

Use Of Computer Games For The Development Of Mathematical Concepts Among Children With Intellectual Disabilities: Teacher's Perspective

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Abstract

The aim of this research was to identify the effect of digital game-based learning to teach mathematical concepts to children with intellectual disabilities (CWID) and opinion of their teachers about digital game-based learning. Computer assisted games provides the opportunity to these children to learn mathematical concepts according to their pace through the trial-and-error basis, practice and immediate feedback. Researchers conducted an experiment on the use of computer games for teaching mathematical concepts to CWID. The sample of this research was 15 CWIID and 13 special education teachers. Pre and posttest design was used. Valid and reliable test (Cronbach alpha: 0.89) was conducted to determine the base line of the children in five mathematical concepts. After conducting the intervention program of 50 sessions, posttest was applied. The opinion of teachers about the effectiveness of computer assisted learning was obtained through questionnaire. Results of the study found that mathematical concept score of experimental group was significantly greater than the score of control group. Moreover, teachers had the positive attitude towards the use of computers games as an instructional strategy for the development of mathematical concepts. This study recommended that further study might explore teacher's knowledge of computer, availability and accessibility of technology.

Keywords: Digital computer games, Mathematical concepts, Intellectual disability.

Introduction

Intellectual disability is a lasting state describe by considerable restrictions in the academic performance and in the adaptive capability of persons concerning perceptual, social and adaptive skills, self- management, living at home, self-reliance, health and safety, practical learning, recreation and work (Alkahtani, 2016). For the education of children with intellectual disability (CWID), collective behavioral and cognitive approaches are generally useful (Wajihullah, Ashraf, & Majid, 2020; Hayes, Villatte, Levin, & Hildebrandt, 2011). However, the preference for modern interdisciplinary approaches to address the needs of students with intellectual disabilities is strongly appreciated by professionals (Vereenooghe, & Langdon, 2013).

In this perspective, teachers plan and integrate daily teaching practice activities to impart knowledge and skills to CWID (Buli-Holmberg, & Jeyaprathaban, 2016). Alternative methods, strategies and instructional resources are useful for addressing the specific needs of CWID. For example, the use of information and communication technologies (ICT) are being effectively used for the education of CWID (Wajihullah, Ashraf, & Majid, 2020). As a current educational advancement, teaching through computer is a mind-boggling procedure where many experts play a vital role (Baumol, 2005). But unfortunately, a great number of early researches on computer-based learning as a part of teaching and learning process has ignored about the teacher's views toward this new technology (Albirini, 2006).

Researches on computer-based learning have demonstrated that the successful execution of educational advancement in digital technology depends to a great extent on the attitude of teachers, who in the long run decide how they are utilizing this technology as a part of the classroom instruction (Lawless, & Pellegrino, 2007). Khlaif (2018) found that teacher's attitude is an important factor in the acceptance of new technologies. Likewise, Niess, (2005) and Albirini, (2006) found that teachers who have positive attitude toward new technologies feel easier with utilizing it and generally include it in their teaching. According to the Goktas, Yildirim, & Yildirim, (2009) any successful conversion in educational practice requires the positive user attitude towards the new technology. Enhancement of teacher's positive attitude toward computer based instructions is a key factor for improving computer incorporation in teaching (Wozney, Venkatesh, & Abrami, 2006).

Brewer, & Gajendran, (2012) stated that attitude of the group of people towards any new technology is a key component for its transmission. Bose, & Luo, (2011) in their assumption of Innovation Decision Process expresses that technology diffusion is a procedure that happens through five phases: Knowledge, Influence, Decision, Implementation and authentication. According to the Straub, (2009) because of the interest of computer-based instructions and their related technologies, researches about technology diffusion in teaching have frequently focused on the first three phases of the development choice process. This is additionally in light of the fact that the status of computer-based instruction is considered, still not authentic (Vicente, 1999). According to Hew, & Brush, (2007) in the case of most under developed countries where technology of computer-based instructions has newly introduced researches has merely focused on first two phases of technology development i.e. knowledge about the technology and attitude about it.

