The Use of the Math Sprint in a Tutorial Program for Sixth Grade Students to Improve End of Grade Test Scores

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Abstract - What is the effect of a math sprint tutorial model on Mathematics achievement of sixth graders at Elizabeth City Middle School in Elizabeth City, North Carolina? A math sprint tutorial process was used during a three-week study with a group of 13 sixth-grade students to increase test scores from the previous 2011 Spring end of grade (EOG) test. The data, gathered from the post-test as a result of the series of tutoring sessions, was compared with the scores from the 2011 Spring EOG. Research studied the improvements made in scores on the North Carolina mathematics state test.

The North Carolina Mathematics Standard Course of Study provides a set of mathematical competencies for each grade and high school course to ensure rigorous student academic performance standards that are uniform across the state. It is based on a philosophy of teaching and learning mathematics that is consistent with the current research, exemplary practices, and national standards.

Keywords- Algebra, Combinatorial Mathematics, Tree Graphs, Estimation, Geometry, Probability, Statistics, Transformations

I. INTRODUCTION

The North Carolina Mathematics Standard Course of Study is organized in five strands or goals for K-8: Number and Operations, Measurements, Geometry, Data Analysis and Probability, and Algebra. These are the objectives for each goal in complexity at each grade level and throughout the high school courses. It is the framework upon which classroom instruction and assessment should be planned. It is the ultimate guide for textbook selections and the foundation of the North Carolina testing program. A variety of North Carolina Department of Public Instruction support documents articulate and enhance this curriculum. The Standard Course of Study describes the mathematical concepts, skills, operations, and relationships that are the significant mathematics that all North Carolina students should learn and understand. This is the mathematics that will give North Carolina students the greatest opportunity to shape their future [1].

Math sprint is a strategy designed to help middle school students. Elizabeth City State University sponsors a Math Sprint program headed by Dr. Darnell Johnson. This program involves students completing problems; from the State's Release Items of the previous years' tests, in a timed environment in order to receive points for correct answers. This method uses competition to motivate student learning over a period of time. In return, helps students develop better learning and cooperative skills, as well as enhance their knowledge of the subjects presented when doing math sprint. This was an essential part of the team's project with middle school students from Elizabeth City Middle School.

The Mathematics Team project was to observe if tutoring and using Math Sprint to re-teach sixth grade students would help to increase the scores from the 2011 Spring End-of-Grade (EOG) test. To begin the project, materials were given to explain what had to be researched in order to prepare students from Elizabeth City Middle School. The team examined the material and collectively developed a method to teach the students. The team made lesson plans, power points, and work sheets to teach to the class daily. A diagnostic test was administered the first day of class to see where the students stood comprehensively. The worksheets were graded and kept on file for the use of research, and so were the tests. A review of simpler skills, such as multiplication, was used to refresh the students' memory, as the study showed difficulty recalling information from the 2011 spring semester. Observations were done daily on the students: how the students behaved, what the students response to math topics, which way was easiest for them to learn, and how much the students already knew about the subject. With these observations, the diagnostic test, work sheets, and the EOG Release test given at the end of the program, data and results were obtained for this project [1].

II. OBSERVATIONS

A. Curriculum Observation

The North Carolina Mathematics Education Curriculum for K-8 is composed of five competencies: Number Operations, Measurement & Area, Geometry, Data Analysis & Probability, and Algebra. Within these competencies, students are expected to learn a specific amount of material, from number line concepts to solving systems of equations. However, for students to be successful in these competencies basic skills in math were required. During the tutoring session with the students, there were several cases where the students did not possess the necessary background skills to understand the concepts. These barriers consisted of understanding how to

multiple and divide without calculators, understanding what fractions represented, and understanding decimal points. The students had challenges multiplying two-digit numbers. Extra work, dealing with multiplication and division, was given each morning as a warm up for the students. Remediation accounted for time taken from the core curriculum. When given the warm up, most of the students did problems at a given comfort level with and failed to work problems that involved critical thinking.

