The Effect of Math Sprint Competition

In

Student Achievement

On

SOL Mathematics Tests

At

Camelot Elementary School

In

Chesapeake, Virginia

Submitted

By

Math Sprint Team
TreAsia Fields, Chelsea Goins, Spencer Weeks-Jamieson,
Illiana Thomas, Tiwana Walton

Mentor
Dr. Darnell Johnson

Principal Investigator
Dr. Linda B. Hayden

The Effect of Math Sprint Competition In Student Achievement on SOL Mathematics Tests at Camelot Elementary School in Chesapeake, Virginia

Spencer P. Weeks-Jamieson, Tiwana Walton, Chelsea Goins, Illiana Thomas, TreAsia Fields
Dr. Darnell Johnson
Dr. Linda B. Hayden
1704 Weeksville Road, Box 672
Elizabeth City, North Carolina 27909

Abstract- Given Virginia's *Standards of Learning* (SOL) (1995) mandates, Virginia's elementary teachers and school leaders utilized research for teaching methods that encouraged gains on the end of course mathematics tests. The relationship between teacher motivation methods and student achievement on Virginia's End of Course SOL Test for elementary deserves investigation. Virginia's elementary students in grades three, four and five must maintain an annual pass rate to meet Annual Yearly Progress (AYP) as recommended by the national "No Child Left Behind Act" of 2001. Camelot Elementary School is a Title I school housing high concentrations of minority students who normally achieve lower test score gains than students in other schools. Camelot has a student population receiving at least seventy percent free and reduced lunch nested in a low middle class neighborhood in Chesapeake, Virginia.

This research was based on school effectiveness by developing and testing hypotheses about the specific relationships between student competition and state wide testing results in elementary mathematics in grades three and five at Camelot Elementary School in Chesapeake, Virginia. The study compiled data from the "Math Sprint Competition", a series of student group related reviews of state released test items in a math test relay format. Research focused on methods for motivating an experimental group of students motivated by the use of a math sprint competition from 2005 to 2007 versus a control group of elementary students in mathematics for grades three and five from 2002 to 2004. Student learning activities were compared from teaching methods that included: direct instruction, problem-based learning, technology aided instruction, cooperative learning, manipulative, models, and multiple representations, communication, and study skills.

A group of twenty-four elementary teachers from Camelot Elementary School participated in this research to ascertain how frequently they used research-based teaching methods and determined the influence of teaching methods on their students' achievement. A multiple regression analysis was used to show results from a 40-item state wide test for each grade level. Individual Pearson Product Moment Correlations were conducted to determine which variables possess strong and statistically significant relationships. This analysis determined if gains on the end of the year SOL scores were a result of an impact of the series of math sprint competitions used as motivators before each benchmark assessment leading to the SOL tests in 3rd and 5th grade mathematics.

I. INTRODUCTION

The claim considered the SOL math scores at Camelot during the 2005-2007 school years were higher than those who did not use these same math sprint exercises during the 2002-2004 school years. The relationship between teacher motivation methods and student achievement on Virginia's End of Course SOL Test for elementary students deserved investigation. Virginia's elementary students in grades three and five must maintain an annual pass rate to meet Annual Yearly Progress (AYP) as recommended by the national "No Child Left Behind Act" of 2001. Camelot Elementary School is a Title I school housing high

concentrations of minority students who normally achieve lower test score gains than students in other schools. Camelot has a student population receiving at least seventy percent free and reduced lunch nested in a neighborhood of Chesapeake, Virginia. The school administration of Camelot continued using the math sprint exercises because they were strongly convinced that were raised the SOL scores. The only way to prove or disprove the claim was to use sample data to form a conclusion. It was assumed that sample test results were obtained from an independent testing source.

Competition among young children has been known to force them to pick up on new material quickly and retain the old material in order to out-do the others. The research of how competition helps raise math scores was conducted and experimented on groups of children in third grade and fifth grade. The competition came from the many math sprints in which students participated. Questions missed collectively were reviewed in various ways and made sure that the students were comfortable with the concepts. In addition, questions answered correctly were reviewed to refresh the students' memory. With the scores from the math sprints, benchmark tests, and SOL tests, a determination was made as to whether the math sprints indeed improved the SOL math scores of the participating students.

