Richardson Math Project
Final Report: Math TAKS Results
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Introduction

The Richardson Independent School District in Richardson Texas has implemented a novel program to improve mathematical skills for some 7th and 8th graders. With the help of new technology and innovative assessments students are able to communicate their mathematical thinking and then receive immediate feedback regarding their mathematical knowledge.

Earlier pilot results indicate several components of the intervention are crucial to the success of the intervention. These key components include: extended learning time, use of technology to motivate and enhance learning opportunities, provision of common, aligned assessments, increased teacher content knowledge, and development of high expectations for all students.

The teachers involved in the program received specialized professional development training. Students participate in a 100-minute mathematics class that focuses on enhancing mathematical understanding through the use of TI Navigator™ system and advanced graphing calculators, in-classroom networks and daily problem solving. The students also participated in daily lessons where they must communicate solutions, apply content, and connect mathematical models to abstract concepts. The technology allows teachers to monitor, on a screen, each student's progress as concepts are taught and problems are worked. This allows for immediate feedback and opportunities for intervention. Taken together, the elements of this program are called the "Richardson Model."

This current report includes the results from the previous analysis of student scores through descriptive and Ordinary Least Squares (OLS) regression techniques using the math Normal Curve Equivalent (NCE) Texas Assessment of Knowledge and Skills (TAKS) scores for the academic school year 2004-05 to academic school year 2005-06. It also contains new results from the use of descriptive, OLS regression techniques, and *regression discontinuity* design techniques. In all analyses the outcome variable examined is math TAKS NCE scores.

Methodology

Student Demographic Information

Data provided by the district includes indicators for student ethnicity and whether student is classified as economically disadvantaged. There were no other indicators such as classification as Limited English Proficient (LEP) or participation in Gifted and Talented classes. Students included in the analyses were required to have both a 2005 and 2006 math TAKS score (so change could be assessed). This means that highly mobile students tend to be excluded from the analysis. Students were both 7th and 8th graders in the 2005-06 school year in regular math classes in *Analysis One* and in regular math or Pre AP math classes in *Analysis Two*. The variable "Economically Disadvantaged" is the indicator for whether a student is participating in the federal Free and Reduced Priced Lunch (FRPL) program. If a student is in the FRPL program then they are referred to as *economically disadvantaged*.

Normal Curve Equivalent scores (NCE) were used to compare TAKS tests across years. NCEs are represented on a scale of 1 – 99. The NCE scale corresponds with a percentile rank scale at 1, 50, and 99. Unlike percentile rank scores, the interval between scores is equal. This allows researchers to manipulate the test data algebraically, e.g., comparing across tests across years and subjects. The equivalent NCE score for the 2005 passing was 46.80 for the 6th grade TAKS and 51.60 for the 7th grade TAKS for a mean of 49.20. And for the 2006 TAKS the equivalent NCE score for the passing (scale score 2100) was 51.60 for both 7th and 8th grade.

This report includes two full analyses, the first is from the previous report (August 24, 2006) where only regular math students were assessed through OLS regression. The second analysis presented in this report, assesses students in both regular math and Pre-AP math and also applies OLS regression, however adds the results from the examination through *regression discontinuity design* techniques.

Analysis One

In these analyses, value-added Ordinary Least Squares (OLS) regression models were constructed by using each student's previous-year TAKS score as a proxy for each student's academic level. Using a previous score allowed for a value-added analysis from a baseline test (TAKS) to the following assessment.

A total of four groups of students were compared across analyses. The *study group* received the TI implemented intervention in three 7th grade classrooms and four 8th grade classrooms. Among the intervention group, 79 students had both a 2005 and 2006 math TAKS score. The study students were placed in the classrooms receiving the intervention based on their 2005 math TAKS score. All the students in the study group had a *below* passing score on the math TAKS. Due to the high district mobility rates, many students receiving the intervention (as well as comparison students) were not included in the study because a prior TAKS score was not available.

A second group was located at the same campus. These students were not selected for treatment based on their TAKS scores, these students were the *control group*. A third group, called *comparison students,* was created from another school in the same district with similar demographics (recommended by project director). The comparison student group included 234 7th and 8th graders enrolled in regular math classes (students in Pre-AP math courses were excluded). The final comparison group was all *other 7th and 8th grade students* (N = 1876) in the district that were enrolled in regular math classes (students in Pre-AP math courses were excluded) and had a 2005 and 2006 math TAKS score.

