Enhancing Therapeutic Learning Through Mobile Technology

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Therapists and teachers are in agreement that children, especially those with special needs, need to gain a more acute awareness of self and the ability to increase organization and attention in their daily activities. Dyspraxia, also called Developmental Co-ordination Disorder, is defined by the American Psychiatric Association as "a condition marked by the significant impairment in the development of motor co-ordination, which interferes with academic achievement and/or activities of daily living…" (Novak, 2011, p. 829) Dyspraxia affects fine motor skills, gross motor skills, speech and language, organization, and attention, and is often linked to other learning disabilities and Attention Deficit Hyperactivity Disorder (ADHD). Currently, there are a handful of apps and tools for children with various learning impairments, such as apps for fine motor skills that work on handwriting or grasping, and fewer apps that work on improving attention and organization. Psychologists and other therapists agree that practice in many of the skills associated with dyspraxia will help improve a child's ability to function in a social setting and in school and to communicate better with adults and peers, for both children with dyspraxia and others. Most of the applications that currently exist are rather limited, lacking the appeal to children with already compromised attention spans or failing to address the desired skill. Apps for assisting with word acquisition focus only on the auditory aspects and repetition of the words; attention-improving apps are few and often lack appeal to children or the tools to properly monitor and improve attention; handwriting apps are much more prevalent but focus only on the handwriting side of fine motor skills. Many of these apps have been used outside of therapy, for children with challenges and young children whose parents want them to

get an early start. Today, more interactive and mobile digital devices are being incorporated into therapy sessions for speech therapy (speech) and occupational therapy (OT) in the forms of apps for iPads and other tablets. The technology is there for making the most of therapy sessions, helping children who are struggling, and making significant improvements to schoolwork. The new problem is getting the therapist, teacher, client, and developers to utilize it to its fullest potential.

In my interviews and surveys, a child's short attention-span was often identified as one of the biggest hurdles faced by teachers and therapists. Retaining the user's attention and giving them a relevant model are keys to them having a successful experience with a tool or program. Constructivist and social learning theories engage users through interactive approaches to learning that put the learner in realistic settings that provide the scaffolding of support and guidance. Many have turned to theories such as Multimedia Theory, Social Learning and Constructivist Theories, including Authentic Learning, and Problem-Base and Blended Learning models due to their scaffolding and attention-based structures. It is important to provide the user, in this case children who are struggling developmentally and are partaking in therapy, with clear-cut goals and objectives, as well as attractive motivators in order to engage them and orient them in their learning process. Utilizing the available technology and coupling it with educational theories and models will lead to the development of successful, highly-engaging and highly-interactive tools that can enhance the therapeutic experience for therapist and client in an organized and structured digital environment that supplements the typical therapy session.

Currently, intensive therapy sessions in speech may involve the child repeating words over and over to practice the correct sounds, having the therapist or an application model the appropriate pronunciation, and teaching the child about mouth placement and sound

development. In occupational therapy, again depending on the case, various activities that work on correcting motor performance and coordination are performed, and repetition and modeling are both used; usage of the correct form and posture is encouraged. In both cases technology has been helpful in engaging the children and maintaining their attention. Many children are attracted to and enjoy using and playing with technology and computers. For most children, tools need to have a certain look and feel that makes them much less like a tool or training device than a basic game.

The learning problem and the need

Children with abnormal development in communications, such as those with dyspraxia and other impairments that interfere with coordination, attention, speech, and organization, often lag behind in their communicative development. According to several of the speech therapists that I interviewed, one of the greatest challenges in working with these children is to maintain their attention. In one study of a boy with ADHD, the therapist noted that "while he was working on the iPad, he sat perfectly still for at least 10 minutes and stayed closely focused on the game", whereas the traditional approach, "using sentence strips to teach context clues", was unsuccessful (McClanahan, 2012). This and like studies are beginning to show us that the iPad and other digital devices are quite possibly responsible for improving attention spans and helping to engage the child during therapy due to the attractiveness of the technology. There is the issue, however, of over- or under-stimulating the user by failing to provide a balanced user experience. As an example, some of the apps on market for attention had audio and visual feedback going throughout the task concurrently, which could result in over-stimulation and/or distraction for the user. On the other end, a speech app that merely plays the audio and does not provide the visual

