Innovative Educational Technology for Special Education and Usability Issues

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Abstract. The purpose of this study is to introduce educational technology project, OZTEK, for special education students and present usability issues related to those developed technologies. With the OZTEK, the researchers intend to develop innovative, technology enhanced learning environments to support the education of children with such special needs and to investigate effectiveness of such learning environments.

Within the scope of the OZTEK, to provide support for special education, various instructional technologies have been developed, which are unique in terms of innovation regarding not only in Turkey but also other countries in the world. Throughout the project the following products will be developed which can either be used separately as standalone tools or together as a whole obtained by integration to each other: Interactive multimedia educational software that will detect body movements, interactive multi-touch table/board, applications and smart/interactive toys.

In this paper, the findings regarding how computer supported educational materials for special education have been developed, what kind of usability challenges were faced with, how challenges have been overcome and how those technologies are used by teachers and students are presented.

Keywords: Usability, innovative technology, technology enhanced learning environments, special needs, students with special needs.

1 Introduction

Even though the rates of special education services that children with mental disabilities benefited from have increased in recent years, the offering of effective educational services and the use of innovative instructional materials did not reach to the desired point yet. Therefore, quality of the present state of education offered

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to children with such special needs is questionable. Related to this, there is lack of information related to how instructional technology are utilized in special education.

Use of technology in education of students with disabilities has a considerable history. The literature provided evidence that several technological instruments might be used effectively in the classrooms (King-Sears & Evmenova, 2007; Hasselbring & Glaser, 2000; Alper & Raharinirina, 2006; Williams, Jamali & Nicholas, 2006). The technology not only targets teaching related to a certain content area but also might focus on limiting the difficulties caused by a disability (Hasselbring & Glasser, 2000; Lancioni & others, 2011; Lancioni et al, 2010; Kaspi-Tsahor, Heiman & Olenik-Shemesh, 2011).

The primary goal of the this project is to develop and produce technology enhanced learning programs in the light of the designated special education curriculum, for teaching basic essential and cognitive concepts. To be utilized for the education of children with special needs, OZTEK (Investigation of the teaching process of basic essential and cognitive concepts to Special education students and its effectiveness using Technology Enhanced Learning environments) has been designed and developed as interactive environments, which are consisted of content that is edited and enriched specifically for such children and of multimedia that addresses all the senses by providing audio/visual/physical and tactile interactions. Considering the cost/performance tradeoff, these technologies will be developed as to be accessible not only to schools but also to everyone including home users who own a personal computer and have an Internet access.

2 Methodology

Observation methodology, particularly nonparticipant observation, and unstructured interviews were used to collect data from the first testing process. In the process of nonparticipant observation, "researchers do not participate in the activity being observed but rather "sit on the sidelines" and watch; they are not directly involved in the situation they are observing" (Fraenkel, Wallen & Hyun, 2012, p. 446). Therefore, special education students were observed to understand usability related issues without participating the game itself. Moreover, opinion and advices of teachers for correction of the materials were taken during testing as well as interviewing with them after testing.

2.1 Research Questions of the Study

This study will be sought answers for the following question:

- What is the usability (effectiveness, efficiency and satisfaction) of the materials developed in the project by teachers?

In this study, the findings regarding how computer supported educational materials for special education have been developed, what kind of usability challenges were faced with, how challenges have been overcome and how those technologies are used by teachers and students were presented and discussed.

2.2 Participants

First of all, the prototype developed with the help of Kinect technology to improve social skills of students had revised and evaluated by an instructional technology specialist and a special education specialist at early stages of project before 2 special education teachers were interviewed about the prototype and some students were observed while they were interacting with the prototype. Additionally, before the prototype was developed, developers tested similar Kinect based games with 5 students with special needs in order to understand attitudes and abilities of the students related to usage of the games. In parallel of development of Kinect based prototype, an interactive multi-touch table/board game, which aims to help improvement of the life skills of the students, was tested with 2 students with special needs and then 3 special education teachers were interviewed in order to investigate the weaknesses of the interactive multi-touch table game and poor aspects of it. Lastly, smart/interactive toys were tested with 1 student with special needs and evaluated 1 special education teacher in order to get feedbacks in development process.

