How to Increase Mathematics Achievement in At-Risk 6th Grade Students

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Abstract

This study examined the impact of two interventions, Accelerated Math (AM) and Response to Intervention (RTI), on at-risk 6th grade students' mathematics achievement. Participants with similar mathematics skills and who were identified as 'at-risk' were grouped into two groups of five. Each participant received a pretest, intervention, and posttest. One group received AM, and the other group received RTI. The groups met four times a week for 55-minute sessions for a total of three weeks. It was predicted that providing the mathematics interventions would not increase at-risk students' mathematics scores. However, students' scores improved under both conditions. Mean gains were 7.2 points for the AM condition and 10 points for the RTI condition. Therefore, the hypotheses that the interventions would not significantly improve mathematics scores were rejected. The hypothesis that the two interventions would yield statistically equivalent results was retained, however, as the mean difference in gains for the AM and RTI groups was not statistically significant.

CHAPTER I

INTRODUCTION

At-risk students have become a mainstream challenge in the academic setting and workforce today. Students who are considered at-risk often fall behind in class; they have poor test scores, frequent absences, and other dynamics that affect their ability to learn. Mathematics, a subject that requires students to engage in critical thinking, problem solving, and analyzing, is a subject area in which many at-risk students experience difficulty. Research by Kasten and Howe (1988) states “They are entering the work-force unable to use mathematics effectively, and probably account for a significant amount of the reason national assessment scores in mathematics do not show much improvement” (p. 2).

The researcher’s personal experience in a public school where the entire population is considered at risk has indicated that most at-risk students struggle with mathematics. These students often seem totally unaware of how to approach or solve mathematics problems. Students’ inability to understand simple mathematics functions at the middle school level is frustrating to them, disheartening to teachers, and influential in terms of students’ ability to succeed in school and work. This paper will focus on interventions aimed at helping at-risk students improve their mathematics achievement.

Statement of the Problem

The purpose of this study was to determine how to increase mathematics achievement in at-risk 6th grade/middle school students.

Mathematics skills are crucial and needed to survive in today’s society. Mathematics is used in every part of life, such as cooking, cleaning, gardening, using the phone, budgeting time and money, and understanding finances, to name a few. Students who are at risk often have difficulty developing math skills.

Byrnes (2009) states,

> When the term at-risk is applied to the field of education, it pertains to children who are identified as being more likely than other students to experience undesirable educational outcomes such as low achievement, suspensions, or dropping out of high school. After identifying the children who are particularly at risk for such outcomes, the goal then becomes one of creating interventions to help these children be more successful. (n.p.)

Finding an intervention could better prepare at-risk students for the many tasks of adulthood and also prepare them for higher learning, which can give them more opportunities beyond school.

Hypothesis

For this study, the null hypothesis was proposed: The two mathematics interventions implemented for at-risk students would not result in significant or significantly different mean increases in their mathematics achievement.

To determine whether the two intervention groups were similar in terms of mathematics scores, the mean WJIII pretest scores were compared using a t-test. Then comparisons to assess the difference in the impact of AM and RTI were made.

To determine whether either program resulted in statistically significant gains, the following two hypotheses were tested.

Ho1: Mean Math score gains for AM = 0

Ho2: Mean gains for RTI = 0

To determine whether either intervention yielded significantly larger gains than the other, the following hypothesis was also tested.

Ho3: Mean Math score gains with AM = Mean math score gains with RTI

Operational Definitions

The independent variable in this study was the intervention provided that was designed to enhance at-risk students' mathematics skills. Two interventions were implemented, and students' subsequent mathematics gains were compared.

- Accelerated Math (AM) was one level of the independent variable in the study.

Accelerated Math is learning software through the accelerated-learning program. Accelerated Math allows teachers to monitor, manage, and measure students' progress.

- Response to Intervention (RTI) was the second level independent variable in this study. Response to Intervention is a multi-tiered approach designed to provide support with students' target areas and increase their level of learning.

The dependent variable in this study was the students' mathematics achievement scores. Mathematics achievement was measured using the Woodcock-Johnson III (WJIII) test.