component to aid in pronunciation becomes less interesting for the user. The Multimedia Learning Theory states that learners have a more internalized learning experience by receiving data in a combination of forms of media, or approaches, such as auditory plus visual, but with one form being the lead and the other an aid. For example, having a graphic-based exercise in which the user is learning pronunciation but is focusing on *how* they make the sounds rather than on what the sounds are should put more weight into the graphic display of the mouth and tongue positions and decrease the actual auditory feedback, such as hearing the word. A child is more likely to get a handle on the required changes and adjustments that he/she needs to make when he/she can both hear and see his/her own sounds and then compare them with the correct sounds but only if he/she doesn't suffer from a cognitive overload due to trying to focus on both parts, auditory and visual, simultaneously. On a separate note, the same idea also applies to those working on accent adjustments and in cases of motor-skill impairments.

Another issue concerning the currently available applications that is worth mentioning is that too many of them are either too heavy on the teaching/training front or too heavy on the game-play and entertainment side. Finding an engaging and educational balance is a necessary effort. Children need to learn but also must have the desire to engage in the often challenging learning process. The balancing act comes in where the engagement must not overshadow the education; therefore a structured environment that provokes curiosity but provides relevance is needed.

The learning goal and objectives

1. Enhancing therapy by use of technology to aid in training students with impairments commonly associated with dyspraxia, learning disorders, and ADHD.

   a. Providing easily accessible and appropriate tools for therapists and parents to use in helping the children achieve their goals.
   b. Helping the child to improve speech and communication, attention/focus, organization, motor skills.

2. Improving confidence in skills and abilities.
   a. Building confidence in abilities through continual practice of skills.
   b. Increasing self-efficacy.
3. Improving quality of life by mastering skills or improving dexterity and/or communicative abilities.
   a. Providing the tools for practicing and exercising the skills needed for everyday tasks and interactions.

User characteristics

My main focus is on young children with cognitive and motor impairments, and their therapists. Many of these learners suffer from issues that hinder their executive functioning and/or motor skills, which often add emotional and/or social struggles to the table as well. These struggles result in lower self-confidence and self-efficacy and, many times, less motivation to improve. It becomes a cycle of confidence-motivation-skills. These learners participate in therapy sessions with trained therapists to help build and improve their confidence and skills in these areas.

Two problems faced by the therapists and care givers, including teachers, are: helping the child to understand what is going on in his/her body, thus providing motivation, and keeping the child's attention on track. According to therapists, maintaining the child's attention during

therapy sessions affects the majority of cases, although technology, such as iPads, in therapy has done much to improve their attention spans.

As well, many of these children are unable to walk or have weak muscles or lack of control where their motor skills are concerned. For example, a child may be able to walk but has little use of the muscles in his/her hands, thus making writing, typing, and holding objects difficult.

Content with which the learners will engage

The content supplied in ACTIVaide consists of tools and exercises to build the skills and knowledge necessary for the child to improve performance and quality of life and to understand the underlying causes of any problems to the best of their ability in order to improve it. Exercises in will focus on organizational, attention, speech and language, and fine-motor skills. Organizational tools will focus on improving organization skills as well as providing means for the user to use to organize daily routines, and so on. Speech and language content will consist of simulations and multimedia to help track and improve pronunciation and articulation. Attention and fine-motor categories will contain content that focuses on memory and recollection and movement, respectively. Each of these components make up the suite of tools in ACTIVaide that will be supplemental to therapy and essential for practicing skills at home and away from therapy.

The setting or context in which learners will engage

A lot of the therapy a child receives comes from the school or other organizations where the child goes out of the home to meet with a therapist (or has a therapist come to the home once

or more times a week). This means that most therapy sessions are done with supervision, although the child may be asked to complete exercises regularly at home on his/her own time. Digital tools are needed to create a blended learning environment that combines the supervised non-technical therapy with technology as a supplement. The digital and non-digital tools can range from audio recordings to written text to physical objects. In considering technology, voice recognition and gesture recognition provide another option for supplementary tools for therapy sessions. One of the pluses with digital technology is its increased mobility, so that the patient has the opportunity to use the same application or program during sessions with his/her therapist and then again while completing the exercises alone back home, even if it is a smaller or simplified version of what is used in therapy. Digital tools that address the therapy goals of the child and can engage him/her in his/her endeavors while maintaining attention have a flexibility that other therapeutic tools do not, which is probably their greatest strength.

