Effectiveness of computer-assisted instruction on enhancing the classification skill in second-graders at risk for learning disabilities

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Abstract

Introduction. Computers and other technological instruments in general have become a more common practice in our schools nowadays, and Computer- assisted instruction (CAI) has been recently provided in various formats from kindergartens on. It can help children at- risk for learning disabilities.

Method. This study investigated the effectiveness of Computer- assisted instruction on enhancing the classification skill in second graders at – risk for learning disabilities. Participants were 68 second graders at risk for learning disabilities from Zagazig, Egypt. They were randomly divided into two matched groups (experimental and control) with 34 participants each. ANCOVA, T- Test, Repeated measure, and scheffe were employed for data analysis.

Results. The results indicated that the use of CAI enhanced classification skill in the target participants, i.e. second graders at – risk for learning disabilities.

Discussion. Results were discussed, and it was concluded that CAI often leads to substantial gains in at- risk children`s early academic skills.

Keywords: Computer- assisted instruction; classification skill; at- risk for learning disabilities ; second graders; between groups design.

Eficacia de la enseñanza asistida por ordenador para mejorar la capacidad clasificadora de alumnos de segundo curso de primaria con riesgo de dificultades de aprendizaje

Resumen

Introducción. Hoy en día los ordenadores y otros instrumentos tecnológicos son comúnmente usados en la práctica educativa en los colegios. Así la instrucción asistida por ordenador (Computer Assisted Instruction – CAI) ha sido proporcionada en diferentes formatos, ya desde la educación infantil. Y ello, puede ayudar a facilitar el aprendizaje en alumnado que se encuentra en riesgo de dificultades de aprendizaje.

Método. Este estudio analiza la efectividad de un programa instruccional asistido por ordenador para incrementar las habilidades de clasificación en alumnos de segundo curso en riesgo de dificultades de aprendizaje. Los participantes fueron 68 alumnos de segundo curso de Zagazig, Egipto. Fueron distribuidos aleatoriamente en dos grupos equivalentes (experimental y control) con 34 alumnos cada uno. Se siguió un diseño experimental, con medidas de pretest, postest y seguimiento, las cuales fueron sometidas a análisis estadísticos.

Resultados. Los resultados obtenidos sugirieron que el uso de una instrucción asistida por ordenador incrementa las habilidades de clasificación en los participantes objetivo de estudio, ejemplificados en alumnado de Segundo curso en situación de riesgo de dificultades de aprendizaje.

Discusión. Se discutieron los resultados, concluyéndose que la instrucción asistida por ordenador a menudo conlleva una mejora sustancial de las habilidades académicas tempranas en alumnado en riesgo de dificultades de aprendizaje.

Palabras clave: Instrucción asistida por ordenador; habilidad de clasificación; riesgo de dificultades de aprendizaje; Segundo curso.

Introduction

The last decade has witnessed a general technological revolution particularly in the Egyptian public schools to the extent that even kindergarten, which are not included in the educational hierarchy, had computers to provide various formats of computer- assisted instruction, particularly games.

Students with learning disabilities (LD) have been described in essence as those children and adolescents with at least average potential to learn, but for whom academic achievement in the core areas of learning including reading, mathematics, and writing fall far short of their potential (Hallahan & Kauffman, 2007; Hallahan, Lloyd, Kauffman, Marteniz,& Weiss, 2005). There is growing evidence that the academic difficulties experienced by students with LD are in fact cumulative in nature such that the gap between achievement and potential grows from childhood to adolescence (Miller, Fitzgerald, Koury, Mitchem, & Hollingsead, 2007). On the other hand, there is evidence that children with LD fall behind their peers without LD in the level of their cognitive development. The difference between both parties reaches half a stage or about a substage . At the time the children without learning disabilities reach the substage of intuitive thought of the preoperational stage according to Piaget, their peers with LD are in the preconceptual thought (Mohammed, 2006). This gap should be borne in mind when dealing with those children or trying to educate them.

The purpose of this study was to investigate the effectiveness of computer- assisted instruction developed by the authors for use with primary school pupils, particularly second graders, for improving their classification skills. Follow up was gathered to determine the maintenance of CAI.

