Utilizing Remediation/Support Intervention to Improve Pre Algebra Math Skills

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A Special Project

Presented to

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Utilizing Remediation/Support Intervention to Improve Pre-Algebra Math Skills

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ABSTRACT

The purpose of this experimental research project was to determine the extent to which implementation of a Remediation/Support class improved Pre Algebra skills among repeating Pre Algebra students. The assessment tool used to obtain relevant and reliable data was the Measurement of Academic Progress (MAP) standardized assessment. To accomplish this purpose, a review of selected literatures was conducted. A *t*-test for non independent samples was used to analyze essential baseline data. According to the analysis of the data collected in this research; support was found for the hypothesis. Students retaking a Remedial Pre Algebra class in conjunction with a Support class made greater than expected achievement in Pre Algebra skills as measured by the MAP assessment.

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CHAPTER 1

Introduction

Background for the Project

> Early in the history of our schools, objectives of mathematics instruction centered on the development of computational skills. By the 1920s and 1930s , objectives shifted to a more practical application of mathematics. Today, mathematics educators are concerned with providing a balanced program in mathematics in which students not only attain computational skills, but also have an understanding of mathematics concepts and reasoning. The rapid increase in the number of microscopic in … schools has resulted in the need for … students to perceive and understand structure in mathematics, including concepts, relationships, principles, and modes of mathematical reasoning (Wiles & Bondib, 1998).

As stated above, Wiles & Bondi (1998) have described the evolution of mathematics. Instruction in recent years, while emphasizing how new technology has generated an even greater need for students to be proficient in mathematics concepts, principles, and reasoning.

In October of 2008 the National Mathematics Advisory Panel (NMAP) reported the following:

> The concerns of national policy relating to mathematics education go far beyond those in our society who will become scientist or engineers. The

> national workforce of future years will surely have to handle quantitative concepts more fully and more deftly than at present. So will the citizens and policy leaders who deal with the public interest in positions of civic leadership. Sound education in mathematics across the population was a national interest (Flawn, 2008).

The NMAP clearly stated it was in our national interest to not only focus on increasing the number of students going to become scientist and engineers, but on the need to increase the mathematics skill of the population as a whole. With an increasing technologically sophisticated world our future workforce needed to have increased proficiency in mathematics (Flawn, 2008).

Statement of the Problem

Study was needed in order to determine current and future interventions in regards to students' achievement in mathematics skills. A high school with a significant failure rate in freshmen Pre Algebra was looking for an intervention to address the issue. Students at the high school were taking Pre Algebra first semester, failing the class; taking the class again and failing a second time. Some teachers, counselors, and administrators concluded; simply repeating the class was not enough. In addition to retaking Pre Algebra, change in the form of implementing new teaching and learning practices in conjunction with offering students a Support class was needed in order for students to pass Pre Algebra. A

lack of study and data driven action resulted in a continuation of failing students due to lack of acquisition of math skills.

Purpose of the Project

The purpose of this experimental research project was to determine the extent to which implementation of a Remediation/Support class improved Pre Algebra skills among repeating Pre Algebra students. The assessment tool used to obtain relevant and reliable data was the Measurement of Academic Progress (MAP) standardized assessment. To accomplish this purpose, a review of selected literatures was conducted. A *t*-test for non independent samples was used to analyze essential baseline data from which related generalizations, conclusions, and recommendations were formulated.

Delimitations

The research included students who were administer the MAP assessment and for whom the data was recorded during the Winter 2009 and Spring of 2009. The sample was composed of students identified as failing Pre Algebra due to lacking Pre Algebra skills and not discipline or attendance issues. The students enrolled in both the Remediation Pre Algebra class and the Support class for the second semester of the school year between January 2009 and June 2009. The sample was composed of ten girls and six boys. The students were enrolled and received the schools approved Remediation Pre Algebra curriculum with daily dedicated time for learning activities. In addition to the Remediation Pre Algebra class

participants were enrolled in an additional Support class for skill building in mathematics, organizational, test taking, and note takings skills. In addition students were also allowed in class work time for homework. Both classes were attended on a daily basis by all participants.

Assumptions

The researcher assumed the MAP scores of participating high school students represented their best efforts at the time of each test. The researcher assumed all students were given as much time as needed to complete the MAP assessment and was completed in accordance with the MAP testing protocols. Finally, the researcher assumed the instructor of the Support class focused daily instruction on mathematics skill building activities, and developing skills in organization, test taking and note taking.

Hypothesis

A high school with a significant failure rate in freshmen Pre Algebra was in search of an intervention to address the issue of failing Pre Algebra. Students retaking Pre Algebra with a remedial component in conjunction with a Support class will make greater than expected achievement in pre-algebra skills as measured by the MAP assessment.

