

The Effect of Study Island on the Mathematical Achievement of Self-Contained Seventh Grade
Students with Learning Disabilities

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Abstract

The purpose of this study was to determine the effect of Study Island on the mathematical achievement of self-contained seventh grade Adaptive Learning Support (ALS) and Behavior Learning Support (BLS) students with learning disabilities. The measurement tool was the online Measures of Academic Progress (MAP) test. This study involved the use of a pretest/posttest designed to compare data from September 2012 to data from February 2013. Achievement gains were not statistically significant. Research in the area of high-tech mathematical interventions should continue given the increase in accountability for all students at the federal, state, and local level.

CHAPTER I

INTRODUCTION

Middle school students receiving special education services in a self-contained environment often struggle to achieve in mathematics. Advancements in mathematical instruction that includes rigorous, research-based teaching practices have failed to reach many special education classrooms (Billingsley, Scheuermann, & Webber, 2009). As a result, Parmar, Frazita, and Cawley (1996) found that a middle school student with mild disabilities today performs at the same mathematical level of a middle school student with mild disabilities in the 1930's. With the increase in accountability of mathematical achievement for all students as mandated at the federal, state, and local level, it is essential to identify the components that comprise mathematical achievement, examine the traditional mathematical interventions, and evaluate the emerging mathematical interventions.

Many trends in mathematics instruction have not been successful. Maryland School Assessment (MSA) results for mathematics show an achievement gap for seventh grade students receiving special education services in comparison to their peers. According to the Maryland State Department of Education (2012), 3,635 of the 6,793 or 53.5% tested seventh grade students receiving special education services scored basic in mathematics. In the category of all students in the seventh grade, 14,212 of the 60,010 or 23.7% tested scored basic in mathematics during the same time period. The emergence of technology now provides new mathematical interventions aimed at closing the existing achievement gap for students receiving special education services.

Statement of the Problem

This study was conducted to determine the effect of Study Island on the mathematical achievement of self-contained seventh grade Adaptive Learning Support (ALS) and Behavior Learning Support (BLS) students with learning disabilities.

Hypothesis

There will be no difference on the mathematical achievement of self-contained seventh grade Adaptive Learning Support (ALS) and Behavior Learning Support (BLS) students with learning disabilities with the technology-based mathematics instruction.

Operational Definitions and Limitations

The independent variable was technology-based mathematics instruction. In this context, *technology-based mathematics instruction* is a mathematical instructional approach that emphasizes the delivery of instruction using the high-tech software of Study Island by a highly qualified special education mathematics teacher.

The dependent variable was mathematical achievement. In this context, *mathematical achievement* is defined as the individual student's scores earned on the Measures of Academic Progress (MAP) pretest and posttest.

Additionally, there were two critical terms the reader must understand. *Adaptive Learning Support* (ALS) refers to the delivery of instruction in the core academic area of mathematics in a self-contained classroom environment due to the complex learning needs of identified students with learning disabilities. Students requiring services in an ALS classroom are unable to make progress toward Individualized Education Plan (IEP) goals in the general education setting in spite of significant accommodations and modifications made to the mathematics curriculum. *Behavior Learning Support* (BLS) refers to the delivery of instruction

in the core academic area of mathematics in a self-contained classroom environment due to significant social, emotional, and behavioral needs of identified students with learning disabilities. Students requiring services in a BLS classroom usually have normal intelligence but may not be achieving academically due to the adverse impact of social, emotional, and behavioral difficulties.

In addition, the reader must understand a limitation to this study. For the purpose of this research, the literature was reviewed from 1996 to 2012.

CHAPTER II

REVIEW OF THE LITERATURE

This review of the literature will examine traditional interventions for mathematics as well as evaluate new interventions. Section one will examine the current state of mathematical achievement of middle school students receiving special education services in a self-contained environment. Section two will outline the five major content strands of mathematical achievement for all students. Section three will review the traditional low-tech mathematical interventions that have been engrained in special education classrooms. Section four will explore the emerging high-tech mathematical interventions. Finally, section five reveals the outcome for middle school students when both traditional and emerging mathematical interventions are incorporated into self-contained special education mathematics classrooms.

Five Major Content Strands of Mathematical Achievement

Similar to reading achievement, confusion exists as to what constitutes mathematical achievement. In reading, many believe that comprehension is the key to achievement. However, the National Institute for Literacy states that proficiency in reading relies on instruction in phonemic awareness, phonics, fluency, vocabulary, and text comprehension (Armbruster, Lehr, & Osborn, 2001). Likewise, one content strand of mathematics should not be viewed in isolation to predict academic achievement.