CHAPTER II

REVIEW OF THE LITERATURE

The purpose of this review is to inform readers about the dynamics associated with at-risk students and mathematics achievement. This literature review will provide information about the definition of at-risk students as well as about at-risk students' mathematics performance. The first section discusses the characteristics of at-risk students. The second section discusses the beliefs about at-risk students. The third section reviews information about mathematics achievement for at-risk students. The fourth section addresses the importance of mathematics. The fifth section talks about the need for intervention, and the sixth section discusses two types of interventions, Accelerated Learning and Response to Intervention (RTI), which may hold promise for addressing the mathematics achievement issues of at-risk students.

Characteristics of At-Risk Students

At-risk students are students who are not experiencing success in school and are potential dropouts. They are usually low academic achievers who exhibit low self-esteem (Green, 1986). Youth identified as at-risk are often those whose learning styles, learning disabilities, or life experiences may be factors in low achievement or who may have behavior considered unacceptable (Sagor as cited in McDonald, 2002). There are many different definitions for the term "at-risk." Johnson (2010) states, "Students are considered to be at-risk when certain factors such as low socioeconomic status, language and cultural differences and dysfunctional family situations are present which increases the probability of students dropping out of school" (p. 167). Sagor and Cox (2004) believe that an at-risk child is "any child who is unlikely to graduate, on schedule, with both the skills and self-esteem necessary to exercise meaningful options in the areas of work, leisure, culture, civic affairs, and inter/intra-personal relationships"

(p. 1). Grant, Popp, and Strong (2008) describe at-risk students as students who have experienced "meager environmental factors beyond their control" (p. 2) (e.g., homelessness, high mobility, poverty) or had challenges in attending, succeeding, and remaining in school.

Beliefs about At-Risk Students

Many beliefs exist about at-risk students. The National At-Risk Education Network (n.d.) offers the following summation:

> Many people, including some school personnel, believe that attempting to train and educate at-risk children and youth is a waste of time because they will never amount to much anyway. At times, even some dedicated educators, counselors, and social workers feel helpless and inadequate in reaching the at-risk population due to lack of resources, funding shortfalls, insufficient training, or other impediments to providing appropriate services. (p. 1)

Some researchers believe at-risk students' success or lack thereof is attributable to the learning approach implemented. In Baker's (2002) research, the study's purpose was to improve the mathematics achievement of students considered low achieving or at risk for failure. He synthesized the research on the effects of the interventions and found that at-risk students' mathematics achievement can be improved through different types of mathematics interventions such as peer tutoring, direct instruction, providing specific feedback to parents about their child's performance, and making recommendations to parents about their child's progress. According to Means and Knapp (1991), the dominant approaches to teaching at-risk students provide "little or nothing to foster the growth of reasoning, problem solving, and independent thinking" (p. 4).

Mathematics Achievement and At-Risk Students

According to Mullich (2007), The United States National Academies, an influential advisory organization, issued a blue-ribbon report in 2005 called “Rising above the Gathering Storm” warning that America was losing critical ground in mathematics and science skills. In fact, national achievement data do show that elementary school students in the United States, particularly those from low socioeconomic backgrounds, have weak mathematics skills. Students who are at risk often struggle in mathematics, a subject that requires critical thinking and problem solving. In addition, students who are at risk often have psychological needs that are unmet (National Center for the Accelerated Schools Project, 1991), and their unmet needs can influence their ability to learn. Kasten and Howe (1988) believe that at-risk students contribute to the behavior problems that exist in the classroom; they believe that their low level of understanding and competence in mathematics causes problems for the entire class. Balfanz and Byrnes (2006) found that high-poverty students struggle with mathematics during their middle school years and that, between fourth and eighth grades, the achievement gap for mathematics balloons.

According to Hanushek, Peterson, and Woessmann (2011), the No Child Left Behind Act (NCLB) of 2001 is a federal mandate that supports standards-based education reform. NCLB requires that schools administer standardized tests to all students. Mathematics is included in these assessments, and these assessments determine whether or not students will be promoted to the next grade. This act is based on a belief that setting high standards and setting measurable goals can improve individual outcomes in education.