This research was based on the relationship between student competition and state wide testing results in elementary mathematics for grades three and five at Camelot Elementary School in Chesapeake, Virginia. The study compiled data from the "Math Sprint Competition", a series of student group related reviews of state released test items in a math test relay format. Research focused on methods for motivating control groups for grades three and five from 2002 to 2004 versus experimental groups motivated by the use of a math sprint competition from 2005 to 2007.

Pictures of Camelot students participating in a math sprint exercise and 3rd and 5th grade competition winners with Dr. Stephanie D. Johnson, Principal and Dr. Darnell Johnson,

Math Sprint Coordinator from Elizabeth City State University:

II.   DATA COLLECTION

For the purpose of this analysis, the math SOL test scores of Camelot Elementary School 3rd and 5th grade students were used. The cohorts were students tested in the third grade for the 2002-2007 and fifth grade for the 2002-2007 end of the year mathematics SOL tests for the fall of 2001 school year through the spring of 2007 school year (six years). These students included in the analysis also attended Camelot Elementary School for three consecutive years in grades three, four, and five. The raw data for these students were found in the table below of students in each sample was as follows:

Yearly Comparison of SOL Scores at Camelot Percentage of Students Passing						
GRADE 3						
Va. SOL Test	2002	2003	2004	2005	2006	2007
Math	**74.2**	**86.1**	**100**	**100**	**100**	97
Science	**63.0**	**79.0**	**85.5**	**95.3**	**96.5**	**97.0**
GRADE 5						
Va. SOL Test	2002	2003	2004	2005	2006	2007
Math	**64.1**	**77.4**	**84.4**	**89.4**	**86.6**	**97.0**
Science	**66.3**	**77.2**	**91.5**	**90.7**	**87.2**	**92.0**
Area shaded purple indicates growth over the previous year.						

School Year		Total # of students
2002	3rd Grade	71
2004	5th Grade	71
2003	3rd Grade	81
2005	5th Grade	81
2004	3rd Grade	55
2006	5th Grade	55
2005	3rd Grade	67
2007	5th Grade	67
Total		548

III.   METHODOLOGY

A group of twelve elementary teachers from Camelot Elementary School participated in this research to ascertain how frequently they used math sprint competitions to determine positive gains in students' achievement. A multiple regression analysis, Pearson Product Moment Correlations, and tests of hypotheses made about two population means were conducted from a 40-item state wide test for each grade level to determine which variables possess strong and statistically significant relationships. Many real and practical situations in the educational setting used such tests successfully. These analyses determined that gains in the benchmark scores resulted from the series of math sprint competitions used as motivators before benchmark assessments and SOL testing.

The following illustrated the complete method of testing hypotheses. A fundamental concept used to denote hypothesis testing was that of tests of significance. We outlined the general procedure for testing hypotheses, and demonstrated how this procedure applied to a specific example. The following were some of the standard terms used in this procedure.

- **Null hypothesis** (denoted by H_o): The statement of a zero or null difference that is directly tested. This will correspond to the original claim if that claim includes the condition of no change or difference (such as $=, <, >$). Otherwise, the null hypothesis is the negation of the original claim. We test the null hypothesis directly in the sense that the final conclusion will be either rejection of H_o or failure to reject H_o.
- **Alternative hypothesis** (denoted by H_1): The statement that must be true if the null hypothesis is false.
- **Type I error**: The mistake of rejecting the null hypothesis when it is true.
- **Type II error**: The mistake of failing to reject the null hypothesis.
- α (**alpha**): Symbol used to represent the probability of a type I error.
- β (**beta**): Symbol used to represent the probability of a type II error.

- **Test statistic**: A sample statistic or a value based on the sample data. It is used in making the decision about the rejection of the null hypothesis.
- **Critical region**: The set of all values of the test statistic that would cause us to reject the null hypothesis.
- **Critical value(s)**: The value(s) that separates the critical region from the values of the test statistic that would not lead to rejection of the null hypothesis. The critical value(s) depends on the nature of the null hypothesis, the relevant sampling distribution, and the level of significance α.
- **Significance level**: The probability of rejecting the null hypothesis when it is true. Typical values selected are 0.05 and 0.01. That is, the values of $\alpha = 0.05$ and $\alpha = 0.01$ are typically used. (We use the symbol α to represent the significance level.)
- **Elation**: The feeling experienced when the techniques of hypothesis testing are mastered.

