Design for Social Inclusion
Experience Design for Children with Developmental Disabilities

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Abstract: This paper examines the roles of emotion, cognition, behavior, and motivation as a methodology for designing and evaluating the effectiveness of educational experiences for children with developmental disabilities. It also examines the role of experience design as a socially mediating device that can serve as a way of moderating or enhancing social inclusion. In particular games and technology are examined with respect to their inherent socially mediating properties. The educational games developed through these student projects can be used as case studies in schools or clinical settings to study their effectiveness with the target audiences.

Key words: experience design, universal design, inclusive design, design for children, developmental disabilities, autism, epilepsy, cerebral palsy

1. Introduction
A studio project for the design of an educational game is used to teach audience analysis, creative problem solving, behaviorism, educational strategies and multi-sensory communication to graphic design and engineering students. Students must select a target audience of children with epilepsy, autism, or cerebral palsy between the ages of 2 and 5 years old. Their solution must incorporate the use of sign language, an age appropriate learning objective, and a game paradigm to socially mediate play-based interactions with typical peers, caregivers, or parents. The game must be fun and motivational to the child with disabilities and to their typical peers. The solution must consider the unique abilities and challenges faced by children with developmental disabilities. It must also make the learning process easier for non-experts and must include a system to reward users for correct responses.

This project is one assignment in a graduate level course that is part of the required curriculum for MFA students in graphic design. It is also an elective course in the MA and Ph’d programs in the Human Computer Interaction (HCI) as part of a design concentration. The project is also included as an assignment in an online course for the MA program in HCI. The HCI students have backgrounds in computer science, engineering, business or other technical fields. For many of those students this is their first course in visual information design.

2. Design Methodology
The design methodology uses a combination of research techniques from fields such as perceptual psychology, occupational therapy, physical therapy, education, and neurology in order to understand and identify those concepts that affect human interaction, graphic design, and sensory communication.

The methodology then incorporates basic design principles such color, typography, and grid structures as techniques to organize and enhance visual information. These principles are taught through demonstrations,
hands-on exercises, and critiques where students receive instructor feedback. The visual design of the educational experience is informed by the research from the other areas.

2.1 Experience Design
Students are required to research ways of identifying and utilizing emotion in the design of user experiences. Their research should indicate how design can be used as a catalyst or facilitation tool for human interaction on a variety of social, emotional, and cognitive levels. At the experience design level, physical, sensory, and informational needs must all be addressed. In addition, the experience should be able to accommodate all target audience groups in an integrated way. This means that successful projects have multiple learning opportunities and multiple ways of being praised or motivated through reinforcement.

In his book, *Designing Interactions*, Bill Moggridge says that usability is only first quality of a technology. He sites the “Software Design Manifesto” by Mitch Kapor that says, “…we must start by thinking about designing things so that they’re right for people, rather than by thinking first about how to build it.” Our designs, says Moggridge, need to provide more than utilitarian needs and the functions which satisfy them. They should also satisfy us emotionally and enrich our lives. Interaction systems, he says, have both implicit and explicit meanings. And design should communicate on one level the purpose of an object or an experience. But at another level, it should communicate about aesthetics and quality. The final level of design, says Moggridge, is designing for sociability; that aspect of a design that supports the social aspects of work or leisure. [1]

2.2 Education Theory
According to John Dewey, in his book *Interest and Effort in Education*, a child must be challenged by an experience in order to be conscious of his or her actions. When challenged, says Dewey, children think about what they are doing rather than just doing an action blindly from instinct or habit. [2] For children with disabilities, it is critical to take their actions beyond the habitual or ritualized into sufficiently motivating and challenging directed activity. Therefore in order to facilitate both the child with disabilities and a typical peer, the designed experience must have a variety of challenge levels that can be tailored to the needs of the user.

One of the first learning experiences humans encounter, according to Dewey, is learning to use the sensory systems of the body. It involves the coordination of the sensory organs for touch, sight, smell, sound, and movement. The mastery of these systems, says Dewey, is not merely physical, but is also mental and intellectual in quality. The learning involves the intellectual discover of the significance of actions. [3] These type of experiences are typically taught to young infants however, for children with disabilities these activities have tremendous therapeutic and intellectual value as a form of sensory learning.