2.3 Instruments

Under the project, in order to respond to research questions, many new instructional technology products have been produced in the purpose of to support the educational process of mentally handicapped children, not only for our country but also for other countries in the world. The materials to be developed can be used integrated with each other or separately. In this projects, materials have been developing in three different areas:

Kinect-based Game. Kinect-based serious game developed to practice the process of making shopping in order to improve the students' social skills. In this digital game, there are two shelves with 5 milk cartons per half liter placed on each shelf. In the beginning of the game, the student hears an instruction: "Get a carton of milk and drop into the basket". After then, when the student put his hand on one of the milk cartons and waits for over 2 seconds, the milk carton sticks into hand. Additionally, right after leading to cart, the milk carton is dropped into cart from the hand and the sound of applause can be heard as reinforcement (see Fig. 1). All these sequential operations happen by using students' bodily movements (see Fig. 2).

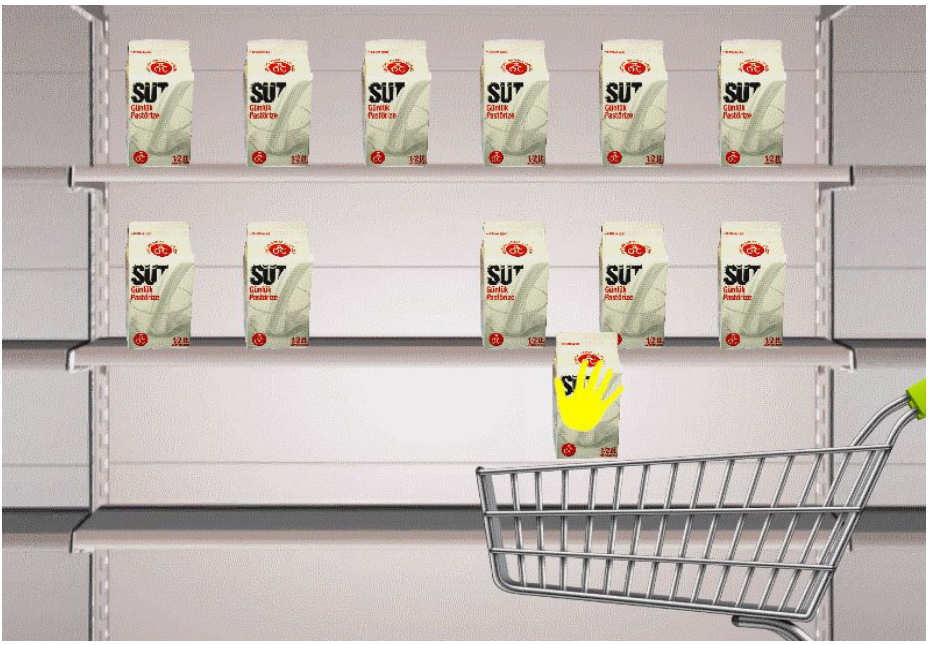

Fig. 1. Kinect-based game interface

Fig. 2. A scene from the student's performance

The game was developed with Unity game engine and requires a PC, a Kinect camera and a projector or TV to run. There will be three difficulty levels in the game that enable mentally handicapped children on the different level of intellectual disability to access the game.

Interactive Multi-touch Table/board Application. A mobile application was developed in order to teach to mop floor as one of the cleaning skills in order to improve the life skills of the students (see Fig. 3 and Fig. 4). The application has certain sequential steps: Firstly, a step is shown to students in the app and then the students apply it as it was shown previously. The application was designed to be used with the help of teachers and parents so as to ensure that the students master this skill and provide implementation of the skill into everyday life without problems to be faced by students. The application was run on tablet.

