

**Development of Number Concepts in Students with Intellectual Disability
by using Digital Game based Learning**

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Abstract

Intellectual disability is characterized by substantial limitations in both intellectual functioning and in adaptive behavior. Teaching students with intellectual disability is not an easy task. Use of computer assisted techniques to teach students with intellectual disability is a recent initiative in developing countries. Digital game based learning is an example of computer assisted teaching technique. The objectives of the study were to investigate the use of digital games to develop number concept among students with intellectual disability and to highlight the effectiveness of digital game based learning in attaining number concepts among students with intellectual disability. The researchers used quasi experimental research design (pre-test, post-test control group) to conduct the study. The population of the study consisted of students with intellectual disability at the age of 8 to 16 years having mild to moderate level of I.Q. A sample of 30 students with intellectual disability was taken by using random sampling technique. The students were randomly assigned to two group (15=control group, 15= experimental group). Two (2) mathematical achievement tests were used as an instrument of the study (one for pre-test and one for post). Total 10 sessions were given to teach the number concept to the subjects of experimental group by using digital game as an intervention. The data were analyzed by using IBM version22. The results of independent sample t-test show a significant difference between the pre-test and post -test scores of experimental group after treatment. The study recommended use of digital game to teach the number concepts to children with intellectual disability.

Keywords: Digital Game Based Learning, Number Concept, Efficacy, Intellectual Disability

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Introduction

Learning Mathematics is an essential skill for all students including students with intellectual disability. Mathematical concepts include problem solving skills, Algebra skills and computational skills (Fritz, Ehlert, & Balzer, 2013). At initial level, the most prominent primary concepts are finding patterns, building rods and making blocks of different sizes (Soyke, 2015). Mathematical skills help students' prepare for the world outside the school. These skills help them make a firm foundation for success in mathematical content (Gravemeijer, Stephan, Julie, Lai, Lin, & Ohtani, 2017).

Use of digital games for learning is a recent trend in the education of children with intellectual disability. According to research, digital games has potential to hold the attention of students and develop their interest in task and give them confidence about their potential to attain the targeted skill (Radford, 2000; Woo, 2013; Nussbaum, 2007; Ke & Abras, 2012), the attention skills of students with slight intellectual disability (Karal, Kokoç, & Ayyıldız, 2010), the social problem solving skills of children with intellectual problems (Rezaiyan, Mohammadi, & Fallah, 2007) and the psychomotor abilities of students with attention and hyperactivity problems (Goldsworthy, Barab, & Goldsworthy, 2000). The features mentioned above has placed digital games among most effective learning tools.

Use of digital games has also made teaching of number concepts less difficult for intellectually challenged students (Abramovich, 2010; Bottino, Ferlino, Ott, & Tavella, 2007; Moreno & Duran, 2004; Wang & Chen, 2010.). Although for many children with intellectual disability, learning number concept is a difficult task (Sedig, 2008).

In Pakistan, the uses of information and communication technology (ICT) to facilitate in the education of students with intellectual disability are still not evident particularly in the institutes of children with intellectual disability, which causes lack of mathematical skills in intellectually challenged children. Therefore, it is need of time to take revolutionary steps in the teaching of intellectually challenged children through the use of innovative methods for teaching mathematics. Keeping in view the above discussion on importance and role of DGBL for teaching students with intellectual and other disabilities, it is desirable to conduct a study on the use of DGBL as medium of instruction for students with intellectual disability in the area of Mathematics.

Objectives of the Study

This research was conducted to achieve the following objectives:

- 1- To highlight the importance of digital game based learning for the acquisition of number concept in students with intellectual disability.
- 2- To explore the use of digital game based learning to develop number concept in students with intellectual disability.

- 3- To highlight the efficacy of digital game in acquiring number concept among students with intellectual disability.

Methodology

The research was conducted by applying quasi-experimental research design (pre-test, post-test and control group).

Participants of the Study

Population of the study comprised of total number of 192 students at the age of 8 to 15 years with mild to moderate level of I.Q. A number of 30 students with intellectual disability at the age of 8 to 15 years having mild to moderate I.Q level were selected randomly as subjects of the study. The school situated in the University of the Punjab was selected for the place of experimentation due to the availability of computer lab/latest computers, internet and volunteers. For experimentation, researchers formulated two groups, control and experimental and assigned 15 students randomly to each group.

Instruments of the Study

Two different tests comprised of items on number concepts were developed as an instrument of the study. First test was applied to check the current level of performance by taking pre-test and second test was administered after the experimentation to see the improvement in the performance of the students in number concepts after intervention. Content validity was estimated by taking experts opinion related to the field of Special Education and Mathematics. Test was piloted on a sample of 13 students with intellectual disability. The Cronbach Alpha reliability of this test was .850.