Teachers' attitude have been observed to be an important sign of the utilization of new technologies in educational settings (Pynoo, Devolder, Tondeur, Van Braak, Duyck, & Duyck, 2011). According to the Sang, Valcke, Van Braak, & Tondeur, (2010) teachers' attitude towards the use of computer also influences on the behavior of the students they teach. According to Borden, Lee, Serido, & Collins, (2008) changing people behavior is possible once their attitude has been identified. Moreover Baylor, & Ritchie, 2002 indicated that teachers progress in technology require changes in attitude more than to skill. A person attitude is comprised on three components: affective, cognition and behavior (Kurniawati, Minnaert, Mangunsong, & Ahmed, 2012). The affective component is the people enthusiastic reaction or getting a kick out of the chance to a man or object (Mumtaz, 2000). The cognitive component comprises of people accurate information about a man or question (Kruglanski, 1989). At last, the behavioral component includes a man natural behavior coordinated toward a man or object (Hu, Tan, Wang, & Maybank, 2004). One of the main considerations influencing people attitudes toward the technology is simply the qualities of the technology itself (Albbirini, 2007).

Objective of the Study

This research was conducted to achieve the following objectives:

1. To identify the effect of computer assisted learning to teach mathematical concepts to CWID.
2. To compare the performance of children with intellectual disabilities of experimental group and control group in subject of mathematics.
3. Find out the opinions of special education teachers about the effectiveness of computer game-based learning of mathematical concepts in CWID.

Research Methodology

It was an experimental research and quasi experiment research design was used to conduct the study. Following procedure was used to complete the study:

Step 1: Development of pretest and posttest

For the development of pre/posttest researchers collected the syllabus of CWID used in special education. The researchers consulted the workbooks for preschoolers and preschool teachers to align the test items to the cognitive level of the participant of the study (with the mental age of 3 to 5 years). The test included the concepts of number, ordering and sequencing shapes, money and time. The content validity of the test was estimated with the help of 10 experts from the field of special education. Pilot testing was conducted to check the reliability of the items. The sample of 13 CWID for pilot testing was selected from two schools. The reliability of the mathematical test was estimated 0.89 on Cronbach alpha.