Testing a Claim About a Mean

In this study, tests of hypotheses made about two population means were considered. Many real and practical situations used such tests successfully. For example, this process would be used if an educator wanted to compare mean test scores produced by two teaching methods, a manager wanted to test for a difference in the mean weight of cereal loaded into boxes by two machines, or a car manufacturer wanted to test for a difference in the mean longevity of batteries produced by two suppliers.

The way in which we compared means using sample data taken from two populations were affected by the presence or absence of a relationship between those samples. **By definition**: Two samples are **dependent** if the values in one are related to the values in the other in some way. Two samples are **independent** if the values in one are *not* related to the values in the other.

Consider the sample data given below. The sample of SOL math test scores were expected without the use of math sprint exercises and the sample of SOL math test scores with math sprint exercises to be two dependent samples, since each pair was matched according to the students involved.

Regression Analysis

Next, each data set was examined in a regression analysis. A regression analysis, in statistics, examined the relationship between an independent and a dependent variable. The independent variable in this study was the predictor variable, the 2002-2004 SOL scores. The dependent variable was the criteria variable or the 2005-2007 SOL scores. With this data given, a regression equation was formulated using MINITAB statistical software. These equations gave the best estimate to the relationship the dependent variable had with the independent variable, and were graphically shown using what was known as a fitted line plot. The line illustrated the estimation of the relationship the two variables have. A regression equation was given and a line was drawn in the scatter plot of data. Also given was the coefficient of determination, called *R-squared,* which was the proportion of variability in a data set.

Correlation Coefficient

Finally, a correlation was shown. A correlation, or correlation coefficient, determined the strength and direction of a linear relationship between two random variables. In this situation, the "Pearson Product Moment correlation coefficient" was used. What was shown was that as the 2002-2004 scores increased, the 2005-2007 scores increased. The Pearson correlation coefficient measured those tendencies. The range of the coefficients is from -1 to 1, with 1 suggested a perfect and positive relationship, a 0 suggested that there is no relationship, and a -1 suggested that while there is a linear relationship, the relationship is negative, in other words, as 2002-2004 scores increased, 2005-2007 scores decreased. As a rule of thumb, correlation coefficients are considered **weak** from .00 to .30, **moderate** from .30 to .70, and **strong** from .70 to 1.00.

After all 6 years worth of data was analyzed, this analysis determined what kind of correlation 2002-2004 scores had with 2005-2007 SOL scores. A comparison showed the difference between the correlation coefficient of the original data and the projected data. A determination then was made whether or not the correlation between 2002-2004 scores and 2005-2007 SOL scores were weak, moderate, or strong.

IV. RESULTS

Two-Tailed Hypothesis Testing

The study undertaken involved a two-tailed test because the critical region was comprised of two components located in the two extreme regions under the curve. In the two-tailed case, α was divided equally between the two components comprising the critical region. In each case, we converted the claim into symbolic form and then determined the symbolic alternative. The null hypothesis H_o became the symbolic statement containing the condition of equality. The alternative hypothesis became the other symbolic statement. We rejected H_o because there was significant evidence supporting H_1. For this reason, critical regions corresponded to the extremes indicated by H_1. The inequality sign pointed to the critical region. The symbol $\neq$ was often expressed in programming languages as $<>$, and this reminded us that an alternative hypothesis such as $\mu = 120$ corresponded to a two-tailed test.

3rd Grade SOL Tests

Two SOL test scores and samples were selected from 3rd grade classes in 2002-2004 and 2005-2007. Denoting the results from the 2002-2004 group as the control group and denoting the results from the 2005-2007 group as the experimental group, $n_1 = 113$ and $x_1 = 455$ for the control group and $n_2 = 91$ and $x_2 = 493$ for the experimental group.

