Methodological Considerations for Involving SpLD Practitioners and Specialists in Designing Interactive Learning Systems

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Abstract. User involvement in designing learning environments to support individuals with Specific Learning Difficulties (SpLDs) is essential, particularly in inadequately examined languages such as Arabic. Three interactive systems to support students with SpLDs, two for students with dyslexia and one for students with dyscalculia were developed in a design-based research approach. In this paper, we describe a number of user involvement issues that emerged in the context of developing interactive learning systems for children with SpLDs in Arabic-speaking target populations. Findings indicate that language, context and culture emerge as challenges in creative and exploratory design approaches. Some of the ways these challenges have been approached are outlined.

Keywords: SpLD**,** Dyslexia, Arabic Software.

1 Introduction

Design is often seen at the heart of software engineering, a practice directed at the production of software systems. While research examining user involvement in designing systems for people with special needs has yielded insights into methodological considerations, work on involving users with SpLDs has often focused on design implications of tools or applications [1-3]. User involvement issues in designing systems to support the learning of people with SpLDs are often ignored or relegated to practicing software engineers in industry. This study sought to explore how involving SpLD practitioners and specialists in the context of Arabic-speaking populations can aid in the design of software that would be accommodating to varying learner needs. The specific research questions posed in this study were: How can the prior knowledge and experience of SpLD specialists be considered in the software design process? And how can software designers elicit requirements effectively? In this paper, we present a summary of the acquired experience in involving specialists and practitioners in the design process of interactive learning systems for people with SpLDs, particularly Arabic-language users, as an encouragement to others considering engaging in this challenging but rewarding process.

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2 Method

For this study, we used a design-based research approach [4] to devise three interactive learning systems. These systems were developed as learning support tools through which students with SpLDs acquire skills, usually with the help of SpLDs practitioners in what is often referred to as 'resource rooms' in the local context, specific to reading in the Arabic language or math.

Procedure. Two SpLD practitioners and one domain specialist in SpLDs were involved, one for each system proposed. Sixteen groups of software engineering students participated as designers of bespoke software systems; each group was comprised of 5 to 7 developers. The study was conducted for a period of four months commencing with requirements discovery and ending with system deployment. Three requirements' discovery sessions were conducted; each involved the participation of designers, researchers and the SpLD specialists to elicit the systems' functional and design requirements. Each session was composed of two parts: First, SpLD specialists described their instructional design models and demonstrated their handmade artifacts and tools used in resource rooms that have been shown to be effective in their field. Following that, designers explored different ways of transferring these strategies and artifacts into interactive systems by proposing ideas and eliciting the specialists' views. Designers were also offered the opportunity to include innovative interactive games supporting the teaching strategy. Iterative design allowed for some prototypes to be reviewed by specialists and refined before deployment. At the end of the project, specialists were involved in evaluating the functionality, accessibility, and usability of the systems.

3 Results and Discussion

Three types of software systems were developed. Two programs focused on Dyslexia in Arabic and one program focused on Dyscalculia with Eastern Arabic numerals. These are described in turn (Fig. 1 shows an example of these interactive systems).

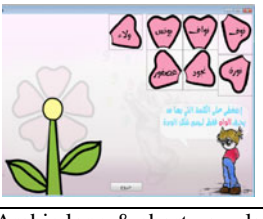
Interactive Systems		
Dyslexia		Dyscalculia
		
Arabic prefix Al & silent consonants	Arabic long & short vowels (diacritics)	Math using Eastern Arabic numerals
7 systems,35 designers	*4 systems, 27 designers*	*5 systems, 30 designers*

Fig. 1. Types of interactive systems developed for Arabic-speaking children with Dyslexia and Dyscalculia

Table 1. Mapping user requirements to design elements in the software

User Requirement	Design Element
Artifacts were demonstrated to designers in order to transform hands-on interaction (e.g. placing an element on a physical tree object) to an activity in the learning system.	Games were designed with click-drag & drop ways of interaction to simulate the activity with immediate visual indications reflecting the placement.
Specialists described lessons and scenarios that they use to support learning of concepts to students (e.g. stories).	Transforming these stories and lessons into instructional multimedia videos.
Considerations in how feedback is presented to students, especially when incorrect responses are exhibited.	Feedback regarding incorrect answers was positive and included visual cheerful characters to encourage users to try again.
Avoid animations as they distract students from the task at hand.	Animations were not incorporated in the system. Static images of characters were used and animated text was avoided.
Specific considerations in how text is read out-loud were demonstrated by a reading from the SpLD practitioner that emphasizes clear pronunciation, appropriate speed and level of pitch. Following text with a reading pacer (e.g. finger, ruler) was relevant to some parts of the system.	Spoken text in the system was re-created by designers based on the demo by practitioners. Synchronization of highlighting with spoken text was included to represent reading pacers to keep users' attention on the text being read.
The system needed to be used by students without the need for assistance from specialists.	Usability was a key consideration. Instructions were offered visually and in audio format as well as including videos demonstrating help for specific tasks.

3.1 Interactive Learning Systems

The first program was the Raindrop Program for learning the 'Al' prefix for dyslexic students. This program was to teach students how to discriminate between the 'Al' in the two formats, either silent or spoken in Arabic texts depending on the context of use. The second program was the Long & Short Vowel program for dyslexics. This program was designed to teach students with dyslexia how to discriminate between long vowels and short vowels as they are represented as diacritics in the Arabic language. The third program was the Basic Maths program using Arabic numerals for students with dyscalculia. This program focused on basic skills of addition and subtraction of 1-2 digit numbers in accordance with the 1st grade curriculum.

3.2 Understanding User Requirements

Creative solutions. Creativity was exhibited by designers in modifying the simple tutorials and lessons that specialists presented in the requirements discovery sessions. Some ideas were presented to specialists for feedback before further implementation was considered.

Cultural and language considerations. Selection of characters was a key design consideration as the appearance and name need to be extracted from the local context. This is essential for child engagement in the interactive learning system. Furthermore, designers initially did not consider exact matching of spoken feedback to the text appearing in the interface, which later on was highlighted by practitioners as an important design element so that students with auditory or language processing difficulties receive similar responses from the system. Another issue that emerged was considering grammar rules of spoken language in auditory feedback; this was a challenge for designers due to the complexity of the Modern Standard Language (MSA) which is used in teaching that differs from the spoken Arabic used in general populations.

4 Conclusion

This study has shown that the involvement of SpLD specialists in the design process is essential for efficient transfer of domain knowledge, and that creativity and exploratory approaches can be effective when language, context and culture are taken into consideration. Furthermore, the design based research method has been effective in advancing the design, research and practice of supporting the learning of students with SpLDs.

References

1. Dickinson, A., Eisma, R., Gregor, P.: Challenging Interfaces / Redesigning users. In: Proceedings of CUU 2003, Vancouver, British Columbia (November 2003)
2. Gregor, P., Newell, A.: An empirical investigation of ways in which some of the problems encountered by some dyslexics be alleviated using computer techniques. In: Proceedings of Assets 2000, pp. 85–91 (2000)
3. Petrie, H., Weber, G., Fisher, W.: Personalisation, interaction, and navigation in rich multimedia documents for print-disabled users. IBM Systems Journal 44(3), 629–635 (2005)
4. Wang, F., Hannafin, M.J.: Design-based research and technology-enhanced learning environments. Educational Technology Research and Development 53(4), 5–23 (2005)