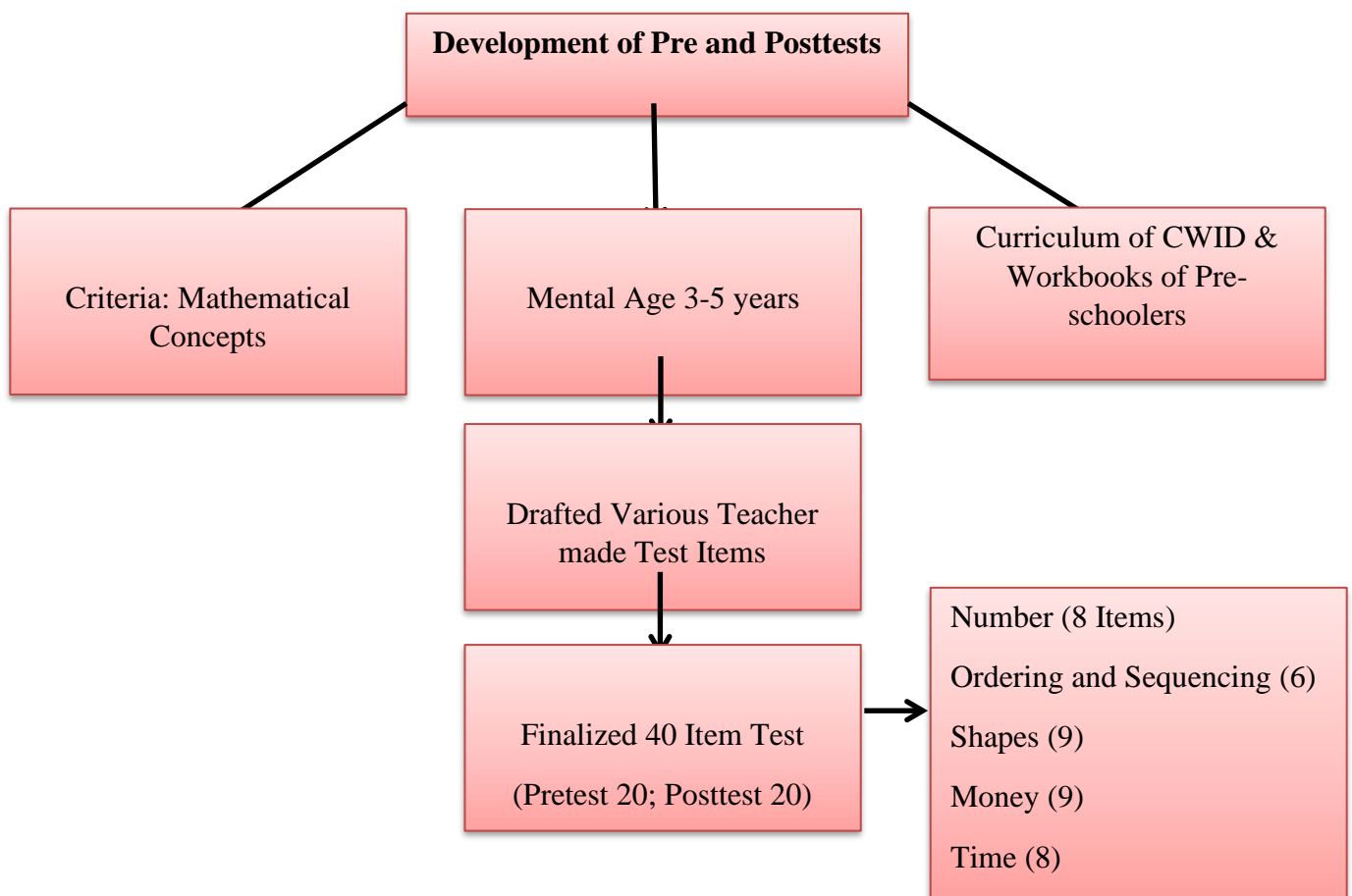


Figure 1: Nature of Items in Pretest and Posttest

Step 2: Participant of the Study

The participants of the study were children with intellectual disabilities and their teachers of Child Welfare Centre, University of the Punjab, Lahore was selected as the place for experiment due to the availability of both type of participant and computer lab. A number of 30 children with ID were selected out of 55 following the inclusion criteria decided by the researchers. Selected 30 CWID were divided in two groups control as well as experimental groups.

For the formation of two parallel groups for experiment preliminarily analysis was run to determine if a significant difference exist between the experimental and control groups of CWID on mathematical achievement level. This was necessary because participants had variation in age groups and were with medication history. Participants were randomly assigned to control and experimental groups on the basis of age and medication history and further balancing was made on the bases of pre-test score.

Step 3: Selection of Digital Games

For the selection of appropriate games for the intervention program a checklist was developed for the experts on the basis of information suggested by previous researches; students mental age, disability characteristics, easy to use for CWID, alignment of games with math's concepts

and availability of free online games. It contained 10 questions with five-point Likert response categories. Content validity of the checklist was determined by expert's opinion. The expert's responses were collected and checklist based on 7 questions was finalized for the selection of games for experiment. Figure 2 indicate the procedure of selection of digital games.