The standard deviations of the SOL test by the control group and the experimental group were 455 and 493 respectively, tested the claim that the mean of the control group equal the mean of the experimental group. A 0.05 significance level was assumed.

Solution
The two means were independent and δ_1 and δ_2 were known. It was given below that a normal distribution test should be used with the null and alternative hypotheses described as
H_o: $\mu_1 = \mu_2$ (or $\mu_1 - \mu_2 = 0$)
H_1: $\mu_1 \neq \mu_2$ (or $\mu_1 - \mu_2 \neq 0$)
With $\alpha = 0.05$ it was concluded that the test involved two tails. Extracted below were the critical z values of -60.4 and -14.8. The test statistic of -3.25 was inside the critical region, and therefore rejected the *Ho* and concluded that the population means corresponded to the test means that were equal. It appeared that the experimental group had a mean that was significantly greater that the mean of the control group.

The results of the 2002-2004 3rd grade SOL scores given without the use of the math sprints gave a mean score of 455 while results of the 2005-2007 3rd grade SOL scores given with the use of the math sprints gave a mean score of 493. The temptation was to conclude that the hypothesis of a mean score of 493 with the use of the math sprints were correct simply because the sample mean of 455 was less than the population mean of 493. In analyzing this comparison critically, it was known that sample data fluctuates and displays errors of various amounts on test by the same students on the same test items and did not necessarily provide identical results. Recognizing this, a key question was formulated: Does the population mean of 493 represent a statistically significant increase from the sample mean score of 455, or is the difference more likely due to chance variations in the math sprint exercise difference? By summarizing these key points we concluded:

- Traditional test results gave a 3rd grade SOL mean score of 455.
- The experimental test results with the use of math sprint exercises gave a 3rd grade SOL mean score of 493.

- Claim: The population of SOL test scores had a mean, μ that was higher than 455.
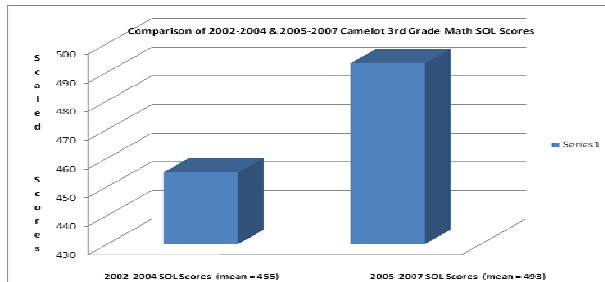
Two sample T for 2002-2004 3rd Grade vs 2005-2007 3rd Grade Math SOL Scores

Two Sample T-Test and Confidence Interval
Two sample T for 2002-2004 3rd Grade vs. 2005-2007 3rd Grade Scores

	N	Mean	StDev	SE Mean
2002-2004	113	455.5	72.8	6.8
2005-2007	91	493.1	88.9	9.3

95% CI for mu 2002-2004 - mu 2005-2007: (-60.4, -14.8)

T-Test mu 2002-2004 = mu 2005-2007
(vs not =): T = -3.25 P = 0.0014 DF = 172

5th Grade SOL Tests

Two SOL test scores and samples were selected from 5th grade classes in 2002-2004 and 2005-2007. Denoting the results from the 2002-2004 group as the control group and denoting the results from the 2005-2007 group as the experimental group, data gave $n_1 = 120$ and $x_1 = 419$ for the control group and $n_2 = 91$ and $x_2 = 493$ for the experimental group.

The standard deviations of the SOL test by the control group and the experimental group were 416 and 493 respectively, test the claim that the mean of the control group equals the mean of the experimental group. Assume a 0.05 significance level.

Solution
The two means were independent and δ_1 and δ_2 were known. Data below used a normal distribution test with the null and alternative hypotheses described as

H_o: $\mu_1 = \mu_2$ (or $\mu_1 - \mu_2 = 0$)
H_1: $\mu_1 \neq \mu_2$ (or $\mu_1 - \mu_2 \neq 0$)

And $\alpha = 0.05$, it was concluded that the test involved two tails. Below was extracted the critical z values of -97.0 and -56.7. The test statistic of -7.60 was inside the critical region, and we therefore rejected the Ho and concluded the population means corresponded to the test means that were equal. It appears that the experimental group had a mean that was significantly greater that the mean of the control group.

