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Investigating the characteristics of educational computer games developed for children with autism: a project proposal

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Abstract

Autism is a neural developmental disorder that interfere the brain development and causes deficit in social interaction and communication skills as a result. One of the most important outcomes of education of children with autism is the functional independence skills. Effective instructional techniques and methods are immensely important for children with autism to improve their functional independence skills. At this point we think that since playing is a fundamental part of a child's physical, cognitive, linguistic, emotional and social development, educational computer games which are used effectively in education of children without developmental disorders can also be used effectively in education of children with autism. This paper proposes a project for investigating how children with autism interact with computer games, how computer games can be used for educational purposes, and what characteristics educational computer games should have in education of children with autism. For this project educational computer games for children with autism will be designed and developed. In this process, design based research methodology will be used to investigate the characteristics of educational computer games for children with autism.

Keywords: Educational computer games; education of children with autism

1. Introduction

For a lot of people, teaching and learning activities are boring and effortful as mentioned in an English proverb: no pain no gain. But according to Prensky (2001), this belief is not correct. Children learn by playing and having fun. Playing provides the opportunity to make mistakes without getting harmed. In this way people learn by their experiences obtained from mistakes. According to Vygotsky, while children are playing, they make an effort as if they are older than their average age (Nicolopoulou, 1993).

Learning requires effort. For this, learners should attend learning activities voluntarily. Thus, if teachers want their students to learn, they should motivate students and ensure that students attend learning activities. Games are incentive by its nature because they are amusing participatory activities.

There has been a big transformation in game preferences of children with the rapid development of information and communication technology. Children are playing computer and Internet games much more day by day. According to Mumtaz (2001), computer games became the mostly preferred spare time activity for children.

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Kubey, Lavin, and Barrows (2001) describe the computer games and Internet as technological miracles which support children in reaching information, practicing, problem solving, creating and critical thinking. According to Rieber (1996), educational computer games are the best way for children to take responsibility of their own learning. In literature, there are a good number of researches showing that computer games can be used effectively to create educational environments (Prensky, 2001; Mitchell & Savill-Smith, 2004).

At this point we think that since playing is a fundamental part of a child's physical, cognitive, linguistic, emotional and social development, educational computer games which are used effectively in education of children without developmental disorders can also be used effectively in education of children with autism. Autism is a neural developmental disorder that interfere the brain development and causes deficit in social interaction and communication skills as a result (Laushey & Heflin, 2000; Myles & Simpson, 2001; Dawson, Toth, Abbott, Osterling, Munson, Estes & Liaw, 2004; Shukla-Mehta, Miller & Callahan, 2010). Intellectual capacity of children with autism is markedly below the average. Prevalence of autism is estimated at 1.3 in 1000 children and prevalence of autism spectrum conditions is estimated at 6.0-6.5 in 1000 children (Fombonne, 2005).

It is realized that the best treatment method for autism is education according to previous researches. Characteristics of children with autism limit their opportunity to take advantage of formal education. Thus, it is very important to develop effective educational methods including educational technology for children with autism.

Studies about educational technology for children with autism mostly focused on the use of video technology. There are quite a lot of studies in literature which used video technology to teach social and communication skills and transfer these skills to the natural environments (e.g., Shukla-Mehta, Miller & Callahan, 2010; Charlop-Christy & Daneshvar, 2003; Hine & Wolery, 2006; Paterson & Arco, 2007).

Moreover, Sehaba, Estraillier & Lambert (2005) dealt with the design issues of development of educational computer games within the scope of an autism project for early diagnosis of autism and mental retardation and education of children with autism and mental retardation. According to their findings, educational computer games should be flexible enough to accommodate the individual differences of every child with autism. These games should include the child's own world and beliefs. Computer games used in the research were played with objects which were determined whether child was interested with. To insure flexibility and modularity, they used multi-agent architecture. As a result they expressed that their findings were promising. They also emphasized that new researches should be performed to check the validity of the findings and used model.

The purpose of the project is to determine the standards of educational computer games for children with autism, to develop educational computer games according to the standards, and to determine the effectiveness of educational computer games developed. According to the main purpose, the following questions will be looked for answers.