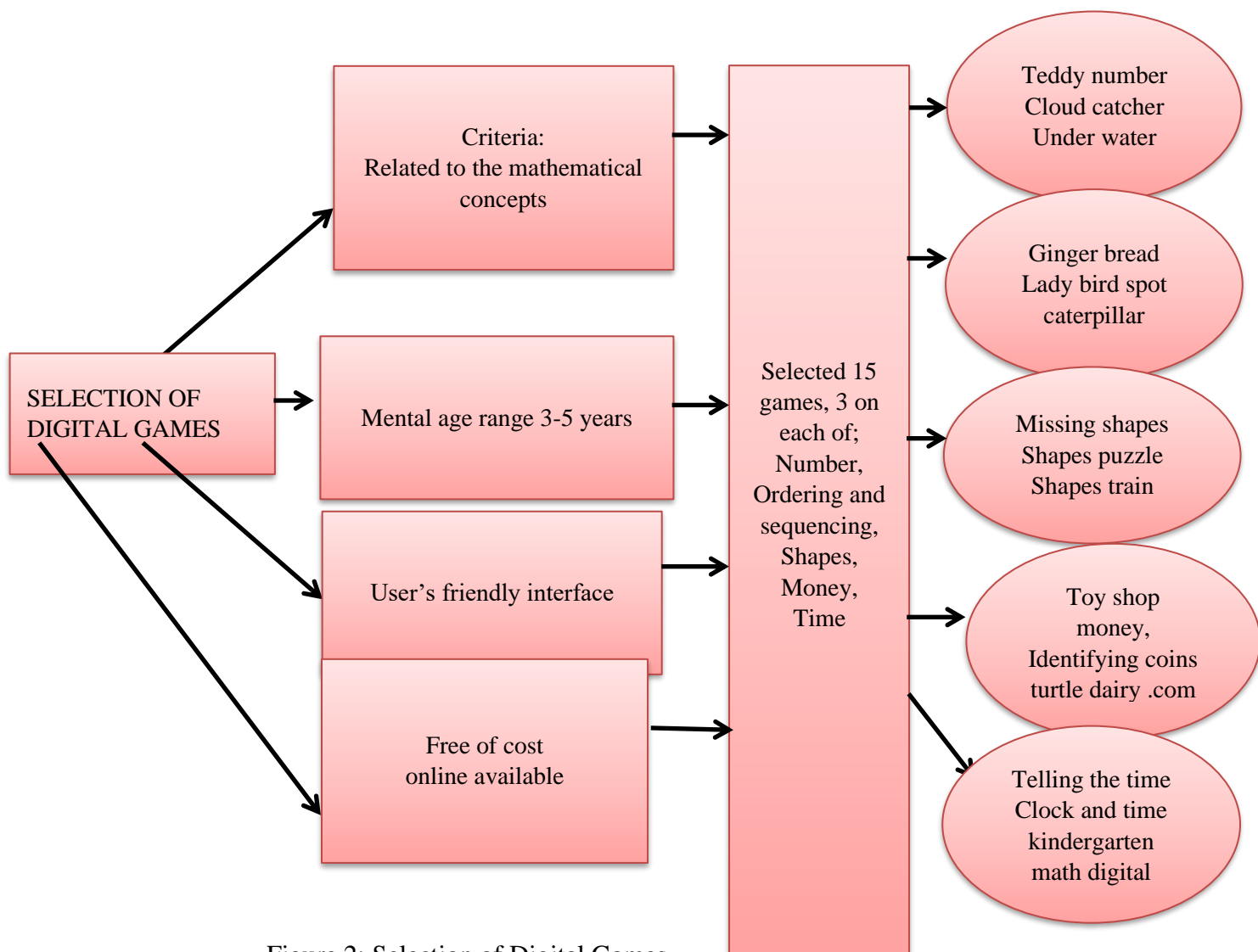


Figure 2: Selection of Digital Games

Step 4: Implementation of Pretest

Researchers administered pretest of mathematics on control group (n:15) and experimental group (n:15).

Step 4: Intervention (Digital Game)

Researchers implemented 3 months' intervention to experimental group, 10 sessions for each concept were delivered included: number, ordering and sequencing shapes, money and time. The duration of session was half an hour. At the end of each concept test was conducted.

Step 5: Implementation of Posttest

Researcher administered posttest of mathematics on control group (n:15) and experimental group (n:15) and compared the results of both.

Step 6: Teachers Opinion about effectiveness of Computer Game based Learning

A questionnaire was developed on five-point Likert scale pattern to collect data from teachers of children with intellectual disability. Initially 36 items were developed on four factors of:

- i. Relevance to the subject matter of digital games for children with intellectual disability
- ii. Relevance to the requirement of digital game for children, with intellectual disability
- iii. Interest of the children with intellectual disability in digital games
- iv. Age-appropriate activities of digital games for children with intellectual disability (mental age of 3 to 5 years).

Items 1-8 were related to the factor relevance to the subject matter of digital games with children with intellectual disability, items 9-26 were related to the factor of relevance to the requirement of digital games for children with intellectual disability, items 27-31 were related to the factor of interest of children with intellectual disability and items 32-36 were related to the factor of age-appropriate activities of digital games for children with intellectual disability. Validity of questionnaire regarding the opinion of teachers of participant children was evaluated by the penal of experts through content validity analysis procedures.

Questionnaire was sent to a penal of seven experts at university level from the field of special education and psychology. Five experts were from the field of special education and two were from the field of psychology. According to the experts' views, the questionnaire having good content validity and all the items of questionnaire measure the Teachers views on computer game-based learning for the acquisition of mathematical concepts in CWID.

Suggestions of the experts for the formation of questions were incorporated to improve the questionnaire. There were 54 items on four factors were finalized by experts. Items 1-27 were related to the factor relevance to the subject matter of computer games with CWID, items 28-44 were related to the factor of relevance to the requirement of computer games for CWID, items 45-49 were related to the factor of interest of CWID and items 50- 54 were related to the factor of age-appropriate activities of computer games for CWID. Content validity index of teacher's questionnaire was 0.95.

Results

Table1 Independent sample t-test comparing pre- test scores between control and experimental groups

	Groups	N	Mean	SD	F	Sig
Pre test	control group	15	12.07	8.46		
	experimental group	15	12.20	6.00	3.1	.09

Table 1 showed that there is no significant difference between control and experimental groups on total score of pretest before intervention.