Null Hypothesis

Students retaking Pre Algebra with a remedial component in conjunction with a Support class will not make greater than expected achievement in Pre

Algebra skills as measured by a *t*-test for non independent samples at .05, .01, .001 level of significance.

Significance of the Project

The outcomes of the project were important to the high school and school district because the research provided quantifiable data that could be used to make curriculum changes. Having a significant number of students repeat Pre Algebra with little success had been an issue for some time. The research outcomes served as justification for curricular adjustment to the high school math class sequence. If support for the hypothesis was found the district could expand remediation components or a combination of Remediation class with Support classes not only in mathematics but other academic classes. If the null hypothesis was accepted the school district would have data to support ending the Remediation class and allowing for immediate devolvement of another intervention. The allocation of resources was a key responsibility of administrators; for this reason, being able to provide data as to the effects of a program/intervention being implemented greatly aided administrators in their decisions to continue or terminate said programs or intervention.

Procedure

During January, 2009 the researcher was assigned to under take the present study. The researcher along with the principal, counselor and support teacher participated in the planning of the classes in late fall of 2008. The

determination was also made to utilize the MAP scores of the failing Pre Algebra students for the Winter of 2009 in order to provide baseline data needed to validate the possible success of the Remediation/Support class. The writer collected the data from the MAP assessment students administered during the Winter of 2009. The students were then placed in a Remediation/Support class schedule for the 2nd semester of the school year; January 2009 to June 2009. Students were then administered the MAP assessment for a second time Spring of 2009. The researcher collected the data for both the Winter and Spring of 2009 assessment report. From the report the researcher recorded the RIT (Rasch Unit) scores for statistical analysis of the data. A statistical analysis software application, StatPack (2008) was used for the statistical analysis. A *t*-test for non independent samples was used to treat the data.

Definition of Terms

Significant terms used in the context of the present study have been defined as follows:

experimental research. Research in which at least one independent variable were manipulated, other relevant variables were controlled and the effect on one or more dependent variables were observed.

Measures of Academic Progress. A computerized adaptive assessment tool provides teachers with detailed information they need to improve curriculum and meet students' needs.

No Child Left Behind Act. Federal legislation that enacted the theories of standard based education reforms, which were based on the belief that setting high standards and establishing measurable goals can improve individual outcomes in education.

RIT. Rasch Unit was an equal interval unit of measure used by MAP.

t-test. An inferential statistics technique used to determine whether the means of the two groups were significantly different at a given probability level.

Acronyms

CTP. The Center for the Study of Teaching and Policy.

MAP. Measures of Academic Progress.

NAMP. National Advisory Mathematics Panel.

NCTM. National Council of Teachers of Mathematics

NWEA. Northwest Evaluation Association

RIT. Rasch Unit

SIOP. Sheltered Instruction Observation Protocol.

CHAPTER 2

Review of Selected Literature

Introduction

The following literature introduced and discussed regarding the need for restructuring of the nation's educations system. "The National Mathematics Advisory Panel agreed that the delivery system of mathematics education is broken and needs repair," (Flawn, 2008). Literature was presented on studies that included what teachers had identified as the major challenge when dealing with struggling Algebra students. Finally, the selected literature reviewed also presented innovative teaching and learning practices; such as student centered learning activities and interventions being implemented that were working in increasing student learning of mathematics skills. Literature was reviewed concerning the need for teacher support with focus on increasing the use and organization of professional learning. Literature on the use of assessment not only for student assessment and curriculum adjustments; but use as a tool in pairing students with intervention available that address the individual needs of the students. Literature on effective teaching practices such as Sheltered Instruction Observation Protocol (SIOP) was also presented. The literature reviewed offered expert finding on the current state of the nation's education system, what instruction practices were currently being implemented, to address various challenges in mathematics education, and finally research on proven

instructional practices that consistently resulted in significant increases in the mathematics of student leaning. The review of literature focused attention on the need for the development and implementation of the Remedial/Support intervention.

Mathematics Education in the United States

"The level of success nations experienced was linked to the ability of its people to tackle sophisticated challenges in the areas of medicine and health, technology and commerce, in navigation and exploration and in defense and finance," (Flawn, 2008). Without change the education system in the United States will relinquish its position of leadership in the 21st century. Flawn (2008) stated:

> During most of the 20th century, the United States possessed peerless mathematical prowess – not just as measured by the depth and number of the mathematical specialist who practiced here, but also by the scale and quality of its engineering, science, and financial leadership.