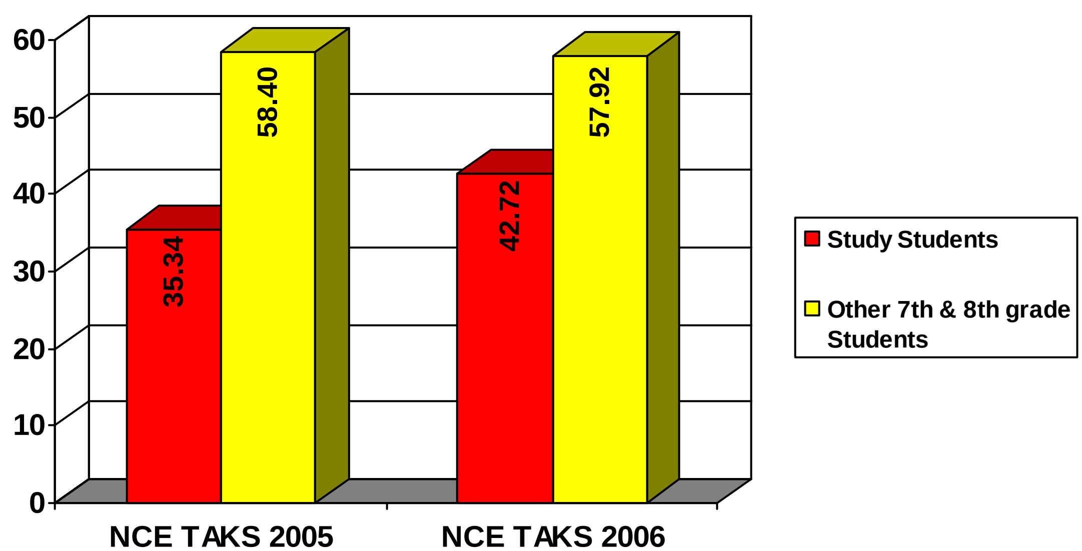
Table 1: Comparison of study group students, control group students, comparison students, and other 7th and 8th grade students in the district.

Percents	% Econ. Disad	% White	% African American	% Hispanic	% Other	% Below Pass 2005	% Below Pass 2006	TAKS 2005 NCE	TAKS 2006 NCE
Study Students[1] N=79	65.8	5.1	69.6	25.3	0	100	67.1	35.34	42.72
Control Students at Study Campus[1,2] N=102	46.8	25.5	49.0	23.5	2.0	0	35.3	62.06	58.58
Comparison Students[1] N=234	59.3	23.9	50.4	21.0	4.7	41.9	53.0	49.36	47.83
Other District Students[1] N=2119	53.0	31.0	28.4	34.0	6.6	28.2	29.2	58.40	57.92

[1] Students in Regular Math with a 2005 *and* 2006 math TAKS score
[2] Control Students all scored *above* passing (2100)

The most striking change noted in Table 1 is the increase NCE mean score of the study students' math TAKS scores from 35.34 in 2005 to 47.72 in 2006. This is particularly noteworthy due to the fact that all three comparison groups had NCE scores decreased from 2005 to 2006. The NCE scores for 2005 and 2006 are illustrated in the bar graph in Figure 1 for each of the four groups of students that were compared across analyses in this first round.

Figure 1: NCE scores of Math TAKS for Regular Math Students



The bars help illustrate that the study student's TAKS NCE score increased from the TAKS 2005 to TAKS 2006 more than the other regular math students in the district.

Analysis Two

In these analyses, a value-added Ordinary Least Squares (OLS) regression models were also constructed by using each student's previous-year TAKS score as a proxy for each student's academic level. In the models that analyze the regression discontinuity design the pre-test scores are changed to create a variance score from the cutoff. This was accomplished by subtracting the cutoff from all pre-test scores (the NCE cutoff that corresponded to each 2005 grade level).

Before continuing, a description of regression discontinuity and its usefulness in *need-based* programs is necessary. Regression discontinuity studies rely on the hypothesis that observations will have a different pattern at a pre-defined point on a continuum (Cook and Shadish, 1994). Or in other words, in the absence of the treatment program, the pre-post relationship of the groups would be equivalent (Trochim, 2006). The regression discontinuity is basically a pretest-posttest program-comparison group design. This type of design is appropriate when educators want to target a program to students who need intervention the most (Trochim, 2006). Assignment of participants to a particular treatment or programs is based on a cutoff point. Because we know that the treatment and control group means differ since the group assignment is based on a pretest score, we can estimate the treatment effect by the size of the projected discontinuity (jump or change) at the cutoff.

The traditional regression discontinuity design requires that all participants must belong to one population prior to being assigned to either the treatment or control group (Shadish, Cook, & Campbell, 2001). This means that it must be possible for all participants in the study to receive treatment had the cutoff been set differently group (Shadish, Cook, & Campbell, 2001). In this context, the 7th and 8th grade students at the study campus are probably the best description of the population, so model 1 is the most appropriate model. For the regression discontinuity design, if there are possible interactions or nonlinearities, it is very important to include these in the model. It is better to over-fit a model because over-fitting still yields unbiased coefficients, although it decreases power. Over specification assures that all necessary terms have been included even at the expense of unnecessary ones. The models presented below are over specified, because upon observing the bivariate distributions, there appears to be only minor flexion points, but when the higher order terms and interactions are included, coefficients for the higher-order terms were significant. As a result higher-order terms were included in the models.

A total of three groups of students were compared across analyses were in regular math or Pre-AP math and all had both a 2005 and 2006 math TAKS score. The *treatment group* received the TI implemented intervention in three 7th grade classrooms and four 8th grade classrooms. Among the intervention group, 79 students had both a 2005 and 2006 math TAKS score. The treatment students were placed in the classrooms receiving the intervention based on their 2005 math TAKS score. All the students in the treatment group had a *below* passing score on the math TAKS. Due to the high district mobility rates, many students receiving the intervention (as well as comparison students) were not included in the treatment because a prior TAKS score was not available.

