Texas Instruments MathForward Intervention

2007-08 Teacher Knowledge for Teaching Mathematics Assessments

Prepared by

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Executive Summary

Continuing as part of the larger MathForward project, 67 teachers across five sites completed the Content Knowledge for Teaching Mathematics (CKT-M) assessment to help track any changes in pedagogical and content knowledge related to their participation in the intervention. In the past, scores on this assessment were shown to relate to important student educational outcomes across participating sites. While this year's assessment did show some limited evidence of a positive association between CKT-M domain scores and student performance on statewide tests, participation rates and difficulties in initial administration schedules limited the power of the evaluation effort.

Introduction

Teacher knowledge within a given subject has been shown to be an important factor in successful educational outcomes. In recent years, much attention has focused on mathematics teaching, and measuring teachers' subject knowledge can offer insight into the success of intervention programs. Over the past few years, as part of Texas Instruments' MathForward program, participating teachers have agreed to complete the Content Knowledge for Teaching Mathematics assessment (CKT-M) developed by Deborah Ball and her associates[1]. Past research has shown that scores on this assessment are related to student success in math, and over the past few years this assessment has been positively linked with achievement outcomes in the MathForward schools. Five districts participated in this year's assessment, and although the scheduling and level of participation was not as consistent as past years, some evidence of teacher content knowledge growth was obtained.

Methodology

Table one summarizes the participation rates within and across the districts. The number of teachers being assessed was relatively lower than in prior years due to the late start in initial testing and conflicts with state testing schedules at the end of the academic year. Data were collected during the fall assessment period from late September through December, while the spring assessments were completed in April and May. Somewhat more teachers completed the initial round of assessment, and overall 41 teachers complete both the pre- and post-tests.

Table 1: Assessment Period Participation Rates

District/School	Fall Assessment	Spring Assessment	Both
Richardson ISD	20	12	12
Dallas ISD	7	9	6
Palm Beach SD	11	13	8
Stark/Summit Collective	25	12	11
Brentwood (Edna Hill MS)	4	4	4
Overall	67	50	41

The lower participation rates led to some problems in interpretation with this assessment as the number of teachers in some districts was too low to yield reliable results and the smaller set of teachers completing both the pre- and post-tests assessments further limits subsequent analysis possibilities. In addition, the comparisons that can be made are also limited due to the lack of available teacher-level outcome results as only Richardson ISD

[1] Hill, H. C. & Ball, D. L. (2004) Learning mathematics for teaching: Results from California's Mathematics Professional Development Institutes. Journal of Research in Mathematics Education 35, 330-351.

and Edna Mills Middle School in Brentwood reported teacher-level results from the year-end student assessments.

Teacher Mathematics Content Level by District

When compared with results from prior years across the districts, some evidence of growth in content knowledge in the two domains assessed is present. The district average CKT-M results for 2006-07 appear in Table 2, and those for 2007-08 in Table 3. Three of the districts (Richardson, Dallas and Palm Beach) were assessed in both periods while two additional sites were added for the 2007-08 year. Scores on the CKT-M domains are reported in standard deviation units, with a mean of 0.0 representing average teacher knowledge on the assessment. In the 2006 academic year, the averages for each of the districts fell within .4 units above or below average.

Table 2: 2006-07 District Averages on CKT-M Domains

District	2006-07 Numbers and Operations Average	2006-07 Patterns, Functions and Algebra Average
Richardson ISD	.2294	.3953
Dallas ISD	-.0756	-.0200
Palm Beach	.1820	-.2310

As illustrated in Table 3 below, for the teachers assessed this year in both Richardson ISD and Palm Beach SD, the district average scores on the CKT-M domains are higher. Dallas ISD is also higher in the Numbers and Operations domain, but the average in Patterns, Functions and Algebra is slightly lower. The Stark/Summit Collaboration and Brentwood are in their first year of participation, but there scores are reported for comparisons purposes. As there are different teachers contributing to these average scores, no growth assumptions can be made. The average level of knowledge of the teachers participating in the MathForward program is higher in five of the six comparisons.

Table 3: 2007-08 District Averages on CKT-M Domains

District	2007-08 Numbers and Operations Average	2007-08 Patterns, Functions and Algebra Average
Richardson ISD	.4537	.4645
Dallas ISD	.1046	-.0239
Palm Beach	.2263	.3350
Stark/Summit	.4130	-.2290
Brentwood	1.3625	1.320

Gains in Teacher Math Content Knowledge in 2008

For those who did complete both assessments, the longitudinal results are presented in Table 4. Teachers in three of the five districts on average showed growth on their Numbers and Operations score, while improvement was evident for only two of the district averages in the Patterns, Functions and Algebra Score. When combined overall, however, modest improvement is shown for both domains over the year.