B. Attendance Observations

For the three-week period, the students were Monday through Friday from 10am to noon. The students upon arriving were required to sign an attendance sheet, documentation that they received instruction for the day. At the end of each day the attendance sheets were taken and compiled into a spreadsheet, so that their daily attendance could be easily monitored. The student's attendance greatly affected their abilities to comprehend the tutoring sessions, and caused problems in the student's abilities to retain material. From the first week, problems with student's attendance arose and continued all the way until the last day of instruction. Students on the first day completed a 90-minute entrance exam, and then the tutoring sessions began following their completion. All students arriving late for the opening session missed material that was covered the first day. These absences impacted the amount of material the students were able to improve upon and the students lost the opportunity to ask questions and receive practice with them. Absences also affected the sample size of how many students would take the exit exam for the research. The starting size of 13 students changed to 10 by the end of the three -week program.

C. Math Sprint

Math sprint was incorporated in between the lessons to challenge the students on the curriculum they learned. The math sprint was given during the last 30 minutes of class. The first day math sprint was used the students were given a number from one through four and were put into groups. The first group that was done would get an incentive for doing so. The problems that were given were multiple choice given the students a chance to get the problems right [2]. When the timer was started each student leader from each group came and got the first problem. Some of the students that were not group leaders, tried to take over and just have everyone do what the students wanted them to do. When the first group came to turn in the response from the first question, the second group continued to work to get the right answer, but the third group seemed to just brush through the activity.

The second time math sprint was done the questions were not multiple choice, so the students had to actually work on them. The students were also not receiving any reward for these problems. Since there were an equal amount of students in each row, the students were divided by rows. When the timer was started each student from each group came and got the first problem. Again, the first group was working diligently and also fast. The second group was working also but not at a rapid pace. The third group appeared to not have been doing any work and would be on one problem for more than seven to eight minutes. The first group won again this time around. The use of a reward offered to students groups during this Math Sprint served as a motivation for success.

III. DATA

From the three-week research period, to determine the success of the re-teaching tutorial, a released EOG exam was compared to the students spring EOG scores. A diagnostic test, modeled after the End-of-Grade (EOG), was administered on the first day. The released EOG exam provided from the North Carolina Department of Education however, was not given until the last day. Each test was designed to carry a specific weight from each competency to fit the standards defined by the Department of Education. The diagnostic exam consisted of 30 multiple choice questions, 20 to be done with a calculator, and 10 to be without. After students took their first diagnostic test, the scores were put into excel spreadsheets. The chart showed how many students got the questions right and what percent of the class that represented. Since this was the beginning of the program, data was gathered for thirteen students that took the exam and the ten students who completed the three-week program. "Table. 1" is of the ten students who finished the required time period.

TABLE I. DIAGNOSTIC EXAM

Diagnostic % Pass Question: Final taken	# of Students W/ Question Correct	% of Class w/question correct
C1:	**8**	**80**
C2:	**1**	**10**
C3:	**0**	**0**
C4:	**3**	**30**
C5:	**3**	**30**
C6:	**3**	**30**
C7:	**1**	**10**
C8:	**5**	**50**
C9:	**3**	**30**
C10:	**2**	**20**
C11:	**9**	**90**
C12:	**3**	**30**
C13:	**3**	**30**
C14:	**2**	**20**
C15:	**2**	**20**
C16:	**2**	**20**
C17:	**5**	**50**
C18:	**8**	**80**
C19:	**4**	**40**
C20:	**8**	**80**
NC1:	**5**	**50**
NC2:	**2**	**20**
NC3:	**8**	**80**
NC4:	**4**	**40**
NC5:	**4**	**40**
NC6:	**2**	**20**
NC7:	**0**	**0**
NC8:	**5**	**50**
NC9:	**4**	**40**
NC10:	**5**	**50**

"Fig. 1" below shows the difference between the scores of 13 students compared the scores of the last 10 students. The percentage of the 10 students decreased by 2% without the involvement of the other 3 students.