A second group was located at the same campus. These students were the *control group,* the 7th and 8th grade students not selected for treatment based on their TAKS scores at the same campus. A final group that was analyzed was all the *other 7th and 8th grade students* (N = 3137) in the district that were enrolled in math classes (both regular and Pre-AP math courses) and scored at or above passing.

The means and percents are illustrated in Table 2. Again, the most striking change noted in Table 1 is the increase NCE mean score of the treatment students' math TAKS score from 35.34 NCE score in 2005 to 42.72 NCE score in 2006. Noting that the other two comparison groups had NCE scores decreased from 2005 to 2006.

Table 2: Comparison of treatment group students, control group students, and other 7th and 8th grade students in the district.

Percents	% Econ. Disad	% Wht	% Afric. Amer -ican	% His-panic	% Othr	TAKS 2005 Scale score	TAKS 2006 Scale score	TAKS 2005 NCE	TAKS 2006 NCE
Treatment Students[1] N=79	65.8	5.1	69.6	25.3	0	2002	2052	35.34	42.72
Control Students[2] N= 310	29.0	56.5	26.5	14.8	2.3	2372	2298	73.99	71.38
Other District Students[3] N=3137	34.0	50.4	17.0	23.0	9.8	2379	2309	74.28	72.62

[1] Treatment Students with 2005 *and* 2006 math TAKS scores. The 2005 TAKS score *below* passing.
[2] Control Students with 2005 *and* 2006 math TAKS scores. The 2005 TAKS score *above* passing.
[3] Other Districts Students with 2005 *and* 2006 math TAKS scores. The 2005 TAKS score *above* passing.

The NCE scores for 2005 and 2006 are illustrated in the bar graph in Figure 2a for each of the three groups of students that were compared across analyses. The bars help illustrate that although the treatment student's TAKS NCE scores began low (those who failed TAKS), their scores increased from 2005 to 2006 more than the other 7th and 8th grade students at the same campus or in the district. Figure 2b illustrates the change in math NCE scores for the three groups.

Figure 2a: NCE scores for Math TAKS for All Math Students in 2005 and 2006.

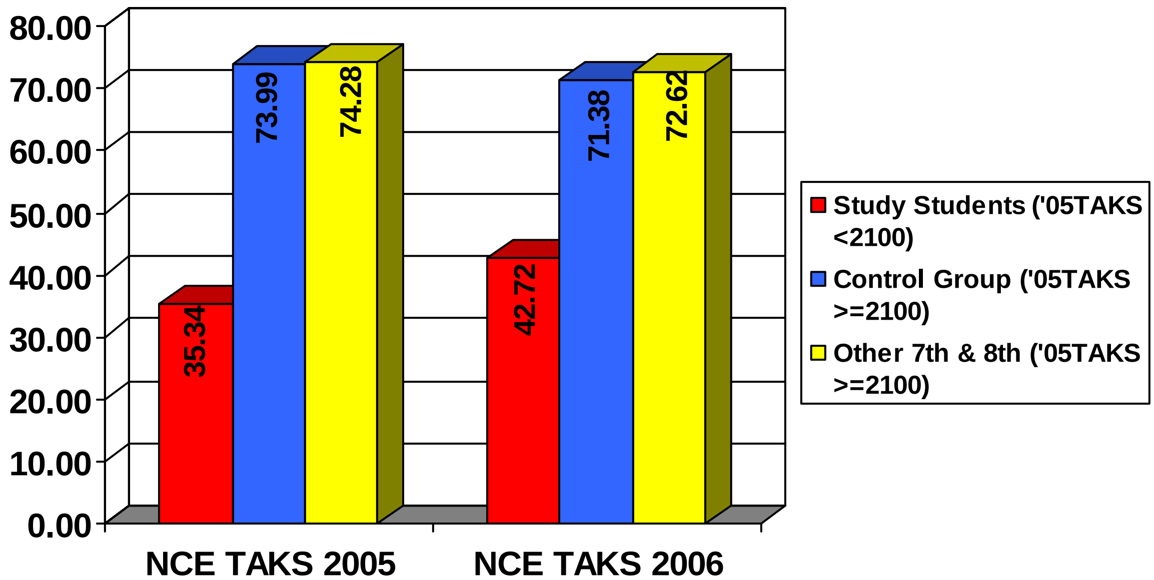
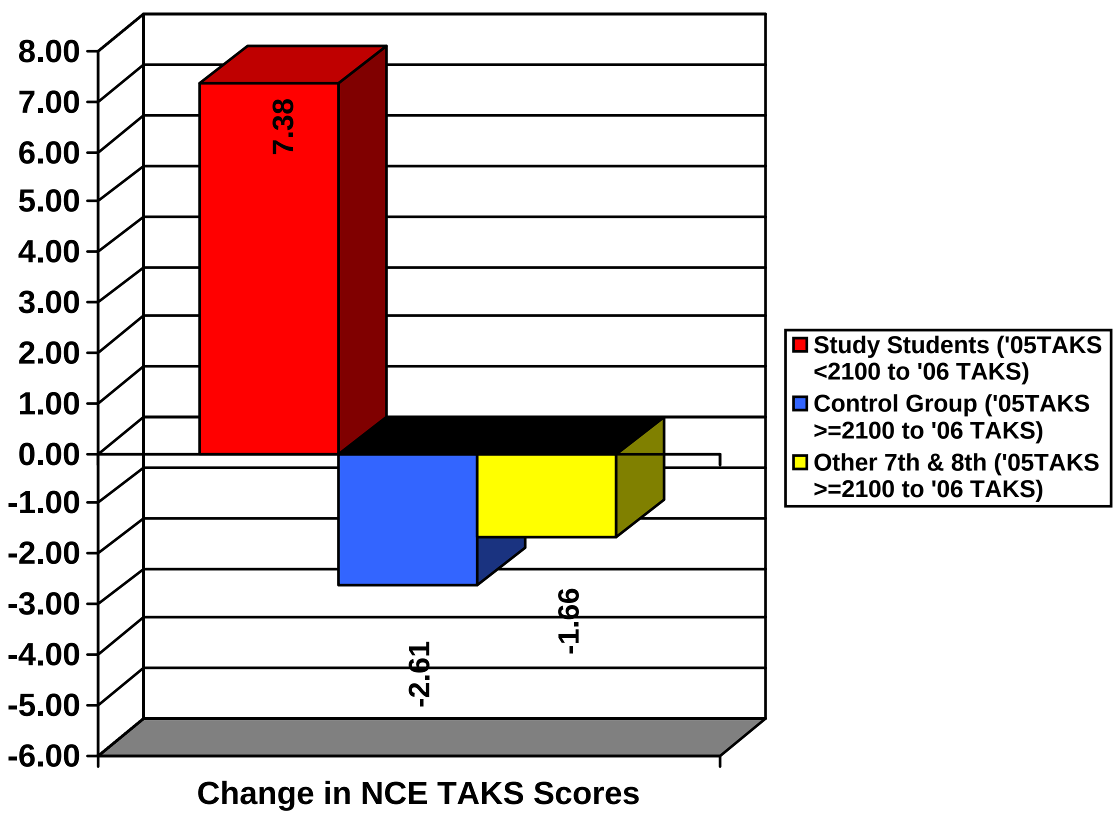