Table 4: 2007-08 Average Gains in Teacher Mathematics Content Knowledge

District	2007-08 Pre-test Numbers and Operations Average	2007-08 Post-test Numbers and Operations Average	2007-08 Pre-test Patterns, Functions and Algebra Average	2007-08 Post-test Patterns, Functions and Algebra Average
Richardson ISD	.7416	.7299	.7765	.8128
Dallas ISD	-.4512	-.1247	-.0172	-.0710
Palm Beach	-.0164	.0421	.3299	.3011
Stark/Summit	.1442	.0180	-.5569	.0590
Brentwood	1.0535	1.3625	1.4365	1.3200
Overall	.2693	.3294	.2757	.4206

(note that averages only include scores for teachers who completed both fall and spring assessments)

CKT-M Scores and District Assessment Outcomes

In past years, scores on the CKT-M assessments were positively associated with scores on state mathematics assessments. In this year's round of assessments, only two of the districts (Richardson and Brentwood) provided teacher-level outcome data derived from the student scores on the annual state tests. The Brentwood site consists of only a single school with four teachers completing the assessments, a sample too small to yield reliable comparisons.

In Richardson ISD, Table 5 reports the correlations between the Percentage Correct on the TAKS Mathematics Test, the Class Percentage for Meeting the Minimum Standard, and the Teachers' CKT-M Domain Averages. While the scores on the CKT-M domains are related, the important associations here are between the CKT-M Domains (Numbers and Operations and Patterns, Functions, and Algebra) and outcome criteria from the state year-end student assessment, the mathematics portion of the Texas Assessment of Knowledge and Skills (TAKS). Of concern here is the classroom average of percent correct on the assessment, and the percentage of students within each class the meet the minimum passing standard.

Table 5: Associations between TAKS Results and CKT-M Domain Averages in RISD

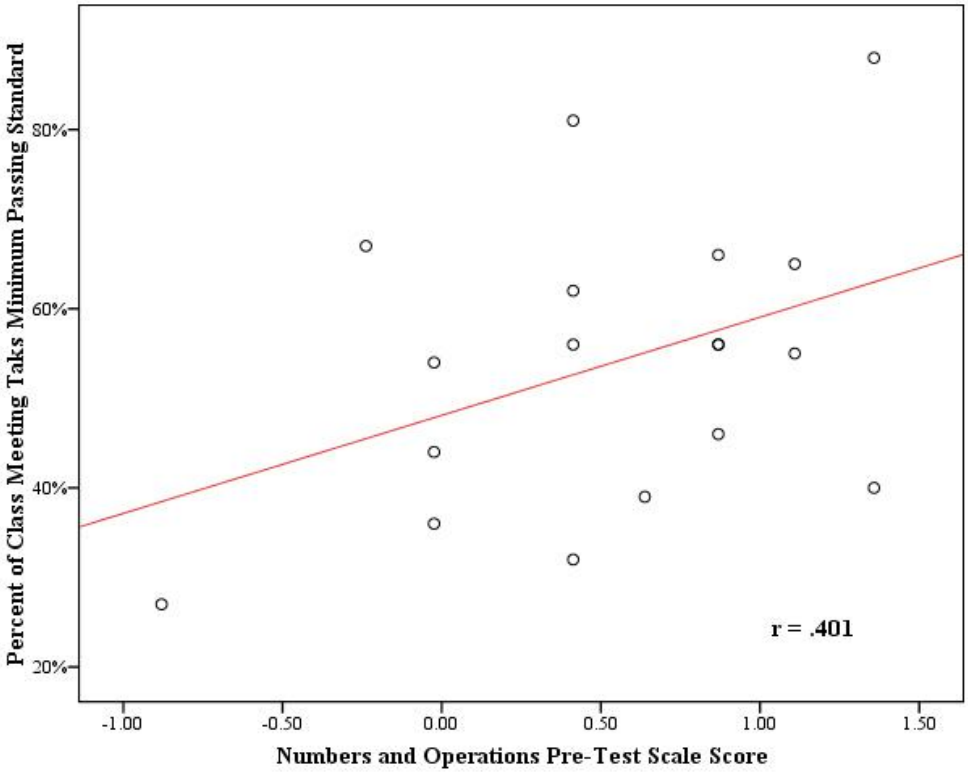
		Class Met Minimum Percentage	NCO Pre-Test Average	PFA Pre-Test Average	NCO Post-Test Average	PFA Post-Test Average
Class Correct Percentage	Pearson Correlation	.870(**)	.383	-.141	.166	-.216
	Sig. (1-tailed)	.000	.058	.289	.303	.250
	N	18	18	18	12	12
Class Met Minimum Percentage	Pearson Correlation	1	.401(*)	.048	.384	.080
	Sig. (1-tailed)		.049	.425	.109	.403
	N		18	18	12	12
NCO Pre-Test Average	Pearson Correlation			.655(**)	.746(**)	.322(*)
	Sig. (1-tailed)			.000	.000	.020
	N			67	41	41
PFA Pre-Test Average	Pearson Correlation				.578(**)	.460(**)
	Sig. (1-tailed)				.000	.001
	N				41	41
NCO Post-Test Average	Pearson Correlation					.676(**)
	Sig. (1-tailed)					.000
	N					50