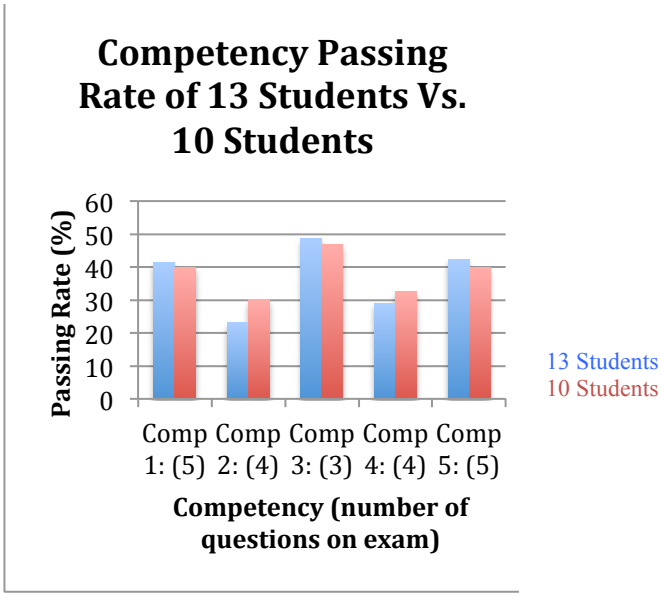

Figure 1. Competency breakdown of the students correct responses

In "Fig. 1" above, three of the competencies seem to be even but competency two and four have major differences in them and shows where the students need the most work.

The released EOG exam consisted of 50 multiple choice questions, with 36 calculator assisted and 14 without. The final test showed some improvement in the students' scores individually as well as a group. Though some students' scores were in the same range as their diagnostic test, a few of students made improvements. "Table. 2" below shows the percentage per question that the remaining 10 students scored correct on the post exam.

TABLE II. RELEASED EOG EXAM

	EOG Release Test Results		10 students
With Calculator	**Competency and Test Number**	**# of students correct**	**% of students correct**
	1) C2	9	90
	2) C2	4	40
	3) C2	6	60
	4) C3	6	60
	5) C3	5	50
	6) C3	5	50
	7) C3	4	40
	8) C3	6	60
	9) C4	9	90
	10) C4	6	60
	11) C4	5	50
	12) C4	3	30
	13) C4	4	40
	14) C4	0	0
	15) C5	4	40
	16) C5	6	60
	17) C5	3	30
	18) C5	4	40
	19) C2	4	40
	20) C2	2	20
	21) C2	0	0
	22) C2	1	10
	23) C3	5	50
	24) C3	5	50
	25) C3	4	40
	26) C3	7	70
	27) C3	4	40
	28) C4	8	80
	29) C4	7	70
	30) C4	3	30
	31) C4	5	50
	32) C4	3	30
	33) C5	3	30
	34) C5	4	40
	35) C5	3	30
	36) C5	3	30
W/O calculator			
	1) C1	8	80
	2) C1	6	60
	3) C1	8	80
	4) C1	5	50
	5) C1	1	10
	6) C1	2	20
	7) C1	1	10
	8) C1	5	50
	9) C1	3	30
	10) C1	4	40
	11) C1	2	20
	12) C5	6	60
	13) C5	4	40
	14) C5	4	40

"Table. 2" initially shows the same results as the diagnostic chart, separating each question and displaying how many students out of ten answered the question right. "Fig. 2" is separated into two separate parts: problems done with a calculator and problem done without a calculator. This test is also the exact release item from the North Carolina Department of Public Instruction, which mimics the original test.

