MEMORANDUM January 16, 2015

TO: Board Members

FROM: Terry B. Grier, Ed.D.
Superintendent of Schools

SUBJECT: **THE EFFECT OF THE BAYLOR COLLEGE OF MEDICINE SUMMER SCIENCE INSTITUTE ON HISD ELEMENTARY AND MIDDLE SCHOOL STUDENTS' SCIENCE PERFORMANCE, 2013–2014**

CONTACT: Carla Stevens, (713) 556-6700

A total of 345 HISD teachers participated in the Baylor College of Medicine Summer Science Institute (BCMSSI) which offered professional development in current and effective teaching strategies, in-depth science content lessons, assessment, and relevant science concepts aligned to Texas Essential Knowledge and Skills (TEKS) and State of Texas Assessments of Academic Readiness (STAAR) recommended learning objectives. The purpose of this report was to measure the effect of the BCMSSI on the science performance of students whose teachers participated in the program during summer 2013.

Paired t-test results showed statistically significant increases in the BCMSSI students' Stanford 10 science performance at the third, fourth, and eighth grades. The results also showed moderate to substantively positive BCMSSI program effects, .20, .31 and .32, respectively, on these grade levels.

Linear regression analysis indicated that students' previous year, (2013) Stanford 10 science scores were the strongest predictors of science performance. At-risk status predicted science performance in all but the third grade and special education in all but the seventh grade, reflecting lower mean science scores. Summer hours positively predicted science scores in the fourth, fifth, and eighth grades and follow-up professional development hours positively predicted the science performance of third and fourth-grade BCMSSI students.

Implications include additional mentoring and science support throughout the school year, and close monitoring of the instructional practices BCMSSI teachers use in the classroom. Future BCMSSI may also focus on specific strategies designed to meet the specialized needs of HISD at-risk, economically disadvantaged, and special education students.

Administrative Response: The Baylor College of Medicine Summer Science Institute will continue as an option for professional development for elementary and middle school teachers. At the same time, the program does warrant further investigation to determine (a) the extent to which teachers' instructional practices can be measured to show the use of the programs' activities and strategies and how that might impact results; (b) more effective ways of designing activities and strategies to address specialized groups to improve the negative beta Standard 10 scores for special education, economic-disadvantaged, and at-risk students; and (c) how the inclusion of future longitudinal tracking of science interest and knowledge would affect results.

Should you have any questions or require any further information, please contact me or Carla Stevens in the Department of Research and Accountability, at 713-556-6700.

_______________________TBG

TBG/CS:tds

cc: Superintendent's Direct Reports
Chief School Officers
School Support Officers
Lance Menster
Teresa Phillips
Hortense Campbell
Annie Wolfe

HOUSTON INDEPENDENT SCHOOL DISTRICT

RESEARCH

Educational Program Report

THE EFFECT OF THE BAYLOR COLLEGE OF MEDICINE SUMMER TEACHER INSTITUTE ON HISD ELEMENTARY AND MIDDLE SCHOOL STUDENTS' SCIENCE PERFORMANCE, 2013–2014

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EVALUATION REPORT

BUREAU OF PROGRAM EVALUATION

Volume 8, Issue 1, October 2014

The effect of the Baylor College of Medicine Summer Science Institute on HISD elementary and middle school students' science performance, 2013–2014

By Ted D. Serrant, PhD.

The purpose of this report was to measure the effect of the Baylor College of Medicine Summer Science Institute (BCMSSI) on science performance of students whose teachers participated in the program during summer 2013. Paired t-test results showed statistically significant increases in the BCM students' Stanford 10 science performance at the third, fourth, and eighth grades. Results also showed moderate to substantively positive BCMSSCI program effect at these grade levels. Linear regression analysis indicated that students' previous year Stanford 10 science scores were the strongest predictor of science performance. Implications include additional mentoring and science support throughout the school year, and close monitoring of the instructional practices that BCMSSI teachers use in the classroom.

Background

The BCM Summer Science Institute (BCMSSI) is a professional development program that offers current and effective teaching strategies, in-depth science content lessons, assessment, and relevant science concepts that are aligned with the Texas Essential Knowledge and Skills (TEKS) and the State of Texas Assessment of Academic Readiness (STAAR) recommended learning objectives (BCM, 2013). This program targeted the Houston Independent School District (HISD) prekindergarten to eighth-grade teachers who taught science in self-contained classes, science labs, and regular education classes. The Institute included presentations by scientists and the use of inquiry-based, grade-appropriate science lessons. Hands-on lessons and activities with online lessons were available for workshop participants and other teachers.