Often, students with learning disabilities demonstrate deficits in mathematical computation and applied problems. However, these skills are only a portion of the five major content strands of mathematical achievement. Proficiency in mathematics can only exist in a classroom that provides curriculum, teaching, and assessment in the areas of number sense, properties, and operations; measurement; geometry and spatial sense; data analysis, statistics,

and probability; and algebra and functions (Grouws & McNaught, 2008). Unless teachers incorporate each of these components into the self-contained middle school mathematics classroom, student achievement will continue to remain at the basic or low proficient level.

Traditional Mathematics Interventions for Self-Contained Students with Learning Disabilities (Low-Tech)

Self-contained middle school mathematics classrooms continue to rely on outdated teaching methods and low-tech devices in an attempt to provide students with disabilities remedial mathematics instruction. These substandard mathematical instructional practices focus on direct instruction, manipulative use, and the acquisition of basic facts through use of a calculation device. Although each of these interventions has a limited place in every mathematics classroom, the exclusive use of direct instruction and low-tech devices in self-contained middle school mathematics classrooms inhibits all students with learning disabilities from achieving academic growth commensurate with their nondisabled peers.

Direct or explicit instruction has long been believed to be the most beneficial teaching method for students with disabilities. Gunter, Hummel, and Venn (as cited in Billingsley et al., 2009) state that this instructional practice presents a new mathematical concept in a highly controlled and logical way that includes reviewing prior learning, providing ample support when introducing new concepts, allowing for numerous opportunities of interaction between the teacher and the student, and offering continuous practice to ensure a grasp of the new concept. Recent research indicates that explicit instruction is only beneficial to students with learning disabilities at the tier 2 level of a 3 tier Responsiveness to Instruction (RTI) approach (Allsopp, McHatton, & Farmer, 2010). Furthermore, Bottge, Rueda, Grant, Stevens, and Laroque (2010) observed that students with learning disabilities in math who received instruction utilizing a

computer-based instructional module refused to complete work once instruction returned to direct instruction.

The mathematical ability of a student receiving instruction in a self-contained middle school environment can range from a basic to an advanced level. Some students may require intense remedial instruction and may be placed in an Adapted Learning Support (ALS) mathematics classroom. However, some students are federally coded with an Emotional Disability and have no mathematics deficits but are still placed in a self-contained mathematics environment known as Behavior and Learning Support (BLS). Often, due to budget constraints, these students are serviced in a combined classroom.

Traditionally, low-tech devices that include manipulatives and nonscientific calculators have been used in the self-contained mathematics classroom regardless of the mathematical ability of the student. Li and Ma (2010) contend that the widespread use of manipulatives provides students with a foundation for learning abstract mathematical ideas. Students performing at a basic level in mathematics benefit when a mathematical concept is moved from a concrete-to-representational-to-abstract manner. When confronted with finding the area of a rectangle, for example, students can first be introduced to the concept using the concrete manipulative of centimeter blocks. After ample time for exploration, students can be moved to a picture representation utilizing centimeter grid paper. Lastly, students can apply the formula to find the area of a rectangle abstractly without the use of manipulatives. Students who demonstrate difficulty at any stage of learning can be moved back to either the representational or concrete depending upon their ability to grasp the new mathematical concept.

The same results hold true for calculator use. Allsopp et al. (2010) state that calculator use can bypass the barriers that exist when performing basic arithmetic in a higher-level

mathematics class for a student with a learning disability. However, research was not found to indicate that manipulatives or nonscientific calculator use provide measurable benefits for a student with an emotional disability performing at the proficient or advanced level in a self-contained mathematics classroom.

Emerging Mathematics Interventions for Self-Contained Students with Learning Disabilities (High-Tech)

Advancements in technology have begun to transform instructional practices in the middle school mathematics classroom. However, limited research has been conducted in the self-contained mathematics environment that services students with learning disabilities. The National Council of Teachers of Mathematics (as cited in Yang & Tsai, 2010) asserts that an essential component to enhancing the learning of students is to incorporate technology into every mathematics classroom. With this in mind, a closer examination into the emerging technologies is vital to advance the mathematical achievement of students with learning disabilities.