The National Mathematics Advisory Panel prepared the report in order to highlight actions that needed to be taken in order to strengthen the people of the United States position in teaching and learning. Experiencing success were not only good for the country; but for its individual people and families due to the opportunities presented by a high level of education. President Barak Obama agreed with Flawn, in his inaugural speech to a joint session of Congress,

President Obama (2009) stated, “In a global economy where the most valuable skill you have is your knowledge, a good education is no longer just a pathway to opportunity – it is a pre-requisite.” President Obama’s statement was in line with Bondi. Both indentified the need for students to have an increased understanding of mathematics due to the increased use of technology in contemporary society. The NMAP identified the delivery system of mathematics education was broken and needed repair. Flawn (2008) presented its finding and recommendations in the following areas:

1. Curricular Content
2. Learning Processes
3. Teachers and Teacher Education
4. Instructional Practices
5. Instructional Materials
6. Assessment
7. Research Policies and Mechanisms

The Curricular Content section reported findings on the structure of school curricula across the nation and how it compared to that of other high performing mathematics nations. For example, in the United States mathematics curricula typically presented a great number of concepts at each grade level resulting in receiving relatively limited time for students development of concepts before moving on to the next. On the other hand, top performing countries presented

fewer mathematics concepts at each grade level but allowed for time for students to develop deeper understanding. Likewise, in an article from the National Council of Teachers of Mathematics (NCTM), Hart (2009) stated, "A curriculum is more than a collection of activities: it must be coherent, focused on important mathematics, and well articulated across the grades." A second difference between curricula of the United States and other top performing countries was spiral curriculum vs. developing proficiency. Spiral curriculum was commonly practiced in many subjects in the United States curricula. Spiral curricula generally revise and extend on topics as students move from one grade level to the next. The developing proficiency model practiced by top mathematics performing nations expect proficiency in topics presented before introducing more complex topics (Flawn, 2008).

The Learning Processes section of the text reports findings on how students developed and learned; with emphasis on not acquisition of facts but also implementing curriculum that developed conceptual understanding, computational fluency, and problem-solving skills. The National Mathematics Advisory Panel identified these factors of students learning to have been crucial in the student development of mathematics (Flawn, 2008). In efforts to address these crucial factors affecting students in regards to learning mathematics; several states including the state of Washington, "banded together with the goal of creating high-quality rigorous, assessments aligned to increase expectations,

including an assessment that could serve as an indicator of readiness for college mathematics" (Cohen, 2009).

Instructional Practices was also addressed by the NMAP. The NMAP recommended struggling student not only receive explicit mathematics instruction regularly; but that, "Time should be dedicated to ensuring that these students possess the foundational skills and conceptual knowledge necessary for understanding the mathematics they are learning at their grade level," (Flawn, 2008). An important recommendation presented by the NMAP points to a need of student proficiency with whole numbers, fractions, and aspects of geometry and measurement in the middle grade levels. Proficiency in mathematical concepts were considered to be a critical foundation to Algebra. The NMAP stated:

> The coherence and sequential nature of mathematics dictate the foundation skills that were necessary for the learning of algebra. The most important foundational skill not presently developed appears to have been proficiency with fractions (including decimals, percents, and negative fractions). The teaching of fractions must be acknowledge as critically important and improved before an increase in student achievement in algebra can be expected (Flawn, 2008).

According to Wadsworth (1996) Piaget's theory of cognitive development, school aged children were either in the concrete stage of development or in the stage of formal operational. Students in the concrete stage

of needed to work with each mathematics exercise in isolation, and were not able to form new knowledge from individual reflection. Furthermore, the student in the concrete operational stage were able to learn basic relationships of rational numbers, but was unable to advance very far into to constructivist domain with out fully understanding. If instruction continued, the student would be unable to cognitively construct understanding of rational numbers (Lamon, 1999). The uses of researched-based interventions that helped students understand mathematics concepts and progress from one stage to another more efficiently were recommended by the NMAP. Some schools had addressed this skill deficiency by using calculators for basic arithmetic acquisition, "When calculators are used in instruction and assessment, the operational skills, computational skills, skills necessary to understand mathematics concepts, and problem-solving skills are improved," (Beswich, 2007). In addition the NMAP recommended:

> The scaling-up and experimental evaluation of support-focused interventions the have been shown to improve the mathematics outcomes of African-American and Hispanic students. These and related studies focused on improving task engagement and self-efficacy of such students hold promise for helping to close the mathematics achievement gaps that were prevalent in U.S. society (Flawn, 2008).

Research Polices and Mechanisms were the final area of mathematics education presented by the NMAP. In this section of the report the NMAP

recommended further study on the various aspects affecting the teaching and learning of mathematics. Testing items and features that improve the assessment of mathematical knowledge needed to have been developed. The Mechanisms in developing these items must have been based on rigorous scientific research (Flawn, 2008).

