Towards a Usable Serious Game App to Support Children's Language Therapy

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ABSTRACT

Speech and language disorders in children account for about 6% of the population, and if not treated adequately they persist. Thus, affected children may experience long-term problems such as both diminished socialization and literacy in later life. Assistive technologies in the form of serious games have been successfully used to support language and speech therapies, but their developers have the challenge of improving their human-computer interfaces. This paper describes the design and development of a mobile software (a serious game app) that runs on a tablet. Its main objective is to support children's speech and language therapy of English language tenses. Important usability testing and design guidelines regarding mobile interfaces are addressed. Future work will include usability testing based on the user-centered design (UCD) paradigm and prototyping to improve its interface design.

CCS CONCEPTS

• Human-centered computing~Usability testing.

KEYWORDS

Speech and language therapy, children, disabilities, user-centered design, special needs, usability, mobile computing, HCI.

1 Introduction

It seems that the demand and development of assistive technologies (technologies used to increase, maintain, or improve functional capabilities of people with disabilities) has increased as recent software and hardware computing is getting more reliable, easier to implement and more affordable. However, to maximize their efficiency, efficacy and pleasantness of use (that is, their general usability [1]), their user interfaces should require the application of adequate design guidelines and usability testing. That is the case of speech and language therapy software. A number of research projects and commercial ventures around the world have developed speech and language therapy software programs to support treatment of speech and language disorders by including interactive auditory, visual and even tactile interfaces. Nevertheless, most of them have the challenge of significantly improving their user interfaces (UIs). However, there are few studies devoted to usability testing of speech and language therapy human-computer interfaces (e.g. [20]). Speech and language disorders in children account for about 6% of the population, and if not treated adequately they persist. Thus, affected children may have long-term problems such as both diminished socialization and literacy in later life [2]. One of the key steps in speech and language therapy sessions is one-on-one practice between the patient and a speech therapist. These private sessions typically involve some practical activities, such as playing games, which provide useful insight for the therapists and invaluable feedback and engagement for the children. Serious games (video games that are designed to educate, train and entertain [3]) have been researched and used for speech and language therapy. A premise on serious games for speech and language therapy is that they are a key resource to motivate patients to keep practicing therapeutic exercises, and they may provide useful multisensory feedback both for the therapist and the children [21].

There are a number of positive reasons why mobile serious games may be useful for supporting language and speech therapies [21, 22]:

- They are interactive. There is a useful exchange of information between the player and the mobile device.
- They are multisensorial. Both the player and the mobile device exchange multisensorial (auditory, visual, and tactile) information, stimulating almost all the player's senses. In addition, one human sensory information may complement or supplement another.
- Mobile serious games can be played anytime-anywhere (at school, home, the therapist's office, etc.)
- Many children are getting used to mobile computers (e.g. tablets and smartphones), therefore the use of a mobile device may be ubiquitous for them.

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- They are tangible. Many children can touch the screen to select, activate and manipulate features from the programs running on mobile devices.
- They can be a powerful motivator for children to keep going with the therapy sessions, since they can be both stimulating and useful for therapies.
- A serious game can be programmed to keep records of all the children's program usage during the therapeutic sessions. The stored data can be useful for further therapist's debriefs.

2 Literature review

Literature reports few studies on usability issues regarding mobile serious games used to support children's language and speech disabilities, due to the novelty of this research and development area. For example, [4] developed and tested a number of serious games to treat some skills that have been proven to be effective against dyslexia (a cognitive disorder that may affect language). Children interacted with the serious games using an iPad™. Researchers found that interviews conducted with participating children were useful to measure how easy and enjoyable the interfaces were.

The review written by [5] addresses a number of usability studies done with children with Autism Spectrum Disorders (ASD) using multitouch tablets. Data collection methods used in the studies were usability questionnaires (some of them answered by the researchers), direct observation, and the use of the Think-Aloud Protocol method.

[6] developed ten serious games that run on a smartphone to support a number of intellectual disabilities, to prepare people for their daily life by working with daily situations, such as buying goods in a supermarket. The usability of the serious games was evaluated using usability post-questionnaires with Likert scales and open questions.

[7] described a study on development of a serious game in the form of a 3D environment used for speech and language therapy of children. The study points out that their serious game can be used anytime-anywhere to support a cognitive disorder treatment.

