

Seek and Sign: An early experience of the joys and challenges of software design with young Deaf children

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ABSTRACT

This paper describes the initial stages of a research project aimed at teaching preliterate Deaf children Australian sign language (Auslan) using a software application deployed on a mobile technology device. We discuss the user centred design techniques to be used in this project, specifically Gestural Think Aloud Protocol and the Problem Identification Picture Cards method. An initial design session exploring the feasibility of the design approach suggests that the approach is suitable and desirable. Our design questions for future development are listed.

Author Keywords

Mobile computing, eLearning, UCD, children

ACM Classification Keywords

H.5.2 User Interfaces (User-centered design)

INTRODUCTION

A recent survey in North America found that 78% of Deaf children are born to hearing parents who may be unfamiliar with sign language, and that only 24% of households with Deaf children use sign language regularly (GRI, 2008). The Deaf children raised in these households tend not to experience the immersion in language that most children experience during their early years. These children rely heavily on face to face resources from education and deaf support services, with minimal help available from parents who are learning the language alongside them. This lack of exposure to a normal language environment before the commencement of formal education causes delays which often continue throughout adolescence and into adulthood (Mayberry and Eichen (1991), cited in Huang, Smith, Spreen, & Jones, 2008). Research has shown that Deaf children of hearing parents lag behind those born to deaf parents in their language development, indicating that it is the atypical learning environment rather than deafness per se which causes the delay (Goldin-Meadows and Mayberry (2001), cited in Huang, et al., 2008).

Although many deaf and hearing impaired children are now being provided with assistive technologies such as cochlear implants and hearing aids, research shows that

most families still prefer to take a total communication approach to their child's disability, rather than relying solely on auditory methods (Hyde & Punch, 2011). The total communication approach includes signing, the use of visual and other resources as well as attempting to speak and listen. Moreover Hyde and Punch (2011) also indicate a bilingual approach (signing and verbal language) tends to improve language learning outcomes for deaf and seriously hearing impaired children. They report on a survey which showed that more than 45% of children with cochlear implants continued to use signing regularly to supplement verbal communication. Overall, the learning of signing at an early age appears to improve language development in deaf children, with or without other assistive technologies (Kyle, 2001). Therefore development of technologies to support early learning of sign language will potentially support this improvement.

There is a lack of learning resources for deaf children who have not yet learned to read or write (Munoz-Baell, Alvarez-Dardet, Ruiz-Cantero, Ferreiro-Lago, & Aroca-Fernandez, 2011). While there are many resources available to help hearing and literate people learn sign languages, there are very few resources available to help preliterate Deaf children learn Australian sign language (Auslan) (Ellis, 2009). Our own preliminary research has found that some schools which specialise in teaching Deaf children have created their own resources, but these are considered fairly ad hoc, and reach only a limited audience of children, preschool age or older (Birch, 2011).

The Seek and Sign project is important in addressing the application of new technologies to enriching the learning and communication environments of very young deaf children. This long-term project aims to advance knowledge in three main areas: usability factors for software for very young children with a communication deficit, user centred design methods applicable to very young clients, and the applicability of mobile and internet technologies for assisting very young children to learn signing. Specifically, the project will investigate requirements for the learning of signing for preliterate deaf children in Australia, identify the functionality of mobile technologies for providing learning resources, investigate and implement methods for involving young children in the design of appropriate technologies, and specify the requirements for appropriate technologies, including building prototypes. The project is also expected to provide insights into how such resources may assist deaf children's access to literacy and numeracy resources.

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This paper discusses the preliminary stage of this project – an initial design session aimed at exploring the feasibility of the design techniques and the experience of designing with young Deaf children. The Seek and Sign application will be a game based program designed to introduce sign language in an engaging fashion using mobile technology devices. The mobile technology platform has been chosen due to the ease of access to these technologies amongst parents. The use of mobile technologies also enables the development of context aware functionality in the application, where screens relevant to the child's current physical location may be generated. The application will give children the opportunity to navigate through a virtual scene and to interact with elements in the scene, triggering flash card style images, written words, and signing videos. As the child progresses, the system responds to their activities and endeavours to adapt the behaviour of the interface, allowing access to a second level of words.

This paper will describe the application to be developed as part of the Seek and Sign project and the design approach chosen for the application. We will outline the results of the exploratory design session, and discuss the design questions we have developed.

DESIGN APPROACH

Specific issues apply when exploring the development of the Seek and Sign application. The nature of the product and the audience for this development has particular characteristics that must be taken into account.