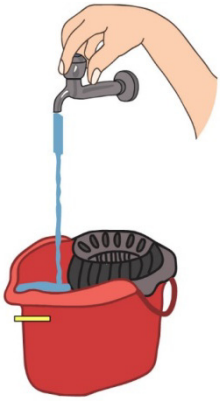

Fig. 3. Interface of mopping floor application

Fig. 4. Interface of mopping floor application -2

Smart/interactive Toys Game. A game was designed with the help of smart toys to teach appropriate clothes for each season of a year. Miniature outfits were designed as much as similar how they appear on the screen and RFID sensors were placed into the outfits. When the student uses RFID reader for the game, the selected outfit appears on the screen or related instruction is given based on correct/wrong selection.

The game consists of history and game parts. Firstly, the history part of the game gives information related to chosen season of the year and the body parts that we put clothes on. Secondly, after given information in history part, the game starts and ask for the appropriate clothe for the chosen season among two presented clothes on the sides of the character (see Fig. 5 and Fig. 6). If the student is able to select correct clothe which matches with the season, the sound of applause and "thank you, I can wear a hat for sun protection" can be heard. Unless the student selects the right one, 2 different clothes continue to appear in the bubbles on both sides of the character. For wrong selection, "if I wear a thick knit beret, I can sweat and get sick" and "now look at them carefully and try again" can be heard as instructions.

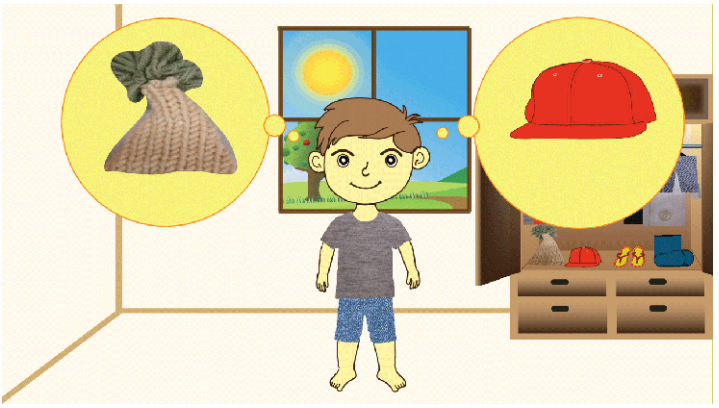

Fig. 5. Seasons-themed Smart toys' Interface

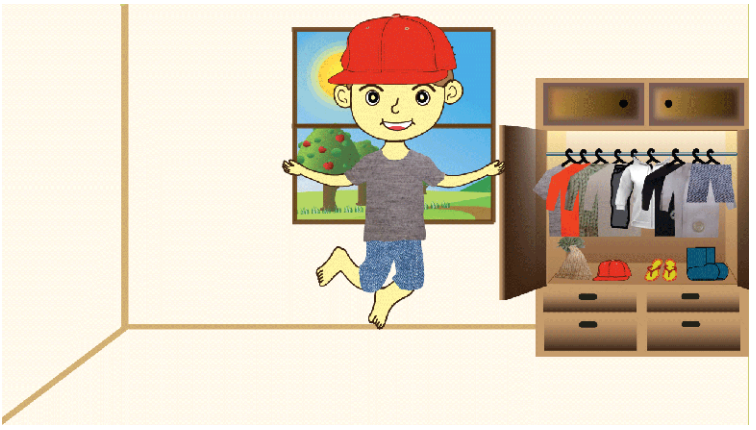

Fig. 6. Seasons-themed Smart toys' Interface -2

3 Findings

In this part, the opinions of the teachers about the developed materials and the observation of the students are examined and reviewed. During the development of the materials, the materials were revised based on suggestions of subject matter experts and a specialist in instructional technology.