Prior to the No Child left Behind Act of 2001, students in Maryland were required to pass the Maryland Functional Mathematics Test in order to graduate from high school. Many students were introduced to the test in middle school; however, they had several opportunities to pass the test before graduating from high school. Meeting national mathematics standards has become a prerequisite for being promoted to the next grade.

Mathematics achievement for at-risk students is widespread. From kindergarten to college, many at-risk students struggle with mathematics. Maxwell (as cited in Walsh, 2003) argues that this group of students' skills, knowledge, motivation, and/or academic ability are significantly below those of the typical student in the college or curriculum in which they are enrolled.

Importance of Mathematics

Baker (2002) believes "Mathematics ability plays an important role in daily living skills, college success, and a large number of careers" (p. 45). Paulos (1995) writes the following:

> As a mathematician, I'm often challenged to come up with compelling reasons to study mathematics. If the questioner is serious, I reply that there are three reasons or, more accurately, three broad classes of reasons to study mathematics. Only the first and most basic class is practical. It pertains to job skills and the needs of science and technology. The second concerns the understandings that are essential to an informed and effective citizenry. The last class of reasons involves considerations of curiosity, beauty, playfulness, perhaps even transcendence and wisdom. (p. 164)

Rao (2007) describes the importance of mathematics as being two-fold; one, it is important in the advancement of science, and two, it is important in our understanding of the workings of the universe. Mathematics equips pupils with a uniquely powerful set of tools to understand and change the world. These tools include logical reasoning, problem-solving skills, and the ability to think in abstract ways. Mathematics is important in everyday life, many forms of employment, science and technology, medicine, the economy, the environment and development, and in public decision-making.

Need For Intervention

At-risk students struggling with mathematics may benefit from early interventions aimed at improving their mathematics ability and ultimately preventing subsequent failure (Gersten et al., 2009). Data indicate that a strong relationship exists between early mathematics achievement and later mathematics achievement. Mathematics competency appears to be learned (Baker, 2002). According to Kasten and Howe (1988),

> Mathematics programs that are planned and operated to attempt to ensure success tend to have fewer remedial pupils and fewer intermediate mathematics pupils; these students stay in high school and may even go on to college, but their mathematics education is not adequate to allow them maximum educational and life choices**.** Prevention is far more successful than remediation; early remediation is more successful than late remediation. (n.p.)

Interventions to Aid Mathematics Achievement in At-Risk Students

Two mathematics interventions show potential for success in increasing mathematics skills and test scores for students who are considered at risk.

Accelerated Learning

Accelerated learning has been identified as one intervention method that has proven to be successful in helping students improve mathematics scores. According to the National Center for the Accelerated Schools Project (1991),

> At-risk students often are behind in their learning when they come to school. Rather than providing a slowed-down instructional program, schools need to provide accelerated

learning for these students. Accelerated learning provides a relevant and demanding curriculum, instructional approaches that build on students' strengths, problem solving and authentic applications, and high expectations for all students. (n.p.)

Accelerated Math is a software tool published by Renaissance Learning. This software is designed to customize assignments and monitor students' mathematics progress in grades 1–12. There have been several studies conducted on Accelerated Math with the following study designs: experimental, quasi-experimental, correlational, case study, and psychometric (reliability and validity) research (Nunnery & Ross, 2007).

Nunnery and Ross (2007) conducted a study of the effects of the Renaissance program on students' achievement in mathematics and reading using a quasi-experimental design. They used a total of 992 8th grade students from four middle schools. There were two treatments groups and two comparison groups. The students in the treatment group were given two years of instruction using the Renaissance program which includes Accelerated Math. Students in the treatment group experienced two years of the Accelerated Math program. The study found that students made one year of academic progress.

Ysseldyke and Tardrew (2003) conducted the same study on the effects of the Renaissance program using a different design, a randomized trial with attrition. The study was conducted using eight middle schools from seven school districts. Students were taught mathematics using the Accelerated Math program with their regular mathematics curriculum. Their study found that the Accelerated Math program had a positive effect on student achievement.