1. How do the children with autism communicate with the computer games?
2. What are the success levels of children with autism according to the difficulty level of computer games?
3. What are the success levels of children with autism according to the different types of computer games?
4. Which standards do the education computer games for children with autism should have?
5. What is the effect of educational computer games developed according to the standards to the success level of children with autism?

At the end of this project,

1. Standards of educational computer games for children with autism will be determined,
2. Educational computer games will be developed according to the standards determined.
3. An educational environment enriched with educational computer games will be developed and published in a web site.

2. Method

There will be two stages in the research:
Stage 1: Development of educational computer games,
Stage 2: Investigating the effectiveness of educational computer games.

Design based research methodology will be used in the software development stage. Design based research is a research method used for designing new applications like educational software or designing new teaching and learning theories (Brown, 1992). In design based research, designed structure is subjected to repetitious tests, evaluations, and revisions. Figure 1 shows the loop structure of design based research.

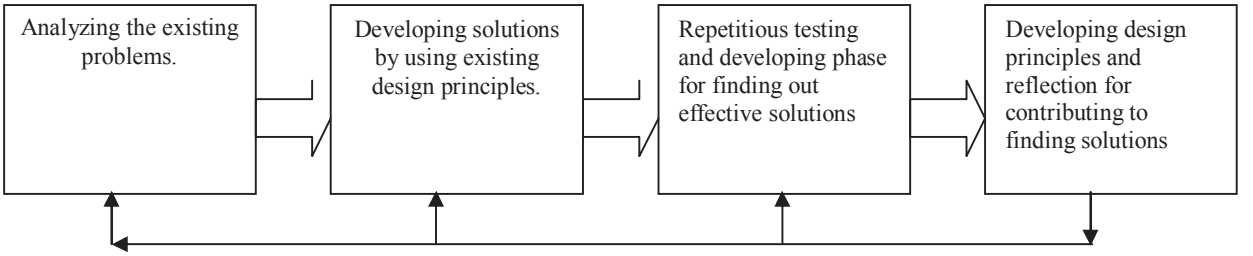

Figure 1. Design based research loop

Innovations came along with design based research support the understanding of the relationship between theory and practice, and concretization of theories about teaching and learning (Brown, 1992; Collins, 1992). Design based research also contributes greatly to designing technology based environments thanks to its features like repetitious design process and collaboration with participants. Design based research focuses on the design process and the investigation of designed innovations. It can be used effectively in the researches including the issues like activity design, educational message design, curriculum design, technology based educational environment design. According to Wang and Hannafin (2005), design based research has five basic characteristics: pragmatic, grounded, interactive (including iterative & flexible), integrative and contextual which are summarized in Table 1 below.

Table 1. Characteristics of design based research

Characteristics	Explanations
Pragmatic	Design-based research refines both theory and practice. The value of theory is appraised by the extent to which principles inform and improve practice.
Grounded	Design is theory-driven and grounded in relevant research, theory and practice. Design is conducted in real-world settings and the design process is embedded in, and studied through, design-based research.
Interactive, iterative, and flexible	Designers are involved in the design processes and work together with participants. Processes are iterative cycle of analysis, design, implementation, and redesign. Initial plan is usually insufficiently detailed so that designers can make deliberate changes when necessary.
Integrative	Mixed research methods are used to maximize the credibility of ongoing research. Methods vary during different phases as new needs and issues emerge and the focus of the research evolves. Rigor is purposefully maintained and discipline applied appropriate to the development phase.
Contextual	The research process, research findings, and changes from the initial plan are documented. Research results are connected with the design process and the setting. The content and depth of generated design principles varies. Guidance for applying generated principles is needed.

In the process of designing and developing learning environments and theories, design based research has a loop of design, decision making, analysis and revision (Cobb, 2001; Collins, 1992). In this project, design based research

methodology will be used because there will be a software development process. Design based research can be thought as an adaptation of action research in which researchers try to find out solutions for design problems.