Table 2 ANCOVA for Posttest as Dependent Variable (DV) and Pretest as Covariate in the Acquisition of Mathematical Concepts of CG and EG

Source	Sum of Squares	df	Mean Square	F	P	Partial η^2
Total score	1427.435	1	1427.435	41.836	.000	.608
Groups	1320.612	1	1320.612	38.705	.000	.59
Error	921.232	27	34.120			

Table 2 indicate groups analysis of covariance to assess the difference of the intervention program by post-test scores of mathematical concepts. The independent variable (IV) was total score; the dependent variable was score on the posttest. Score on pretest were used as covariate. Initial analysis was performed to ensure that there was no violation of the assumption of normality, linearity, homogeneity of variance and reliable measurement of the covariate. The main effect was statistically significant on groups (1, 27) =38.75, $p < .000$ with large effect size ($\eta^2 = .59$). Results of the ANCOVA showed that the efficacy of DGBL in the acquisition of mathematical concept is significantly greater than the acquisition of mathematical concepts through traditional methods.

Table 3 Descriptive statistics indicating mean and standard deviation of teacher's responses

Sr. No	Statements	Mean	SD
1.	The DGBL intervention followed the procedural system of instructions.	4.6923	.48038
2.	The DGBL intervention was based on content specific task of mathematical skills.	4.5385	.51887
3.	There was a clear alignment between intervention and learning objectives.	4.3846	.50637
4.	Intervention of DGBL clearly provided challenging goals of mathematical concepts.	4.3846	.50637
5.	Intervention of DGBL presented a functional setting to learn number concept.	4.6154	.50637
6.	Intervention of DGBL presented a functional setting to learn object counting.	4.6923	.48038
7.	Intervention of DGBL presented a functional setting to learn arrange the number in order.	4.4615	.51887
8.	Intervention of DGBL presented a functional setting to learn sequencing and ordering the position.	4.3077	.63043
9.	Intervention of DGBL presented a functional setting to learn write counting in serial.	4.3846	.50637
10.	Intervention of DGBL presented a functional setting to learn fill the missing numbers.	4.3077	.48038

11.	Intervention of DGBL presented a functional setting to learn money concept.	4.5385	.51887
12.	Intervention of DGBL presented a functional setting to learn identification of coins/currency.	4.2308	.59914
13.	Intervention of DGBL presented a functional setting to learn value of coins/currency.	4.3846	.50637
14.	Intervention of DGBL presented a functional setting to learn addition of coins/currency.	4.3077	.85485
15.	Intervention of DGBL presented a functional setting to learn understanding of clock.	4.4615	.51887
16.	Intervention of DGBL presented a functional setting to learn reading time in hours.	4.4615	.51887
17.	Intervention of DGBL presented a functional setting to learn time concept in half past.	4.0000	.91287
18.	Intervention of DGBL presented a functional setting to learn time concept in quarter past.	4.1538	.80064
19.	Intervention of DGBL presented a functional setting to learn time concept in quarter to hour.	4.0769	.86232
20.	Intervention of DGBL presented a functional setting to learn time concept in minutes past.	4.2308	.83205
21.	Intervention of DGBL presented a functional setting to learn identification of shapes.	4.5385	.51887
22.	Intervention of DGBL presented a functional setting to learn matching of shapes.	4.5385	.51887
23.	Intervention of DGBL presented a functional setting to learn labeling of shapes.	4.3077	.85485
24.	Intervention of DGBL presented a functional setting to learn sorting of shapes.	4.3846	.50637
25.	It enabled the students to deal with progressive difficulty level for learning mathematical skills.	4.3846	.50637
26.	Intervention of DGBL provided the opportunity to students with intellectual disability to achieve the learning objective.	4.3077	.48038
27.	Intervention of DGBL has the potential of being customized to fit the abilities of students with intellectual disability on individual basis.	4.3846	.65044
28.	DGBL intervention improved interactive skill of students with intellectual disability.	4.3846	.50637
29.	Through DGBL intervention students with intellectual disability might have benefitted from conceptual skills.	4.3846	.50637
30.	Intervention of DGBL improved the student fine motor skills through the mouse dragging.	4.5385	.51887