Response to Intervention

According to the 2004 reauthorization of the Individuals with Disabilities Education Act

(IDEA) (PL 108-446), states were encouraged to use a “Response to Intervention” (RTI) as an intervention method for students struggling academically or who have a learning disability (Gersten et al., 2009). RTI is a mathematics intervention program geared toward preventing students from falling behind. It also provides early detection and support systems. RTI allows teachers to screen, monitor, and provide intervention methods to students who are at risk. RTI consists of screening, identification, and placement into three tiers of instruction and progress monitoring.

Ardoin, Witt, Connell, and Koenig (2005) conducted a study to present a demonstration of a Response to Intervention (RTI) model. The purpose of the study was to answer the following question: “To what degree does a class wide intervention and individual intervention improve student mathematics outcomes?” (Ardoin et al., 2005, n.p.). The study consisted of fourteen 4th grade students with low mathematics achievement. Students in the study were divided into two classrooms that were taught using team teaching. Both teachers divided their classroom into three mathematics sections. Each phase of the RTI model was used during the study. In the 1st phase, students were screened using multiplication, addition, and subtraction examinations. The 2nd phase consisted of a class wide intervention, due to the screen data indicating the same target area for all participants. The class wide intervention included modeling the target skill, guided practice with frequent opportunities to respond and provide immediate feedback, timed independent practice to yield a score for progress monitoring, and the use of delayed error correction with a verbal rehearsal strategy (Ardoin et al., 2005). After the class wide intervention, five students needed further intervention. Phase three consisted of peer tutoring, cover, copy, compare, and instruction. The study concluded with nine of the fourteen students showing improvement past the baseline and five students demonstrating little progress.

Summary

At-risk youth face many obstacles throughout life. At-risk students often struggle with mathematics for many different reasons; some of these struggles are attributed to their environment and to a lack of educational resources. Intervention has become an important way for teachers to ensure that all students succeed in today's high stakes testing environment. Since these tests have become the basis for promotion to next grade (Hanushek et al., 2011), a range of educational policies, programs, and methods have been identified to help support at-risk students in the classroom. Accelerated Math, which provides daily, progress-monitoring software tools that monitors and manages mathematics skill practice, from preschool mathematics through calculus (Learning, n.d.), is one potential method that has proven to be successful in increasing at-risk students' mathematics scores. RTI is another intervention method that has been used by many different school districts to assist at-risk youth. The framework of RTI provides research-based instruction and interventions using a multiple step approach.

CHAPTER III

METHODS

The purpose of this study was to determine how to increase mathematics achievement in at-risk 6th grade/middle school students. This experiment had a quasi-experimental design with a pretest and posttest. According to the National Center for Technology (n.d.) a quasi-experimental study is a type of evaluation that focuses on whether a program or intervention has the intended effect on a study's participants. Quasi-experiments may result from either studying naturally formed groups or from the use of pre-existing groups (Quasi-experiment, n.d.). Quasi-experimental studies have different forms such as a pre-/posttest design, treatment and control group, and random assignment of study participants. For this study, the pre-/posttest design (National Center for Technology, n.d.) was employed.

The study focused on a person-by-treatment design. A person-by-person design allows the experimenter to test one independent variable and measure one variable (Morgan, 2000). For this study, students' mathematics achievement served as the dependent variable. The dependent variable was measured against the independent variable, in this case, the intervention: small group lessons and one-to-one tutoring time with each student.

Participants

Participants were 6th grade students from a local school in Baltimore, Maryland. They all attend the same middle school. Participants are considered at-risk students using the following qualifications: low income, repeated a grade in the past, living in a single-parent household, poor test scores on standardized tests, assigned an IEP or 504 plan, and/or homeless or living in a zip code that is considered at-risk by the city of Baltimore. Participants were required to meet at least four of the eight qualifications listed to be considered at-risk. All ten participants were

African-American and reside in low income areas of Baltimore city. The group was comprised of five boys and five girls, each age 11.There were no 6^{th} grade repeaters in the group. All participants met four of the eight qualifying characteristics to be in the group. When determining the participants, other factors were also considered; however, these factors neither qualified nor precluded students from participating in the study. Other factors considered were:

- Achievement below grade level.
- Consistently requiring additional support.
- Memory or retention deficits.
- Consistently working at a slow pace.