The results of the 2002-2004 5th grade SOL scores given without the use of the math sprints gave a mean score of 416 while results of the 2005-2007 5th grade SOL scores given with the use of the math sprint gave a mean score of 493. Data used tempted to conclude that the hypothesis of a mean score of 493 with the use of the math sprints was correct simply because the sample mean of 416 was less than the population mean of 493. In analyzing this comparison critically, it was shown that sample data fluctuates and displays errors of various amounts on test by the same students on the same test items and did not necessarily provide identical results. Recognizing this, it was formulated a key question: Does the population mean of 493 represent a statistically significant increase from the sample mean score of 416, or is the difference more likely due to chance variations in the math sprint exercise difference? By summarizing these key points we concluded:

- Traditional test results gave a 5th grade SOL mean score of 416.
- The experimental test results with the use of math sprint exercises gave a 5th grade SOL mean score of 493.
- Claim: The population of SOL test scores had a mean, μ that was higher than 416.

2002-2004 & 2005-2007 Camelot 5th Grade Math SOL Scores
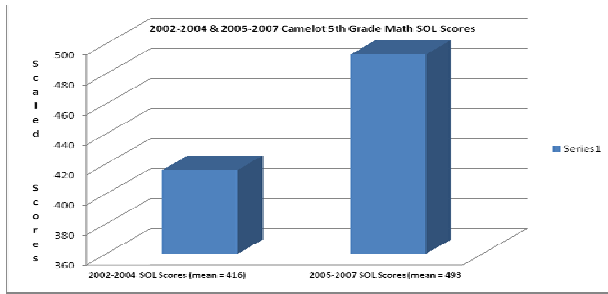
Two sample T for 2002-2004 5th Grade vs. 2005-2007 5th Grade Math SOL Scores

Two Sample T-Test and Confidence Interval
Two sample T for 2002-2004 5th Grade vs. 2005-2007 5th Grade Scores

	N	Mean	St Dev	SE Mean
2002-2004	120	416.1	43.4	4.0
2005-2007	91	493.1	88.9	9.3

95% CI for mu 2002-2004 - mu 2005-2007: (-97.0, -56.9)

T-Test mu 2002-2004 = mu 2005-2007
(vs not =): T = -7.60 P = 0.0000 DF = 122

A Six Year 3rd Grade and 5th Grade Math SOL Scaled Score Breakdown for Perfect, Pass Advance, and Pass Score Results by Year(2002-2007)

2002 3rd Grade SOL Scaled Scores by Category:
Perfect:	0	
Pass Advance:	28	
Pass:	86	
Percent Pass:	86/111	77.4%

2002 5th Grade SOL Scaled Scores by Category:
Perfect:	0	
Pass Advance:	2	
Pass:	77	
Percent Pass:	77/116	65.5%

2003 3rd Grade SOL Scaled Scores by Category:
Perfect:	3	
Pass Advance:	48	
Pass:	95	
Percent Pass:	95/109	87.1%

2003 5th Grade SOL Scaled Scores by Category:
Perfect:	0	
Pass Advance:	15	
Pass:	86	
Percent Pass:	86/111	77.6%

2004 3rd Grade SOL Scaled Scores by Category:
Perfect:	11	
Pass Advance:	42	
Pass:	83	
Percent Pass:	83/91	91.2%

2004 5th Grade SOL Scaled Scores by Category:
Perfect:	2	
Pass Advance:	27	
Pass:	96	
Percent Pass:	96/116	82.7%

2005 3rd Grade SOL Scaled Scores by Category:
Perfect:	9	
Pass Advance:	54	
Pass:	87	
Percent Pass:	87/91	95.6%

2005 5th Grade SOL Scaled Scores by Category:
Perfect:	5	
Pass Advance:	27	
Pass:	91	
Percent Pass:	91/121	75.2%

2006 3rd Grade SOL Scaled Scores by Category:
Perfect:	7	
Pass Advance:	47	
Pass:	75	
Percent Pass:	75/76	98.5%

2006 5th Grade SOL Scaled Scores by Category:
Perfect:	23	
Pass Advance:	44	
Pass:	77	
Percent Pass:	77/97	79.3%