31.	Interventions of DGBL improved the student's cognitive skills (short term memory, long term memory. processing speed, visual processing etc.	4.6154	.65044
32.	DGBL intervention improved the student eye hand coordination.	4.6923	.48038
33.	Intervention of DGBL improved the student on seat behavior.	4.6154	.50637
34.	Intervention of DGBL provided immediate and constructive feedback to students with intellectual disability.	4.3846	.50637
35.	Intervention of DGBL improved the engagement of students with intellectual disability.	4.3846	.50637
36.	Intervention of DGBL maintained a balance between fun and learning for students with intellectual disability.	4.6154	.50637
37.	Intervention of DGBL provided students self-driven activities according to their intellectual disability.	4.3077	.75107
38.	Intervention of DGBL improved their attention span required for learning.	4.6923	.48038
39.	DGBL improved the students overall mathematical skills during intervention.	4.6154	.65044
40.	Students with intellectual disability operated the intervention games independently.	3.3077	.94733
41.	Students with ID operated the intervention games without sticking in.	3.0769	1.03775
42.	DGBL intervention was easy for students with intellectual disability to operate.	3.5385	.96742
43.	DGBL intervention mechanism was simple for decision making for teachers how to use game as learning tools.	4.0000	.91287
44.	Teachers could easily use DGBL for students with ID without any formal training.	4.0769	.64051
45.	DGBL intervention enabled the students with ID to focus on learning during game session.	4.2308	.43853
46.	DGBL intervention maintained the interest of students with intellectual disability during gaming session.	4.3077	.48038
47.	Intervention of DGBL ensured the engagement of diverse learners.	4.0769	.49355
48.	Sense of competence due to feedback mechanism of DGBL intervention increased interest of students with ID.	4.6154	.50637
49.	Intervention enhanced the intrinsic motivation of students with intellectual disability for learning mathematical concepts.	4.5385	.51887
50.	Intervention of DGBL provided an opportunity to learn (mental) age-appropriate mathematical skills to students with ID.	4.0000	.57735
51.	Intervention of DGBL provided an opportunity to students with ID to have age-appropriate mathematical activities.	4.4615	.51887
52.	Intervention of DGBL provided an opportunity to cope with age-appropriate difficulty level.	4.0769	.27735

53.	Intervention of DGBL provided an opportunity of age-appropriate types of feedback.	4.0000	.40825
54.	Intervention of DGBL provided an opportunity of age-appropriate mathematical skills evaluation activities.	4.2308	.59914

Table 3 indicate descriptive statistics (mean, standard deviation) of teachers of CWID, high mean indicates that their responses toward digital games are very positive.

Table 4 One sample t-test comparing opinion of special education teachers on the efficacy of digital game-based learning

	Test value=3					
	N	M	S.D	S.E	t(df)	P
Relevance to the subject matter of students.	13	4.38	.42	.12	11.82(12)	<.001
Age appropriateness of the students.	13	4.25	.24	.07	18.37(12)	<.001
Relevance to the requirement of the students.	13	4.35	.29	.08	16.48(12)	<.001
Interest of the students.	13	4.15	.35	.09	11.96(12)	<.001
Total responses		4.32	.32	.08	14.73(12)	<.001

Table 4 indicate that descriptive statistics (Mean and SD) and t-test of relevance to the subject matter, age appropriateness, Relevance to the requirement and interest of the students and total score. Mean score on the relevance to the subject matter of students was 4.38 & SD=.42 (N=13). Difference from test value (3) to mean was measured by one sample t-test; (df)=11.82(12), p<.001 which is significant. However mean score on the age appropriateness of the students was 4.25 & SD=.24 (N=13). Difference from test value (3) to mean was measured by one sample t-test; (t (df) =18.37 (12), p<.001 which is significant. Whereas Mean score on the relevance of the requirement of the students was 4.35 & SD=.29 (N=13). Difference from test value (3) to mean was measured by one sample t-test; (t (df) =16.48(12), p<.001 which is significant. Moreover, mean score on the interest of the students was 4.15 &SD =.35 (N=13). Difference from test value (3) to mean was measured by one sample t-test; (t (df) =11.96(12), p<.001 which is significant. Although mean score on the total responses about intervention was 4.32 & SD=.32 (N=13). Difference from test value (3) to mean was measured by one sample t-test; (t (df) =14.73(12), p<.001 which is significant. Results of one sample t-test showed that special education teachers have the positive attitude towards the digital game-based learning for the development of mathematical concepts in children with intellectual disability.

Conclusions

It was also concluded that mathematical concept score of experimental group was significantly greater than the score of control group, they performed better when taught through computer

based games. Special education teachers have positive attitude towards computer game-based learning for the acquisition of mathematical concepts in CWID.