Theories

A large part of creating successful learning tools has to do with its design and presentation. The Blended Learning theory states that combining the typical classroom/lecture experience with online, digital learning tools will enhance the students' understanding of concepts by providing a more integrated approach. Multimedia Learning theory addresses that need of multiple forms of media, or presentations of instruction, to ensure stress due to cognitive overload is avoided and that memory banks and storage are used to their full potential. Bandura's Social Learning Theory suggests that children, or people in general, learn from observing and modeling, or imitating, others. Together, these theories provide the building blocks for the design and presentation of an integrated, flexible learning environment that is

conducive in both maintaining attention through motivation and in learning through expert modeling. As well as providing the ideas on how to develop a successful learning environment, the implementation of these theories also help to create a setting in which focus and attention are addressed and where users are more likely to become engaged in their learning.

Blending the face-to-face therapy time with innovative technology, such as the iPad or a smartphone, allows the patient to practice the same skill-building exercises both in therapy and at home or at school. According to the Penn State University Blended Learning Initiative (2009), classroom, or therapy, time "can be used to engage students in advanced interactive experiences" and the technology-based portion allows the patient access to the "multimedia-rich content at any time of day, anywhere the student has [] access" (Penn State, 2009). This allows the therapist to teach the skills and go over the exercises during therapy and then allow the patient to practice these same techniques using the same modes remotely, such as at home or in school.

The use of multiple forms of media in education technology eases the cognitive load for learners by providing data that is processed through different channels based on its type, such as the visual or auditory form of data. The working memory receives data from sensory information that can take the form of an icon or graphic (visual) or sound (auditory). Providing the patients with exercises that utilizes both visual depictions and auditory depictions will increase the amount of data that is able to be processed at one time without increasing the cognitive load. Inserting gestures as a third mode of representation is something I hope to look into in future research, though it falls under tactile learning.

Human interaction has always been an integral part of learning. We learn to speak, to walk, to work, and to function from observing our parents and those around us. Imitation is a key to learning and toning skills. When a student is able to watch an adult, or even a peer,

perform an action, he/she is more motivated and more coordinated when trying it him/herself. Bandura's Social Learning Theory suggests that people learn through modeling the behavior of others. Through imitating, or modeling, the correct sounds of speech or the completion of specific tasks, users will begin to improve their own natural abilities. When a child has the opportunity to reproduce the sounds or actions of a model, their own performance is more developed than when they are left to their own devices. This was seen in observation of children interacting with a familiar adult, where the "children's imitated utterances were more syntactically and semantically complex than their spontaneous utterances" (Bradford-Heit, 1998). Interaction and imitation can occur when the child observes his/her therapist performing an action or when watching a computer simulation of, for example, the correct pronunciation of a word or sound. Of course, imitation alone is not enough.

Models:

The main function of any therapeutic training tool or device is behavioral modification, which can be achieved in many ways and by various means. A tool in the cases of speech and occupational therapy must help to improve and positively adjust the child's, or patient's, performance and improve their quality of life. This means allowing the user to understand the problem, figure out what they are doing and how to modify their behavior, and then practice correct form.

Attention was the big word that kept coming up in studies and conversations I had with experts in the field. Trying to maintain a child's attention, after gaining it in the first place, seemed to be one of the toughest challenges for therapists and teachers in the child's classroom. Attention is addressed in both Keller's ARCS (Attention, Relevance, Confidence, Satisfaction)

model (Keller, 2001) and the ARRMs (Attention, Retention, Reproduction, Motivation) model in Bandura's Social Learning Theory. According to both models, attention is best obtained by provocation with something unfamiliar and, in a way, challenging (as in just out of their reach). Arousing curiosity by challenge through presenting a problem to be solved (Keller, 2001) not only garners the child's interest initially, but also connects the next phases of each model, especially Retention, Motivation, and Relevance, and, at the end, Confidence and Satisfaction.