Literature Review

Learning disabilities may well exist through out ones' life span. According to The National Joint Committee, it is a general term that refers to a heterogeneous group of disorders manifested by significant difficulties in the acquisition and use of listening, speaking, reading, writing, reasoning, or mathematical abilities. These disorders are intrinsic to the individual, presumed to be due to central nervous system dysfunction, and may occur across the life span. Problems in self- regulatory behaviors, social perception and social

interaction may exist with LD but do not by themselves constitute a learning disability (Hallahan & Kauffman, 2007; Hallahan ,et al., 2005; Jorge, 2003). When we are testing children at an early age for LD, we are really dealing with prediction rather than identification as those children are not ordinarily engaged in academics (Foorman, Francis, Shaywitz, Shaywitz, & Fletcher, 1997; Lerner, 2000). Preacademic skills which are behaviors that are needed before formal instruction can begin, such as identification of numbers, shapes, alphabets, and colors in addition to phonological awareness which is important for reading are the most accurate predictors we may encounter at such an early age (Sotiria, 2004; Torgesen, 2001). According to literature, computer and computerized instruction have their important impact on those children in the primary grades (Fuchs ,et al., 2006; Hitchcock & Noonan, 2000; Huang, Liu,& Shiu, 2008; Xin & Asha, 1999).

Since 1960s several studies have reported positive outcomes when employing CAI. These have included pre-mathematical knowledge (Hasselbring, Goin, & Bransford, 1988; Howard, Eatson, Brinkley, & Ingels-Young, 1994), counting skills (Hungate, 1982; Clements & Nastasi, 1993), recognizing numerals (Hungate, 1982; McCollister, Burts, Wright, & Hildreth, 1986), learning numerical concepts (Grover, 1986), as well as improvement in standardized tests of number skills (Elliot & Hall, 1997; Hughes & Macleod, 1986). The largest gains in the use of CAI have been in primary grade children's mathematics, especially when used as additional practice (Ragosta, Holland, & Jamison, 1981; Lavin & Sanders, 1983; Niemiec &Walberg, 1987).

When the target skills short term interventions using CAI have been successful. Kraus (1981) reported a study in which second graders with only an average of one hour of computer game playing over a two-week period responded correctly to twice as many items on an addition facts speed test as did students in the control group. Based on their results Clements and Nastasi (1993) estimated that even 10 min of daily practice is sufficient for significant gains.

Similar positive outcomes in mathematics learning have been found in studies in which CAI has been used with broader content. Fletcher-Flinn and Gravatt (1995) reported that CAI was more effective than traditional instruction for a wide range of skills in maths, science, art, reading, and writing. CAI effectiveness was demonstrated for preschool and elementary as well as special education. However, in CAI studies (e.g., Moxley, Warash,

Coffman, Brinton, & Concannon 1997 , Din & Calao 2001 , McDermott & Watkins 1983 , Reitsma & Wesseling 1998 , and Shute & Miksad 1997) children did show improvement in reading related skills, but no differences were found in the development of mathematical skills.

Only a few studies have directly compared different types of CAI. Okolo (1992) and Christensen and Gerber (1990) both contrasted CAI on number combinations in a game-like format to CAI in a simple drill format. For students with learning disabilities in grades 3–6, Okolo found no significant differences between groups, but both groups improved their number combination competence. Investigating a similar question in grades 4–6, Christensen and Gerber found that students with learning disabilities were disadvantaged by the game-like format. Unfortunately, neither study incorporated a control group to verify whether the CAI condition improved more than would have been expected by just repeating the assessments. In their study with preschool children at risk for early learning difficulties, Elliot and Hall (1997) did have two groups who used computer based math activities and a third group with non-computer-based math activities. Those who used CAI scored significantly higher on a test of early mathematical ability.

In their meta-analyses Kroesbergen and van Luit (2003) and Malofeeva (2005) concluded that a computer was less effective than a teacher in assisting learning. Only Xin and Jitendra (1999) reported that CAI was the most effective method. However, Xin and Jitendra (1999) analyzed only mathematical problem solving, and, like most of the studies, did not restrict their analysis to preschool age and early number skills.