Educational principles from the Dewey School have been used to inform the educational design aspects of this student project. Children with disabilities are often not given adequate opportunities to learn from everyday social experiences with typical peers. This absence of natural learning experiences leaves children with disabilities at a disadvantage when trying to learn the necessary social and emotional skills to succeed in typical environments. Therefore, because they demonstrate the need for social and emotional learning experiences for all children, the Dewey School principles are a good model for this project. The four principles guiding the growth of children in Dewey Schools were:

1. the increased ability of children to relate means and end;
2. the willingness of a child to plan means to an end;
3. the quality of work is not judged in isolation as merely the child’s own work but also evaluated for its social importance; and
4. students develop a emotional accomplishment of development, which Dewey described as “happiness.” [4]

For this project, the Dewey School principles can be interpreted as (1) creating a learning experience that uses simple cause-effect principles. These experiences can be easily modeled by a typical peer or by an avatar in the game. They can then be (2) rewarded or reinforced with regard to various degrees of correctness. The aspect of willingness to participate is determined by the level of motivation integrated into the experience. By using a game paradigm, motivation can be more easily incorporated into the experience. The game also allows the child’s participation (3) to become part of a social experience with typical peers or other players in the game. The final outcome of the experience is to (4) elevate the quality of the social and learning experience to an emotional accomplishment for both the child with disabilities and the typical peer or caregiver.

### 2.3 Activity Theory

Activity Theory provides a good framework for the role of the educational experience in this project (See Figure 1). The purpose of the educational experience is to mediate or facilitate a social experience between a child with developmental disabilities and neurologically typical peers or caregivers. As a mediating device, the educational experience provides a reason for the interaction between these two groups of people. It gives them permission to act freely within the framework of the experience and it gives them a similar set of goals, objectives, and motivations through which to interact. The ultimate purpose of the educational experience is to try to take the interaction experience beyond the game itself and provide a building block for social and emotional experiences between the target audience groups in other community settings such as the classroom environment.

![Engeström’s Model for the Role of Mediating Tools, Audiences, and Communities](image)

The educational experience is offering a common space for people from diverse backgrounds to come together and interact. It can be tailored to the needs of each target audience and can offer a virtual environment that can serve as a rehearsal space for interactions that might take place in the actual community of the target audiences.

Because a game can be played again and again, it gives the target audience a chance to safely model their behavior over the course of many iterations of the game. A person with a developmental disability may need far more iterations of social experiences than a typical peer to actually internalize or master them. The game
paradigm because of its inherently fun and reinforcing nature allows for a higher than normal amount of iterations without becoming excessively repetitive.

Activity theory developed by Vygotsky, says that social interaction is key to child development. One way that children interact with a world they do not understand is by mimicking adult activity. [6] This mimicking of adults and typical peers is critical to learning for children with developmental disabilities. This social scaffolding between children with disabilities and typical peers or adults can be mediated by the educational experience. Vygotsky identified the following three principles for the design of educational environments:

1. Authentic Activities: those that are age appropriate and modeled on adult activities
2. Construction: children should be constructing artifacts and sharing them with their community
3. Collaboration: the environment should facilitate collaboration between experts and novices and between learners. [7]

Vygotsky’s principles have been emphasized with regard to the design of these educational experiences. The focus on authentic activities modeled on typical peer or adult activities is important for children with developmental disabilities and allows them to socially rehearse activities based on those from their real community. The construction concept allows children with disabilities to focus on building or creating things through a chaining or reverse chaining process that allows the child to break down tasks into smaller, more manageable pieces. The collaboration aspect, allows for the child with disabilities to socially interact with typical peers and adults to complete a larger task. The facilitated collaboration provides a safe and controlled space for interactions to occur. It also gives all of the collaborators permission to take credit for larger and more successful outcomes. A well-designed educational experience will consider the strengths and weaknesses of all participant groups and use those to the greatest advantage for the community of learners.

2.3 Connectivity Model

Connectivity model is a method of audience analysis that uses principles of activity theory and combines them the trilogy of the mind concept from neuroscience. The trilogy of the mind contextualizes human thought in terms of emotion, cognition, and motivation. Each area has a specific role in how we think. Emotions have been shown to lead our thinking processes. The advent of new brain scan technologies such as the fMRI have shown that the motor strip areas of the brain that control motion are activated before the decision-making areas of the frontal lobes have actually completed their processing. This first emotional processing of an experience determines whether or not we will take physical action. The cognitive processing areas of the brain later try to explain why we took the action that we did. It is thought that this was an evolutionary survival trait that came from the idea that if danger were present, the people who fled the situation were more likely to survive than those who did not.

