Effectiveness of Differentiated Instruction on Achievement in Mathematics of Middle School Students with learning disabilities

Hesham Habib Al Huseini [*] & Rasha Mohammed Abdullah[**]

[*] Associate Prof. of Educational Psychology, National Center for Evaluation and Examinations
[**] Assistant prof , Agman University , United Emirates

Abstract

This study investigated the effect of using differentiated instruction achievement in math in second graders preparatory with learning disabilities. 61 students identified with LD were invited to participate. The sample was randomly divided into two groups; experimental (n= 31; 28 boys and 3 girls) and control (n= 30, 20 boys, 2 girls). ANCOVA and T .test were employed for data analysis. Findings from this study indicated the effectiveness of differentiated instruction on achievement in math in the target students. On the basis of the findings, the study advocated for the effectiveness of using differentiated instruction on achievement in math in learning disabled students.
Key words. Differentiated instruction, academic achievement, learning disabled.

Introduction

The concept of *differentiated instruction* is based on the need for general education teachers to differentiate instruction to meet the needs of diverse learners in the general education class; this includes students with learning disabilities as well as a number of other disabilities.

Tomlinson (2001) suggests several main aspects of the learning experience that can be differentiated according to learner differences—content, process, and products. Some discussions of differentiated instruction (e.g., Tomlinson & Jarvis, 2009) also include learning environments as a separate aspect amenable to classroom modifications. A key theoretical underpinning of differentiated instruction is the social learning theory concept of a "zone of proximal development" (ZPD). Vygotsky (1978) described the ZPD as "the distance between the actual developmental level and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (p. 86).

The concept of ZPD implies that each student should be given learning experiences slightly more challenging than what he or she can currently master independently. The student can be led to progressively greater depths of understanding with the assistance of others. These forms of assistance are frequently referred to as "scaffolding" in the educational literature. Several corollaries of the ZPD concept that inform its application to differentiated instruction are:

- Each student will have an individual ZPD, rendering uniform approaches to instruction ineffective.
- Flexible peer learning groups, fairly implemented, can benefit students of different abilities
- Frequent formative assessment is necessary to continually update educators' evaluations of students' current understandings.

Research on the effectiveness of differentiated instruction on improving students' achievement is still emerging. Castle, Deniz, and Tortora (2005) contend that differentiated instruction is necessary to meet the varied needs of all students in the classroom. Their study indicated student achievement improved after experiencing differentiated instruction over several years.

George (2005) supports differentiated instruction linked with public education and the mixed-ability classrooms in today's schools. The mixed-ability classroom is a reflection of the variety in American society. He goes on to argue that gifted and talented students will not be challenged and will not reach their potential or will become behavior problems due to boredom in the classroom. As students prepare for standardized tests, Tieso (2004) believes

interests, abilities, and strengths are in conflict with a one way approach of teaching. As legislation requires programs for the gifted to be implemented, budget restraints place classroom teachers in a position of meeting the needs of these students in a mixed-ability classroom of students.

Tomlinson, Brimijoin, and Narvaez (2008) report on the experiences of two schools on the differentiated instruction journey. Their book indicates the structure of differentiation in each of the schools and survey results in support of differentiation.

Through her research on differentiated instruction for her dissertation, Bosier (2007) investigated what research studies have been done on the topic of differentiated instruction in math. The purpose of her research was to 1) review the perceptions of differentiated instruction of upper elementary math teachers as an effective and instructional tool, 2) develop a link between mathematic student achievement and teacher commitment of implementing differentiated instruction in the classroom, and 3) determine teacher perceptions of the advantages and disadvantages of differentiated mathematics instruction. This was a mixed methods study. Bosier compared beginning and ending achievement data in the fall and spring and drew conclusions from the teachers‘ perceptions.

In a review of studies regarding direct instruction, Gujjar (2007) found students receiving direct instruction in a small group setting performed better in reading, math, and social studies than those in whole group arrangements. Because the groupings are flexible and change as needed, ongoing assessment becomes necessary. Pre-assessment can also be in the form of teacher or textbook created assessments, interest inventories, learning style inventories, and other non-academic instruments.

Mourad and Amal's (2013) study investigated the effect of using differentiated instruction by integrating multiple intelligences and learning styles on solving problems , achievement in , and attitudes towards math in six graders with learning disabilities in cooperative groups. A total of 60 students identified with LD were invited to participate. The sample was randomly divided into two groups; experimental (n= 30 boys)and control (n= 30 boys). ANCOVA and T .test were employed for data analysis. Findings from this study indicated the effectiveness of differentiated instruction by integrating multiple intelligences and learning styles on solving problems , achievement in , and attitudes towards math in the target students. On the basis of the findings, the study advocated for the effectiveness of using differentiated instruction by integrating multiple intelligences and learning styles on solving problems , achievement in , and attitudes towards math in learning disabled students.