To determine the success of the math sprint, and of the tutoring, specific data was taken from these test scores. The raw scores from the released EOG exams would be compared with the level scores from the spring EOG scores, to see if there was an increase or decrease between the two scores. From the exams, the data that was taken from the diagnostic exam was the average passing rate of the test (i.e. how much of the total test did the class get right as a group), the passing rate of each question (how many students got each question right), and lastly how the class did in regards to each of the five competencies. The students spring EOG exams scores were not

fully submitted values of 350 and 342 were used as substitutes for scores that were not received, and both were compared to the final EOG exam given, to draw conclusions.

A. Calculations

The first part of the data to be calculated was the class-passing rate of the entrance exam. Each of the students' scores were summed and placed into a chart using Excel, where the average of their scores was calculated to determine the average class rate on the exam. For example, the sample size of 10 students from the diagnostic test will be used:

$$2(43.3)+46.7+3(33.3)+2(36.7)+23.3+50 = 379.9$$

$$379.9/10 = 37.99$$

(the average passing rate of the class)

This process was again repeated for the exit exam, and the scores were compared to see if there was an overall increase or decrease in the class's scores.

The second part of the data to be calculated was the individual breakdown of each of the questions on the exam. This allowed to see which questions the students answered correctly the most, and which ones they did not understand how to do, so that the curriculum could focus more strongly on those particular competencies. Each question was put into a table in excel, along with the number of students who answered that question correct. The number of students who took the exam in order to find the percentage of the class who got the questions correct divided into the number of students who answered the question correctly. For example, 5 students scored problem 8 correct. Thus,

$$5/13 = 38.46$$

Again this process was repeated for the exit exam. Lastly, averages were calculated for each of the five competencies. Since each exam was composed of a certain number of questions from each competency, the number of questions from each competency that students scored correctly was entered into a table in Excel. Similar to the calculating the passing average of the class, the average for each competency was calculated. For example, 3 students scored the following out of the 5 questions for competency one:

$$3/5 + 2/5 + 1/5 = 6/5$$

$$(6/5)/3 = .4$$

These processes allowed a comparison between the diagnostic and exit EOG exams as well as with the Spring EOG, to determine if there was any change in scores to determine a connection between the students' scores and math sprint.

IV. Results

The percent of the Diagnostic exam that was passed of the 10 students who took the final exam was 37.2%, the passing percent of all the students was 39.33%. The scores decreased without the other three students incorporated in them.

The graph below shows the results from the EOG Exam chart but it shows the greatest percentage.

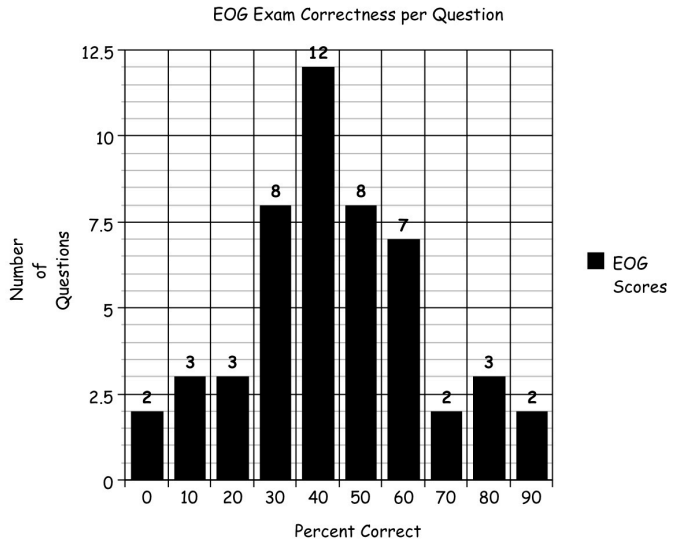

Figure 2. Displays the percent of correct reponses from the released exam

The score from the students spring EOG test were also obtained. These scores were between one and four, one being the lowest. With the score sheet from the exam, it was possible to find the range that their average fell in-between. Only two students' raw scores were given and every other students' score ranged from 342-350. To get a better result of the students scores since only 2 were really obtained, the 342 and the 350 score was averaged in the data. "Fig. 3" below shows the score of 350 on the students' first EOG test compared with their final EOG scores, and "Fig. 4" below it shows the percent passed of each test.