Relevance and Retention can both be achieved through creating a realistic or pertinent narrative in the simulated environment. The value that a learner places on a task or assignment is directly correlated to the learner's perception of the importance and usefulness of the topic and has been shown to be positively related to learner performance (Sibthrop, 2004). Relevant, or realistic, narratives that are applied with the Problem Based Learning approach will appeal to the user's perception of usefulness in that the narratives reflect problems and obstacles that he/she encounters in daily life. When the student engages in these exercises in practice and then applies the same techniques in daily situations, this then reinforces the skills, thus the repetitiveness aids retention.

Confidence is built up as the child progresses through the simulation, completing tasks, conquering challenges, and reaching goals, such as using and pronouncing words or phrases in their correct way or using the correct muscle motions that their OT sessions are focusing on achieving. In portions of the simulations that include modeling, such as producing a specific sound by correctly modeling the mouth form and sound wave patterns produced by the instructor, reproduction is encouraged, required, and rewarded.

Confidence and Motivation are then linked to expectations and self-efficacy where performance is concerned. "[Expectations] appear[] to be important aspects of academic

learning. Personal expectations about getting good grades and understanding material also appear[] to be the best predictors of student success." (Sibthorp, 2004). The more confidence the learner has in his/her abilities, the more motivation he/she will have to advance. It is a cycle that, once started, is self-propelling. The trick is in getting the cycle started. This is where Relevance comes in as a method of engagement – a way to arouse interest.

Motivation and Satisfaction are achieved in the relevance and intrinsic value of the content. When the child realizes that he/she can "do it", achieve the goal that he/she is working on in therapy, in realistic, simulated environments, this holds a more intrinsic meaning than the regular therapy room. Thus, the motivation to succeed is increased along with the satisfaction upon completion of or the reaching of milestones, both virtually and in the real world.

Authentic Learning provides another model, similar to the Relevance in ARCS. By working on skills in an authentic setting, users are better able to perceive relevance, which helps to increase motivation, and to connect what they practice to what they do, thus encouraging retention. This is the idea used for exercises such as those that involve fine-motor skills, where the user must make specific gestures, such as those used for grasping a pencil. According to articles by J. Harrington, et al, "Authentic tasks have real world relevance" (p.236) and provide "important synergies between the three elements: learner, task, and technology" (p.241), which, in turn, provides "positive support for the learner, in the form of meaningful context, motivations, and skill development" (p.242).

The Blended Learning model is manifested through the concept being taught in a typical therapy session and then having the application be "applied" in the digital simulated environment, where it helps to support the child through teaching and guidance, and allowing him/her to practice and achieve through problem-solving and modeling. Having the simulated

environment pushing the child slightly out of his/her comfort zone (Vygotsky's Zone of Proximal Development) will push the child to put into practice the concepts taught under the guidance of the therapist, first in the safety of the digital application and then, once comfort and confidence are increased, in the real world. The blend of the two together, the therapist and the simulation, are what form the environment most conducive to learning.

Technology platform

Putting an interactive [mobile] device into a child's hands is a great way of attracting their attention, say most of the OT and Speech therapists I interviewed. Interactive and "new" technology is a great method to use for attracting the child's attention. After that, it's up to the structure and features of the program to maintain it. According to statistics from the Nielsen Company, about "40 percent of U.S. mobile users own smartphones; 40 percent are Android", whereas the Apple iOS users total around 28 percent (Kellogg). With this in mind, and a goal of keeping it affordable and attainable, I will focus on using smartphones and tablets, which provide a larger screen than a smartphone, as the platforms for my tools, or "apps". The smartphone's capabilities will allow me to get a blended learning environment into the hands of the children by means of a simulated medium that includes animations, narrative, audio and video, and interactive opportunities. The mobility of a handheld device and the high chances of at least one member of the patient's family owning either a smartphone or a tablet also increases the likelihood that the patient will practice skills and exercises at home, at school, in the car, and elsewhere outside of therapy. It also provides an opportunity for communication between members of the therapy team, where notes can be stored in the app, protected by passwords, to track and identify any issues or improvements that will come up for the child.