When one reflects upon utilizing technology in the self-contained mathematics classroom, usually the first thought that comes to mind is using one of the numerous online games that exist to remediate or reinforce math concepts. Online games fall under the broader technology category of Computer-Assisted Instruction (CAI). This type of intervention is widely used in self-contained middle school mathematics classrooms due to its ease of access and the belief that with its use comes an increase in student motivation to learn math. However, recent research conducted by Slavin, Lake, and Groff (2009) indicates similar results when rating standard textbooks to core computer curriculum, where each type received effectiveness ratings of having positive effects, potentially positive effects, or mixed effects.

Other research indicates positive results when incorporating CAI into the mathematics classroom. Ma and Wu (as cited in Huang, Liu, & Chang, 2012) recorded results that show improvements in both the learning interest and the achievement of students. Likewise, significant gains were seen in the word problem solving ability of low-achievers when carefully designed word problems were incorporated into a computerized adventure game (Kajamies, Vauras, & Kinnunen, 2010).

While CAI has widespread use in mathematics classrooms, some lesser utilized technologies are beginning to emerge as having potential in the self-contained middle school environment. Enhanced Anchored Instruction (EAI) presents a mathematical word problem in a video-based format, thus eliminating the reading barrier that often exists with students having learning disabilities. Bottge, Heinrichs, Mehta, Rueda, Hung, and Danneker (2004) assert that students receiving EAI are better prepared for the workforce upon graduation due to the students solving mathematical problems in a way similar to how they would encounter the problem in the real world. Furthermore, Bottge, Rueda, and Skivington (2006) found that students who previously disliked mathematics were motivated to learn when instruction was presented utilizing an EAI format.

Another technology showing potential for the middle school environment is graphing calculators. Long a staple in advanced high school mathematics classroom, graphing calculators are slowly being integrated at the middle school level, replacing nonscientific calculators. Ruthven and Hennessy (2002) found that the perception of the teacher about the value of incorporating graphing calculator use, along with encouragement and flexibility in its use, can aid students with finding meaningful mathematical responses. Equally, the use of virtual manipulatives has shown positive effects on the cognitive abilities of students with learning

disabilities at the middle school level. In particular, Hannafin, Truxaw, Vermillion, and Liu (2008) found improvements in the spatial ability and the working memory of students who were given opportunities to use a graphical tool such as Geometer's Sketchpad over traditional methods. Additionally, Reimer and Moyer (as cited in Li & Ma, 2010) contend that virtual manipulatives are not as limited as concrete manipulatives since they have the capability of connecting dynamic visual images with abstract symbols.

An underutilized technology in the self-contained mathematics classroom involves social networking sites and collaborative wikis. Although there are inherent dangers presented by using the Internet, online tools provide students with an opportunity to interact in a virtual medium where they can gain insight and knowledge from student and teacher postings external to their classroom and also receive near instant instruction and assistance. Calhoun and Fuchs (as cited in Allsopp et al., 2010) suggest that student achievement among students with learning disabilities increases as a result of virtual prompting and cues due to the online interaction received by students with learning disabilities.

Summary

Mathematical achievement for all middle school students is essential to the long-term economic potential of our nation (Slavin et al., 2009). If instructors will embrace the use of research-based, emerging high-tech mathematics interventions while at the same time incorporate only the previously proven effective low-tech mathematics interventions, students with learning disabilities can realize gains in mathematical achievement. Only then can educators fully eliminate the mathematical achievement gap that currently exists for students with learning disabilities.

CHAPTER III

METHODS

This study was conducted to determine the effect of Study Island on the mathematical achievement of self-contained seventh grade students with learning disabilities.

Design

This study utilized a quasiexperimental design of pre/posttest measurement using scores from the Measures of Academic Progress (MAP). The dependent variable in this study was the level of mathematical achievement which was measured with the Spring MAP test. In this study, the independent variable was the high-tech mathematical intervention of Study Island.

Participants

The participants for this study were a convenient sample from one self-contained seventh grade classroom in a Baltimore County, Maryland middle school. There were nine students in the combined Adaptive Learning Support (ALS) and Behavior Learning Support (BLS) class ranging in age from 11 to 13. Seven of the students were boys, and two of the students were girls. Five of the students were racially coded as Black or African American, and four of the students were racially coded as White. Five of the students were ALS, and four of the students were BLS. All of the students have an Individualized Education Plan (IEP). Three students were coded with a specific learning disability, two students were coded with other health impairments, two students were coded with an emotional disability, one student was coded with autism, and one student was coded with an intellectual disability. Of the nine students, three scored basic on the Maryland State Assessment (MSA) in Mathematics, four scored basic on the Modified Maryland State Assessment in Mathematics (Mod MSA), and two were not tested for unknown reasons.