Nationwide schools were not preparing students for post secondary education. As illustrated in Figure 1, National Science Foundation chart reported by Martino (2009). A high prevalence of remedial education classes were required by students in post-secondary education.

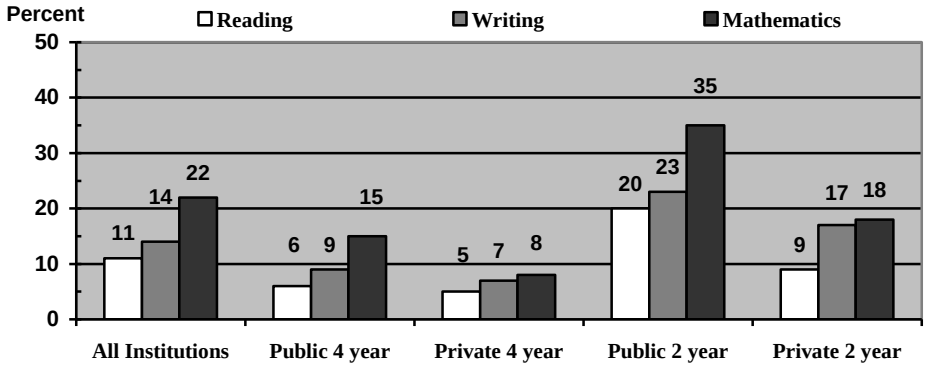

Figure 1
Freshman enrolled in remedial courses, by subject area and institution type: 2000

More than one-fifth of incoming freshmen entering college were entering into remedial college courses. For students this meant paying tuition for course that did not count towards a degree (Martino 2009).

The NMAP final report presented information on a broken system of education presently being practiced in the United States. The NMAP presented recommendations addressing the factors contributing to this broken system. The main finding in curriculum content reported on a comparison of curricula currently practiced in the United States and other high mathematics performing countries. Current instruction practices were a concerned, providing sufficient time for students to learn and possess the foundational skills and conceptual knowledge necessary for understanding the mathematics at grade level was a necessity. In addition to sufficient time, the use of intervention to ensure the understanding of the math concepts was highly recommended. Finally, the use of standardized assessment developed using scientific methods and research were also highly recommended.

Developing Interventions

The Center for the Study of Teaching and Policy (CTP) was a national research consortium. The CTP studied schools, districts, state agencies, and teacher education institutions; in order to study the effects policies and conditions shape the quality of education occurring in the nation's elementary and secondary schools. The CTP reported findings on a variety of teaching and learning aspects of education including categories such as:

1. Support for Math Students
2. Collaboration

3. Support for Math Teachers

4. Assessment and Differential Supports for Students

5. Teaching Practices

Support for math students in the form of after-school tutoring and or summer math programs were reported by two-thirds of the schools included in the research. In smaller school districts the number of schools offering peer tutoring, math clubs, or extra curricular activities involving mathematics lowered (Elfers, 2007).

Elfers (2007) reported, "Overall, teachers indicated that their greatest challenges in working with students who were struggling in math was the lack of one-on-one assistance and the variety of learning needs in the classroom." According to the CTP notable improvement with subgroups generally did serve the most diverse student populations. This positive result was due the support the teachers and student received from administration. The implementation of tutoring programs after school and summer school greatly impacted the teachers' statements regarding the success of student in mathematics (Elfers, 2007).

According to Elfers (2007) collaboration and support for math teachers was also a key feature influencing student success in mathematics. Providing effective classroom instruction based on common content, topics and skills being taught made a great difference. This collaboration was a result of building effective professional learning communities in schools. DuFour (2005) stated:

> Mere collegiality will not cut it. Discussions about curricular issues or popular strategies can feel good but go nowhere. The right image to embrace is of a group of teachers who meet regularly to share, refine, and assess the impact of lessons and strategies continuously to help increasing numbers of students learn at higher levels.

However, many teachers indicated they did not often work together to prepare instructional material and delivery systems and less frequently examined data or student work to identify areas of intervention (Elfers, 2007). The CPT reported, "The most useful professional development support that the math teachers engaged in during the last twelve months included regularly scheduled collaboration with other teachers," (Elfers, 2007). The CTP also found alignment and sequencing of curriculum between grade levels and the need of mastery of basic skills were very necessary. A teacher stated:

> I feel that too many students are being pushed through the curriculum without mastery or understanding and they have a harder and harder time each year. This happens especially in the lower grades (elementary and junior high) and then, there is no good place for them in high school (Markham, 1996).