Structure

There are several features available in this program, as well as the games and simulations. There is a space to record patient information and the contact information of the therapy team assigned to the user (e.g. teachers, therapists, doctors, etc.). Along with this basic data, communication between parties is encouraged through the Notes section of the app, where the various members of the therapy team can record pertinent data to be shared exclusively with the other members of the team. In an article by C. Novak, et al, the authors noted that pro-active parents were "in constant communication with their child's school" (Novak, p.832).

As for the patient user interactions, he/she will be immersed in responsive simulations, colorful games, and creative and goal-based activities where they are required to put into practice, or apply, the concepts taught by their therapist during sessions, often practicing in the simulation under the observation of the therapist. Through challenges, puzzles, and problem solving opportunities encountered throughout, the users will use voice and/or gesture to progress and achieve goals in familiar settings, fun games, or creative applications, practicing movements or sounds that are the basis for their therapy and achieving rewards as motivation.

Modes of representation and formal features

As mentioned before, keeping the child engaged is an important challenge to overcome. Therefore, in order to both attract and aid the user, I aim to develop programs with realistic and colorful graphics, engaging game-play, exercises that touch on familiar and relevant situations, and advanced technology that ensures learning both physiologically and cognitively. Ensuring that some of the graphics and settings in the program are familiar to the user, such as school or

playgrounds, helps the user to make the connections between app and real-world, as supported through the authentic learning model, as well as ARCS and ARRMs.

Tablets and smartphones, like computers, provide the means by which to present information dynamically. It is this "way [that] information is being presented on the computer (graphic objects, colors, sounds, animation, etc.) [that] can be highly stimulating when it comes to individuals with attention problems" (Solomonidou, p. 111), which may be linked to the optimal stimulation theory of ADHD, which "suggests the possibility that the higher levels of sensory stimulation using the iPad…" or other similar devices allows students struggling with attention deficits, whether due to ADHD or another learning disorder, to "engage in the learning task in ways that a typical classroom experience cannot" (McClanahan, p.26).

Most communication will be done graphically or audibly and interactively through feedback. For example, in the simplest activity that aims to improve hand and finger dexterity, users will have a friendly blob of slime, putty, ooze, or other similar item that they can choose, and will be told to *Squeeze it!*, *Stretch it!*, *Pull it left!*, etc. to change the shape and facial expression and sound effect. After discussions with occupational therapists and other experts, it was thought that, in order to add some form of resistance to aid in strength-building, the movements will be time-based, where the user is asked *stretch it* over the course of several seconds in order to build a "virtual" resistance. Though there are words and sounds in this activity, they are in their simplest form and the main focus is on the gestural interactions occurring when the user exercises the proper finger movements.

Another example is that of a game of hide-and-seek, which focuses on improving focus and short-term memory. These are areas where children with dyspraxia, ADHD, and other learning disorders suffer immensely. In order to orient the user by providing a relevant setting,

the game is designed after the often familiar hide-and-seek playground game. In this case, the user will be able to engage in the game play and work on improving focus as they watch to see where the characters run to hide. This is followed by an exercise in recall when it is time to engage the memory while maintaining focus in order to "seek" the characters. This exercise is variable in that its level of complexity can be adjusted based on the user's abilities – the user can decide whether to search for one character, two characters, and so on, as well as control how fast they run to hide.

The notionality of the animations and graphics in the simulations is derived from the desire to maintain the connection to the relevant, real-world problems while allowing for creativity and fun. Creativity can be portrayed in realistic or abstract representations, whereas *realistic* settings can only be realistic and unambiguous. Both of these forms are important for growth in the child. It was mentioned multiple times in the interviews that children with special needs do not always have the opportunity, or ability, to express themselves creatively (of course, there are certain cases where the child would rather avoid abstract and ambiguous situations), but that, still, the child needs to learn how to operate in the real world. Therefore, in some cases, the notional relationship between what is expressed in the simulation and what occurs realistically is more exact and unambiguous. This is pertinent to providing a model conducive to the child's development and growth. This is why the array of activities offered will allow for both the abstract and the realistic, and, in some activities, the option to go from one "environment" to the other.