Teachers' opinion on the effectiveness of using computer games for the acquisition of mathematical concepts: number, ordering and sequencing, shapes, money and time may be influenced by their own experience to observe the performance of the participant of experimental groups in their classrooms.

Discussion

Educational researches proved that clear educational pedagogy of special education to make the CWID able to acquire mathematical concepts that help them in their practical life. However, researches highlighted that the nature of mathematics depends greatly on abstracts concepts. Simple and traditional methods of teaching abstract concepts of mathematics are ineffective for children belong to sensory motor stage (Piaget, 1951). Children of this age group must be dealt with non-traditional and latest methods of teaching. At that stage, CWID have to face difficulty in recognizing numbers, shapes, and other objects. The traditional methods are not capable of teaching these children in an appropriate manner. These children are not equal to normal children concerning learning skills. Because of the mental and cognitive deficiencies, they face lack of understanding and problem-solving ability. Their ability to count the items without concrete and sensory objects is very poor. So, they need to learn mathematical skills with special approach that is understandable for them, rather than a normal way of teaching. One of the latest teaching methods is DGBL. Therefore, there is a clear need that teachers of CWID must use different instructional apparatuses for the development of essential concepts of mathematics which relate to the daily experiences of their life (Higdon, 2018; Raouf, Alenizi & Attia, 2016).

Results of one sample t-test showed that special education teachers have the positive attitude towards the digital game-based learning for the development of mathematical concepts in children with intellectual disability. These results are similar to the results of Ronimus, Eklund, Pesu, & Lyytinen, (2019) and Kosmas, Ioannou, & Retalis, (2018) research. In these study researchers examines the attitude of the teachers towards computer games and investigates the role of these attitudes in the implementation of digital learning in challenging children. Findings of the study show that the teachers have the positive attitude on the use of computer games and on the use of technology in education and training of CWID.

Recommendations and implications for future research

There are many other variables which play mediator role in computer game-based learning as an instructional technique/technology for imparting mathematical skills in CWID. These include teacher's knowledge of computer, availability and accessibility of technology and demographics (e.g., socio-economic status, qualification of teachers and gender etc. These variables require in depth investigation in future studies in different special education school and centers of children with intellectual disabilities.

References

- Albirini, A. (2007). The crisis of educational technology, and the prospect of reinventing education. *Journal of Educational Technology & Society*, 10(1), 227-236.
- Alkahtani, M. A. (2016). Review of the Literature on Children with Special Educational Needs. *Journal of Education and Practice*, 7(35), 70-83.
- Baumol, W. J. (2005). Education for Innovation: Entrepreneurial Breakthroughs.
- Baylor, A. L., & Ritchie, D. (2002). What factors facilitate teacher skill, teacher morale, and perceived student learning in technology-using classrooms? *Computers & education*, 39(4), 395-414.
- Bose, R., & Luo, X. (2011). Integrative framework for assessing firms' potential to undertake Green IT initiatives via virtualization—A theoretical perspective. *The Journal of Strategic Information Systems*, 20(1), 38-54.
- Borden, L. M., Lee, S. A., Serido, J., & Collins, D. (2008). Changing college students' financial knowledge, attitudes, and behavior through seminar participation. *Journal of family and economic issues*, 29(1), 23-40.
- Brewer, G., & Gajendran, T. (2012). Attitudes, behaviors and the transmission of cultural traits. *Construction Innovation*.
- Buli-Holmberg, J., & Jeyaprathaban, S. (2016). Effective practice in inclusive and special needs education. *International Journal of Special Education*, 31(1), 119-134.
- Goktas, Y., Yildirim, S., & Yildirim, Z. (2009). Main barriers and possible enablers of ICTs integration into pre-service teacher education programs. *Journal of Educational Technology & Society*, 12(1), 193-204.
- Grover, P., Kar, A. K., & Janssen, M. (2019). Diffusion of blockchain technology: Insights from academic literature and social media analytics. *Journal of Enterprise Information Management*.
- Hayes, S. C., Villatte, M., Levin, M., & Hildebrandt, M. (2011). Open, aware, and active: Contextual approaches as an emerging trend in the behavioral and cognitive therapies. *Annual review of clinical psychology*, 7.
- Hew, K. F., & Brush, T. (2007). Integrating technology into K-12 teaching and learning: Current knowledge gaps and recommendations for future research. *Educational technology research and development*, 55(3), 223-252.
- Higdon, A. L. (2018). Joint-Admissions Explored: Determining the Existence of a Transfer-Affirming Culture Between Owensboro Community and Technical College and Western Kentucky University-Owensboro (Doctoral dissertation, Western Kentucky University).