Design for hearing impaired children

A design challenge when working with children is gathering the child's ideas, not those of the supervising adult. There is "recognition of the fact that children's views differ from those of adults" (Rabiee, 2005). In order to attempt to gather the child's ideas directly, a participative approach has been chosen. Additional challenges are involved with participative design with Deaf children. Not all Deaf children can communicate verbally, however they do use facial expression and body movement, and this feedback is valuable. The structure of design sessions involving Deaf children should be flexible and communication support should be available (Cavet & Sloper, 2004). Participatory approaches involving Deaf children also require flexibility (Allsop, Holt, Levesley, & Bhakta, 2010).

Druin (2002) describes four levels of involvement, or roles that children may play in designing new technology: user, tester, informant, and design partner. The first two roles involve the children simply as users or testers of the technology, the informant role sees the child assisting in the design process, and design partner role sees the child as a full participant in the design process. The choice of role depends on the specifics of the project itself, and in the case of this project that choice will be influenced by the skills of the children participating. It is intended that the children will participate as users, testers and informants. Each role will require specific techniques in order to obtain feedback.

Guha, Druin, and Fails (2008) built on Druin's (2002) levels of involvement to develop the Cooperative Inquiry technique for children with special needs. The technique is an inclusionary model involving first determining the role the child will play (the first layer of the model), considering the nature and severity of their disability (the second layer of the model), and the availability and intensity of support (the third layer of the model) that is required. It is an iterative, participatory design technique involving the development of low-tech prototypes. Participants and developers work together as co-designers.

A range of techniques can be used within the larger design approach described. The Think Aloud Protocol (TAP) involves a participant in the design process evaluating a section of an application by expressing their thoughts aloud as they work through a task. TAP is still possible with the use of sign language (Roberts & Fels, 2006), however only with participants who can already sign. This is known as Gestural Think Aloud Protocol (GTAP). Roberts and Fels (2006) outline a set of guidelines for conducting GTAP sessions that cover a range of issues including specific activities, physical constraints, the communication skills required for the technique. In addition to communication skills, GTAP requires a level of cognitive ability in order for the participant to express their thoughts. This can be a challenge for small children. In this case, cards can be used in place of language, such as the Problem Identification Picture Cards (PIPC) method developed by Barendregt, Bekker and Baauw (2008). The technique involves the use of eight picture cards to illustrate the feelings children may have. While interacting with an application, the child may place as many cards as they like into a box to indicate their feelings. The technique can be used in conjunction with GTAP and is particularly suited to the requirements of the Seek and Sign development.

Mobile design

Designing an interface for a mobile device presents a different set of challenges and requirements when compared to designing for a desktop interface. Clearly there are issues related to the logistics of screen size and memory capacity between the different platforms. Within the smartphone and tablet computing arenas there is also the difficulty of the different operating system platforms available. Additionally, there is the expectation that as a game application the Seek and Sign development will have a 'fun' factor. Designing for enjoyment was identified as important for mobile devices early in the life cycle of this technology, as was the need for personalization within the interface (Gong & Tarasewich, 2004).

Context Awareness

As mobile computing becomes more ubiquitous, context awareness is an increasingly important area of consideration. It allows applications to increase their relevance to their users by modifying functionality, appearance or content based on the user's context.

Context can roughly be described as the environment the user is operating in, specifically regarding the questions of *who, where, when and what*. (Chen & Kotz, 2000; Hexel, Johnson, Kummerfield, & Quigley, 2004). The potential to include context awareness features within the Seek and Sign application provides the opportunity for a second layer of complexity in the product, with the potential for information and signs to be displayed in the application that are relevant to the user's context and current location.

SEEK AND SIGN

The Seek and Sign application will be a game based program designed to introduce sign language in an engaging fashion using mobile technology devices. The proof of concept prototype consists of a single sample scene: a bedroom. The children are able to explore the room and discover interactive elements in the scene. When an element is selected, a flash card style image is displayed, followed by a video for the sign for that element.

As the children progress through the scene, the system tracks patterns of interaction and adapts to personalise the interface behaviour. For example, if the children habitually view the sign video multiple times, the interface will automatically replay the video on first completion. Alternately, if the children focus on the image, it will be enlarged and shown again at the completion of the video. To encourage continued interest in the program, some items have a second 'level' of words which are unlocked after repeated viewings.