For example, a child in OT for hand therapy will be presented with a realistic drawing-table where he will be the animator creating animations for a cartoon. In order to reach the goal of watching the animation come to life, the child must engage in specific gestures and

movements that work on fine motor skills, such as line and shape tracing exercises. The device, using gesture recognition, along with the therapist, will monitor the gestures and advance the child along with each success. In regards to speech therapy, a similar model of authentic learning, engaging technology, and creativity will be used. For example, the child needs to practice his vowel sounds and is presented with a virtual race. The child, after choosing his character for the race, will say the vowel sounds that appear on the screen (or as audio from the device) and with each correct pronunciation his/her character will advance in the race. The child's pronunciations will be monitored using voice recognition technology and, separately, by the therapist. Other examples that focus more on providing engaging technology than on gaming or narrative-like goals include providing a visual example of the mouth, both an interior view and an exterior view, pronouncing the words or sounds.

In most of the activities, the user is rewarded at the completion of every task with rewards such as an increase in confidence and, ultimately, self-efficacy, as well as badges for each successful completion of an exercise. This can also be coupled with the therapist or teacher offering other, real, rewards after reaching certain goals, which is encouraged. The interaction with and the supervision of the therapist are a necessity in achieving the optimal results from engaging in the tools and activities offered in this app, especially to supervise, correct, and encourage.

Social interaction and scaffolding

Ideally, the therapist will work with the child to teach the skills and forms that are a part of the child's therapy, such as pronouncing certain words or exercising specific motor skills, before moving onto any other outside form of technology. Afterwards, the therapist and patient

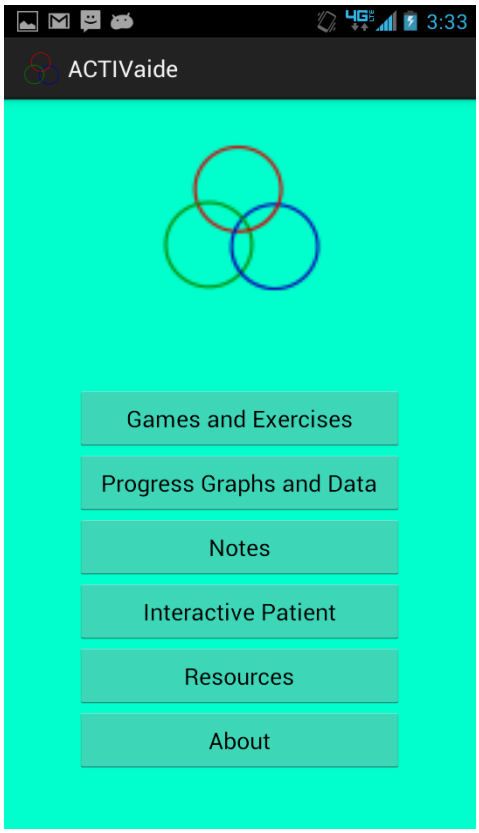
can walk through the digital experience with ACTIVaide. At this point, the child is able to apply the same skills and forms that were covered in the "classroom" portion of the therapy, thus helping to blend the two modes of teaching and learning. For example, if the therapist is working with the child to master fine motor skills, such as grasping tiny objects like pencils, the therapist will go over the motions using actual objects and then use the exercises in ACTIVaide to practice the techniques in a more attractive and engaging manner that the child can do outside of therapy. In the exercises, the child will have to use the same pinching and grasping techniques to play the games or use the methods he/she was taught to help maintain attention. The simulations and tools offered on this device for the child can also be used in class when attention is an issue and he/she needs something stimulating yet constructive that he/she can do within the classroom environment.