** Correlation is significant at the 0.01 level (1-tailed).

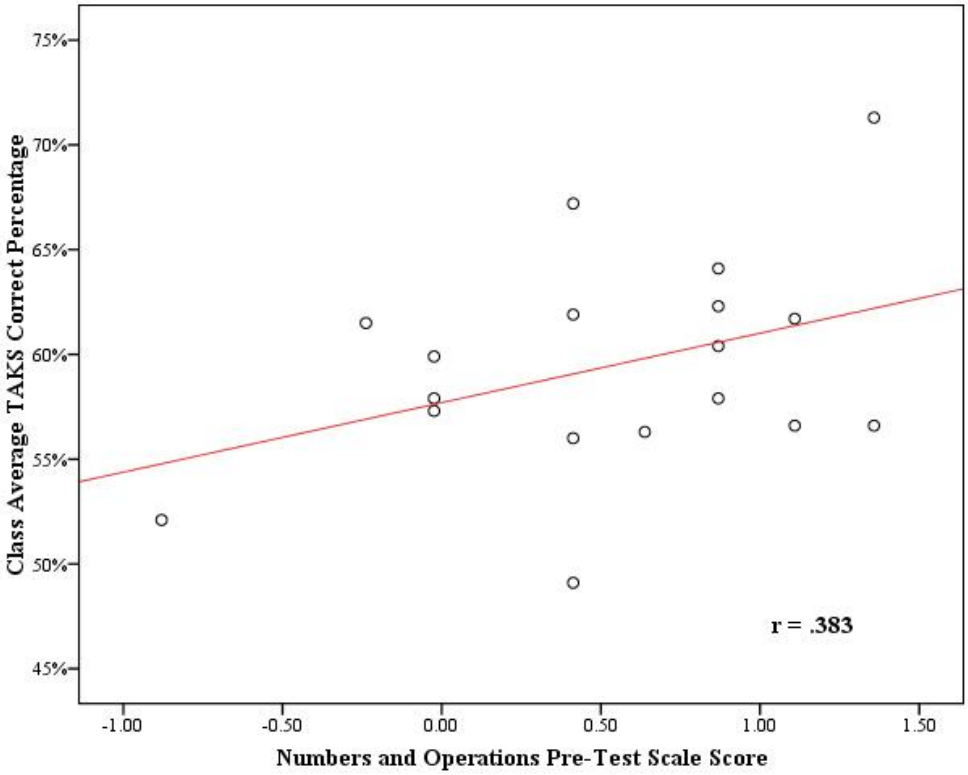
* Correlation is significant at the 0.05 level (1-tailed).

The only association shown between the Math Knowledge Assessment Domains and the TAKS results appears for the Pre-Test Numbers and Operations Scores. The Teachers' Number and Operations Pre-Test Scores are positively associated with the percentage of the class meeting the minimum TAKS passing standard (**r** = .401, **p** = .049), and also show a positive trend with the classroom average percent correct on the TAKS (**r** = .383, **p** = .058). The correlations with the post-test scores show a similar magnitude, but because of the drop-off in the number of teachers completing the post-test assessment, this correlation did reach significance. Graphs 1 and 2 below illustrate the associations with the pre-test scores, while post-test graphs are included in appendix 1.