Only a few CAI studies of early number skills have reported results in sufficient detail to enable numerical comparisons between intervention and control groups (Christensen & Gerber, 1990; Clements, 1986; Fuchs, et al., 2006; Ortega-Tudela & Gmez-Ariza, 2006; Shin et al., 2006). Although all these studies had very different types of aims, groups and measures, the figures presented allowed us to produce comparable "benchmark values" for different types of CAI on early number skills. Clements (1986) randomly divided 72 6–8-year-olds from typically performing class rooms into three groups. One group played LOGO, one group used 18 different commercial computer games for mathematics, reading and problem solving, and one group acted as a control group. The aim of this 22-week intervention was to assess development in metacognitive skills, but measures of classification and seriation were also

collected. Fuchs et al. (2006) compared the number combination skills of at risk first graders in an 18-week intervention study in which the intervention group (n = 16) used mathematics flash cards while the control group (n = 17) used reading flash cards. The aim was to improve children's addition and subtraction fluency. Ortega-Tudela and Ǵmez-Ariza (2006) studied whether 21 weeks of CAI would produce better results in learning cardinality than the same material in a printed format with a group of 18 six-year-olds with Down-Syndrome.

Method

Participants

Participants were 68 second graders at- risk for LD from Zagazig Educational Administration in Sharkiya Governorate, Egypt. They in age from 7.5 – 8 years with mean age of 7.35 years, and SD of 1.02 years. Each participant met the following established criteria to be included in the study: (a) a diagnosis of LD by teacher's references, and LD screening test (Mostafa , 1990), (b) an IQ score on the Mental Abilities Test (Mosa, 1989) between 90 and 118, (c) Low score on the classification skills tasks and (d) absence of any other disabling condition. The sample was randomly divided into two groups; experimental (n= 34; 20 Males, and 14 Females) and control (n= 34; 21 Males, and 13 Females).The two groups were matched on age, IQ, and classification skills. Table 1 shows means, standard deviations, t- value, and significance level for experimental and control groups on age (by month), IQ, and classification skills tasks (pre-test).

Table 1. *Pretest Scores. Means, standard deviations, t- value, and significance level for experimental and control groups on age (by month), IQ, and classification skills tasks*

Variable	Group	N	M	SD	T	Sig.
Age	Experimental	34	92.470	3.43	0.297	-
	Control	34	92.705	3.08		
IQ	Experimental	34	103.823	2.45	0.207	-
	Control	34	103.264	2.24		
Classification	Experimental	34	14.147	1.561	-1.632	-
	Control	34	13.470	1.844		

Table 1 show that t- values did not reach significance level. This indicated that the two groups did not differ in age, IQ, and classification skills tasks (pre-test).

Instrument

A scale for classification tasks was developed by the author where participants were anticipated to classify objects according to color, number, shape, and volume. Hence, eight tasks were developed to constitute the whole scale .Two tasks for every constituent each having three questions and ranging in scores from zero (for not being able to classify) to 2 (classifies perfectly). Therefore, each task has got from zero to 6 scores . This, in turn indicated that the scores dedicated for the scale as a whole ranged from zero to 48, and the higher the score a participant gets, the better. The test-retest correlation was .651, while Cronbach Alpha coefficient was .713. The internal consistency indicated that (r) values for the item- task correlations ranged from .419 – .667. To test the scale validity, a scale for cognitive development of children according to Piaget (Mohammed, 2006) was used as a criterion, and (r) value was .651 .

Procedure

The study was conducted in a primary school from Zagazig Educational Administration in Sharkiya Governorate, Egypt. The school had a population of 600 students. The students of the experimental group were trained using computer-assisted instruction to improve their classification skill. The CAI program of 60 sessions was developed by the author with the help of some experts in programming . Every session lasted for 45 minutes. It was administered to experimental group 4 times a week. Three CAI formats were used, presentations, drill- and- practice, and simulations. Participants were trained to classify items according to the components or the constituents contained. The program consisted of three main phases. The first phase contained six sessions, and it was aimed at creating familiarity between the author and the participants. In addition, the first phase qualifies the participants to receive instruction and training. The second phase in which instruction and training were presented through out 48 sessions was introduced with 12 sessions for each constituent (color, number, shape, and volume). Every one of the three formats employed was used to present instruction and training according to its nature in four sessions where the first three sessions were dedicated to do so, and revision took place in the fourth one. The final stage allowed

quick revision on the constituents contained using the three CAI formats in six sessions with two sessions for each format.

Results

H1" There were differences in post- test mean scores between experimental and control groups on classification skill level in favor of the experimental group".

In order to verify this hypothesis, ANCOVA analysis was used. Table 2 shows data on ANCOVA analysis for the differences in post- test mean scores between experimental and control groups in classification skills scale. The table shows that the $F_{(1, 65)}=1595.05$, p< .05.