Instrument

The instrument used for this quasiexperimental pre/posttest study was the Measures of Academic Progress (MAP) developed by Northwest Evaluation Association. The MAP: Math 6+ MD 2004 (MD Mathematics PK-8, HS:2004) was administered as the pretest in the fall of 2012 and as the posttest in the winter of 2013. The MAP test is a computer-based adaptive assessment given in a multiple-choice format that adjusts up or down in difficulty based on the response of the student to produce a score in each of the five categories of Algebra, Patterns, and Functions; Geometry; Measurement; Statistics and Probability; and Number Relationships and Computation. The mean of these individual scores result in an overall score for the assessment.

The validity and reliability of MAP was reviewed utilizing Buros' Mental Measurement Yearbook. In the area of validity, the reviewer suggests that validity evidence for Measures of Academic Progress (MAP) score interpretations come from two primary sources (Measures of Academic Progress, 2010). First, the comprehensive test development, administration procedures, and documentation support the conclusion that MAP scores differentiate between students' level of ability in tested subjects. The reviewer indicates that, since this is based on the content of MAP tests results from extensive input on the part of users, it is likely that customized MAP test specifications reflect the curricular goals and objectives of the districts involved. Second, MAP scores were compared to the Iowa Tests of Basic Skills (ITBS) and the Stanford Achievement Tests, 9th Edition (SAT9). Concurrent validity coefficients ranged from .78 to .88. The study showed a high degree of stability supporting that MAP scores do not have differing interpretations over time. In the area of reliability, the reviewer states that three types of reliability evidence are reported: marginal reliability, test-retest reliabilities, and conditional

standard errors of measurement (CSEMs). The reviewer concludes that it would appear that users can count on MAP scores to be quite reliable.

Procedure

The researcher began with administering the MAP pretest to all of the students. Students took the computer-based adaptive assessment following Baltimore County Public Schools' guidelines where IEP testing accommodations were not provided so that the individual student's instructional score could be obtained. All students were provided with scrap paper, pencils, and unlimited time to complete the assessment. When allowed, a calculator would appear on the testing screen. Students who completed the assessment at or below a six-minute time frame would receive an invalid score. All students completed the MAP pretest within the allotted testing window and no scores were invalidated.

Over the next ten weeks, students participated in five Study Island sessions. Each session lasted 50 minutes and focused on one of the five mathematical content standards. During the session, students were presented with a lesson, ten practice questions, and various games that supported the mathematical concept. Students participated in each of the sessions at their own pace. Once a passing score of 70% was obtained, the student could move to the next concept within the standard for that session. Students who were unable to reach the passing score were given an opportunity to revisit the lesson, retake the practice questions, and play the games until a passing score was obtained.

After all of the Study Island sessions were conducted, the researcher concluded the study by administering the MAP posttest to all of the students. The MAP posttest followed the same procedures that were utilized during the MAP pretest. The MAP pretest and MAP posttest

results were compared to determine the effect of Study Island on the mathematical achievement of self-contained seventh grade students with learning disabilities.

CHAPTER IV

RESULTS

This study was conducted to determine the effect of Study Island on the mathematical achievement of self-contained seventh grade students with learning disabilities. Nine students were involved in the study. Students had differing special education disabilities. Three of the students were coded with a specific learning disability (LD). Students with LD have difficulty understanding or using spoken or written language. Two of the students were coded with an emotional disturbance (ED). Students with ED demonstrate inappropriate behaviors that adversely affect their educational performance. Two of the students were coded with an other health impairment (OHI). Students with OHI have been diagnosed with a health problem that affects their educational performance. In this study, the two students with OHI have attention deficit hyperactivity disorder (ADHD). One of the students was coded with an intellectual disability (ID). Students with ID have significant limitations in their intellectual functioning and adaptive behaviors that adversely affect their educational performance. One of the students was coded with autism (AU). Students with AU have a developmental disability that affects verbal or nonverbal communication and social interaction. Also, the students were in the combined Adaptive Learning Support (ALS) and Behavior Learning Support (BLS) class.

Pre- and posttest data were gathered on the students. Data were analyzed to determine whether there were significant differences from pre- to posttest using the dependent t (sometimes referred to as the paired t) test (see Table 1). Additional analyses were run to determine whether

the ALS students and BLS students had differential gains from pre- to posttest using the chi square analyses (see Table 2). No statistically significant findings were obtained.