Graph 1: Teachers' Numbers and Operations Pre-Test Score associated with Classroom Percentage of students meeting the TAKS Minimum Standard



Graph 2: Teachers' Numbers and Operations Pre-Test Score associated with Classroom Average TAKS Percent Correct



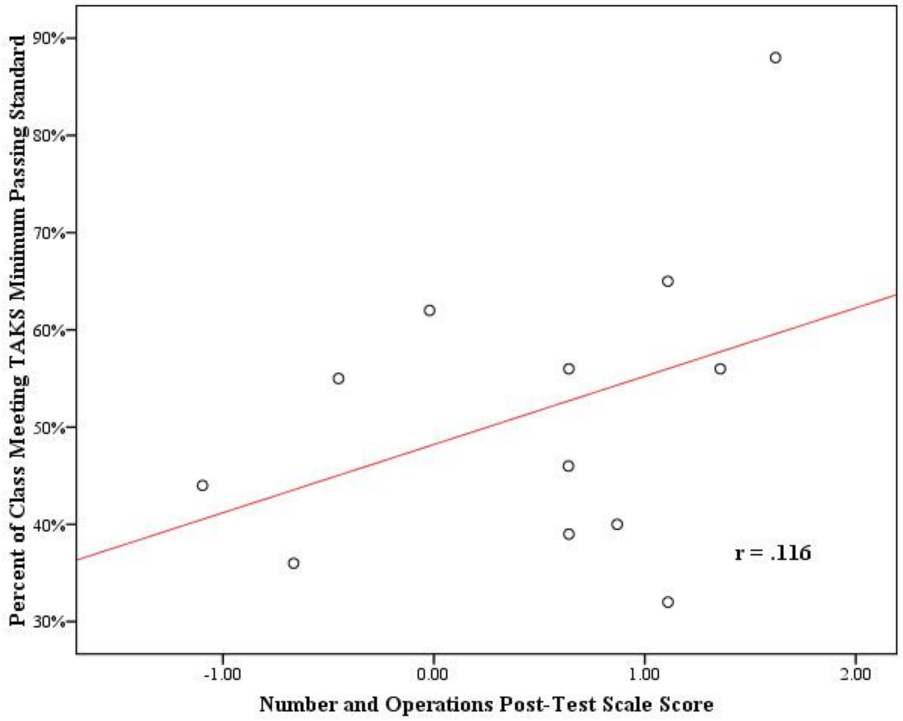
Conclusions

Given the difficulties encountered during the initial administration period and the low response and relatively high attrition rate illustrated in this assessment's time frame, it is not too surprising that few solid outcomes were derived from these results. Overall, however, it does seem that the level of knowledge that the participating teachers are bringing into the classroom is increasing, and these assessments do show some relationship with important outcomes where we have available data to test.

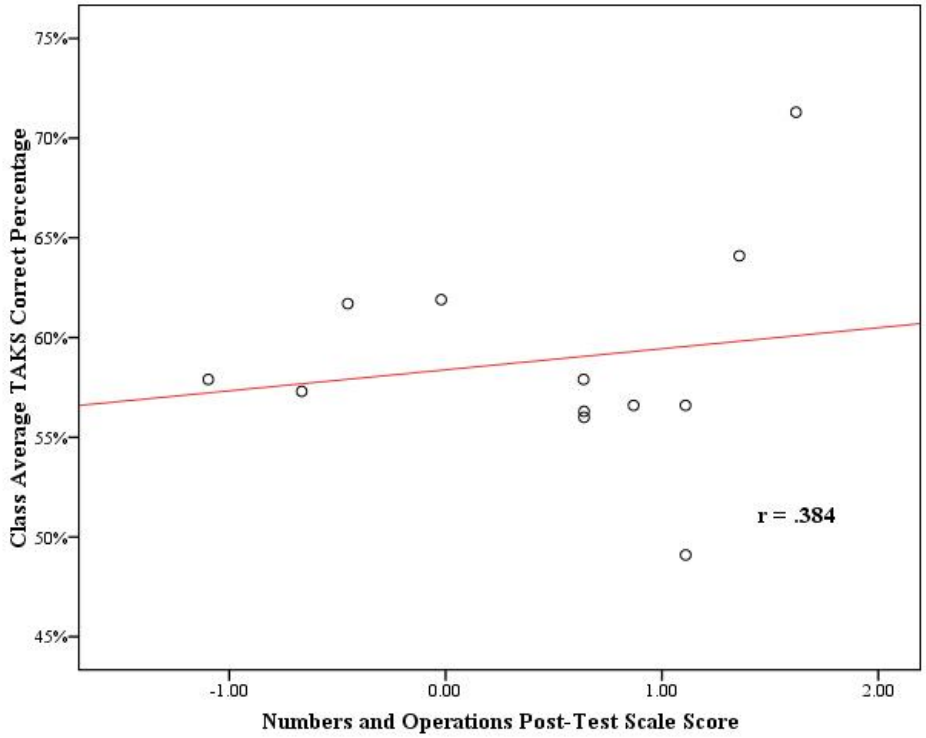
In subsequent years, more longitudinal questions and direct comparison with prior results could be obtained if the continuing teachers across all of the sites are brought into the evaluation.