The selection of participants was influenced by the objective of the study, meaning all participates must be deemed at-risk.

Instruments

The Woodcock-Johnson III (WJIII) is an intelligence test for kids and adults ages 2–90 that measures academic achievement (Mather & Schrank, 2001). Richard Woodcock and Mary Johnson developed the WJIII in 1977 (Woodcock-Johnson Test, n.d.). The WJIII is administered individually. The current version of the test was updated in 2007. WJIII is a well known test that is used in public and private schools around the world. The WJIII measures academic achievement, psychological processes, oral language, and intellectual abilities. According to Wikipedia (Woodcock-Johnson Test, n.d.),

> The Cattell–Horn–Carroll theory factors that this test examines are based on 9 broad stratum abilities which are: Comprehension-Knowledge, Long-Term Retrieval, Visual-Spatial Thinking, Auditory Processing, Fluid Reasoning, Processing Speed, Short-Term

Memory, Quantitative Knowledge and Reading-Writing.[4] A General Intellectual Ability (GIA) or Brief Intellectual Ability (BIA) may be obtained. (n.p.)

For the purpose of this study, the WJIII Broad Math cluster, which consists of Calculation, Math Fluency, and Applied Problems subtests, was administered. The Broad Math measures mathematics achievement, problem solving, number facility, automaticity with facts, and reasoning. The WJIII is broken into subtests. Each section takes about five minutes to complete.

The WJIII is ideal for measuring problem solving interventions, such as response to intervention (Woodcock, McGrew, & Mather, 2007). The WJIII can be used to access and compare subject specific skills related to cognitive abilities; it can also be used to determine ability/achievement discrepancies (Mather & Schrank, 2001). According to Mather and Schrank (2001), “There are two types of discrepancy procedures that can be derived from the WJIII: (a)intra-ability (discrepancies among abilities) and (b) ability/achievement (discrepancies between a predictor score and measured academic performance” (p. 2).

The WJIII achievement test meets standards for reliability. For the standard battery, “the median reliability coefficient alphas range from .81 to .94. The median coefficients on the extended battery range from .76 to .91. These high reliabilities mean that the assessment can be used for decision making purposes. Overall, the WJIII ACH shows validity because its test scores can be used for their proposed purpose” (Mather &Woodcock, 2001, p. 2). The WJIII scores are interpreted in a raw format that is converted to fit an age and/or grade level profile as well as a percentile rank.

Procedures

The WJIII was administered to one group of ten 6^{th} grade students. All students were given a pretest at the start of the study followed by an intervention. Lastly, the posttest was administered at the conclusion of the study. The title of the intervention group was “Morning Enrichment.” Students received their intervention four days a week for 55 minutes, for a total of three weeks, Monday through Thursday 7:00AM–7:45AM. Students were entering the class from breakfast. The intervention consisted of one-to-one work, group assignments, and lecture-style learning.

On Monday, February 18, 2013 at 7:00am students began the first phase of the study; pretesting was conducted over a period of two days, Monday and Tuesday. The first day of intervention (Morning Enrichment) began on February 20, 2013. Each student was called in individually to take the pretest. Each test took less than seven minutes to administer; students’ total time testing did not exceeded 25 minutes. The materials that were used to implement the pretest included a subject response booklet and test booklet. Students came with white scrap paper and two number two pencils. Students first wrote their names on the test booklets and waited for further instructions. Each participant was given the test using the same delivery and implementation methods. The test began with calculation, test number 5, followed by test number 6, and, finally, test 7.At the end of testing, students’ test information was analyzed in order to make informed decisions on which intervention methods would be implemented to students as a group and individually in the future.