The behavioral component of this model takes into consideration the idea that many human behaviors can be modeled, learned, developed and mastered. It also considers the fact that learning takes places through iterations of a sequence of thoughts or actions and is influenced by the amount of praise or reinforcement that is given. When actions are positively reinforced, they will often times be repeated. When negatively reinforced, the actions will be diminished or extinguished. For purposes of learning and refining a targeted skill, differential reinforcement can be used. The concept of differentiating a reinforcer means that the closer the skill comes to the
perfect model, the greater the degree of positive reinforcement. This encourages early attempts while still maintaining an environment that encourages the learner to keep honing the skill.

2.4 Ethnographic Research
Ethnographic research is an important way to research target audiences for the purpose of designing for that audience. The act of observing a target audience in their typical environment helps the designer become aware of physical and sensory information about the target audience and about the environment. It is important to observe several times and to carefully record observations. By actually going to the site and viewing the target audience, it is also possible to glean social and emotional data from the site and from the interactions of the various target audience groups.

3. The Studio Project: A Tutorial Interface for Signed English
Students in a second year graduate level human interaction design course are given the task of designing an educational experience for children with developmental disabilities. They are allowed to select a target audience with epilepsy, autism, or cerebral palsy between the ages of 2 and 5 years old.

The goals for the project are to incorporate multi-sensory information into a visual design solution. They are expected to explore information design, emotions, and usability as they apply to learning Signed English. They must have a built in system of reinforcement that incorporates behavioral strategies, differential reinforcements, and learning techniques as part of the informational interface. They have to create a visually dynamic design solution that facilitates a fun experience and incorporates concepts of design for social inclusion. They are asked to incorporate an age appropriate educational experience as the primary learning objective with Signed English as an incidental learning experience.

As part of the research phase of the project, students are taken on two ethnographic site visits to observe children. The first observation is done at ChildServe, a local provider of physical, occupational, and speech therapy for children with physical and cognitive disabilities. While at this facility, the students are able to view individual and group therapy sessions between children and therapists. They are able to see the play techniques and strategies employed by the therapists to gain the trust and attention of small children who are expected to do repeated tasks with very little intrinsic motivation. They are able to see how these therapists manage time during a session, how they transition children between activities during a session, and how they negotiate with these children for reinforcement. They are also able to see the level of difficulty presented by even very ordinary tasks such as walking or sitting at a table for a child with physical or cognitive disabilities. They impact of the visit on students in this class is best articulated through the following student’s journal entry:

To begin our research process on these disabilities, we visited a place called "Child Serve"...I went into this research with an idea of what I might see, but nothing could prepare me for the emotions that would smack me right in the gut as I stood there watching these children.

The first kid was the hardest to see - the initial blow. A classmate and myself arrived early, before the rest of the class, and were given the opportunity to go ahead and start observing. We were led to a room and stood behind a tinted glass (we could see in, but they couldn't see us). The little boy located inside the room, not much older than Logan, was receiving physical therapy. I later found out that he suffers a rare genetic disorder and has advanced multiple sclerosis because of it. It also appeared that he had some form
of Downs Syndrome, although I'm not positive this is the case. As I stood there watching him, I began to cry. I couldn't help it. I watched him - he had so many mannerisms that mirrored what I was used to seeing with Logan; the way he interacted with some of his toys, the way he would hold up a toy phone to his ear and say his form of "hello". But the things Logan does, the things we (without a child with a disability) take for granted, this kid could not do. He could not (verbally) talk directly to his therapist and tell her what he was thinking, what made him happy, what was frustrating him at the moment. He couldn't walk without a walker, and even with that, needed help getting around. He couldn't stand up on his own or lay on his belly and hold himself up. But what amazed me (and I think made me cry) is that this kid - he was absolutely full of life. He smiled and screeched to show when something made happy. He took joy in his toys. He was being a little boy, not letting his obstacles drag him down.

I also had the opportunity to observe three other autistic boys, all similar in most ways, but all clearly unique. The way they each communicated with their therapists was incredible. They may not be able to talk, but they showed they clearly had something to say.

The second observation experience was to the Iowa State University Child Development Laboratory School. The Lab School offers year round programming for infants, toddlers, and pre-schoolers. “The mission of the Lab School is to provide students at ISU the opportunity to work with and observe young children while serving as a model childhood program for young children, including those with disabilities, and their families.” [8] During this visit students were able to freely view the infant and toddler room, the two and three-year-old classroom, and the four and five-year-old classroom. Students observed children in free play, structured learning activities, and during lunch-time. They were encouraged to pay special attention to types of activities that the children were engaged in, parallel versus collaborative play, gender roles, and the use of language to negotiate social and emotional space.

