

Games for People with Developmental Disabilities

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ABSTRACT

This study presents the work on the development and evaluation of web based applications for people with developmental disabilities (DD) in collaboration with Hope Services, a California based non-profit organization that provides services to improve the quality of life for individuals with DD. The system includes two games that aim to teach basic skills such as relationship concepts, causality, and or improve upon cognitive skills. User evaluation suggests that these games provide a good platform for people with DD to increase their independence, provide an additional or alternative learning system, as well as improve their life satisfaction.

Keywords

Developmental disability, tablet devices, game, accessibility.

1. INTRODUCTION

The term developmental disability refers to a "severe and chronic disability that is attributable to a mental or physical impairment that begins before adulthood, such as intellectual disability, cerebral palsy, epilepsy, autism, and Down syndrome" [1]. For people with DD performing daily tasks can be difficult if they never successfully developed these basic skills. As a consequence, people with DD rely heavily on other people, such as their caregivers, to perform basic activities for them. However this limits their independence, participation within society, and their overall life satisfaction.

Most applications that currently exist with similar applications are designed for children, cost money, or simply do not exist. We designed two games so adults could play and learn skills while remaining engaged with age appropriate material.

Current technologies have the ability of assisting people with DD in academic, employment, and independent living environments. Games such as the two in this study, would allow people with DD to have a more active role in society. Studies have shown that current technology can improve how people with DD perform academically [2]. Before touch screen tech-

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nology was invented, studies showed that computer-aided systems promoted independent task completion as opposed to card-based system [3].

The purpose of this study is to evaluate an alternative method of providing basic skills to people with DD. Two web applications were developed to evaluate the user's cognitive capability. The first game aims to teach basic skills such as relationship concepts (e.g. smaller, larger, less, more) and the second game aims to help users learn about causality and or improve upon cognitive skills (e.g. memory, focus). This study also evaluates the appropriateness of the game and its target demographic, determines if performance in game transfers to improvement performance in the target real-life tasks, and identify areas of improvements for both games.

2. GAMES

2.1 Concept Game

The purpose of the Concept Game (CG) is to test the participant's understanding of relationship concepts (longer, shorter, fuller, emptier, etc). The participant answers ten questions that present a particular relation and are asked to identify from two or three images, which image satisfies that relation. If they answer incorrectly a yellow box will highlight the correct response. If the user answers incorrectly again, all other options will become unselectable.

2.2 StarBlaster

The purpose StarBlaster (SB) is to assess the participant's understanding of causality and improve their cognitive skills such as focus and memory. The game consists of three levels, each level is three minutes long. The objective of the game is to tap the screen whenever an asteroid appeared. Each increasing level of the game adds a new object that can appear, but the directive remains the same. Since the instructions remain the same as the game's complexity increases, this assesses the participant's problem solving abilities.

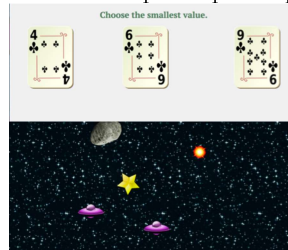


Figure 1: Top: Concept Game Bottom: StarBlaster

2.2.1 Users Evaluation

Each game was tested by 10 participants from Hope Services. The ages of the participants ranged from 24-37 ($M = 26.6$). All participants had various ranges of cognitive function.

Age	DD
26	Etiology X Chromosome inversion
25	Autism
31	Down Syndrome
27	Tubular Sclerosis
28	Intellectual Disability
24	Cerebral Palsy
29	Down Syndrome
37	Down Syndrome
36	Intellectual Disability
27	Williams Syndrome

Figure 2: Participant demographics

2.2.2 Testing Setup

Two HTML-5-based web applications designed for Android and Windows tablets were tested over a four-week period. Participants played both games once a week for the first two weeks, followed by a one week break, concluding with a final week of testing. Participants were shown a demonstration of each game. After the demonstrations, the subject played the CG twice, and then played each level of SB once. All gameplay performed by the user was recorded through screen-capture to calculate statistics at a later time. At the end of the study, the participants answered a short questionnaire which consisted of nine questions assessing if the participant felt the games improved their performance in real-life tasks, how hard the games were, whether they were entertaining, and improvements they would recommend. The questionnaire is available upon request.

2.2.3 Statistics Gathering

Participant's gameplay was screen-captured to review afterwards. For the CG the experimenter kept track of the participant's total number of attempts per question. For SB the experimenter kept track of the number of asteroids that below the bottom of the screen and the number of unnecessary taps (participant touches the screen when no asteroid is present).

2.2.4 Results

For the first two sessions, all ten participants played the game. However for the final session one participant was absent. So data for the final trial/survey was only from nine participants.

Concept Game

From the survey responses most of the participants found the game relatively easy. Only two participants rated the game as very hard. To assess the participant's progress between the first and final trail the number of correct answers between both play-throughs for each trial were added together for trail 1 and trial 3. Their scores for trial 1 and trial 3 were then compared to find if there was a significant correlation between their scores at the beginning and end of the study. Since one of the participants missed the third trial, their data was omitted from this evaluation. From observing this data, seven out of the ten participants had improved their score by the end of the study. On average, participants scores improved by 1.75 points between the first and third sessions, a statistically significant difference ($t(8)=2.88$, $p=.02$).

The number of incorrect responses per question type for all the trials were added together. Then the number of incorrect

responses per question type across all trails were summed together. This was done to find which relationship concepts had the highest error rate. Less/more had the highest error rate followed by closest/furthest, shortest/longest, a tie between emptiest/fullest and smallest value/largest value, and smallest/largest.

StarBlaster

From the survey responses, eight out of the nine participants found the game relatively easy with only one participant rating the game as difficult. No participant missed a single asteroid during any of the trials. To assess whether the participant's gameplay improved between the first and final trail, the number of unnecessary taps for the first and third trail were added together for each level then compared. No significant correlation was found ($p > .05$).

Survey

From the nine surveys, all nine participants said they had fun playing both games and eight out of nine of the participants claimed that these games improved their performance in real-world tasks. Examples given by participants are as following: these games helped with her problem solving and recognizing the relation between more and less, and that these games helped them play other games.

3. DISCUSSION

Both games were well-received by the participants. This means that this is a good and engaging media for people with varying levels of DD to learn through. The questionnaire responses showed that the app-lessons were well-received by all participants and provided suggestions for game improvements. These ideas include: (1) adding another level of difficulty to the CG, (2) including more mini-games, (3) more questions that focus on the relationship concepts that most participants struggled with, (4) possibly adding themes to the CG, (5) adding more asteroids to SB.

4. CONCLUSION AND FUTURE WORK

The next steps for this project includes transforming these web-apps into smart-phone and tablet apps and improving the system based on the feedback from the surveys conducted at the end of the study. A caregiver interface must also be created, implemented, and tested which would make individual's statistics available to the caregiver. After this app has been developed, the system will have the potential to be an alternative learning mechanism for people with DD, give people with DD a sense of independence, and improve upon their life satisfaction.

5. REFERENCES

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