First Testing of a Kinect- Based Game in Special Education: "Magic Hands"

1. Introduction

There is literature about creating effective learning environments for students and the key components of technology enhanced learning environments are defined such as pedagogy, technology and social interaction (Chen, 2003; Kirschner et al. 2004; Wang, 2008). Here, the important thing is integration of technology in the learning environment with the appropriate pedagogical framework. It is clear that in order to support learning and meet the needs and learning intentions of students, learning environments should be enriched with different learning materials, resources and activities that help students learn (Chen, 2003; Kirschner et al., 2004; Cooze & Barbour 2007). On the other hand, although technology has a remarkable potential in supporting students' learning and providing them with more interactive and life-like environments, there are not many studies targeting directly at students with intellectual disabilities.

1.1. Children with Intellectual Disabilities

The term "intellectual disability" (ID) often refers to the limitations in mental development, social skills and communication. These limitations are not restricted to intellectual functioning such as low attention span and impaired working memory but are also observable in adaptive behaviors (Schalock et al., 2007; Durkin, 2010). Basically, people with an ID have limitations in two main areas: intellectual functioning and adaptive behavior (conceptual, social and practical skills) (AAIDD, 2010).

1.2. Special Education

It is important to understand the nature of the students' special educational needs in order to help remove the encountered obstacles students with ID can experience because this understanding might help to support an effective implementation of these special education (SE) methods. Individualized instruction and appropriate methods are worth-emphasizing in SE (Cook & Schirmer, 2003; Detterman & Thompson, 1997). In the literature, there are supporting evidences for positive effects of computer assisted instruction on the process of learning students with ID, when compared to traditional instruction (Bosseler&Massaro, 2003; Howard, Greyrose, Kehr, Espinosa & Beckwith, 1996).

1.3. Digital Games as Educational Software in SE

In education, using a computer is an effective method of teaching concepts to children with an ID (MEGEP, 2007). Furthermore, when subject to be learned is given in a game concept, this also might have a positive effect on motivation (Saridaki et al., 2009). According to researchers, what makes serious games a powerful tool for education is that they bring fun, gameplay and narratives together (Gee, 2003; Malone, 1980; 1981; Csikszentmihalyi, 1975; Lambert, 2006).

Even though serious games support SE in various positive ways, one of the most important limitations is the medium of interaction with the digital world. According to Williams (2006), without a mouse and keyboard, students with ID can focus easier on their task (cited in Uzun et al., 2011). In literature, it is stated that the children with ID often have limited control of hand movements as well as limited gross and fine motor skills (Aral and Gürsoy, 2007 cited Uzun et al., 2011). Therefore in our study, we preferred to implement a gesture-based interaction where students can use their body as a controller.

1.4. Gesture Based Learning

Gestures constitute natural and powerful parts of everyday communication. Several studies suggest that using gestures has a positive impact on learning such as improvement in comprehension and memory and in deep and long-lasting learning (eg, Alibali & Goldin-Meadow, 1993; Broaders, Cook, Mitchell & Goldin-Meadow 2007; Stevanoni & Salmon, 2005; Broaders et al, 2007 as cited in Ozcelik & Sengul, 2012). Recently, gesture-based technology showed that it is possible to create innovative interfaces for individuals with special needs (NMC[1], 2012; Pirani et al, 2010).

[1] The NMC (New Media Consortium) is an international community of experts in educational technology.

2. Methodology

2.1. Participants of the Study

The purpose of this study is to examine the usability issues of the learning material designed with the help of Kinect for students with intellectual disabilities. Thus, the participants are students with intellectual disabilities and developmental delays. The participants of the current study includes 6 students; 2 of them were 2nd graders at age 8; 2 of them were 3rd graders at age 11 and 12; 2 of them were 5th graders at age 11 and 15. Besides our observations on participants, additional data about our materials were gathered from 3 SE teachers from a SE school, an expert in SE and a specialist in Instructional Technology. The main data sources of this study are provided by their opinions, feedback, reactions and observations.

2.2. Instrument

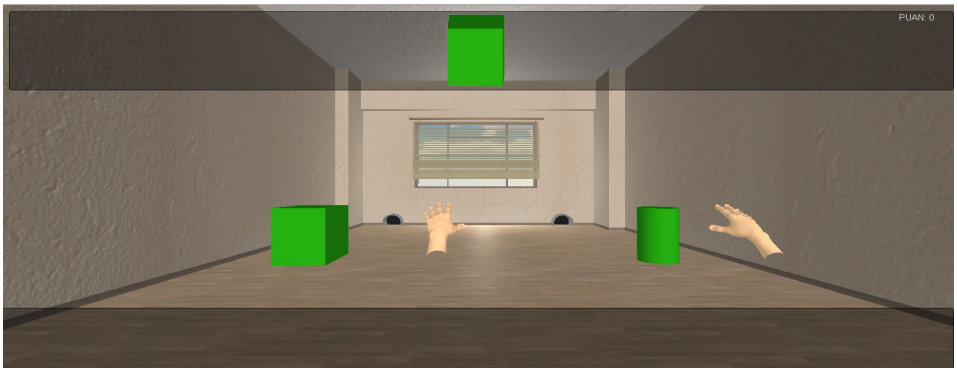
"Magic Hands" is a Kinect-based serious game developed to practice basic concept learning. In this digital game, students match four main geometric shapes by using their bodily movements. The game was developed with Unity game engine and requires a PC, a Kinect camera and a projector to run.