Further research is necessary to build on the vast amount of research into differentiated instruction with learning disabled students. This will allow researchers to determine how differentiated instruction can be best used as an intervention with learning disabled students as there is a dearth of research with this population. In order to address this issue with the lack of research on differentiated instruction with learning disabled students. Thus the present study seeks to give answers to the following question: *Are there differences in post-test scores mean between control and experimental groups on Academic Achievement test?*

Method

Participants

Sixty – one students identified with LD were invited to participate. Each student participant met the following established criteria to be included in the study: (a) a diagnosis of LD by teacher's references, and learning disabilities screening test (Kamel, 1990) (b) an IQ

score on the Mental Abilities Test (Mosa, 1989) between 90 and 114 (c) low scores on Mathematical achievement test (d) absence of any other disabling condition. The sample was randomly divided into two groups; experimental (n= 31; 28 boys and 3 girls) and control (n= 30, 20 boys, 2 girls).

The two groups were matched on age , IQ , achievement and attitude tests .Table 1. shows means, standard deviations ,t- value , and significance level for experimental and control groups on age (by month) , IQ , Academic achievement test (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 achievement test.*

Variable	Group	N	M	SD	t	Sig.
Age	Experimental	31	145.51	2.42	0.453	-
	Control	30	145.23	2.45		
IQ	Experimental	31	109.19	7.44	-.305	-
	Control	30	109.80	8.05		
Achievement	Experimental	31	12.129	1.14	0.097	-
	Control	30	12.100	1.18		

Table 1. shows that al t- values did not reach significance level . This indicated that the two groups did not differ in age , IQ , and achievement test (pre-test) .

Measure

Academic Achievement Test. The end-of- year examination results of the participants in math standardized and marked by the teachers , and provided the summative evaluation scores for the analysis. Hence, scores in the math served as the measures of students‘ achievement.

Procedure

All the sixty-one students in two preparatory completed Academic Achievement Test, which assesses students‘ Mathematical academic Achievement. Additionally, the end-of- year examination results of the participants in math standardized and marked by the teachers ,and provided the summative evaluation scores for the analysis. Hence, scores in the math served as the measures of students‘ achievement. Thus data was reported for the students who completed the study .

The teacher was provided with a notebook that contained detailed directions for implementing all activities and lessons. Students received 3 training sessions a week, lasting between 40 and 45 min .Instruction took place in the regular classroom in order to naturalize the situation.

For 42% of the sessions, the researcher also assessed treatment integrity by recording the presence or absence of each component. Session integrity was computed by dividing the number of lesson components taught by the total number of components and multiplying the quantity by 100. Average session integrity scores were computed for each participant.

Design and Analysis

The effects of implementing the differentiated instruction on students' academic achievement in math was assessed using pre- post testing.

Results

Mathematics Achievement

Table 2. shows data on ANCOVA analysis for the differences in post- test mean scores between experimental and control groups in Mathematics Achievement. The table shows that the (F) value was (416.92) and it was significant value at the level (0.01).

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

Source	Type 111 sum of squares	df	Mean square	F	Sig.
Pre	3.894	1	3.894		
Group	6327.64	1	6327.64	416.92	0.01
Error		58			
Total	880.27	60	880.27		
	7208.85				

Table 3. shows T. test results for the differences in post- test mean scores between experimental and control groups in Mathematics Achievement. The table shows that (t) vale was (20.54). This value is significant at the level (0.01) 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 Mathematics Achievement in the favor of experimental group.

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

Group	N	Mean	Std. deviation	T	Sig.
Experimental	31	35.97	2.58	20.54	0.01
Control	30	15.59	4.85		

Discussion

The main objective of the present study was to explore the effects of differentiated instruction by integrating multiple intelligences and learning styles on solving problems , achievement in, and attitudes towards math in six graders with learning disabilities in cooperative groups.

The results of this study as revealed in table 3 shows that the differentiated instruction that integrated multiple intelligences and learning styles was effective in improving achievement in math of students in experimental group, compared to the control group whose individuals were left to be taught in a traditional way.

Differentiated instruction is a promising approach for supporting the diverse needs of all students for it consistently had positively affected student achievement. The conclusions of this study encourage the use of differentiated instruction because it is of substantial benefit to students who may be struggling in the classroom and is responsible teaching in that it acknowledges not only the strengths and differences among learners, but also the increasing diversity in the modern classroom. Differentiated instruction is an effective method of teaching mathematics for it gives students hands-on learning and more opportunities to communicate with their classmates as compared to conventional instructional approach.

Recommendations

Based on the findings and conclusions made in this study, it is recommended that use of differentiated instruction be adopted for mathematics instruction. Evaluation of education

goals of mathematics and a massive restructuring of the curriculum should be done to incorporate the use of differentiated instruction approach on various topics. This is due to the positive influence exerted on the students' achievement in mathematics when differentiated instruction approach was used. Mathematics curriculum developers should include differentiated instruction approach in the teaching of mathematics during the training of mathematics teachers that is teacher education institutions should develop and provide pre-service and in-service programs that use differentiated instruction. Training sessions and professional development for differentiated instruction that require concerted response from all stakeholders including school principals, teachers and school authorities should be done.

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