2007 3rd Grade SOL Scaled Scores by Category:

Perfect:	8	
Pass Advance:	49	
Pass:	83	
Percent Pass:	83/91	91.2%

2007 5th Grade SOL Scaled Scores by Category:

Perfect:	19	
Pass Advance:	52	
Pass:	94	
Percent Pass:	94/96	99.9%

Scatter Plots

From this data, a scatter plot graph was drawn using MINITAB statistical software. After the data was defined, MINITAB drew the graph that features the data. The graph featured the predictor variable as the x-axis and the criteria variable as the y-axis. The predictor variable was the 2002-2004 SOL scores and the criteria variable consists of the 2005-2007 SOL scores, therefore different scatter plots were be drawn for 3rd and 5th grade level comparison, for a total of 4 scatter plots.

The regression equation is y = 75.2 + 0.811 x

Predictor	Coef	StDev	T	P
Constant	75.23	25.44	2.96	0.004
x	0.81144	0.05338	15.20	0.000

S = 39.54   R-Sq = 77.0%   R-Sq(adj) = 76.7%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	361290	361290	231.09	0.000
Residual Error	69	107874	1563		
Total	70	469164			

Correlation (Pearson)
Correlation of 2002 3rd grade. Scaled Score and 2004 5th grade. Scaled Score = 0.878, P-Value = 0.000

Two Sample T-Test and Confidence Interval

Two sample T for 2002 3rd Grade SOL Scores vs. 2004 5th Grade SOL Scores
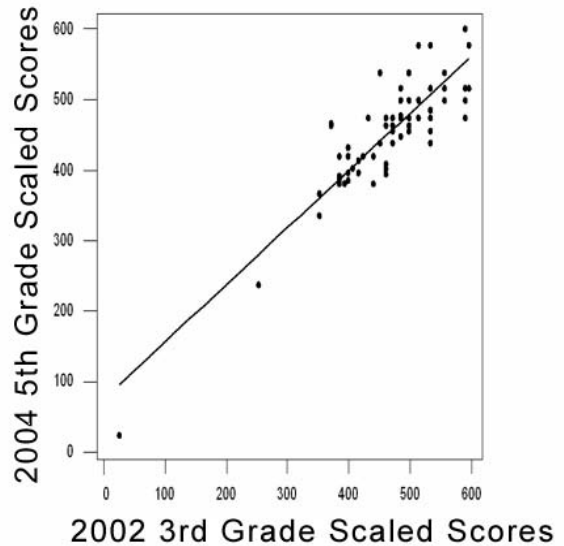
	N	Mean	StDev	SE Mean
2002 3rd	71	468.4	88.5	11.0
2004 5th	71	455.3	81.9	9.7

95% CI for mu 2002 3rd - mu 2004 5th: (-15, 41.4)
T-Test mu 2002 3rd = mu 2004 5th (vs. not =): T = 0.91 P = 0.36
DF = 139

Regression Plot

Y = 75.2286 + 0.811439X

R-Sq = 77.0 %

The regression equation is y = 165 + 0.619 x

Predictor	Coef	StDev	T	P
Constant	164.80	38.86	4.24	0.000
x	0.61943	0.07966	7.78	0.000

S = 49.87   R-Sq = 43.4%   R-Sq(adj) = 42.6%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	150363	150363	60.47	0.000
Residual Error	79	196450	2487		
Total	80	346813			

Correlations (Pearson)

Correlation of 2003 3rd.Scaled Score and 2005
5th. Scaled Score = 0.658, P-Value = 0.000

Two Sample T-Test and Confidence Interval

Two sample T for 2003 3rd Grade SOL Scores vs. 2005 5th Grade
SOL Scores

	N	Mean	StDev	SE Mean
2003 3rd	81	482.9	70.0	7.8
2005 5th	81	463.9	65.8	7.3

95% CI for mu 2003 3rd - mu 2005 5th: (-2.1, 40.0)
T-Test mu 2003 3rd = mu 2005 5th (vs. not =): T = 1.78 P = 0.078
DF = 159