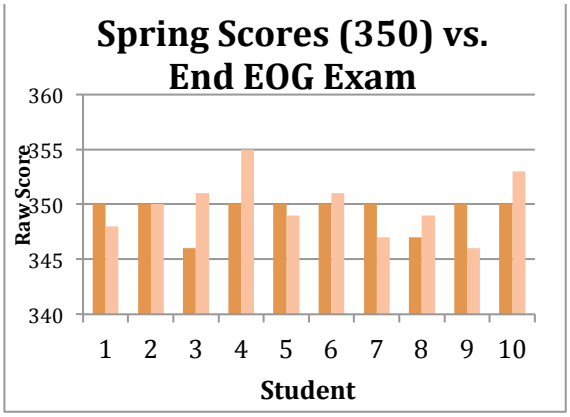

Figure 3. Spring 2011 score compared to the released exam score

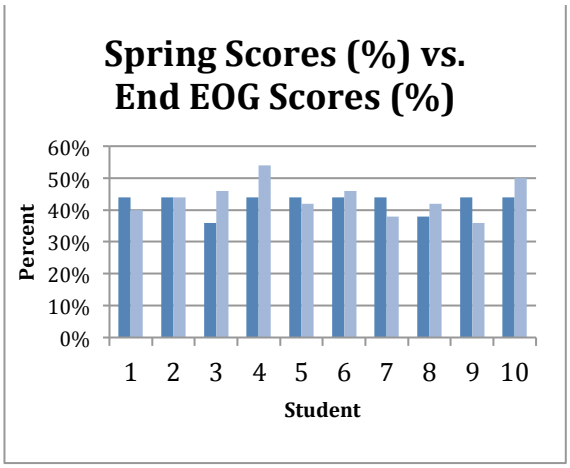

Figure 4. Percent of Spring 2011 score compared to released exam score

The highest the students could have possibly scored is graphed, now the lowest, which is 342, is in "fig. 5" below compared to the EOG release exam they took at the end of the program. Below "fig. 5" is "fig. 6" averaging the students percent on the test at 342.

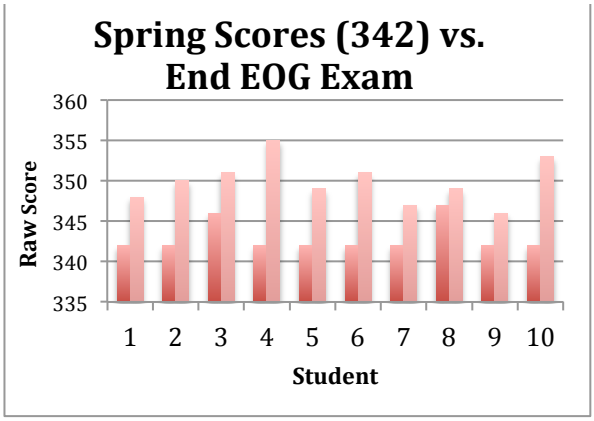

Figure 5. Spring 2011 score compared with released exam score

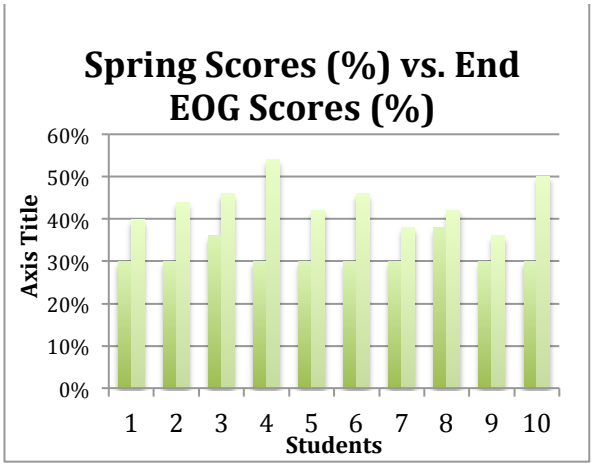

Figure 6. Percent of Spring 2011 scores compared to released exam score

The percent of the 10 students EOG exam that the students took before getting out of school was found, first at 350 and than at 342. The percent that was found from the 350 score was 42.6% and the percent that was found using the 342 score was 31.4%.