In the second stage of the research (investigating the effectiveness of educational computer games), Triangulation Mixed Methods design will be used (Creswell, 2005) which is one of the mixed methods designs in which quantitative and qualitative procedures are conducted separately from each other in order to maintain the independence of data analysis. In triangulation mixed methods design, qualitative and quantitative data are collected simultaneously, and analysis results of qualitative and quantitative data are interpreted together. The reference point of triangulation mixed methods design is that data from qualitative and quantitative are valued equally. In this stage of the project quantitative data will be collected with a survey and qualitative data will be collected with semi-structured interviews. These data and software logs will be analyzed to determine the effectiveness of educational computer games developed.

2.1. Data Collection Methods and Data Analysis

In this research qualitative and quantitative data will be collected from various resources like field notes, research diaries, semi-structured interviews, video records, software logs, software usage records, and survey. A research diary is an important data source in a qualitative research. A research diary is a record of the researcher's involvement in a project. The diary contains information about the researcher, what the researcher does, and the process of research. It complements the data yielded by the research methodology.

In interviews and observations, a sound recorder and a video recorder will be used to enrich data and support validity. Results acquired from interviews and observations will be written and confirmed by the participants. Data acquired will be analyzed with qualitative and quantitative data analysis methods and will be interpreted.

2.2. Participants

In first stage of the project (software development stage), participants will be selected with criterion sampling method which is one of the purposive sampling methods. According to this, maximum five participants will be selected according to the following criteria. Families of the participants will be asked for written permissions.

Criteria to select participants:

- Being 12-15 years old child with autism.
- Does not has a physical retardation that obstruct the use of educational computer games
- Does not know the information which is the subject of educational computer games
- Can use computers and technology in basic level.

In second stage of the project, whole list of children with autism matching the criteria will be reached across Turkey. Voluntary families will be determined and maximum 100 participants will be selected with random sampling method which is one of the probability sampling methods. The number of participants needs to be limited because there will be an application phase. Participants and their families will be informed with face to face meetings about the project and application. Besides 10 participants among them will be selected for interviews with maximum variation sampling method which is one of the purposive sampling methods. Semi-structured interviews will be performed with these 10 participants and their families. In maximum variation sampling method, participants are chosen to be as different as possible from one another. It aims at capturing the central themes that cut across participant variations (Yıldırım ve Şimşek, 2006). To select 10 participants, all participants' names will be ordered in a list according to the success levels in the educational computer games and 3 of 10 participants will be selected from top of the list, 3 of 10 participants will be selected from bottom of the list and 4 of 10 participants will be selected from middle of the list.

2.3. Application Stages

1. Stage: Development of educational computer games
   - Candidate children with autism will be determined according to the criteria.
   - Parents of children will be called for an invitation to a meeting
   - In the meeting, parents will be informed about the project and the expectations from them and their children
   - In the end of the meeting, at the most five voluntary participants will be selected.
   - Children's responses and successes will be investigated in various types of computer games and in different difficulty levels.
   - Principles which an educational computer game should have will be determined according to the information gathered from literature review, workshops with experts, and children's responses to computer games,
   - According to the determined principles, new educational computer games will be developed.
   - Children will be observed and interviewed while they will play educational computer games developed.
   - According to the data from observations and interviews, revisions will be made to the educational computer games.
   - At the end of the development stage, semi-structured interviews will be performed with parents and children about the effectiveness of the software.
   - Interview results and software logs will be interpreted together.
2. Stage: Investigating the effectiveness of educational computer games
   - A quantitative scaling tool (survey) will be developed and a pilot study will be performed.
   - Children will be determined across Turkey according to the criteria.
   - Families of children will be called, and voluntary families will be determined.
   - At the most 100 voluntary families will be selected randomly from the list.
   - Families will be visited for information purposes about the project and the expectations from them
   - Children will play the educational computer games under parents' supervision.
   - Usage statistics and success status of children will be recorded by software to the database.
   - At the end of the application phase, survey will be applied to the families.
   - 10 families and their children will be interviewed.
   - Data from various sources will be analyzed and interpreted.
   - Analysis and interpretation results will be reported.

3. Conclusion

This project is an interdisciplinary project requiring the integration of research in two fields: educational technology and special education. It can be said that this project will make a contribution in the fields of special educational technology, assistive technology, software development and human-computer interaction. The work done during this project will probably lead to a number of publications in SSCI Journals.

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