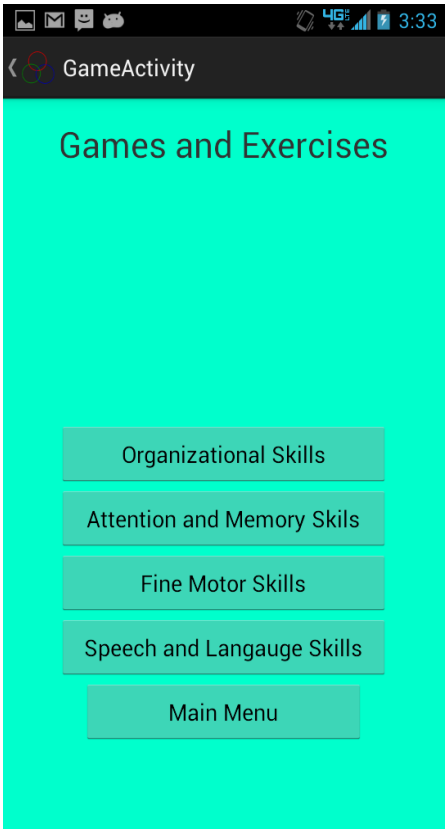
The therapist, along with the scaffolding provided within the exercises, will offer guidance in both a teaching and social aspect, which will help guide the child through the simulation and enhance his/her progression. The guidance and the feedback are pertinent in making physical and psychological progress in therapy goals, increasing confidence and self-efficacy, and, ultimately, helping to improve the child's quality of life.

Storyboards, Mock-ups, and Screen Shots

Animated storyboard: http://greenmooses.com/classwork/thesis/activaidestoryboard.gif

Interactive mock-up: http://greenmooses.com/classwork/thesis/activaidegamesnav.swf


3:33
ACTIVaide
Games and Exercises
Progress Graphs and Data
Notes
Interactive Patient
Resources
About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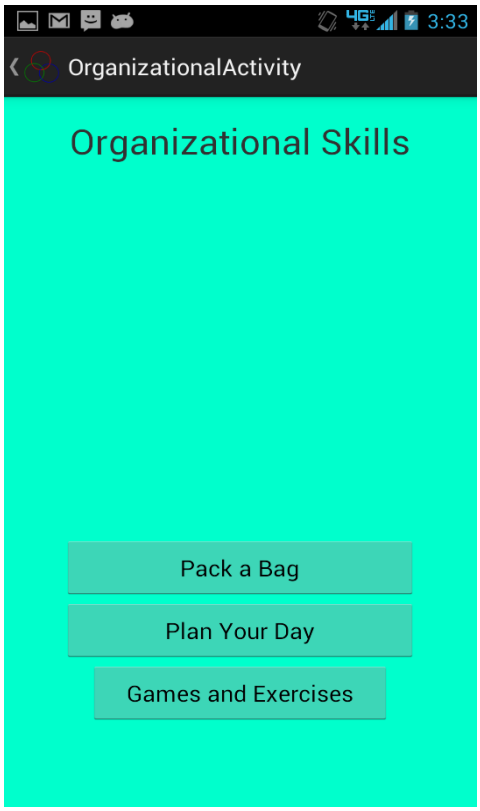
GameActivity
Games and Exercises
Organizational Skills
Attention and Memory Skils
Fine Motor Skills
Speech and Langauge Skills
Main Menu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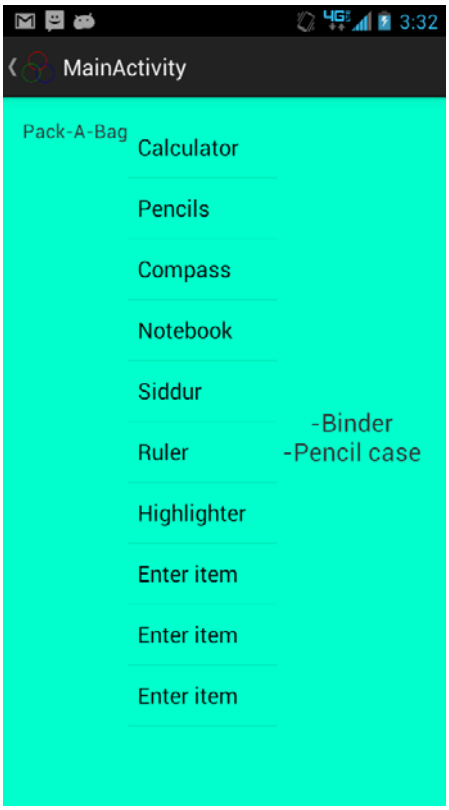
OrganizationalActivity
Organizational Skills
Pack a Bag
Plan Your Day
Games and Exercises


3:32
MainActivity
Pack-A-Bag
Calculator
Pencils
Compass
Notebook
Siddur
Ruler
Highlighter
Enter item
Enter item
Enter item
-Binder
-Pencil case

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