After calculating and comparing the students test, calculation was done on how they did individually. "Table. 3" shows the first diagnostic test compared to the second, the percent difference, and the percent increase of all the students. All of the students had a slight or substantial increase except one student who dropped from the diagnostic test.

TABLE III. INDIVIDUAL STUDENT INCREASE

DT Problems Correct	Diagnostic Test %	EOG Problems Correct	EOG Release Test %	Overall % Increase
10	33	22	44	11
11	37	20	40	3
13	43	23	46	3
15	50	27	54	4
14	47	21	42	-5
13	43	23	46	3
7	23	19	38	13
10	33	21	42	9
10	33	18	36	3
11	37	25	50	13

"Fig. 7" that follows "Table. 3" first compares the students' scores from the diagnostic test and the EOG release exam and "Fig. 8" will cover the percent increase or decrease of the students.

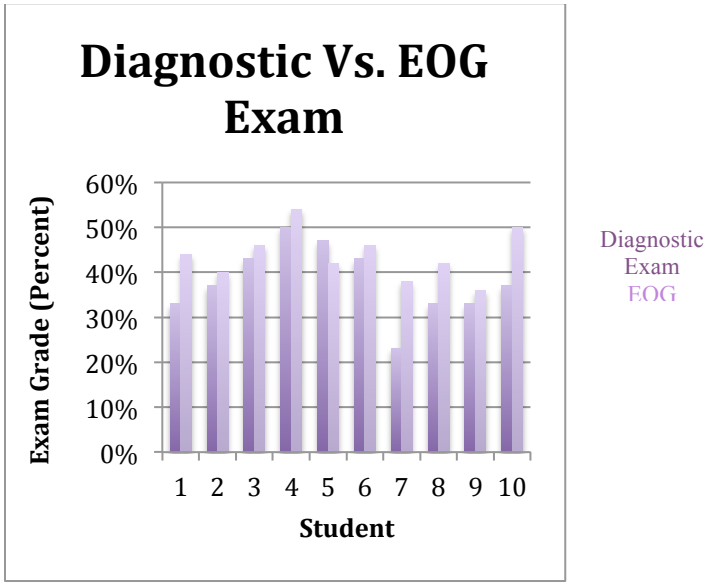

Figure 7. Compares the scores of the diagnostic test and the released EOG exam after the three week tutoring session

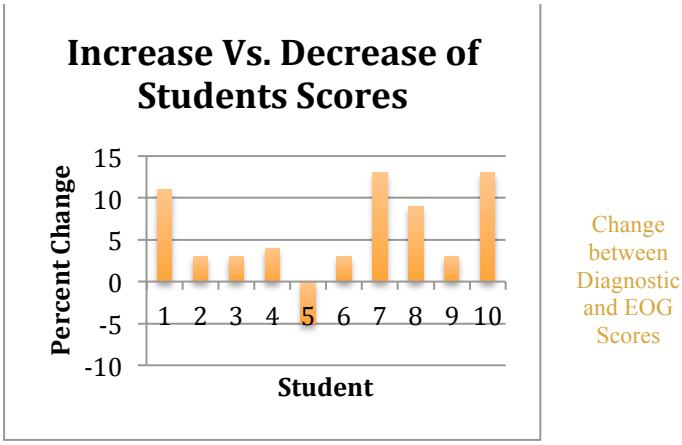

Figure 8. Displays the increase/decrease in student scores between the diagnostic and released exams