3.1 Findings Related to Kinect-Based Game

In overall, the first prototype of the game was found appropriate to test with the students at special education schools by the instructional technology specialist and the special education specialist because of short stories, focused and adequate illustrations, selection of products in everyday life in the game. Moreover, two special education teachers stated that visuals used in the game are suitable due to real-like representations of the actual objects. However, one of the teacher emphasized the distinctness between designs of objects in order to support obvious object detection and distinction between the objects. Addition to this, importance of videos of the stories and verbal instructions were underlined.

The findings regarding usability issues, apparently the students were able to use the materials easily, nevertheless, at the beginning of the process, the students experienced difficulties in getting used to play the game because of the lack of videos that show how to play the game. Thus, one of the teachers suggested that there can be a video that demo how to hold an object in the game. Additionally, another teacher pointed out that a user manual might be prepared for teachers in order to present what skills are taught at which stage or the contents of each level so as to increase the usability of the material.

3.2 Findings Related to Interactive Multi-touch Table/board Application

The design and flow of the game are found appropriate to use for the students with special needs by the teachers. Also, the application got attention of the students due to appearing on the tablet. However, they pointed out that the background should be more realistic and it should remind students about the place where they prepare cleaning equipment and where they would clean in real instead of using plane background in one color in order to enhance understanding of new concept and relation among the objects. Moreover, during testing process of the app, verbal instructions, quality of them (stress, tone of voice, apparentness), repetition of actions and certain distinction between the steps come out as points that should be considered for useful and effective application design for the students with special needs.

Furthermore, as findings in terms of usability issues, buttons for navigations on the screens are small and so the students have difficulties in using them. For this reason, the buttons need to be bigger. Additionally, there should be more control buttons that enable the teachers to have more supervision in game. Besides these, there should be a user manual that describes steps of the cleaning activity and present new objects and concepts to be used for this activity.

3.3 Findings Related to Smart/interactive Toys Game

The seasons-themed smart toys' game starts with a story which describes the season. According to the teacher, the story should be shorter and shouldn't be only with voice. Moreover, the objects and characteristics of seasons in the game and story should be given more obvious, clear and understandable. The clothes are given as selectable objects shouldn't mean slightly different clothes. For example, jumper-T-shirt combination is considered as good example instead of shirt-T-shirt combination. Furthermore, in this game, verbal instruction and their quality are pointed out as very important point once again. Because, verbal instructions describes every single action, they use as reinforcement and in this manner they lead students to follow steps of activities.

Furthermore, for this game, there is a need to prepare a user manual. It should have boy and girl avatars and also the RFID reader should introduce as the hand of avatars as well as identifying seasonal pictures and clothes and their explanations. The students experienced difficulties in recognizing that RFID reader refers to avatar's hand, thus the teacher suggested that RFID reader should be dressed as a hand to help the students make the connection. Moreover, the teacher stated that the miniature outfits as smart toys should represent real feeling of fabrics no matter what it is.

4 Discussion and Conclusion

The study focuses on innovative educational technology for special education and usability issues. This study aims to examine the materials developed for students with special needs in order to understand the usability of the games, students' impressions and teachers' opinions about them. Moreover, the findings related to the materials might help to improve the software developed and gain a perspective for developing similar material considering future studies.

In general, findings related the materials showed that quality of verbal instructions, size of designed objects and controls, having a user manual and real-like design are at the forefront of usable designs in special education field. For instance, if verbal instruction can be used effectively and properly, it can reduce usability issues. Because, sometimes the students were confused about what the next step is or about reinforcements due to lack of correct and sufficient verbal instructions. Teachers' verbal instructions help students stay on task (Williams, 2009) and in special education, teaching with visual reinforcement and supportive verbal instruction is considered as promising teaching approach (Davis & Florian, 2004). Thus, verbal instructions should be prepared carefully and their quality also be taken into account.

For all materials, there is a need to provide a user manual. User manual might remove some usability issues, because the user manual aims to assist teachers in effectively operating a system (Chafin, 1982). Thus, in order to help the teachers and students to use the materials effectively and efficiently, user manuals might be provided in special education as well.

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