Regression Plot

Y = 164.799 + 0.619433X
R-Sq = 43.4 %
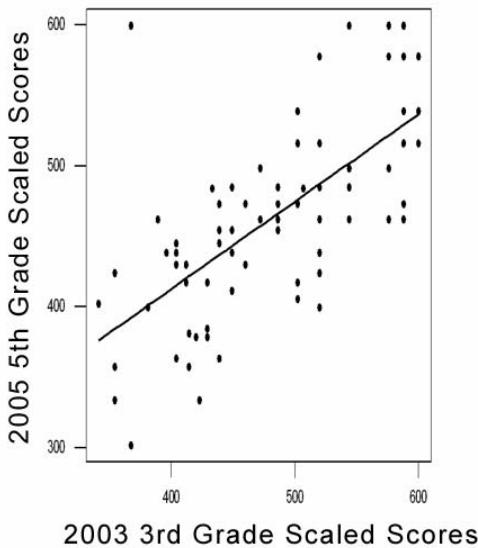
The regression equation is y = 179.8 + 0.66 x

Predictor	Coef	StDev	T	P
Constant	179.83	74.25	2.42	0.019
x	0.6568	0.1467	4.48	0.000

S = 71.76   R-Sq = 27.8%   R-Sq(adj) = 26.4%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	103184	103184	20.04	0.000
Residual Error	52	267775	5150		
Total	53	370959			

Correlations (Pearson)
Correlation of 2004 3rd.Scaled Score and 2006
5th.Scaled Score = 0.527, P-Value = 0.000
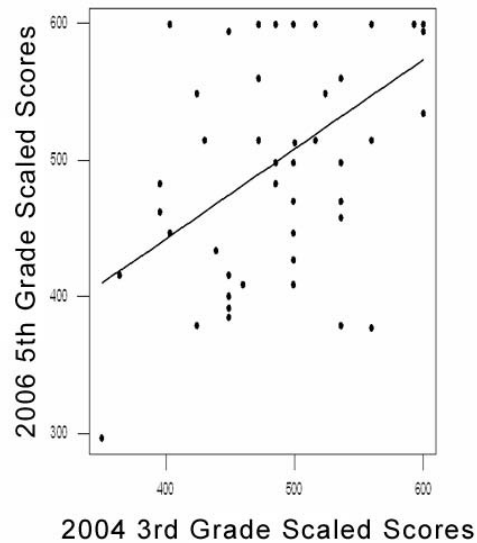
Two Sample T-Test and Confidence Interval

Two sample T for 2004 3rd Grade SOL Scores vs. 2006 5th
GRADE SOL Scores

	N	Mean	StDev	SE Mean
2004 3rd	55	499.9	67.9	9.2
2006 5th	55	509.3	83.7	11.0

95% CI for mu 2004 3rd - mu 2006 5th: (-38.4, 20)
T-Test mu 2004 3rd = mu 2006 5th (vs. not =): T = -0.65, P = 0.52
DF = 101

Regression Plot

Y = 179.833 + 0.656761X
R-Sq = 27.8 %

The regression equation is y = 101 + 0.795 x

Predictor	Coef	StDev	T	P
Constant	101.32	47.80	2.12	0.038
x	0.79467	0.09191	8.65	0.000

S = 49.53   R-Sq = 53.5%   R-Sq(adj) = 52.8%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	183428	183428	74.76	0.000
Residual Error	65	159477	2453		
Total	66	342905			

Correlations (Pearson)
Correlation of 2005 3rd.Scaled Score and 2007
5th grade Scaled Score = 0.731, P-Value = 0.000

Two Sample T-Test and Confidence Interval

Two sample T for 2005 3rd Grade SOL Scores vs. 2007 5th Grade
SOL Scores

	N	Mean	StDev	SE Mean
2005 3rd	67	516.0	66.3	8.1
2007 5th	67	511.3	72.1	8.8

95% CI for mu 2005 3rd - mu 2007 5th: (-19.0, 28.3)
T-Test mu 2005 3rd = mu 2007 5th (vs. not =): T = 0.39, P = 0.70
DF = 131