A possible solution presented was allowing for smaller class size in order to allow teachers more time to address individual student learning need; making the time in the classroom more responsive and meaningful (Elfers, 2007).

Successful schools developed assessment based on collected date. The data represented student work that was being analyzed collaboratively with other math teachers. From this data assessments were created and used to better gauge student learning and to identify the needs and adjustments in instruction needed. This provided an opportunity for teachers to examine student data to assist in instructional decisions and curriculum alignment. The data collected from the assessments was a valuable tool when trying to match up and or make additional support and or interventions available to students (Elfers, 2007).

According to Elfers (2007), school experiencing success in the teaching and learning of mathematics had supplementary programs and activities to support student learning were a common characteristic. These programs and interventions were matched up with the individual need of the students by way of teachers working together in collaborative communities that have set protocols established and developed assessment mechanisms for the and data collection and analysis of student assessment scores.

The use of multiple instructional strategies with a focus on problem solving and critical thinking in the classroom were a common trend in high performing schools. The CTP stated, "The teachers surveyed in these schools with high or improving math performance use a variety of pedagogical strategies to communicate mathematical concepts and processes," (Elfers, 2007).

The literature reviewed focused on the importance of providing well planned and implemented support systems for students. Support for teachers and the development of professional learning communities were all discussed. Finally, professional development for teachers focused on increasing the effective use of assessment for matching students with intervention designed to meet the needs of the students and learning and implementation of proven teaching practices were also presented.

Instructional Practices

Graduation requirement across the nation have changed due to standard-based reform and high stakes testing adopted by many states across the country. The No Child Left Behind Act in 2001 required schools to test annually for reading and mathematics for all students grades three through eight (eSchoolNews, 2009).

As an incentive President Obama allocated 29 billion dollars in aid for schools. According to Anderson (2010) from the Washington Post; President Obama said, "Schools that achieve excellence or show real progress will be rewarded, and local districts will be encouraged to commit to change in schools that are clearly letting their students down."

Another challenge facing many schools across the nation was an increasing immigrant population. Findings reported by Echeverria (2004) reflect growing evidence that most schools were not meeting the challenge of educating

linguistically and culturally diverse students well. Furthermore Echeverria (2004) stated:

> Given the variability in these students' backgrounds, they often need different pathways for academic success. To meet this challenge, fundamental shifts need to occur in teacher development, program design, curriculum and materials, and instructional and assessment practices. This book will address in particular, strategies fro improved teacher developmental and instructional practices.

The Sheltered Instruction Observation Protocol (SIOP) was an example of an instructional practice used at the time to address closing the achievement gap by increasing the amount of skills a student acquired. The model focused on addressing key factors proven to increase student involvement and participation. The SIOP model allowed for teachers to incorporate components into the lesson planning that address, language objectives, previously learned skills, and cultural components. Sheltered Instruction Observation Protocol enhanced and expanded teachers' instruction practices (Echeverria, 2004).

Summary

According to The National Mathematics Advisory Panel "The delivery system of mathematics education in the United States of America is broken and needs repair," (Echeverria, 2004). Countries in the world with high achievement mathematics programs tended to implement curriculum that presented fewer

learning targets per grade level and practiced a model focused on student proficiency before introducing new material. In a spiral curriculum students were expected to learn skills to proficiency by exposing student to a concept multiple times over the course of several years. Each time the mathematics concept were presented the difficulty was increased or the concept was expanded upon. Colleges and universities across the United States had experienced an increase in the number of remedial courses needed in mathematics in comparison to reading and writing. A solid foundation in Algebra was a great predictor of success in post secondary education. Schools across the nation had been implementing support systems for students as well as teachers by providing support mechanisms and collaboration systems to increase the teaching and learning in the classroom. Schools were providing professional development in order for teachers to better use assessment for not only instructional adjustments and student achievement but to better match up support systems with students needs more effectively. The use of proven instructional practices that increase student learning were being used across the nation to address the nations mathematics challenge. The SIOP model had been one such instructional tool used that was proven to increase student learning. According to the NMAP a solid foundation in arithmetic was needed in order to be successful in the acquisition of Algebra skills. The literature reviewed offer a basis for the need identified by not only educators but leaders at the

nation’s capital, to implement well planned remediation and support systems tailored to the needs of the students that were designed to increase increased mathematics skills.