2.2.1. Educational Software Design

The design process carried out with both an expert in SE and a specialist in Instructional Technology. According to Official Turkish curriculum of SE and the advice of field experts, we decided to implement a basic shape matching activity.

The experts reported that the digital environment should be realistic but also simple. For simplicity we decided to limit our environment by selecting a room as our game space. Additionally we used 3D objects and light effects for realism (Figure-1).

Figure-1: Kinect-based Game interface



2.2.2. Game Play

Our game takes place in an empty room. Players can control the virtual hands on the screen by moving their hands. During a session there is an object called *guiding shape* which appears on top of the screen. Also two other shapes come from the left and right sides. Player must select one of these shapes which is similar to the guiding shape. If the user goes for the wrong shape, then a happy smiley is shown, otherwise a neutral smiley will appear. For each correct choice 10 points are added to the score and the sound of applause plays and a new session begins. The game continues until 10 shapes are correctly identified.

2.3. Research Design

Observation methodology was used to collect data from the first testing process. For this research, nonparticipant observation study was conducted. During a nonparticipant observation study," 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). Thus, we observed SE students to see the problems related to the software usability issues without participating the game itself. Additionally, for future work, the opinion and advices of teachers were taken during testing.

2.4. First Testing Process

Fraenkel, Wallen and Hyun (2012) stated that a major difficulty in observing people is missing some points when several behaviors which are concerned are occurring quickly in an educational setting. Additionally, they defined other difficulties such as the necessity of reaching a consensus on the meaning of behaviors or reactions of interest and the comparison of researchers' and experts' insights in to what was happening. To overcome these obstacles, a video recording device was used during the first testing process. Moreover, notes were taken.

First of all, the testing took place in a SE school of Ankara. An empty room was organized for our game setup. The participating students were selected based on the availability of their teachers. The students with ID were taken to the room in pairs and with their teacher. The students had to stand at a specific distance from the Kinect camera due to the limitations.

After placing the student appropriately we observed another barrier; making the students familiar with the virtual hands on the screen. Expectedly students did not directly recognize the relation between their hands and the virtual hands. So, one of the researchers and one of

the teachers helped the students match their hands with the virtual hands on the screen and showed how virtual hands may be controlled with their hands (Figure-2).

Figure-2: A scene from the student's adaptation

The students continued to be supported about how to play the game by the researchers and teachers until they could start to play on their own. After that, only verbal directions were given such as "look at this shape now" (pointing at the *guiding shape*) or "find the same shape now" (Figure-3).

Figure-3: Giving Instructions

3. Findings

In this part, the opinions of the teachers about the developed material and the observation of participants will be examined and reviewed. During the development of the Kinect-based serious game, the material was revised based on suggestions of subject matter experts and a specialist in instructional technology.

3.1. The findings related to settings

According to our observations and opinions of teachers, the students lacked an abstract understanding and they needed to see something concrete surrounding them when they were standing in order to comprehend the invisible detecting field of the Kinect camera. Therefore we will need to mark a square area for the students to move within. Secondly, the room was a conference room and is hardly used by students. Thus it was calm enough for testing. Also the darkness of the room was helpful both for focusing to the game and for the details on projected screen.

3.2. The feedback about the material developed

On the one hand teachers expressed some problems about our game. The first important problem of the material was a lack of verbal interactions. Clear and short directions were necessary to add emphasis to shapes one by one. Secondly, two hands on the screen made the students confused. Teachers suggested that one hand control could be easier for students.

On the other hand, teachers were exited to experience this new technology because they thought that it could facilitate the students' with intellectual learning disabilities with its life-like environment and remarkable interface. They also consider our game and in general serious games as an opportunity to find diverse materials which are necessary to meet the different needs of students.

3.3. The findings about first experiences of the students

The study was conducted on 2nd, 3rd and 5th grades students. Although, most of the students were not experienced at all with this innovative technology, it didn't take a long time for them to adapt to it. 2nd grade students had difficulty in playing the game when compared with the others. 3rd and 5th grade students could play without any help after a few sessions and finish

the game on their own. According to our observations the students were eager to play the game we developed and we think that students with intellectual disabilities are open to using new technologies.

4. Discussion & Conclusion

This study aims to examine the first testing process of the Kinect-based serious game in order to understand the usability of our game for the students with intellectual disabilities, setting conditions for the Kinect-based game and the first impressions from teachers and students about the game. We hope that the findings above will help to improve the software developed and gain a perspective for developing Kinect-based material considering future studies.

In Turkey, the SE teachers may have a different theoretical background in instruction which depends on the university and the year of graduation. These differences also bring along conflicts between teachers during implementation. Therefore, it is not always possible to satisfy all teachers while developing educational software. One general conclusion about developing SE material is that the researchers must stick to the same teacher and students during the testing process.

Our study is important because it is one of the first examples of Kinect-based serious game which was specifically developed for the needs of special education students. Although our first working prototype was not extensively tested for a long period of time, the results of the study demonstrate clearly that, there is room for improvement. Both the feedback of the teachers and our observations reveal a number of problems in the current material. Further development of the game is necessary to understand if this approach is successful in enhancing learning environment and in increasing student motivation in SE.

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