Figure 2b: NCE scores for Math TAKS for All Math Students from 2005 to 2006.



Statistical results

Analysis One

The statistical technique of multiple regression was used to analyze the data. The indicator variables that were used to help control for the types of students taking the exam were if a student was a minority or if a student was classified as economically disadvantaged. For this analysis, the most important variable to examine was the study student variable. Three models were created using the different groups as comparisons.

All assumptions for model validity of regression were examined. The Durban-Watson statistic was used to measure the correlation among the errors to test the independence assumption. A formal test of the assumption of equal variance was made that indicated that the outputs from the final model outputs did not present a statistically significant departure from equal variance.

The two models presented examined TAKS growth from the 2005 to 2006 administration. Due to the low numbers (particularly for the study students) the 7th and 8th grade students were combined to form one group.

The dependent variable is the 2006 math TAKS NCE for each student. A previous 2005 math TAKS NCE score for each student is included as an independent variable. This is included as a *proxy* for previous learning and allows for a value-added analysis from a baseline year to assess growth (change) in student scores. In general student test scores of economically disadvantaged and minority students tend to be significantly less than those of non-economically disadvantaged and non-minority students. The variables used as controls for economically disadvantaged and minority status are applied to help take into account the effect these individual characteristics tend to have on test scores.

The major findings for Model 1 (Table 3), indicate that study students, on average, tend to have a significantly higher growth in percent items correct than the comparison students $F(295, 4) = 82.25$, $p < .001$, $R^2 = .53$. These results include controlling for economically disadvantaged status and minority status (See Table 3). Study student's estimated math NCE score tends to be 5 NCE points greater in gains than comparison students. Although, not statistically significant, minority students tend to have a lower math TAKS gain than non-minority comparison students.

Table 3: Model 1: Regression Results-TAKS Math — study and comparison students (2005-06)

Variables[1]	Unstandardized coefficients		Standardized coefficients		
	B	Std. error	Beta	*t*	Sig.
TAKS 2005 NCE	0.734	0.042	0.758	17.363	0.000**
Students in study campus	5.022	1.720	0.127	2.919	0.004*
Minority	-2.094	2.562	-0.034	-0.817	0.414
Econ. disadvantaged	0.175	1.625	0.005	0.107	0.915

[1] Dependent variable: TAKS 2006 NCE

Note. R^2 = .532, Durbin-Watson = 2.024, Cohen's *d* effect size = -0.93, N = 295
*p<.05. **p<.001.

The major findings for Model 2 (see Table 4), indicate that study students, on average, tend to have a slightly higher growth (although not significant) in NCE than the other 7th and 8th grade students in regular math in the district while controlling for the comparison students F(2070, 4) = 612.425, p< .001, R^2 = .54. These results include controlling for economically disadvantaged status and minority status (See Table 4). Study students' estimated NCE score increase tends to be almost 1 NCE point higher the other 7th and 8th grade students in the district, but is not significant. Minority students tended to have significantly less gains in math TAKS than the non-minority 7th and 8th grade district students.