Treatment

The researchers used digital game as treatment. For the selection of the game the researchers searched the games from the internet from BBC math's games on <http://www.bbc.co.uk/bitesiz/ks1/maths>. The games were developed for the students of 3 to 5 years age. Initially researchers had searched and selected 3 games. After it, the games were presented to the experts for the final selection of 1 game to be used as intervention. The experts were provided following 4 point criteria for the selection of final game, 1) developed for number concepts, 2) suitable for the students with intellectual disability (SWID), 3) age appropriateness and 4) free and online availability. The detail of rating of experts against each game has been presented in the table no.1. Which game was selected and why preferred

Table 1

Frequencies and percentages calculate on the basis of experts rating against each game (N=7)

Name of games	Developed on number concept		Age appropriateness		Suitable for SWID		Availability of the game	
	F	%	F	%	F	%	F	%
Game 1	6	86	6	86	5	72	5	72
Game 2	3	43	2	29	4	57.2	5	72
Game 3	2	29	2	29	2	29	5	72

Implementation of Treatment Plan

After selection of one game, researchers developed a plan to implement the intervention. Experimental group was instructed number concepts by implementing intervention i.e., use of digital game for 30 minutes daily (five days in a week). Total 10 sessions were administered for teaching number concept to students with intellectual disability. Every student was instructed independently by the researchers and with the help of volunteers. Uniformity for providing instruction had been ensured through training of the volunteers.

The subjects of experimental group had been taught number concepts in four phases. The first phase was designed to develop the skills of count through objects. In second phase the skill of count and match was developed. And third phase was designed to color the desired numbers of objects. Fourth phase was on write in serial.

Table.2

Implementation plan of sessions

Phases	Concepts	Time of one session	Total
Phase 1	Count the objects	30 minutes	(3 session)
Phase 2	Count and match	30 minutes	(3 session)
Phase 3	Colour the desired number of objects	30 minutes	(2 session)
Phase 4	Write in serial	30 minutes	(2 session)

Data Analysis

Data analysis was carried out by using SPSS. Independent sample t-test was performed to see the difference in the learning of mathematical concepts of students belongs to control and experimental group before treatment. Whereas, paired sample t-test was applied to see the difference between the performance of control and experimental group after treatment.

Results

The results of independent sample t-test show no significant difference between the performance of control and experimental group (Mean of group 1= .77, Mean of group2= .53) in pre-test. Results showed no difference in scores on number concepts of both control and experimental before the intervention. (Table.4)

Table4

Independent sample t-test on pre test scores on number concepts of both groups

Control group		Experimental groups		sig
<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
.77	.74	.53	.53	.601

The above table shows no significant difference between the mean of control and experimental group before treatment/intervention (Mean G.1=.77, Mean G 2=.53).

Table. 5

Paired sample t-test applied on experimental groups before and after intervention

	<i>T</i>	<i>Df</i>	<i>Sig</i>
Pre-test	.99	28	.33
Post-test	-2.05	28	.049

Above table shows significant difference between the performances of experimental group on number concepts before and after intervention/treatment. After implementing the intervention, both groups were given post-test and tabulated (Table.6)

Table 6

Independent sample t-test to see the difference between the performance of control and experimental group after treatment

	Control Group			Experimental Group		
	Mean	SD	Sig	Mean	SD	Sig
Post Test	.77	.40	.96	1.09	.45	.001

The above table shows significant difference between the performance of control and experimental group on number concepts after treatment (sig=.001 which is less than .005).

Discussion

This study was conducted to observe the effect of digital games on the acquisition of number concept skills in students with intellectual disability. The results of pre-test indicated no significant difference between control and experimental group on scores in number concepts. Post-test results showed significant improvement in number concept score of experimental group. These findings are inconformity with the

findings of many previous researches (Sugimoto, 2007, Hill, 2006). These researches had reported that use of digital game motivates learning, offer immediate feedback, and influence changes in behavior and attitudes (Huang, 2011: Pastergiou, 2009). According to the Panoutsopoulos and Sampson (2012) there are multiphase educational benefits in the instructional technology of DGBL. These digital games are helpful in improving the knowledge and have the capacity to teach the desire learning skills.

Conclusion

In this study, students from experimental group showed improved results in the acquisition of number concept through count objects and click on relevant number, count the objects and match with relevant number through mouse, color in desired numbers of objects and put the objects according to serial number. This study is very important for the acquisition of number concept skills of students with intellectual disability. Participants of intervention group enjoyed to played games activities during 10 session as reported by their concerned class teachers.

Limitation and Directions for Future Research

The researchers used self-developed instruments due to unavailability of standardized instruments. The study has been conducted only on number concepts due to financial and time constraints. The researchers believe that more mathematical concepts would have been included for determining the efficacy of digital game based learning in the future researches.

Recommendations of the Study

On the basis of findings of the study following recommendations have been made.

1. Students with intellectual disability should be taught with new instructional technology of Digital Game Based Learning.
2. There is a need to train the teachers of students with intellectual disability to use the digital learning techniques for teaching students with intellectual disability by arranging the training courses and workshops.

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