Design Approach

As this was our first experience in designing with young Deaf children, we conducted a preliminary proof of concept development for the Seek and Sign application in order to consider the suitability of the Cooperative Inquiry approach for this project. The first step was to deal with the first layer of the model by considering Druin's (2002) levels of involvement, where children can be involved as users, testers, informants, or design partners. While the ultimate goal is to involve children as design partners using GTAP and PIPC, for the initial proof of concept model we first undertook research to explore the views of a child as a user of similar products in order to develop ideas for potential functionality and scope for the product. This was followed by a design session with a child as tester and as informant using a simple mock-up of the Seek and Sign application.

The process of selecting a participant for the design session was a convenience selection. One of the researchers for this project is the grandmother of a deaf child. The design session was framed by the second and third layers of the model – the nature and severity of the disability, and the availability and intensity of support. The participant in the session was a seven year old, profoundly deaf boy who has had a working cochlear implant for two years. He has limited verbal language and attends a deaf special education unit where Auslan as well as speech is used. His mother and grandmother were present for the design session and his grandmother acted

as translator for him when required. In this case, the child was able to undertake an involved role in the session with the assistance of his grandmother for one-on-one communication. This was further facilitated by the experience his grandmother has with research and design processes.

The format of the session was simple: the participant was provided with a laptop displaying the proof of concept prototype. He was asked to 'play' the game displayed, and his interaction with the game was observed by a researcher in the role of designer. Participant observation notes were made.

Design Session Outcome

Our initial concern was to investigate the success of a young Deaf child in the role of tester and informant. We found that our participant in the design session was able to interact easily with the designer, providing clear feedback and making his opinions known. The proof of concept for the application is a simple prototype, and the participant showed enjoyment of the bright colours of the interface, and understood how to interact with the application. The designer found it easy to interact with the participant with the support of his grandmother as interpreter, which suggested to her that a more active session designed with GTAP specifically would be simple to implement and may provide more informative feedback.

In addition to the feedback he provided, the designer noted some improvements to the interface as a result of observing the participant. These related to navigation changes and interaction revisions. Based on these observations, it was noted that more interaction directly with the participant would have improved the session outcomes, and that the PIPC method appears to be suitable for this purpose.

The aim of this session was for the designer to understand the experience of designing with young Deaf children. As a result of this preliminary session we are able to move towards a more interactive design session and to the involvement of children as design partners. We found the techniques to be comfortable and an excellent fit for the design process in this case. Further, the potential to use GTAP and PIPC was clear from this initial interaction: the active participation of a child using GTAP was possible and desirable, and the use of PIPC would enhance interaction with the younger children who would interact with this application who may potentially struggle with expressing their thoughts or opinions.

DESIGN QUESTIONS

While this paper explores early design questions, the Seek and Sign project is a long term endeavour that will be undertaken over an extended period. Future development work will seek to explore the following design questions over several stages:

Product specific

- **Should the program have some type of set up on first use?** Without set up, children can begin playing

the game immediately. Alternatively, set up functionality could allow for entry of information about the child (eg. name, birthdate) which could be used to personalise the game.

- **Do the children find the program engaging enough to play multiple times?** If the children do not enjoy the program, they may not benefit from its use.
- **How should the children's progress be evaluated?** Should a full system have some type of testing phase for evaluating progress? Results from this testing phase could, for example, be used to unlock higher level words, or new areas.
- **Should parental reporting and control features be included in the program?** Such features could allow parents to see what progress their child has made, or allow parents to change the focus of the learning experience by, for example, including fingerspelling as well as word signing.

Larger issues

- **Are GTAP and PIPC suitable design techniques for this project?**
- **Is the program effective in promoting learning?**
- **Can the use of the context awareness capabilities of mobile devices enhance learning?** Context awareness can be used to promote context-relevant lessons. The most relevant set of items could be presented to the user on start-up based on location. For example, if the user is at the shops, the items they might see could include "register", "shop keeper", "money", etc. Time of day and time of year could also be used.

CONCLUSION

This paper has presented the preliminary stage of the Seek and Sign project – a project aimed at developing an application to assist preliterate Deaf children learn Auslan. The application is to be developed using the Cooperative Inquiry approach, with the aim of using Gesture Think Aloud Protocol in conjunction with the Problem Identification Picture Cards method in participative design.

The process of conducting an initial exploratory design session for this project with the aim of better understanding the techniques and process has been discussed. It was found that the initial methods used were suitable for the project, and that the additional level of using GTAP and PIPC is feasible and desirable.

Context awareness has great potential to enhance all areas of e-learning by assisting the user to access relevant lessons in convenient ways. The Seek and Sign proof of concept provides an example of how they can be implemented, and integrated into an e-learning resource to help a disadvantaged and often-overlooked audience.

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