Observations at both ChildServe and the Lab School were followed up by question and answer sessions with the attending therapists and teachers. The students are encouraged to ask specific questions about what they have seen and are able to get feedback and clarification from those professionals. These discussions are very important in helping to solidify the ethnographic learning experience. It is important to give the students the opportunity to contextualize the two observations and be given the chance to compare and contrast the ChildServe environment with they typical pre-school environment at the Lab School. Through these discussions the similarities, as well as the differences, are discussed.

The emphasis on combined ethnographic and text-based research techniques, gives students a well-rounded research experience. The web and print based research gives students a lot of factual information to inform the cognitive aspects of their design process. While the ethnographic research experience is much more emotionally charged and it leaves students with a sense of duty or compassion for the target audience that is not easily replicated through the text-based method. The combined cognitive and emotional understanding of the target audience provides a very rich basis from which to design a final educational learning experience for both of the target audiences that were observed.

3.1 Role of Sign Language

Signed English is incorporated into the project as a form of incidental learning. The rationale for incorporating Signed English is two fold. First, many of the students in the class are only marginally familiar with sign language. It is introduced to the class as an assignment where they are required to learn the signed alphabet and
then several signs. The following class period they are expected to sign several pieces of information back to the class and to teach the class several sentences in Signed English.

Through learning the signs and teaching them to their class, the students are given the opportunity to experience what it feels like to learn novel material. They may find the physical gestures of the signs difficult to form with their hands and they may find some of the signs difficult to remember. These experiences closely match the experience of a person with physical or cognitive disabilities. Students are encouraged to reflect on what they find difficult and how they formed strategies to compensate for these situations. In the classroom, students with common areas of difficulty are encouraged to identify themselves, thus demonstrating that many people have the same or similar challenges. It helps to reinforce the concept that physical and cognitive abilities vary and are not a measure of the worth of an individual.

The second reason behind teaching Signed English is that many children with epilepsy, autism, and cerebral palsy may have expressive and receptive language impairments. For these children, in the United States, Signed English is often chosen as a manual communication system. It uses the signs from American Sign Language (ASL), but uses the grammar structure from English therefore not requiring children with a language disability to attempt to master a different grammar system.

By teaching children with a language disability a sign language, they are then more able to use multi-modal communication. This is particularly useful for non-verbal children or children whose language is difficult to understand because it allows for more successful communications. For typical children, they view sign language as a “secret language” and find it motivating from the standpoint of its novelty.

Often times, children with language disabilities are only taught language that better facilitates the needs of the parents or caregivers. This tends to be somewhat unsuccessful because it fails to acknowledge the fact that language naturally develops to meet the needs of the person producing the language. Therefore, the sign language that is incorporated as part of the educational experience for this project is expected to be not only age appropriate, but empower the child with the language disability to be able to meet his or her social or emotional needs.

3.2 Educational Strategies

In order facilitate collaborative learning and social goals, the educational method known as scaffolding. Scaffolding allows the collaborators to build on each others skills and achieve greater success than either person might achieve individually. It gives the child with disabilities the chance to see a specific action modeled and to be able to compensate for physical or cognitive disabilities through leveraging the resources or abilities of others. The collaboration process should be designed to encourage the use of language and social skills in order to achieve the desired outcomes. By using the context of the game environment, the collaborators are given increased ability to socialize in ways that might not be attempted outside this experience. The larger goal is that the comfort levels achieved through socialization in this context will generalize to other contexts outside of the educational experience environment.

3.3 Behavioral Strategies

Behavioral techniques from Applied Behavior Analysis (ABA) are introduced to the students as a way to handle drill and practice aspects of their projects. Principles of repetition and breaking down tasks are taught as ways to
make information easier to remember and complete. Concepts such as differential reinforcement and negotiating for reinforcement are introduced as ways to mold behaviors while at the same time praising the target audience for their subsequent achievements. The concept of negotiated reinforcement is taught as a method to give the learner a sense of control over the learning environment and a mechanism to make it more rewarding.