CHAPTER 3

Methodology and Treatment of Data

Introduction

The purpose of this research was to determine if providing students with an alternative strategy for failing Pre Algebra would result in increasing the learning of Pre Algebra skills. Students identified as failing Pre Algebra 1st semester of the 2008 – 2009 school year were selected to participate in a Remedial/Support class combination in order to acquire missing Pre Algebra skills. The students were administered the MAP test before enrolling in the class. The Remediation/Support class was structured to offer students more teacher time due to the low number of students in the class. The Pre Algebra class learning targets presented to the students for a second time were not altered from the first time the student took Pre Algebra. Two interventions were added to the Remediation Pre Algebra class. The first change was the low student number; the second change was daily time for learning activities. An additional support system was added in the form a Support class. In the Support class a second teacher offered tutoring and mathematic skill building opportunities. Student worked with a second teacher to build skill in organizational, test taking, and note taking skill. Students were also asked to keep track of their test progress and where encouraged daily to attend math tutoring after school. At the end of the semester the students were administered the MAP test for a second time.

Methodology

This experimental researched project used pre and post MAP scores. The scores were treated with a *t*-test for non independent samples. Data obtained were used to draw related inferences to reach conclusions related to student acquisition of Pre Algebra skills.

Participants

Participants included ninth and tenth grade students enrolled in the researcher's Pre Algebra class. The students enrolled in the class had previously failed Pre Algebra at least one time at the High School. A second prerequisite for taking the Remedial/Support class was failing the previous Pre Algebra class due to lack of skill and not other factors such as discipline or attendance issues. The High School counselor enrolled students in the both the researcher's Pre Algebra class and the Remedial/Support. The class was composed of ten females and six males. One student was indentified as a Second Language Learner. The ethnic make up of the students included Hispanic and Native American.

Instruments

The participants were administered the MAP test before enrolling in the class. The scores served as a baseline for the study. After the class was completed the participants were then administered the MAP test for a second time. "Measurement of Academic Progress is a computerized adaptive assessment tool provides teachers with detailed information," (Northwest Evaluation Association,

2009). The MAP assessment was used by teacher to improve curriculum and meet students' needs. The Measurement of Academic Progress was a computer based assessment tool made available for educators by the Northwest Evaluation Association (NWEA). The MAP scores in this research were valid because each test item on a MAP assessment corresponds to a value on the RIT (Rasch Unit) scale. The RIT scores were equal interval, making them very useful for statistical analysis. The RIT scores from the MAP assessment administered to the participants was reliable because it was administered according to the guidelines set forth by the NWEA. Furthermore, the data collected using MAP was reliable because the NWEA had been administering the MAP assessment for over 30 years (Northwest Evaluation Association, 2009). The Northwest Evaluation Association (2009) stated the following:

The extensive item bank of questions used on the NWEA Measures of Academic Progress (MAP) tests have been developed over a substantial period of time. The result has been the collection of a significant amount of reliability evidence over time. Test and re-test studies have consistently yielded statistically valid correlations between multiple test events for the same student.

Design

The research was a quantitative study. The statistical tool of analysis used was a *t*-test for non independent samples. The first set of data represented the MAP scores of Winter of 2009. The second set of data represented the MAP scores of

Spring of 2009. Scores were collected from a report generated by the NWEA secure website using a high school registered username and password. The report was printed. The RIT score was then collected and imputed into an Excel spreadsheet by the researcher for filing and organizational purposes.

Procedure

The research required a series of procedures in order to be completed. Procedures undertaken in the present research were as follows:

1. Planning and scheduling Pre Algebra Remediation/Support class for Spring semester.
2. Students identified as failing Pre Algebra were administered the MAP assessment before beginning Remediation/Support class.
3. Worked with counselors and previous Pre Algebra to select students that failed Pre Algebra due to lack of Pre Algebra skills and not discipline or attendance problems.
4. Registered 16 students to both the Remediation Pre Algebra class and Support class.
5. Students participated in the Remediation Pre Algebra class where they received the instruction presented in a regular Pre Algebra class for the first half of the period, the second half of the period students participated in learning activities to enhance student understanding. These activities were student centered activities.

6. Students participated in Support class where students received more one on one help in mathematics with a teacher. Students were also provided with opportunities to develop skills in organization, test taking, and note taking.

7. At the end of the semester students were administered the MAP assessment for a second time.

Treatment of the Data

Data were collected for both the Winter 2009 and the Spring 2009. Using the RIT score from the data collected, the data were treated using StatPack, a statistical analysis software application (StatPack, 2008). A *t*-test for non independent samples was used for statistical analysis.

Summary

The researcher identified a situation at a high school that required study. Planning for the class curriculum and the selection of the participants was completed with the collaborative effort of teachers, counselors, and administrators. The students were selected according to prerequisites established by the planning team. The students were administered the MAP assessment in the Winter of 2009 before enrolling in the class. The students participated in the Remediation/Support class. At the conclusion of the class the students were again administered the MAP assessment. The RIT scores collected from the two assessments was then treated using statistical analysis software. A *t*-test for non independent sample was used to treat the data.