Table 4: Model 2: Regression Results-TAKS Math — study students compared to rest of 7th and 8th graders in the district (including comparison campus) (2005-06)

Variables[1]	Unstandardized coefficients		Standardized coefficients		
	B	Std. error	Beta	*t*	Sig.
TAKS 2004 NCE	0.674	0.016	0.685	43.155	0.000**
Students in study campus	0.971	1.764	0.008	0.550	0.582
Minority	-4.680	0.621	-0.133	-7.533	0.000**
Econ. disadvantaged	-0.389	0.594	-0.011	-0.654	0.513

[1] Dependent variable: TAKS 2006 NCE
Note. R^2 = .54, Durbin-Watson = 0.429, Cohen's *d* effect size = -0.89[1], N = 2070
*p<.05. **p<.001.

Analysis Two

The second type of analysis utilized the regression discontinuity design. This design also uses the statistical technique of multiple regression. The indicator variables that were used to help control for the types of students taking the exam were if a student was classified as economically disadvantaged. For this analysis, the most important variable to examine was the treatment student variable. Two models were created using the different groups as comparisons. The two models presented examined TAKS growth from the 2005 to 2006 administration. Due to the low numbers (particularly for the treatment students) the 7th and 8th grade students were combined to form one group.

All assumptions for model validity of regression were examined. The Durban-Watson statistic was used to measure the correlation among the errors to test the independence assumption. A

[1] The negative sign indicates that the control group has a higher mean TAKS score than the treatment group. Effect sizes can be thought of as the average percentile standing of the average treatment student relative to the average control student. A Cohen's d of –0.89 indicates that the mean of the treatment group is at about the 82nd percentile of the control group.
Effect Size, (2001), http://web.uccs.edu/lbecker/Psy590/es.htm#II.%20independent

formal test of the assumption of equal variance was made that indicated that the outputs from the final model outputs did not present a statistically significant departure from equal variance.

The dependent variable is the 2006 math TAKS NCE for each student. A previous 2005 math TAKS NCE score for each student is included as an independent variable. This is included as a *proxy* for previous learning and allows for a value-added analysis from a baseline year to assess growth (change) in student scores. In general student test scores of economically disadvantaged students tend to be significantly less than those of non-economically disadvantaged. The variable used as a control for economically disadvantaged status was applied to help take into account the effect of being economically disadvantaged tends to have on test scores. There were only four students in the treatment group who were not minority. Due to such a low “cell” count for minority students, the variable for economically disadvantaged was chosen as a control, since 66% students were classified as economically disadvantaged (27 students in the treatment group were not classified as economically disadvantaged.

Table 5: Model 3: Regression Results-TAKS Math — treatment and control students (2005-06) describing the Regression Discontinuity design.

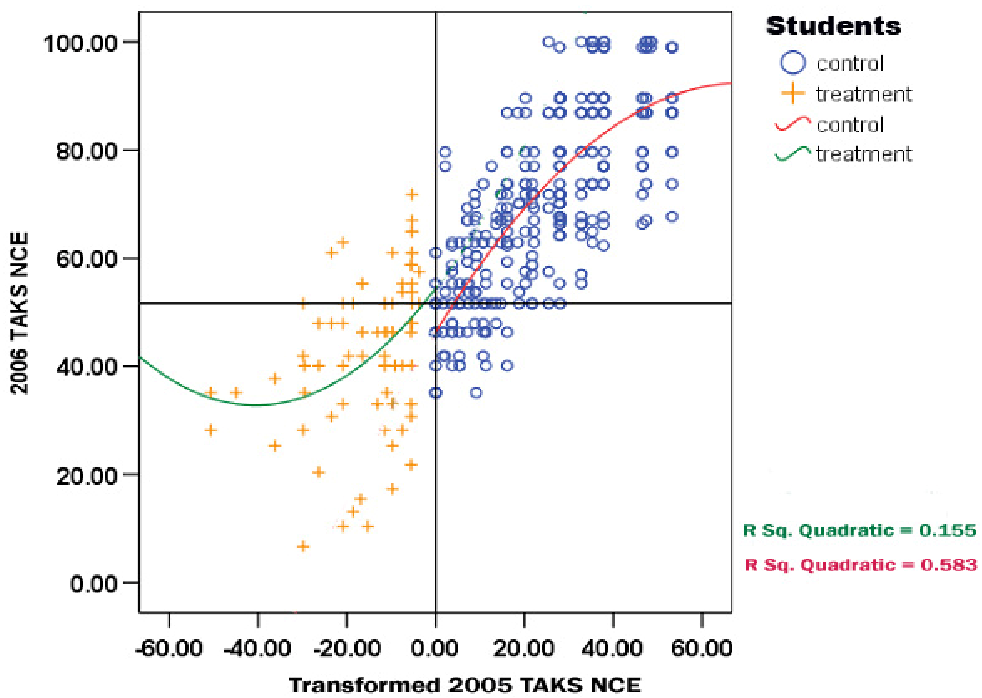
Variables[1]	Unstandardized coefficients		Standardized coefficients		
	B	Std. error	Beta	*t*	Sig.
Transformed 2005 NCE-Pre-test	1.293	0.154	1.400	8.410	0.000**
Economically Disadv.	-2.874	1.285	-0.070	-2.236	0.026*
Treatment Students	7.854	3.913	0.159	2.007	0.045*
Pre-test X Treatment	-0.266	0.413	-0.105	-0.643	0.520
Square Pre-test	-0.009	0.003	-0.363	-3.250	0.001*
Square Pre-test X Treatment	0.022	0.009	0.003	2.569	0.011*

[1] Dependent variable: TAKS 2006 NCE
Note. R^2 = .684, Durbin-Watson = 1.208, Cohen’s *d* effect size = -1.77[2], N = 389
*p<.05. **p<.001.