Table 2. *ANCOVA analysis for the differences in post- test mean scores between experimental and control groups in classification skills scale.*

Source	Type 111 Sum of squares	Df	Mean square	F	Sig.
Pre	8.734	1	8.734		
Group	7826.600	1	7826.600	1595.051	.01
Error	977.771	65	15.278		
Total	3013.194	67			

In order to examine the direction of this significance, t- test analysis was used. Table 3 shows T. test results for the differences in post- test mean scores between experimental and control groups in classification skills scale. The table shows that (t) value was (40.764). This value is significant (p=.01) in the favor of experimental group. The table also shows that there are differences in post- test mean scores between experimental and control groups in classification skills scale in the favor of experimental group, and this indicated that the computer-assisted instruction as effective on enhancing the classification skill in young children (the experimental group) at risk for LD.

Table 3. *T-test results for the differences in post- test mean scores between experimental and control groups classification skills*

Group	N	Mean	SD	T	Sig.
Experimental	34	35.735	2.30	40.764	0.01
Control	34	13.705	2.15		

H2" The program is effective on improving classification skill the experimental group, and this effect is evident a month later".

In order to verify this hypothesis, repeated measures analysis was used. Table 4 shows data on repeated measures for classification skills. The table shows that there are differences between pre, post – and follow –up testing (p = .01)

Table 4. *Repeated measures analysis for classification skills scale*

Source	Type 111 sum of squares	df	Mean square	F	Sig.
Between groups	11400.123	1	11400.123	3023.743	0.01
Error 1	248.833	66	3.770		
Between Measures	5071.098	2	2535.549	832.162	0.01
Measures x Groups	5196.039	2	2598.020	852.665	0.01
Error 2	402.196	132	3.047		

In order to know the direction of significance, Scheffe test was used. The data on Scheffe test for multi- comparisons in classification skills scale are shown in table 5. The table shows that there are differences between pre, and post testing in favor of post testing, and between pre, and follow – up testing in favor of follow –up testing, but no differences between post and follow – up testing.

Table 5. *Scheffe test for multi- comparisons in classification skills scale*

Measure	Pre M=14.147	Post M=35.735	Follow -up M= 35.264
Pre	--	--	--
Post	21.588*	--	--
Follow –up	21.117*	0.470	--

Discussion

The main objective of the present study was to evaluate the effectiveness of a CAI as intervention to improve the classification skills of second-grade students at risk for LD. The study also examined the effect of the instruction , whether there was any, during a follow- up period to know if the effect was still evident a month later. The results of this study revealed that thei nstruction was effective on improving the classification skill level of students in experimental group . No such gains were noted in the control group.

Such results might be interpreted in the light of the fact that computer-assisted instruction improves learning for students with disabilities because students receive immediate feedback and do not continue to practice their errors (Becker, McLaughlin, Weber, & McLaughlin, 2009; Hitchcock & Noonan, 2000; MacArthur *et al.*, 2001). Computers also capture the students' attention and may help them get high scores scores. Also, computer-assisted instruction moves at the students' pace and usually does not move ahead until they have mastered the skill (Mastropieri & Scruggs, 2000). Furthermore, programs provide differentiated lessons to challenge students who are at risk, average, or even who are gifted (Hallahan & Kauffman, 2007).

These findings support Mourad *et al.* (2006) who noted that there is one problem "students who are at risk for learning disabilities often cover any special abilities and talents. Unfortunately their weakness becomes the focus of their teachers and peers, ignoring their abilities. Mourad (2007), however, noted that students with LD, as well as those who are gifted can master the same contents and school subjects, but they need to do that in a way that is different from that used in our schools.

Since computer programs are interactive and can illustrate a concept through attractive animation, sound, and demonstration, they allow students to progress at their own pace and work individually or in a group. Computers provide immediate feedback, letting students know whether their answer is correct. If the answer is not correct, the program shows students how to correctly answer the question (Reiber, 1991; Smaldino *et al.*, 2004). Computers offer a different type of activity and a change of pace from teacher-led or group instruction (Fuchs *et al.*, 2006).

Hence the experimental group participants who received training in the CAI program have become able to classify objects as presented on the tasks included according to color, number, shape, or volume while their control peers were unable to do so.

Finally, On the basis of these findings the authors hereby recommends that CAI should be used with children who are at –risk for LD. This will allow these children, while learning, to proceed at their own pace, work individually and also solve problems in a group. It can also be used to enhance their preacademic skills which in turn help them achieve progress in school.

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