Appendix 1: CKT-M Domain – Outcome Association Scatterplots

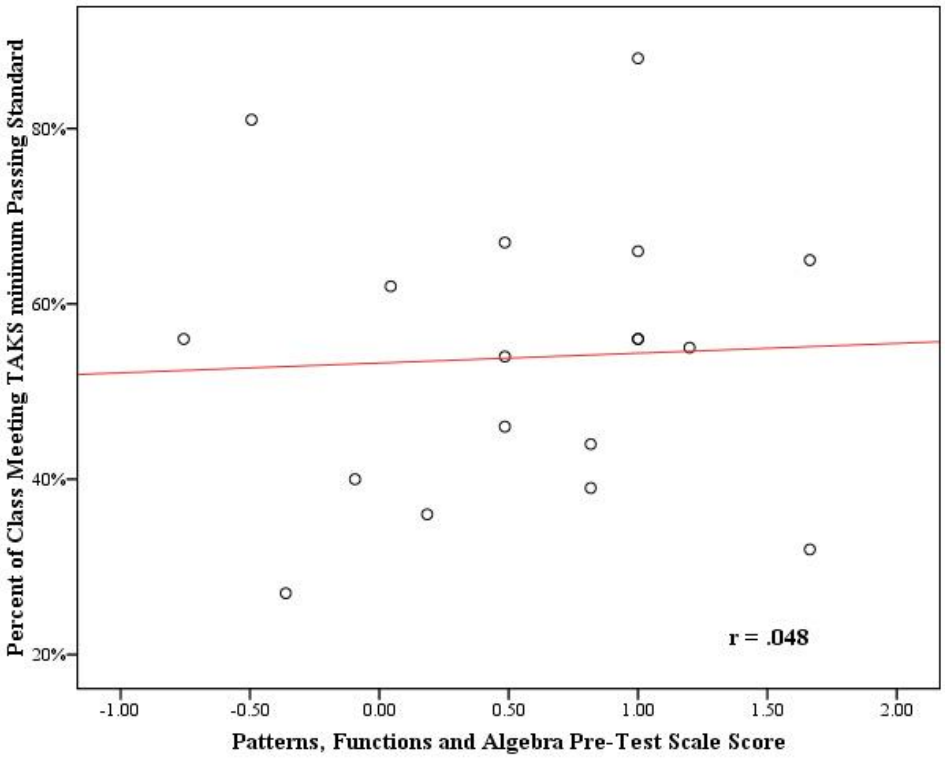
Graph 3: Teachers' Numbers and Operations Post-Test Score associated with Classroom Percentage of students meeting the TAKS Minimum Standard