Some interactions and nonlinearities were accounted for in this model, resulting in a quadratic curve in the model. The major findings for Model 1 (Table 5), indicate that treatment students, on average, tend to have a significantly higher growth in TAKS NCE than the control students $F(388, 6) = 137.835$, $p < .001$, $R^2 = .684$. These results include controlling for economically disadvantaged status. Treatment students estimated NCE score tends to be almost 8 NCE points greater in gains than comparison students. Low SES students tend to have a lower math TAKS gain than high SES students in both groups. Because the interaction is negative, the effect of being in the treatment group is greater for students with lower pretest scores.

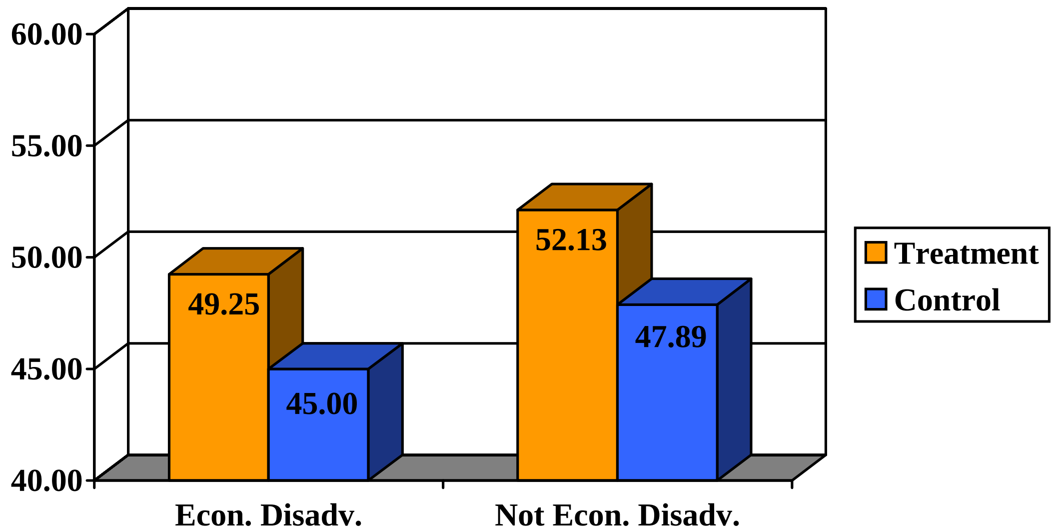
[2] A Cohen’s *d* of -1.77 indicates that the mean of the treatment group is at about the 96th percentile of the control group.

Figure 3: Regression Discontinuity for treatment and control students



The lines have a curve to them, which indicates that there is a quadratic shape present in the data. Scores can be assessed at the cutoff score of TAKS scale score of 2100 (or zero transformed score). In regression discontinuity, the cutoff is important because this is where students are the most similar. Looking at students that are very similar and at the cutoff range can help illustrate the difference between the treatment and control groups. Results when looking at students at the cutoff indicate that for a student in the treatment group just under cut transformed pretest score, if they are economically disadvantaged, their predicted NCE score would be 49.25, and for students who are not economically disadvantaged (not on FRPL) their predicted NCE would be 52.13. This is in contrast to the control group, the students in the control group, who are economically disadvantaged, their predicted NCE score would be 45.02, and for control students who are not economically disadvantaged (not on FRPL) their predicted NCE would be 47.89 (see Figure 3).

Figure 4: Student score differences at the cutoff for the predicted math NCE scores



Since the student are so similar at the cutoff (their 2005 pretest score was very close to the same), is important to look at the differences in the predicted scores for each group at the cutoff. As seen above in Figure 4, the treatment group tends to have higher predicted math NCE scores than the control group for both the students classified as economically disadvantaged and those not classified as economically disadvantaged.

Table 6: Regression Models for Lake Highlands- these models contain the interaction term, quadratic term and quadratic/interaction term. Calculations for the predicted math 2006 TAKS scores for students at the cut-score are presented. All treatment effects were significant.

Models	No demog variables		Low- SES		Minority		Minority and Low-SES	
	Trtmnt	Cntrl	Trtmnt	Cntrl	Trtmnt	Cntrl	Trtmnt	Cntrl
Model R^2	.680		.684		.688		.688	
β for trtmnt grp	8.023		7.854		8.369		8.268	
Std. Error trtmnt	3.933		3.913		3.893		3.898	
Sig. for trtmnt grp	.042*		.045*		.032*		.035*	
TAKS NCE at Cut	50.62	46.36						
TAKS NCE at Cut Hi-SES			52.13	47.89			54.44 (non-min)	49.84 (non-min)
TAKS NCE at Cut Lo-SES			49.25	45.02			53.24 (non-min)	48.64 (non-min)
TAKS NCE at Cut Non-Min					54.40	49.73	54.44 (hi-ses)	49.84 (hi-ses)
TAKS NCE at Cut Min					50.28	45.60	50.96 (hi-ses)	46.36 (hi-ses)
TAKS NCE at Cut Non-Min & Hi-SES							54.44	49.84
TAKS NCE at Cut Min & Lo-SES							49.76	45.16

*p<.05. **p<.001.