Clicker training is taught as a way to mold behaviors non-verbally. Methods for using the clicker sound device as a form of feedback are demonstrated in class. Students are then asked to clicker train someone using only non-verbal cues from the clicker. This helps students understand a method of non-judgmental reinforcement and it increases their belief in the idea that learning can take place outside of the normal technique of using verbal instructions. This is an important concept when working with non-verbal learners.

Classroom demonstrations on the use of social stories and video modeling are also given as examples of other forms of teaching. Through their own projects, students are expected to have a social story that governs the flow of their educational experience. In addition, the use of video modeling as a form of incidental teaching is an important mechanism for allowing children to learn through observation rather than through teaching via verbal instructions.

3.4 Design Strategies
Students design the educational experiences either independently or in groups of no more than 4 students. If students elect to be in a group, the group is comprised of students from both graphic design and human computer interaction majors. The design process begins with concept development through brainstorming processes that include visual and verbal ideation. Students are encouraged to thoroughly explore the communicative potential of typography, color systems, and illustrative styles (See Figure 2).

![Figure 2. Student examples of concept development for branding and identity design.](image)

Through a series of rapid proto-types, students develop all elements of the design from the logo to the interface design, icons, and packaging (See Figure 3). All of the elements need to work as a system, so the style and affect demonstrated in the logo should be reflected in the video taping or the illustration of the interface.

Students are given the flexibility to demonstrate interaction designs through the use of screens in Powerpoint or through the use of flash or programming a game engine. The interaction is also evaluated in terms of its communication and style.
The appropriateness of the graphics and interactions are evaluated with regard to their ability to teach the desired content and their ability to communicate the correct ethos to the target audience (See Figure 4). The students go through a series of large and small group critiques with experts in the fields of human computer interaction, information design, engineering, and graphic design. The input from the critiques is noted and used to refine the next iteration of the design. Final designs typically go through 3-5 iterations in response to a combination of large and small group critiques. Students submit the final deliverable project as a high fidelity proto-type with a final written analysis discussing their design process, their research findings, the visual development of the game and the brand, and their assessment of their learning process and outcomes.

4. Student Outcomes
Student projects have taken a wide variety of forms including animation, video-taping, product designs, and other types of games (See Figure 5). The students have been able to link specific disability issues with design solutions. They are able to see connections and make the appropriate solutions. The following is an example of a final project analysis in terms of the social, emotional, cognitive, and behavioral principles discussed in class:

**Social** - autistic children lack the normal social skills that come naturally to the rest of us, so we found it important to make our game (and supplemental PEC board) something that could help both disabled and non-disabled students to learn social skills by sharing and learning together.

**Cognitive** - through the use of a PEC board and the “hide and seek” play of the interactive game, this allows the student to learn object recognition, both in illustrative style and real world application. The PEC board, especially, is essential because not only can it be used in conjunction with the game, but as a stand-alone piece. A parent or educator can use the board to help a child externally learn to match a character drawing to a real world photo, or to help a child learn object recognition by asking them to “find” an object on the board and to place it in a separate section when said object is found.

**Behavioral** - by using ABA techniques within our interactive game, we are helping children with the emotional aspect of social skills. With eye contact keeping attention and showing emotion, it is detrimental to helping children, especially autistic, connect with their counterpart. Likewise, using the whole idea of “helping” and “sharing” within our game allows children the opportunity to learn manners and common kitchen practices (along with cooking!)
Motivational - we used motivational aspects as a happy dance and a fun atmosphere to help motivate the child playing the game. Although food is not an “ideal” motivator, we are also helping to motivate by the end result of a completed snack or meal. These snacks and meals are ideally healthy (so a good motivator), but also fun for the kids.

Figure 5. Andyland interface and game developed to teach animal names and sounds to children with autism.

5. Conclusion

By using the combined methods of audience analysis from ethnography and text-based research, students are able to better understand the cognitive and emotional needs of their target audience. By choosing a complicated target audience such as children with developmental disabilities, students must be able to understand the target audience in terms of their physical abilities and their social, emotional, motivational, and behavioral needs. Through the framework of activity theory, education theories from Dewey and Vygotsky, and behavioral strategies such as ABA, differential reinforcement, and social stories, students are able to craft an educational experience that is flexible enough to allow for scaffolding of skills and collaboration building between children with developmental disabilities and neurologically typical peers and caregivers. The game paradigm lends itself to heightened motivation through fun learning experiences and let’s children role-play social and emotional situations in a safe environment. In addition, the projects developed can be used as case studies in schools or clinical settings to study their effectiveness with the target audiences.

6. Citations