The research reported at [8] aims to address that students face an increasing focus on independent learning by going beyond conventional approaches with a hybrid game-based app, combining individual and collaborative learning opportunities.

At the University of California Santa Cruz was developed SpokeIt, a mobile serious game designed to support speech articulation therapy [9].

3 The InTense APP

Algoma Games For Health, a game development studio from Sault Ste. Marie, Canada, developed InTense, a serious game app that runs on the iPad™ tablet to support speech and language pathologists to work with children to help develop language skills, specifically focused on verb tenses. InTense has a variety of questions for children to answer (e.g. Figure 1), and when they answer a question correctly they will gain virtual tickets within the game. Children can spend the virtual tickets on a carnival game which helps motivate them in the learning experience.

InTense allows both single and multi-play modes. Pathologists capture children (players) profiles on InTense and are stored in the tablet, which can be retrieved to review player's progress.

The stage of development of InTense is currently a working digital prototype with the main menus, the speech-therapy exercises, and the video game already implemented. The menus and other interfaces ought to be improved in later development iterations.

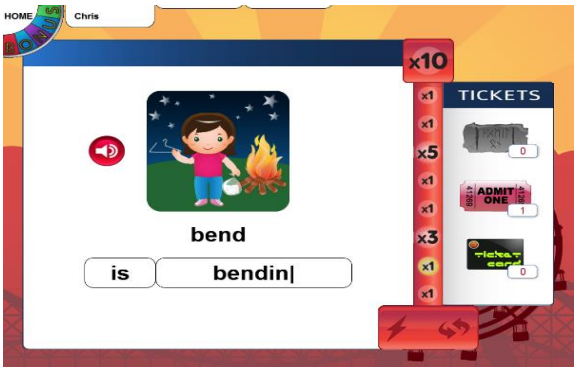

Figure 1. Screenshot of an exercise on the tenses.

InTense contains two major components; the speech language pathology (SLP) tool and an Angry Birds™ (a very popular video game) style game (Figure 2).

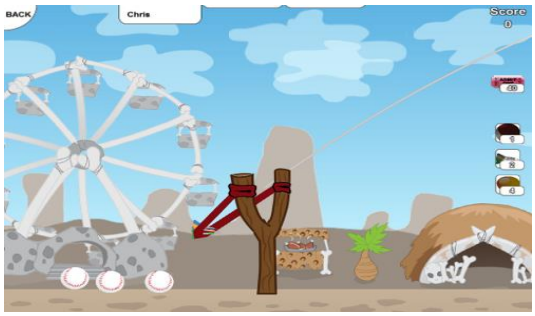

Figure 2. Screenshot of the game.

3.1 Structure of InTense

This section describes the main parts of InTense. Only speech and language pathologists have access to the settings menus, and children have access to the activities and game sections. Children play the serious game when the therapists are present, because the latter need to select options from the menus. It is not intended to be played by children alone.

3.1.1 Menu System. The game can be managed from within the menu system. New players can be created, individual settings

can be modified, and players can be added to or removed from a session.

3.1.2 Create a Player. From the main menu, the create a player option can be seen. This leaves the user with a blank profile to fill in a name. Once the name has been entered, the therapist presses the save button.

3.1.3 View/Edit a Player. Once a player has been created, their settings can be managed from within the same screen. This screen can also be reached by clicking a player's name, then clicking the "options" button that appears. Tenses and Questions can be selected. Tool results and Game trophies can be viewed.

3.1.4 Session Edit. Sessions can be started from within the main menu. Players can be added by clicking their name, then clicking the "add" button. Their name will appear at the top of the screen indicating that the player is active for the session. The player can also be removed from a session by clicking the "subtract" button at the top of the screen. If only one player is active, a single-play session can be started. If more than one player is active, a multi-play session can be started. The multi-play session and all tickets gained will be saved as long as there are at least two active players, and will reset once the active player count is reduced to one.

3.1.5 Single player. The single-play functionality is fairly simple. The player answers questions to gain tickets. The player has the option to jump to a "level select" screen, where they can select a game level to start – If they have the required tickets. They also must progress through each tense levels one after the other.