In the second model in this analysis, the treatment group is compared to the rest of the 7th and 8th grade students in the district that scored above passing. Some interactions and nonlinearities were also accounted for in this model. The major findings for Model 4 (see Table 7), indicate that treatment students, on average, tend to have a higher growth (although not statistically significant) in NCE than the other 7th and 8th grade students in the district $F(3215, 8) = 468.054$, $p < .001$, $R^2 = .538$. These results include controlling for economically disadvantage status (See Table 7).

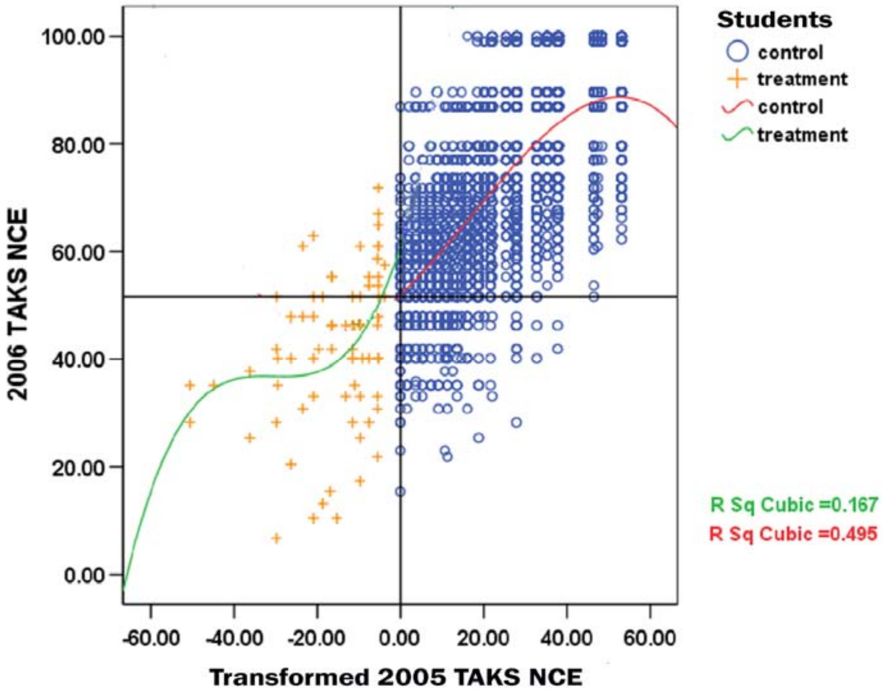
Table 7: Model 4: Regression Results-TAKS Math — treatment students compared to rest of 7th and 8th graders in the district (including comparison campus) (2005-06)

Variables[1]	Unstandardized coefficients		Standard-ized coefficients		
	B	Std. error	Beta	*t*	Sig.
Transformed 2005 NCE-Pre-	.643	.116	.611	5.562	.000**
Economically Disadvantaged	-5.858	.440	-.169	-13.329	.000**
Treatment Students	10.622	6.438	.097	1.650	.099
Pre-test X Treatment	1.862	1.181	.317	1.576	.115
Square Pre-test	.012	.005	.577	2.376	.018*
Square Pre-test X Treatment	.073	.056	.412	1.310	.190
Cube pretest	.000	.000	-.567	-3.670	.000**
Cube pretest X Treatment	.001	.001	.278	1.6286	.104

[1] Dependent variable: TAKS 2006 NCE
Note. $R^2 = .552$, Durbin-Watson = 0.380, Cohen's *d* effect size = -1.82, N = 3216
*p<.05. **p<.001.

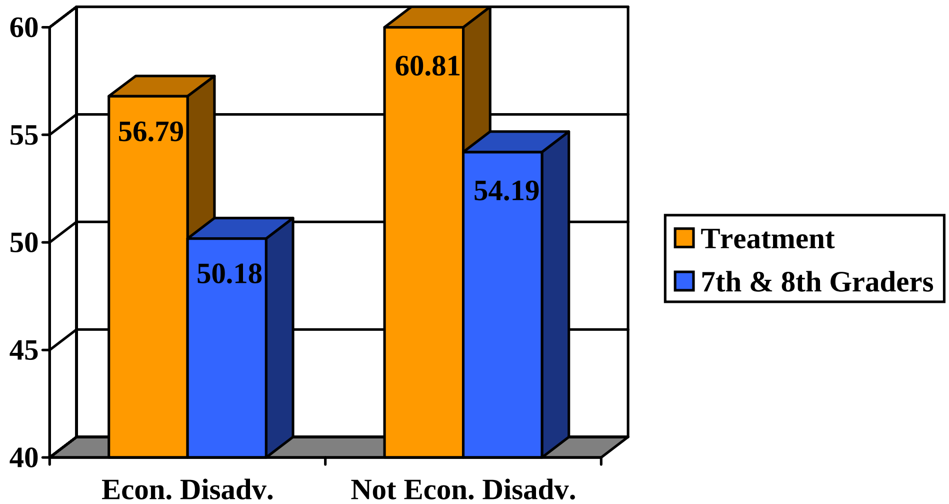
Treatment students' estimated math NCE score increase tends to be 10 NCE point higher the other 7th and 8th grade students in the district, but is not statistically significant. While on average all treatment students tend to have higher math scores, those students who are economically disadvantaged students have lower gains in math TAKS than the non-economically disadvantaged for both the treatment and comparison group 7th and 8th grade students (almost 6 points lower).