After the pretest, the intervention began. Students were given work folders that included activities geared to their individual target areas. Each student was assigned a one-to-one session each week; this session was conducted during the individual assignment time. At the end of the one-to-one session, students were given work to work on in the next session. All work remained in students’ folders. Each one-to-one session lasted for 20 minutes; there were two or three of these sessions during each enrichment class. Students were required to sign in for every enrichment class. Each enrichment class began with a short reflection about what they learned and did not learn from the previous session. Students took turns explaining to the entire group something they learned in the previous session. After reflection, students went right to work on their individual work assignments located in their folders. Student worked until the last minute of enrichment class. Students left all folder materials on the table to be collected by the teacher. This process continued until the end of enrichment classes. The last day of class was Thursday, March 21, 2013. Students took the final test on Thursday and Friday of the week ending March 22, 2013. Testing took place right before the students left for Spring break. At the end of the three-week intervention, each participant was post tested. The posttest was administered in the same format as the pretest.

CHAPTER IV

RESULTS

It was hypothesized that neither the Accelerated Math nor Response to Intervention mathematics interventions implemented for at-risk students would result in statistically significant gains in mathematics scores nor would they yield significantly different mean gains in mathematics achievement for at-risk students.

Descriptive statistics for the pre- and post-intervention WJIII scores, reflecting mathematics achievement, are presented below. These are disaggregated to show both groups' performance before and after the interventions were provided.

Table 1

Descriptive Statistics

Group		N	Mean	Minimum	Maximum	Std. Deviation
RTI	PretestWJIII	5	58	47	68	9.14
	PosttestWJIII	5	68	55	79	9.11
	Days attended	5	7.4	6	8	.89
AM	Pretest WJIII	5	66.8	55	84	12.52
	Posttest WJIII	5	74	65	84	7.787
	Days attended	5	7.8	7	8	.45

Note that the mean scores did increase for both groups over the course of the intervention, from 58 to 68 for the RTI group and from 66.8 to 74 for the AM group. Days of the intervention (out of eight total) attended by each student were also described for each group, and as can be seen in Table 1, each group had fairly good attendance rates (the mean for the RTI group was 7.4 and mean for the AM group was 7.8).

To determine whether the two intervention groups were initially similar in terms of mathematics scores, the mean WJIII pretest scores (58 for the RTI group and 66.8 for the AM group) were compared using a t-test. Results follow in Table 2 and indicate that the 8.8 point difference between the pretest means for the two groups was not statistically significant (t=-1.27, p<.24).

Table 2

Results of t-test Comparing the RTI and AM Groups' WJIII Pretest Means

	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
Pretest WJIII	-1.27	8	24	-8.80	6.93	-24.78	7.18

Equal variance assumed

Next, comparisons to assess the relative impacts of the AM and RTI interventions were made. To determine whether either program resulted in statistically significant gains, hypotheses one and two were tested using t-tests to determine whether each group's mean gain was significantly different from zero. Table 3 shows the results of the t-test for the AM group which indicate that the mean gain of 7.2 for that group was statistically significantly larger than zero (t=3.239, p<.032). Therefore, Ho1: Mean Mathematics score gains for AM = 0 was rejected.

Table 3

Results of One-sample t-test Comparing Mean WJIII Gains for the AM Group to Zero

	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
WJIII GAIN	3.239	4	.032	7.20	1.03	13.37

Table 4 shows the results of the t-test for the RTI group which indicate that the mean gain of ten points on the WJIII mathematics test for the RTI group was also statistically significantly larger than zero (t=9.129, p<.001). Therefore, Ho2: Mean Mathematics score gains for RTI = 0 was also rejected.

Table 4

Results of t-test Comparing Mean WJIII Gains for the RTI Group to Zero

One-Sample Test[a]

	Test Value = 0					
	t	Df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
WJIIIGAIN	9.129	4	.001	10.00	6.96	13.04

Finally, to determine whether either intervention yielded a significantly larger mean gain than the other, hypothesis three, that the mean mathematics score gains of the group participating in AM would equal the mean mathematics score gains of the group participating in RTI, was tested using a t-test of independent samples. Results follow in Table 5 and indicate that, while both groups made gains, the difference in those gains was not statistically significant (t=1.13, p<.291). Therefore, null hypothesis three was retained.

