment, Orientation and Mobility Specialist, Meeting Street. Multiple interviews by author, 2006- 2007, East Providence, RI.

Nordman, Heidi, Director, Bright Futures Program, Meeting Street. Interview by author, 30 March 2007, Providence, RI.