Table 1

Dependent t or Paired t Test Comparison of Fall to Winter (i.e., Pre- to Post) Test Scores

	Paired Differences				
	Mean	Std. Deviation	t	df	Sig. (2-tailed)
Pair 1 Fall 2012 Score (Pretest) - Winter 2013 Score (Posttest)	-3.222	4.494	-2.151	8	.064

Table 2

Chi Square Analysis of ALS versus BLS

			Special Education Program		Total
			ALS	BLS	
Score Difference	-4	Count	1	0	1
		% of Total	11.1%	.0%	11.1%
	-2	Count	0	1	1
		% of Total	.0%	11.1%	11.1%
	0	Count	0	1	1
		% of Total	.0%	11.1%	11.1%
	2	Count	1	0	1
		% of Total	11.1%	.0%	11.1%
	5	Count	2	0	2
		% of Total	22.2%	.0%	22.2%
	6	Count	1	0	1
		% of Total	11.1%	.0%	11.1%
	8	Count	0	1	1
		% of Total	.0%	11.1%	11.1%

	9	Count	0	1	1
		% of Total	.0%	11.1%	11.1%
Total		Count	5	4	9
		% of Total	55.6%	44.4%	100.0%

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	9.000 ^a	7	.253
N of Valid Cases	9		

CHAPTER V

DISCUSSION

This study was conducted to determine the effect of Study Island on the mathematical achievement of self-contained seventh grade students with learning disabilities. Analyses conducted in Chapter IV led to the retention of the null hypothesis.

Threats to the Validity

All experiments contain threats to external and internal validity. External validity refers to the ability to generalize from the sample selected for the experiment to the larger population. Several external threats to the validity exist for this study. First, this study utilized a purposive sample that the researcher believed to be representative of the population of seventh grade students with learning disabilities who receive math instruction in a self-contained ALS/BLS classroom environment. Gay, Mills, and Airasian (2012) indicate that the researcher's criteria and sample choice may contain inaccuracies resulting in limiting the researcher's ability to generalize the results of their study. The second threat to validity was the number of subjects in the sample. This study used a small sample of nine students. Additionally, all of the subjects in the sample were from one public middle school located in the southeast area of Baltimore County, Maryland.

Another threat that must be examined is internal validity which depends on the research design. Several internal threats to the validity exist for this study. This study utilized nonrandomization due to constraints beyond the researcher's control. In order to conduct this study, sample selection was limited to the whole class that the researcher taught instead of the selection of individual students. This resulted in a lack of enough participants to include a control group in the study. Lastly, standardization of the location and time of day may have had

an effect on the results. The researcher was limited to conducting the study when an open time slot existed for one of the computer labs located within the school. On several occasions, it was necessary to use the mobile laptop lab in the mathematics classroom due to unavailability of any of the computer labs. Additionally, the odd/even day schedule used in the school where the study took place did not allow for consistency in the time of day. On odd days, the participants were available to the researcher in the morning, and on even days, students worked in the afternoon. Lastly, the researcher could not control the absenteeism of the participants. While most of the students were present for the entire time period of the study, one student was absent two days and one student was absent five days.

Connections to Previous Studies

Even though the use of the high-tech intervention of Study Island did not prove to increase the mathematical achievement in this study, other studies have found that high-tech interventions can increase the mathematical achievement of students. Ma and Wu (as cited in Huang et al., 2012), used computer assisted instruction to examine the effect of active learning materials on students' problem solving ability. Their research indicated improvements in the learning interest and mathematical achievement of the participants in the study. Similarly, Kajamies et al. (2010) found significant gains in the word problem solving ability of low-achievers when carefully designed word problems were incorporated into a computerized adventure game.

The researcher was surprised that the results of this study did not show the positive outcomes of previous studies. The participants expressed interest in using the high-tech intervention of Study Island. Furthermore, throughout the study, the students were highly motivated and demonstrated on-task behavior. Additionally, the attendance rate increased for

all of the participants except one for the duration of the study. The students often asked the researcher when the next Study Island session was scheduled in the computer lab.

Implications for Future Research

Even though the mathematical achievement of self-contained seventh grade students with learning disabilities did not increase with the use of Study Island in the current study, it would be valuable for math teachers and special educators to know whether positive results could be obtained utilizing this high-tech intervention. Future research could involve using a different sampling technique that would alter the experimental design. The population in this study was small, consisting of students from one self-contained seventh grade class in one middle school. Through expanding the potential participants to include other middle schools and grade levels, the population could increase to allow future research to include a control group.

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