CHAPTER 4

Analysis of the Data

Introduction

This research addressed the extent to which the implementation of a Remediation/Support class had on improving Pre Algebra skills. The statistical analysis of the data collected from the research rejects the null hypothesis by finding a significant change between the first set of MAP scores and the second set. This rejection of the null hypothesis provided support for the hypothesis presented.

Description of the Environment

The research included students who were administer the MAP assessment and for whom the data was recorded during the Winter 2009 and Spring of 2009. The sample was composed of students identified as failing Pre Algebra at least one time prior to taking the MAP assessment. The students must have also failed due to lacking Pre Algebra skills and not discipline or attendance issues. The students were selected to enroll in the Remediation/Support class by a team of teachers, counselors, and administrators. The students enrolled in both the Remediation Pre Algebra class and the Support class for the second semester of the school year between January 2009 and June 2009. Ten girls and six boys were selected; they enrolled and received the Pre Algebra curriculum with a daily intervention of

dedicated time for learning activities in the Pre Algebra class and an additional daily Support class.

Hypothesis

A high school with a significant failure rate in freshmen Pre Algebra was in search of an intervention to address the issue of failing Pre Algebra. Students retaking Pre Algebra with a remedial component in conjunction with a Support class will make greater than expected achievement in pre-algebra skills as measured by the MAP assessment.

Null Hypothesis

Students retaking Pre Algebra with a remedial component in conjunction with a Support class will not make greater than expected achievement in Pre Algebra skills as measured by a *t*-test for non independent samples at .05, .01, .001 level of significance.

Results of the Study

Table 1 contained the Winter and Spring scores of the participants attending both the Pre Algebra class and the Remediation/Support class. During the Winter, sixteen scores were collected, the mean score was 213.44; the scores ranged from a minimum of 195 to a maximum of 226. During the Spring sixteen corresponding scores were collected. The mean for Spring was 223.75. The scores ranged from a minimum of 201 to a maximum of 255.

Table 1

MAP Assessment Scores for Winter 2009 and Spring 2009

Student	Winter 2009	Spring 2009
1	216	220
2	214	255
3	217	234
4	210	216
5	198	219
6	226	242
7	226	218
8	224	229
9	219	224
10	198	201
11	220	223
12	210	222
13	224	220
14	212	212
15	195	214
16	206	231

Note: All 16 student participants were administered both the Winter and Spring MAP assessment. The mean score for Winter was 213.44; Spring 223.75.

The baseline data presented in Table 1 was statistically analyzed using the StatPack statistical analysis software. A *t*-test for non independent samples was used to treat the date. Table 2 presented 16 pairs of scores with a mean difference of 10.31, a *t*-value of 3.33 at 15 degrees of freedom. Table 2 data also illustrated the mathematical computations used to derive the *t*-value.

Table 2

StatPack Results for *t* Test for Non Independent Samples

Statistics	Values
Number of Pairs	16
Sum of D's	165
Mean of D's	10.31
Sum of D's Squared	3997
t-Value	3.33
Degrees of Freedom	15

Note: Values were derived from statistical analysis program (StatPack, 2008). t-value formula (Gay, 2000a).

$$t = \frac{\overline{D}}{\sqrt{\frac{\sum D^2 - \frac{\left(\sum D\right)^2}{N}}{N\left(N-1\right)}}}$$

$$t = \frac{10.31}{\sqrt{\frac{3997 - \frac{27225}{15}}{15\left(15-1\right)}}}$$

$$t = 3.33$$

Table 3 contained data values for the distribution of *t* from Gay (2000b) at .05, .01, and .001 levels of significance. At 15 degrees of freedom the values were 2.131 for .05, 2.947 for 01, and 4.140 for .001.

Table 3

Distribution of *t*

	p		
df	.05	.01	.001
15	2.131	2.947	4.140

Note: p represents the probability value for testing significance.
df represents the degrees of freedom. Levels of significance from Gay (2000b).

The *t*-tests result of 3.33 *t*-value from Table 2, when analyzed using the distribution of *t* resulted greater than 2.131 and 2.947 with 15 degrees of freedom.

Findings

The calculated value of *t* exceeded the provided values of Gay (2000b) at .05 and .01 levels of significance. Thus the null hypothesis was rejected and support was found for the hypothesis. Given the analysis of the data and the testing of the null hypothesis; support was found for the hypothesis. Implementation of a Remedial/Support Pre Algebra class, Pre Algebra skills increased significantly as tested by the MAP assessment.