3.1.6 Multiple players. The multiplayer works similarly to how the single player does. In the tool portion, each player answers three questions and passes the iPad™ to the next player. They collectively gain tickets for the current session (tickets reset for each session). The tickets can be spent on a different "level select" screen to start a multiplayer specific level, each designed with more than one player in mind.

3.1.7 Game. In single player mode, the player has a limited amount of ammunition to destroy all of the targets present on screen in the style of Angry Birds™. For multiplayer, each player will take turns shooting a collective amount of ammunition. In both versions, tickets can be spent in game to use more powerful ammunition.

4 Our usability approach

We took into account the User Centered Design (UCD) paradigm [10-11] in the development of our user interface life cycle development method. UCD is based on the integration of participants to most of the steps of the interface development to improve its usability. Thus, we would like to integrate both children and therapists to test out the prototype versions. The main idea behind this is to have both a participatory and collaborative user interface design [12] that will include both children and therapists working together. Our method oversees the importance of prototype usability evaluation, as [13] established in their Star life cycle method. Figure 3 shows a diagram of the evolutionary prototyping method, which we adapted from [14].

We will consider the following recommendations written by [15], among others, on the design of mobile interfaces for young children:

- Use frequent voice-over audio prompts to convey instructions.
- Replacing mouse-over (pause-on) functionality requires special consideration. Mouse-over functionality is very useful in educational games, providing audio voice-over to identify the object that the cursor is paused on.
- Keep the game structure and gameplay simple.
- Use large, visually distinct hotspots. Children already struggle to use the mouse to click on hotspots, size of hotspots is a concern in moving to a smaller screen. Use larger buttons for that.
- Avoid hotspots near the edge of the screen. Children's fingers creep over the edge of the screen while holding the device, accidentally touching hotspots near the edge.
- Children may not be familiar with some terminology, for example, we as designers should use the term "touching and moving" instead of scrolling.
- Use tilt functionality of some mobile computers with caution. Children may have difficulty to control the tilting.
- Teach new interactions with simplified trials, such as tilting the device.

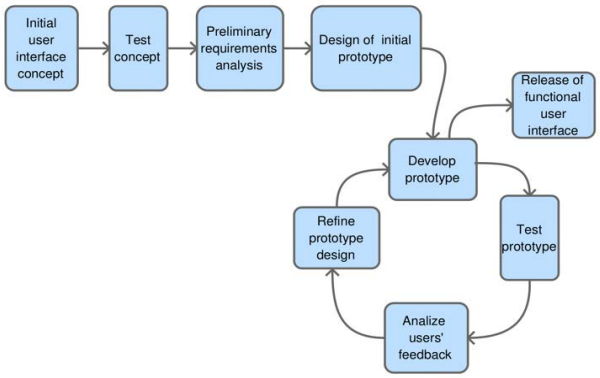

Figure 3. Our evolutionary prototyping method.

We will use direct observations, a post-questionnaire and the Concurrent Think Aloud method to evaluate the prototypes of InTense's interfaces. The Concurrent Think Aloud is a simple usability method where each participant is asked to do some tasks on the proposed system and the participant is asked to say out loud his/her thoughts about each task while performed it

[16]. This method has been proven to be useful to conduct usability testing with children [17]. In addition, [18] provides excellent guidance on the logistics and the actual usability testing with young participants.

In the light of the Concurrent Think Aloud usability method, we propose to use both children and therapists as informants [19] on the usability of the mobile serious game interfaces, where they will report both positive and negative issues on the user interfaces during the usability tests.

We aim to design the InTense's interfaces to be:

- Usable (efficient, effective, and pleasant to use).
- Fun.
- Functional.
- Informative.
- Unobtrusive.
- Motivating.

5. CONCLUSIONS

We have presented the design and development of a mobile serious game used to support language therapy of English tenses, called InTense, developed by Algoma Games for health, a game development studio. One design challenge is the improvement of the user interfaces of the serious game. Important design guidelines regarding user interfaces for mobile computing and usability testing with children were addressed. We propose to use both children and therapists as informants on the usability of the mobile serious game interfaces, where they should report both positive and negative issues on the user interfaces during gameplay and usability tests. Future work will include interface design and usability testing based on the user-centered design (UCD) paradigm to improve InTense's user interfaces.

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