Online Learning System for Teaching Basic Skills to People with Developmental Disabilities

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ABSTRACT
We report an online learning system for adults with developmental disabilities (DD) developed in collaboration with Imagine!, a Colorado based organization that provides support services to people with developmental and cognitive disabilities. Our HTML5 online application includes lessons to teach adults with DD of all ages about numbers, letters and currency. We implemented the application on an iPad to take advantage of the simplicity of touch-based interactions. Our preliminary user evaluation suggests that the system is well-received by its intended users, and unlike competitor systems that teach basic skills, is not considered childish and boring.

Categories and Subject Descriptors
H.5.2. Information interfaces and presentation (e.g., HCI): User interfaces.

Keywords
Developmental disability; iPad; basic skills.

1. INTRODUCTION
People with developmental disabilities (DD) struggle through basic tasks such as recognizing numbers or colors, or using money, and require help from someone else (e.g. those in charge their care) to effectively carry out such tasks. Hence, the participation of such individuals with DD in valued/meaningful social/societal roles (e.g. adult, worker, student, citizen) is limited, and this in turn can reduce these individuals' overall life satisfaction [1, 2, 5]. In addition, this dependency on others increases the amount of care these individuals with DD need from the people in charge of their care.

Technologies such as those based on augmentative and alternative communication and audio [5] and/or video prompting [1, 2] can help support individuals with DD in academic, employment, and independent living settings [1, 2, 4, 5, 6]. This can lead these individuals to have positive expectations and outcomes regarding valued social roles, and further, it may also enable them to assume those roles [1, 5, 6].

The advent of touchscreen devices has spurred development of applications (apps) designed to teach, train, and rehabilitate users with disabilities. A review of various works dealing with the use of an iPad or iPod Touch to teach individuals with DD either 1) daily living skills such as cooking and cleaning (by delivering instructional prompts through the device), or 2) how to use an iPad or iPod Touch; suggests that these devices can be viable technological aids for individuals with DD [3]. While many adults with DD require the same lessons as children, such as learning numbers, letters, and currency; the majority of apps available to teach these basic skills are geared mainly towards children, which are problematic for individuals with DD in two ways: 1) The apps usually contain loud colors, animations and distractive information and 2) The graphics design and reward system for completing tasks are child-appropriate but not necessarily motivating or appropriate for adults with DD. For example, LetterSchool[1] is a letter learning app for iPad and is geared toward 2-5 year olds (Figure 1, left). It has very busy screens with lots of color and images and motion. There is also Learning Gems – Colors N Shapes[2], which is designed for children aged 2-6 (Figure 1). The later latter is more simplistic than LetterSchool, but it is also vibrantly colored and it has a relatively busy design that is not compatible for older individuals with DD. In general and in our preliminary investigation, these apps geared toward children are not well received by adults with DD due to their childish nature.

Figure 1. LetterSchool (left) and Learning Gems – Colors N Shapes (right) are two similar apps in the iTunes store

The purpose of this project is to develop and test a new method of providing lessons of basic skills to individuals with DD of all ages through an online system that works as a web-app on the iPad. This work is in collaboration with Imagine!, a not-for-profit organization based in Boulder, Colorado that provides support services to people with developmental and cognitive disabilities including autism, cerebral palsy and Down syndrome.

2. METHODS
The majority of system requirements were gathered with the help of the technical coordinator of Imagine!. We gathered requirements through ethnographic observations and interviews,

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1 http://www.letterschool.com/

2 http://www.learninggems.com/our-apps/learning-gems-colors-n-shapes

and based on those requirements, we performed a participatory design with a group of professional caregivers and adults with DD to produce a low-fidelity prototype with the desired functionality on a whiteboard. Based on the feedback on the low-fidelity prototype and on the interviews of the group members that we conducted over the phone/Skype, we developed a high-fidelity prototype in the form of an interactive power point that mimicked a web-app that provided all the lessons. Additionally, features for securely logging user data and progress per user were also included. The typical usage scenario is for a caregiver to administer a specific app-based lesson to the person with a developmental and/or cognitive disability that they care for during a day habilitation program. We iterated over the design of this high-fidelity prototype based on the feedback we got through focus group sessions that we held over the phone with the Imagine! group. This was done until the prototype was accepted as the base of the final product. Figure 2 shows the money (left) and color (right) app-based lessons. The money lesson basically asks the user to choose a currency by tapping on the one that was spoken by a prompt. If a wrong currency is chosen, the prompt is repeated and the correct currency is highlighted yellow (seen in Figure 2). When this fails, all the other currencies disappear, leaving only the correct one. A similar scenario is followed in the color lesson (Figure 2, right).

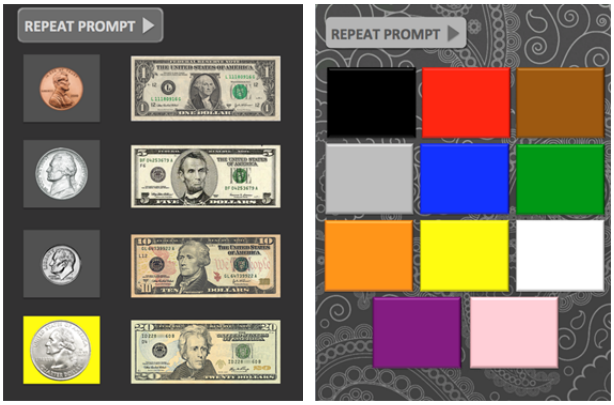

Figure 2. The money (left) and color (right) app-based lessons

Taking into account the feedback, we developed another high-fidelity prototype consisting of only three lessons (Number, Color, and Money) in the form of an actual web-app that worked on the iPad (the requirement that the system had to work on the iPad was set by the Imagine! group, since a lot of their clients' healthcare providers were starting to cover the purchase of such devices for rehabilitation therapy). Again, we iterated over design of this high-fidelity prototype based on the feedback we got through focus group sessions with the Imagine! group. Once the prototype was accepted as the base for the final product, with the help of the Imagine! group we started testing the app-based lessons with persons with developmental or cognitive disabilities at Imagine!'s care providing facilities.

The user study consisted of seven users testing each of the three reviews. They are 28 to 53 years old and a median age of 42. The feedback we sought (qualitative in nature) was mainly on the intuitiveness of the information flow and the graphics design.

3. RESULTS

The three app-based lessons were well received by users in the study. Users that reported normally using flash cards or paper to do similar lessons said that these app-based lessons were more enjoyable than the paper versions. All users reported that the questions and tasks were clear and easy to understand. All users enjoyed the default reinforcers (audio and GIF files that play when the user answers correctly), citing "[Denver] Broncos", "fun", and "telling me good job" as reasons. Constructive feedback from one user was a request for longer sessions and more pictures (reinforcers). Most users reported that the app-based lessons were easy to use and understand.

4. DISCUSSION

The user study shows promising results for the online learning system and showcases the necessity for such a system. By providing a simplistic interface with entertaining reinforcers, adults of various ages enjoyed the time spent practicing fundamentals of daily life. Future development will include increased difficulty and customized reinforcers, as well as widening the application suite to teach several more fundamentals like shapes, money addition, letters, and telling time.

5. ACKNOWLEDGMENTS

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