Discussion

The analysis of the data found significant change in MAP scores for student that participated in the Remediation and Support class between January 2009 and June 2009. The Support class offered students an opportunity to learn Pre Algebra skills to proficiency due to its low student class count which allowed for more one on one teacher-student time and also the tutoring component of the Support class. Learning skills to proficiency before moving onto new skills was indentified by Flawn (2008), as a characteristic countries with high achieving mathematics programs found according to literature reviewed. Furthermore, the use of lessons incorporating student centered learning activities which such emphasis on building on prior knowledge, the use of manipulative and or adding a language objective in order to increase student learning was also presented in the literature reviewed by Echeverria (2004).

Summary

The RIT scores collected from the two MAP administration of the assessment were treated with a *t*-test for independence samples by use of a statistical analysis software. The results of the analyses resulted in a rejection of the null hypothesis providing support for the hypothesis. Students retaking Pre Algebra in conjunction with a remediation Support class component will make greater than expected achievement in pre-algebra skills.

CHAPTER 5

Summary, Conclusions and Recommendations

Introduction

A high school with a significant failure rate in freshmen pre-algebra was looking for an intervention to address the issue. Student at the high school were taking pre-algebra first semester, failing the class; taking the class again and failing a second time. Some teachers and administrators believed, simply repeating the class was not enough. An intervention needed to be implemented in conjunction with retaking the class in order for students to pass Pre Algebra. A lack of study and data driven action may have resulted in a continuation of failing students due to lack of acquisition of math skills. The purpose of this experimental research project was to determine the extent to which implementation of a remediation/support class improved Pre Algebra at the high school.

Summary

According to The National Mathematics Advisory Panel the delivery system of mathematics education in the United States was broken and needed fixing. A solid foundation in Algebra was a necessity in order to be successful with post secondary education. The use of proven instructional practices that increased student learning were being used across the nation to address the nations mathematics challenge. According to NMAP a solid foundation in arithmetic

were needed in order to be successful in the acquisition of Algebra skills. For this reason remediation and support systems tailored to the Pre Algebra needs of students were necessary in order to ensure later success in Algebra.

The research selected students who were administer the MAP assessment and for whom the data was recorded during the Winter 2009 and Spring of 2009. The sample was composed of students identified as failing Pre Algebra. The students must have also failed due to lacking Pre Algebra skills and not discipline or attendance issues. The students enrolled in both the Remediation Pre Algebra class and the Support class for the second semester of the school year between January 2009 and June 2009. Data from the MAP assessment was collected from the two tests, then treated using statistical analysis software. A *t*-test for non independent variables was used to treat the data. The null hypothesis was rejected therefore support was found for the hypothesis.

Conclusions

According to the review of literature presented in this research the system of mathematics education needs change. Countries with high mathematics achievement teach less content per grade but teach to proficiency before introducing new material, allowing students to learn before moving on to the next level. Furthermore, according to the review of literature, in order for the United States to maintain superiority and a position of leadership in the mathematics and science realm; the United States must continue to not only maintain a well

educated population but strive to increase the level of education. In order to increase the population level of education, more students need to successfully move more students into proficiency with the Algebra sequence at the high school level. Again, according to the literature students that pass Algebra II in high school are statically more inclined to complete a four year education (Flawn, 2008).

According to the analysis of the data collected in this research the hypothesis; as well as the literature reviewed were supported. Students retaking a Remedial Pre Algebra class in conjunction with a Support class made greater than expected achievement in Pre Algebra skills as measured by the MAP assessment.

Recommendations

Based on the conclusions, it is the recommendation of the researcher that the implementation of a well planned Remedial Pre Algebra class with integrated learning activities in conjunction with a Support class can have a positive significant impact in Pre Algebra skill student acquire in the high school level class. The current research includes several research proven interventions used in hope of finding a system that increased the learning of Pre Algebra skills to a satisfactory level. It is the researcher's recommendation to replace the Support class with an already existing tutoring or skill building program at the school. This action frees up resources by freeing up a teacher for a period and allows students to take an additional academic or elective class. For schools encountering

a similar challenge, it is this researcher's recommendation to develop, plan, and implement interventions based on existing literature and proven teaching practices that focus on the teaching and learning in the classroom. Furthermore, the researcher recommends for school educators to work collaboratively when addressing issues involving experimental interventions. Each school offer unique characteristics and factors affecting the teaching and learning in the class. Additional, the researcher recommends the study be replicated with more time and an increased number of participants. A more robust statistical analysis on the data is also recommended. Ultimately, it is of vital importance to plan and design a programs or interventions to fit the needs of the students and community the school is responsible for serving.

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