Designing Mobile Applications for Hearing Impaired Children: Guidelines from the Field

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Abstract: The aim of the current study is to represent design guidelines emerged from a research project aimed to create supportive mobile applications for hearing impaired children's literacy instruction. The project is carried out in the Anadolu University's Applied Research Centre for the Education of Hearing-Impaired Children (ICEM), which is the Turkey's unique institution with 35 years of teaching and research experience for hearing impaired children. The project is a multidisciplinary study joining experts from Instructional Design and Technology, Special Education and Fine Arts disciplines. 8 distinct mobile applications were designed and subjected to expert views. Following the expert views applications were edited and usability studies were undertaken. Interaction guidelines emerged from these studies are provided.

Introduction

The aim of the current study is to represent design guidelines emerged from a research project aimed to create supportive mobile applications for hearing impaired children's literacy instruction. The project was funded by "The Scientific and Technological Research Council of Turkey". The project is carried out in the Anadolu University's Applied Research Centre for the Education of Hearing-Impaired Children (ICEM), which is the Turkey's unique institution with 35 years of teaching and research experience for hearing impaired children. The project is a multidisciplinary study joining experts from Instructional Design and Technology, Special Education and Fine Arts disciplines.

Context

The project started with field observations in ICEM's actual classrooms. Three pairs of IDT experts observed Turkish Language classes for a total of 240 minutes. Following the field observations IDT experts analysed collected data and came up with supportive mobile application suggestions for classes. 17 weekly project meetings with all experts' participation were held to evaluate these suggestions. Consequently eight distinct applications were envisaged for supporting Turkish Language classes. Dual and triple subsets of these eight applications are selectively combined into modules for daily 80 minutes classes. Short descriptions for applications classes are provided below.

1. Interactive Storybook: The interactive storybook is an illustrated storybook with interactive text. Users are able to alter the text characteristics (bold, underline, highlight) and add comments to these words.

2. Story Map: Story map is an interactive game for analysing characters, times, places and events in a story. Users are provided with empty lists placed on surfaces of a 3D rotating cube. Once the user finishes filling in the lists, the cube gets flat and shows all user entries.

3. Suffix Pickup: Turkish is an agglutinating language where suffix knowledge is essential. Users are provided with a story filled with interactive names with no suffixes. Once the user touches these names a list of available suffixes is provided. User can choose a suffix to alter the name.

4. Tense analysis: Turkish is an agglutinating language which tenses are loaded on words via suffixes. For example "gel" is a verb meaning "come". The past tense form of "gelmek" is "geldi" whereas the "future" tense form is "gelecek". Users are required to analyse the tense suffixes within given verbs with a radio-button structure.

5. The word wheel: The word wheel is a carnival wheel game for building sentences with given word. Users turn the word wheel with a swipe gesture. Once the wheel stops user required to type in a sentence with given word.

6. Order the sentence: Order the sentence is a puzzle game. Users are supplied with shuffled sentences and required to grammatically order the sentence by dragging the words around.

7. Verb pickup: The verb pickup is a sentence completion game. Users are provided with a no-verb text. Once the user touches the placeholders for verbs five options are provided. Selected word is placed into sentence by the project's mascot ROBO.

8. Verbal pickup: Users are provided with sentences without verbals. Once the user touches the verbal placeholder, five verb options are provided. Selected verb is sent into an interactive verbal generation wheel. User sends generates a verbal and sends it into the sentence.

Methodology

Envisaged initial designs of these applications were created and ported into tablet PCs (iPads). Working examples of these initial designs were demonstrated to experts from Special Education and Fine Arts disciplines. Following these demonstrations, experts were interviewed for visual design and interaction elements. Project group analysed collected data from these semi-structured interviews and findings were reflected to initial designs. Having validation from field experts, projects passed on to usability testing phase. Project group collectively created observation forms and instructions for usability tests.

Usability tests were conducted with 7 hearing-impaired students studying at ICEM's 6th, 7th and 8th classes. Students were supplied with instructions to complete usability tests. Tests' completion times ranged between 9'51" and 21'05". All test sessions were video taped for further analysis with project group. While two IDT experts observed and rated observations forms, an expert from SE helped students in case they had trouble understanding given instructions.

Findings

Following guidelines emerged from usability tests and expert views.

Headers do not work: Most of the mobile applications use header and footer structures for placing navigation elements. These structures are provided in most popular application development frameworks. However, students had problems finding these navigation buttons but tried dragging. Using rather intuitive touch gestures like swipe and drag promotes applications' usability.

Contiguity matters: Since, hearing-impaired children have varying literacy levels; they may need to read over while performing instructed actions (ie. analysing suffixes). Therefore interface should help user as much as possible through tasks. One of the best practices emerged from this study is fading out all the content and showing only the sentence and the optional verbs for the sentence.

Use common elements: A common language for all interaction elements is essential. For example, project group designed all touchable blanks in sentences as yellow boxes with red dashed bottom borders. Once students discovered this pattern, they had no trouble in the consecutive instructions and applications.

Flat design does not work: Project group has initially favoured recently popular flat design paradigm. All images, interactive elements and buttons were designed as flat that had no shadows, highlights or emboss. However flat designed interactive elements did not give the "touchable/clickable" impression to students. For example flat designed "Control" buttons were perceived as instructions rather than buttons. Students thought they were instructed to control their responses on their own rather than pushing the "Control" button. Fruitful options for indicating interactive elements were using 3D button styles, shades and highlights.

More space for little fingers: Even though children have little fingers they needed wide touchable areas for better control. Children especially who had no prior mobile device experience had trouble orienting themselves with interactive elements. Double spacing between lines and bigger fonts proved better for controllability.

Conclusions

Above guidelines emerged from usability studies. Since ICEM embraces an audio-lingual approach in education, these guidelines are applicable in all mobile applications for early literacy instruction. This project will now turn to design based research phase for discovering in-class usability guidelines. Modules will be experimented in actual classes with weekly design cycles.