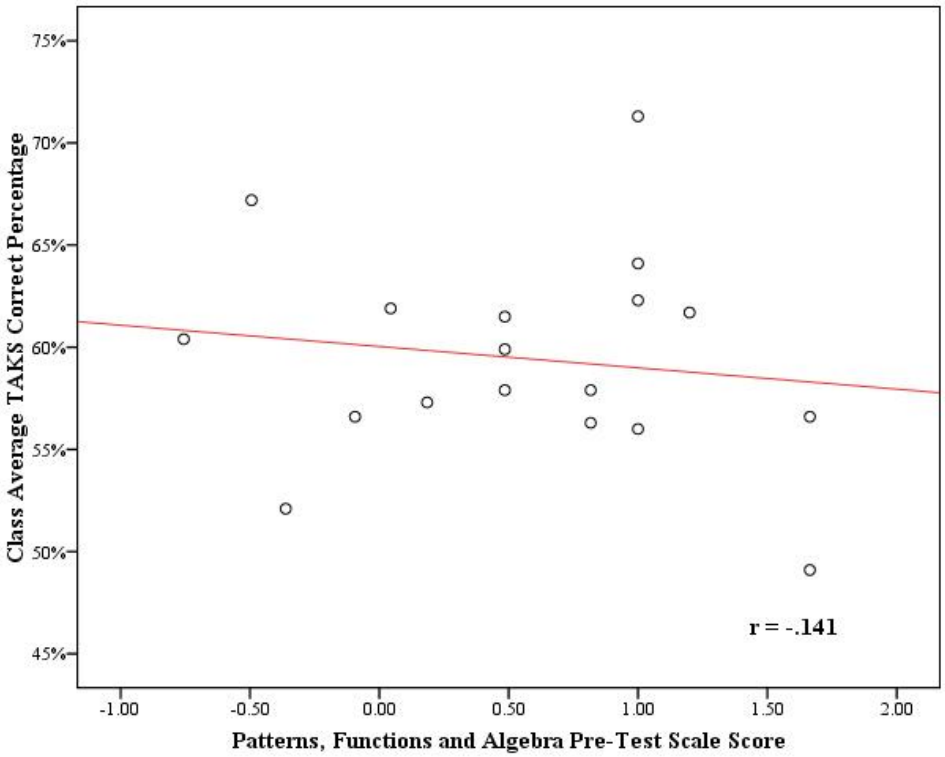
Graph 4: Teachers' Numbers and Operations Post-Test Score associated with Classroom Average TAKS Percent Correct



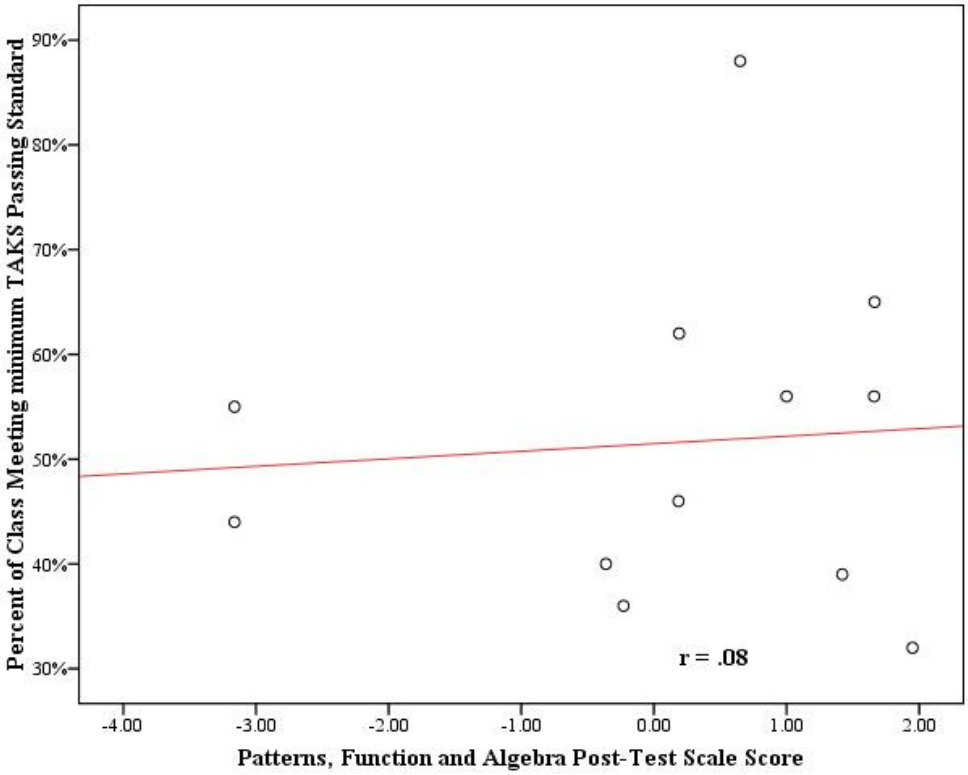
Graph 5: Teachers' Patterns, Functions, and Algebra Pre-Test Score associated with Classroom Percentage of students meeting the TAKS Minimum Standard



Graph 6: Teachers' Patterns, Functions, and Algebra Pre-Test Score associated with Classroom Average TAKS Percent Correct



Graph 7: Teachers' Patterns, Functions, and Algebra Post-Test Score associated with Classroom Percentage of students meeting the TAKS Minimum Standard



Graph 8: Teachers' Patterns, Functions, and Algebra Post-Test Score associated with Classroom Average TAKS Percent Correct