Regression Plot

Y = 101.316 + 0.794667X
R-Sq = 53.5 %
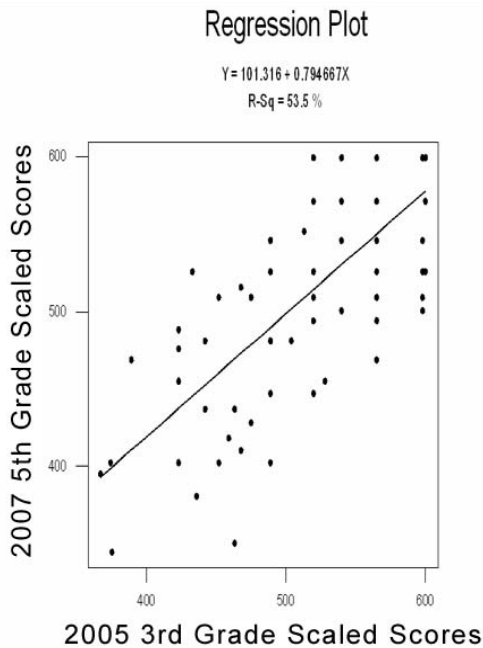
V.   CONCLUSION

In conclusion, the analyses of the Math Sprints and SOL scores determined that gains in the benchmark scores resulted from the series of math sprint competitions used as motivators before benchmark assessment and SOL testing increased mean test scores for 3rd and 5th grade students during the 2005-2007 school years.

VI.   RECOMMENDATIONS FOR FUTURE RESEARCH

It is recommended that further investigation be done on the relationship of math scores between grades three, four, and five for 2006 through 2009 school years. It would also be beneficial to compare the SOL scores of Treakle Elementary and Camelot Elementary Schools for 2006 through 2009. Furthermore, a comparison of Camelot Elementary to the other Title I schools in Chesapeake, Virginia would assist in providing the validity of the SOL scores at Camelot Elementary.

VII.   ACKNOWLEDGEMENTS

VIII.   REFERENCES

[1]Bransford, J., Brown, A., & Cocking, R. (Eds.) (1999). *How people learn: Brain, mind, experience, and school.* Washington, DC: National Academy Press.

[2]Begle, E. (1979). *Critical variables in mathematics education: Findings from a survey of empirical literature.* Washington, DC: Mathematical Association of America.

[3]Education Week. (1997). Quality counts: A report card on the condition of public education in the 50 states. *A Supplement to Education Week*, Vol. 16, January, 22.

[4]Linn, R. L., Dunbar, S. B., Harnisch, D. L., & Hastings, C. N. (1982). The validity of the Title I evaluation and reporting system. In E. R. House, S. Mathison, J. Pearsol, & H. Preskill (Eds.), *Evaluation Studies Review Annual* (Vol. 7, pp. 427-442). Beverly Hills, Calif.: Sage Publications.

[5]Linn, R. L., Graue, M. E., & Sanders, N. M. (1990). Comparing state and district results to national norms: The validity of the claims that "everyone is above average." *Educational Measurement: Issues and Practice*, 9(3), 5-14.

[6]Ma, L. (1999). *Knowing and teaching elementary mathematics: Teachers' understanding of fundamental mathematics in China and the United States.* Mahwah, NJ: Erlbaum.

[7]Monk, D. A. (1994). Subject area preparation of secondary mathematics and science teachers and student achievement. *Economics of Education Review, 13*(2), 125-145.

[8]Moore, D. S. & McCabe, G. (1999). *Introduction to the practice of statistics.* New York: Freeman.

[9]Shaughnessy, M. (1992). Research in probability and statistics: Reflections and directions. In D. A. Grouws (Ed.), *Handbook of research on mathematics teaching and learning* (pp. 465-494). New York: Macmillan Publishing.

[10]Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher, 15*(2), 4-14.

[12]Siu, M. K. (1991). Concept of function—its history and teaching. In F. Swetz et al. (Eds), *Learn from the masters* (pp. 105-121). Washington, DC: Mathematical Association of America.

[13]Springer, L., Stanne, M. E., & Donovan, S. S. (1999). Effects of small-group learning on undergraduates in science, mathematics, engineering, and technology: A meta-analysis. *Review of Educational Research, 69*(1), 21-51.