V. Conclusion

The main focus of this project was to observe if math sprint tutorial model was effective on the mathematics achievement of sixth graders at Elizabeth City Middle School in Elizabeth City, North Carolina. The project started off with 13 students, but by the end of the program there were only 10 students that took the final exam. Different observations were done on the students to perceive how the students learned or the different teaching strategies used to assess the students. The different observations were curriculum, attendance, and math sprint. Along with observation, other data that collected were the students' scores from the diagnostic test, the Spring 2011 EOG Exam scores, and the EOG release exam that was given at the end of the program. The scores varied because the exact scores of the students' EOG exam were not given, so the score ranges it would fall between was found, which was 342 as the lowest and 350 as the highest. Overall, the students EOG release exam was an increase from the students diagnostic and the EOG exam by 2% or more, even wit the two average scores from the EOG exam. "Fig. 9" below shows the Diagnostic and Spring EOG Exam to the release EOG Exam.

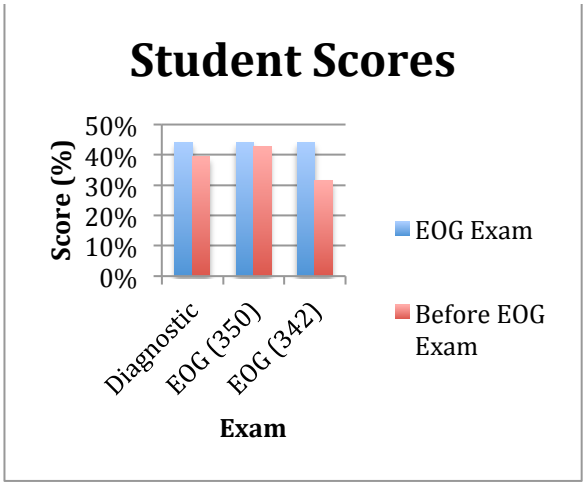

Figure 9. Displays the change in student scores

VI. Future Work

This study was completed during a three-week period and to further determine the success of math sprint, a longer time frame would be strongly recommended. A longer time frame would allow for more material to be covered, and more math sprint sessions to be performed. It is also suggested that if the study period is extended, that the duration of the sessions be adjusted according to the new study period [4]. This can allow the students to continue to be willing to participate in the program, without becoming exhausted. The team also suggests creating a stronger involvement with parents, so the students can also understand the importance of the students' achievement.

The program was originally designed for 20 middle school students, but was adjusted to 10 students that actually participated. To further determine the success of the program, it is suggested that the size of the student body increase. More students would allow for diversity in the classroom, as well as in the Math Sprint and test scores. During the course of the program, students departed early or did not take attendance in the program seriously. It is suggested for future sessions to increase the importance of attendance and to increase student attendance, which can affect future test scores.

Part of the error in the research was that several scores received from parents were the level score (1-4), instead of the scale score. Since each level score is composed of an interval of scaled scores, for every level score a scaled score of 350 and 342 was assigned. This allowed for scores from the lowest and highest possible values of the interval to be used. It is suggested for future study, to obtain the scaled scores from the students score reports at the beginning of the program, so more accurate data can be collected. This can avoid incorrect results on determining the success of the program. The students were also evaluated upon arriving to the program, since the research team did not have access to the students spring EOG scores at that time. Thus, to create a baseline for the study, the team administered an entrance exam so that the team could have a scaled score to set to each student, to compare to the final score at the end of the three-week period. Again, it is suggested for future study that the scores from the EOG exams be obtained from the students, so more time can be focused on the material, and a baseline can already be set for each student.

VII. Discussion

There were several errors in this project. One error was the scores from the spring exam. Some scores were not reported with the raw value, so they were assigned the value of 350 and 342 to find the range the students' average lie between, so results could be calculated and compared. In the graphs presented, the data was calculated using these adjusted scores along with the raw scores provided. Other errors included student attendance, with students missing three to four days consecutively and then others dropping out of the program.

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