- Hu, W., Tan, T., Wang, L., & Maybank, S. (2004). A survey on visual surveillance of object motion and behaviors. *IEEE Transactions on Systems, Man, and Cybernetics, Part C (Applications and Reviews)*, 34(3), 334-352.
- Kosmas, P., Ioannou, A., & Retalis, S. (2018). Moving bodies to moving minds: A study of the use of motion-based games in special education. *Tech Trends*, 62(6), 594-601.
- Kurniawati, F., Minnaert, A., Mangunsong, F., & Ahmed, W. (2012). Empirical study on primary school teachers' attitudes towards inclusive education in Jakarta, Indonesia. *Procedia-Social and Behavioral Sciences*, 69, 1430-1436.
- Knezek, G., & Christensen, R. (2001, July). Impact of new information technologies on teachers and students. In *IFIP World Conference on Computers in Education* (pp. 169-178). Springer, Boston, MA.
- Kruglanski, A. W. (1989). The psychology of being "right": The problem of accuracy in social perception and cognition. *Psychological Bulletin*, 106(3), 395.
- Khlaif, Z. (2018). Teachers' perceptions of factors affecting their adoption and acceptance of mobile technology in K-12 settings. *Computers in the Schools*, 35(1), 49-67.
- Lawless, K. A., & Pellegrino, J. W. (2007). Professional development in integrating technology into teaching and learning: Knowns, unknowns, and ways to pursue better questions and answers. *Review of educational research*, 77(4), 575-614.
- Mumtaz, S. (2000). Factors affecting teachers' use of information and communications technology: a review of the literature. *Journal of information technology for teacher education*, 9(3), 319-342.
- Niess, M. L. (2005). Preparing teachers to teach science and mathematics with technology: Developing a technology pedagogical content knowledge. *Teaching and teacher education*, 21(5), 509-523.
- Osborne, J., Simon, S., & Collins, S. (2003). Attitudes towards science: A review of the literature and its implications. *International journal of science education*, 25(9), 1049-1079.
- Pynoo, B., Devolder, P., Tondeur, J., Van Braak, J., Duyck, W., & Duyck, P. (2011). Predicting secondary school teachers' acceptance and use of a digital learning environment: A cross-sectional study. *Computers in Human behavior*, 27(1), 568-575.
- Raouf, M. S. A., Alenizi, M. A. K., & Attia, K. M. (2016). Effectiveness of an educational program using a computer in the development of some of the mathematical concepts among mentally retarded educable students and modifying their adaptive behavior. *International Journal of Humanities and Cultural Studies (IJHCS) ISSN 2356-5926*, 3(2), 1-23.

- Ronimus, M., Eklund, K., Pesu, L., & Lyytinen, H. (2019). Supporting struggling readers with digital game-based learning. *Educational Technology Research and Development*, 67(3), 639-663.
- Sang, G., Valcke, M., Van Braak, J., & Tondeur, J. (2010). Student teachers' thinking processes and ICT integration: Predictors of prospective teaching behaviors with educational technology. *Computers & Education*, 54(1), 103-112.
- Sins, P. H., Van Joolingen, W. R., Savelsbergh, E. R., & van Hout-Wolters, B. (2008). Motivation and performance within a collaborative computer-based modeling task: Relations between students' achievement goal orientation, self-efficacy, cognitive processing, and achievement. *Contemporary Educational Psychology*, 33(1), 58-77.
- Straub, E. T. (2009). Understanding technology adoption: Theory and future directions for informal learning. *Review of educational research*, 79(2), 625-649.
- Vicente, K. J. (1999). *Cognitive work analysis: Toward safe, productive, and healthy computer-based work*. CRC Press.
- Vereenooghe, L., & Langdon, P. E. (2013). Psychological therapies for people with intellectual disabilities: A systematic review and meta-analysis. *Research in developmental disabilities*, 34(11), 4085-4102.
- Weisberg, R. W. (2006). *Creativity: Understanding innovation in problem solving, science, invention, and the arts*. John Wiley & Sons.
- Wajihullah, A., Ashraf, S., & Majid, S. (2020). Teaching Time Concepts to Children with Intellectual Disability through Computer Game Based Learning. *Review of Education, Administration & Law*, 3(2), 265-274.
- Wozney, L., Venkatesh, V., & Abrami, P. (2006). Implementing computer technologies: Teachers' perceptions and practices. *Journal of Technology and teacher education*, 14(1), 173-207.