Table 5

Results of t-test for Equality of Means Comparing the RTI and AM Groups' Mean Gains

	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
WJIII GAIN	1.13	8	.291	2.80	2.48	-2.91	8.51

Equal variances assumed

CHAPTER V

DISCUSSION

The purpose of the study was to determine whether two interventions, Accelerated Math (AM) and Response to Intervention (RTI) were effective for increasing the mathematics achievement in at-risk 6th grade middle school students. It was predicted that at-risk students' WJIII mathematics scores would not be significantly improved after implementing either of the mathematics interventions. However, results indicated that there was statistically significant improvement in mean mathematics scores for students who participated in each of the interventions. Mean gains were 7.2 points for the AM condition and 10 points for the RTI condition. The gains in students' scores did not differ significantly across the two intervention conditions, suggesting neither program had superior results compared to the other. The overall null hypothesis that interventions would not result in gains was rejected, as significant and comparable gains were made for both treatments.

Implications/Theoretical Consequences

The findings in this study showed that mathematics interventions may be effective for increasing mathematics skills and scores for at-risk youth. Both AM and RTI yielded significant increases in students' mathematics scores. This implies that the interventions did improve the skills over a brief time period. Similar interventions should be tested under more controlled conditions to clarify are the methods for improving at-risk learners' mathematics skills.

Threats to Validity

The validity of this study may have been compromised in several ways. In relation to the sample, a few facets of the study could have impacted the validity of its conclusions. For one, all participants tested were from the same group. There was no randomization of groups and no control group (which received no treatment) to which to compare participants' outcomes. The sample was also limited because it was very small, and the mean WJIII scores for students in both the AM and RTI groups were relatively low and statistically equivalent at the start of the study. Students who received the RTI intervention showed a mean gain of 10 points, while students in the AM group showed a mean gain of 7.2 points. Grouping students differently, for example, by comparing the gains made by subgroups of students of more varied abilities, might have resulted in different results for students of varied abilities. This could help teachers identify students for whom these interventions are most effective and efficient.

The administration of a pretest could have affected the outcome, causing a threat to the validity. The dependent variable, mathematics achievement, was also assessed with a relatively brief measure. Only a small portion of the achievement test was administered (Broad Math); it is possible that students' scores increased some from taking the test the second time rather than being attributable to the AM or RTI interventions.

Time may also have been a factor influencing the validity of the results. Had the intervention taken place over a time period greater than a month, results may have afforded a clearer distinction in the interventions' relative impact on mathematics skills, including and beyond test scores. Observations of student interest and participation performance on more mathematics tasks could have been made to assess the impact of the two interventions on mathematics skills themselves and on factors which influence mathematics performance.

Connections to Previous Studies

The findings in this study are consistent with Baker's (2002) research. Baker (2002) found that outcomes of mathematics interventions can be improved by providing different types of mathematics interventions such as peer tutoring, mentoring, direct instruction, and collection of data. In accord with Baker's (2002) findings, both intervention methods used in the current study required collection of data using a combination of learning methods such as one to one mentoring, group assignments, and direct instruction.

Implications for Future Research

Future research on improving mathematics skills of at-risk students should be conducted and should include a control group. In this way, one could compare the efficacy of the interventions tested to a condition under which no supplemental mathematics interventions are offered. Future research should also conduct the interventions for longer than one month, as it is possible that the rate of improvement seen in this study would not be sustained over a longer interval. Future studies should also include assessment of influences and other outside factors that may have contributed to the students' mathematics achievement, for example, classroom instruction methods, learning in other subjects, class size, climate, and environment. Additionally, expanding the study to include additional participants as well as more diverse participants could yield findings that give better insight regarding the impact of particular interventions for students with more varied characteristics.

Conclusions

In conclusion, the results of the study are important for identifying how to help at-risk students achieve in mathematics, which is an area of difficulty for many at-risk students. The null hypotheses, which posited the interventions would not result in gains, were rejected, suggesting that AM and RTI can help improve skills. It would be informative for future research to include better controls and use varied and longer interventions with more diverse students in order to clarify which interventions work best and with whom. Ideally, random assignment should be used to assign comparable students to the treatment conditions as well.

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