Figure 5: Regression Discontinuity for treatment and 7th and 8th grade students in the district



Although, the statistical results indicate that the treatment group is not statistically different from the other 7th and 8th grade students in the district, we can again examine the students that are very similar at the cutoff range. For students at the cutoff range that are in the treatment group just under the transformed pretest score, if they are economically disadvantaged, their predicted math NCE score would be 56.79, and for students who are not economically disadvantaged (not on FRPL) their predicted math NCE would be 60.81. This is in contrast to the control group, the students in the control group, who are economically disadvantaged, their predicted math NCE score would be 50.18, and for control students who are not economically disadvantaged (not on FRPL) their predicted math NCE would be 54.19. Although, not statistically significant, the same pattern appears in this model (Model 4) as in the previous model (Model 3): the treatment students at the cutoff tend to have higher growth in TAKS scores than similar control students at the cutoff as illustrated in Figure 6.

Figure 6: Student score differences at the cutoff for the Treatment and All 7th and 8th graders



Again, examining the students at the cutoff allows us to compare similar students. Looking at the differences in the predicted scores for each group at the cutoff (Figure 6), the treatment group tends to have higher predicted math NCE scores than the control group for both the students classified as economically disadvantaged and those not classified as economically disadvantaged. Although, the results between the two groups were not statistically significant, the same pattern does continue to be seen in this model as well.

Table 8: Regression Models for Lake Highlands- these models contain the interaction term, quadratic term, quadratic/interaction term, cubic term and cubic/interaction term. None of the treatment effects were significant.

Models	No demog variables	Low-SES	Minority	Minority and Low-SES
	Trtmnt	Trtmnt	Trtmnt	Trtmnt
Model R^2	.527	.539	.552	.692
β for trtmnt grp	8.802	8.154	10.622	12.292
Std. Error trtmnt	6.611	6.532	6.438	6.659
Sig. for trtmnt grp	.183	.212	.099	.066

Summary

This report describes an analysis of an intervention with the goal of enhancing mathematical understanding through the use of graphing technology, in-classroom networks and daily problem solving. The intervention has been implemented in several 7th and 8th grade math classes in a Texas school district. This analysis examined changes in TAKS math scores of student receiving the intervention compared to students not receiving the intervention in the academic school year 2005-06.

These results for all four models presented, indicate that students that are in the treatment group, who received the intervention program, tend to have an increase in the math TAKS assessment scores.

For *Analysis One*, results indicate that being included in the study group tends to predict an increase in the math TAKS assessment. The first model (Table 3), indicated that the estimated math TAKS NCE score tends to be about 5 NCE points greater in gains than comparison students. However, in the second model (Table 4), the study group change was not statistically significant, although the coefficient was positive, indicating that scores for the study students increased slightly compared to other 7^{th} and 8^{th} grade students in the district.

In *Analysis Two*, the third model (Table 5), indicated that the estimated math TAKS NCE score for treatment students tends to be almost 8 NCE points greater in gains than control students. A significant discontinuity was found at the cutoff for differences between the treatment students and the control students at the same campus.

However, in the fourth model (Table 7), the treatment group change was not statistically significant, although the coefficient was positive, indicating that scores for the treatment students tend to increase compared to other 7^{th} and 8^{th} grade students in the district. In this model there was a discontinuity observed at the cutoff, but the treatment group growth was not significantly different from the other 7^{th} and 8^{th} grade students in the district.

Although, causal conclusions can not be made, the students in the treatment program appear to have benefited the intervention and from the key components which included: extended learning time, use of technology to motivate and enhance learning opportunities, provision of common, aligned assessments, increased teacher content knowledge, and development of high expectations for all students. The goal of this systemic intervention was improve mathematics achievement. Results indicate that students who received the intervention had on average, higher math TAKS scores that the students not receiving the intervention.

The research design that utilizes Regression Discontinuity Design (RDD) was applied to produce a “gold standard” study without major disruption of normal school work. These research results indicate that applying an intervention program to those students most in need (students not passing the math TAKS), can produce both high quality research results and benefit students in need.

Based on these analyses and given the goals of the program, the Richardson Model for improving math TAKS results can be considered a success. In addition, the successful use of regression discontinuity design and the consistency in the increases shown under both the regression discontinuity analyses and Ordinary Least Squares analyses speak to the effectiveness of the statistical approaches advanced in this research project.

Further examination of the district administered *Benchmark* tests will be made. From this researchers hope to better understand the connection of program implementation, student progress toward learning objectives, and test performance. Finally, larger "N" or number of students involved in future projects may help some of the positive trends observed in this project reach the level of being statistically significant.

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