New BCMSSI participants attended a two-week workshop. Returning elementary- and middle-school teachers attended a one-week workshop. In addition, teachers were encouraged to attend five follow-up workshop sessions throughout the academic year. The program culminated with a science festival in which participants displayed skills and content learned.

Literature Review

Participation in summer science institutes have increased the number of teachers providing opportunities for their students to conduct full scientific inquiry using deep science content and process knowledge with numerous opportunities for practice (Jeanpiere, Oberhauser, & Freeman, 2005). Where teachers examined student thinking and their implications for instruction, student and teacher science content knowledge and test scores increased (Heller, Dahler, Wong, Shinohara, & Miratrix, 2012).

Research has shown that teachers who demonstrated improvements in science content knowledge and their abilities to analyze science teaching also demonstrated higher gains in student science content knowledge (Roth, et al., 2011). The improvement in student science content knowledge was also associated with teachers' pedagogical content knowledge about student thinking, and teaching practices aimed at improving the coherence of science content storylines (Roth, Garnier, Chen, Lemmens, Schwille, & Wickler, 2011).

Third- and fourth-grade culturally and linguistically diverse students whose teachers had a year-long science professional development program demonstrated significant growth in the inquiry abilities of all students. Low-achieving, low-SES, and LEP students made impressive gains (Cueras, Lee, Hart, & Deaktor, 2005). A three-year professional development program to improve teaching practice significantly raised third- to fifth-grade science scores. It consistently increased the achievement gaps among the third- and fifth-grade demographic groups but held steady for the fourth grade (Luft, Wong, & Ortega, 2009).

A study designed to measure the influence of inquiry science on teacher practices among fourth- and fifth-grade teachers in the Los Angeles United School District found that there was increased incidence of inquiry-based science teaching. The impacts, however, were limited to selected features of the inquiry process to which the teachers were most frequently exposed during the professional development (Griggs, Kelly, & Geoffrey, 2013).

Teachers exposed to long-term professional development programs demonstrated increased content knowledge. Teachers in the four-year Rice Elementary Model Science Lab (REMSL) increased their scientific content knowledge in all four years. In the last two years of the program, their gains in science content knowledge, use of inquiry based instruction, and leadership skills were significantly higher than that of the control group participants (Deaconu, Juskavceric, & Nichol, 2012). Students' science process skills, and their content and concept knowledge was assessed after one-year of participation in an elementary STEM professional development program. Results showed gains in science process skills, science concepts and content knowledge among the general education students. Teacher participation in the program had statistically significant effects on student posttest science scores (Cotabish, Dailey, Ann, & Hughes, 2013).

The 2011 and 2012 evaluation of the BCMSSI's impact on elementary and middle school science performance found statistically significant increases in the Stanford 10 Science scores of third- to fifth-grade students in the 2012 sample and fifth-grade in the 2013 sample. Similar increases existed among the seventh and eighth-grade students whose teachers participated in the PD program. Linear regression modeling indicated that the follow-up or additional hours of professional development was the strongest predictor of students' science performance in 2012 and 2013 (Holmes, 2013).

The purpose of this report is to measure the effect of the BCMSSI on the science and environmental science performance of elementary and middle school students whose teachers participated in the Institute training activities. Specifically, the study sought to answer two questions:

1. How did students whose teachers participated in the 2013 BCM Summer Institute perform in science?
2. What was the effect of the 2013 BCM Science Summer Institute on students' science performance?

Methodology

Data Analysis

A repeated measures design of students' pre- and post-intervention STAAR and Stanford 10 Science and environmental science test scores were used to measure performance based on teachers' participation in the BCMSSI professional development program. Students 2013 and 2014 test results were included in the study. In addition, their teachers had to have participated in the Summer Institute. Those who did not possess both scores and whose teachers did not participate in the Summer Institute were dropped from the sample. The 2013 test scores were treated as the pretest, and the 2014 test score were treated as the posttest scores. Using data from the Public Education Management Information System (PIEMS), State of Texas Assessment of Academic Readiness (STAAR), and Stanford 10 databases, students were matched with their teachers who participated in the BCMSSI and their science scores analyzed. The effect size of the program on the students' science performance was determined by grade using Hedges' g statistic. Hedges' g is a standard deviation-based measure of a program effect. The U.S. Department of Education's Institute of Education Sciences What Works Clearinghouse (WWC) and the Texas Education Agency (TEA) determined that 0.25 is a substantively-important effect size in education (Texas Education Agency, 2011).

Linear Regression Analysis

Pretest scores, summer PD hours, PD follow-up hours, and key demographic variables were analyzed to determine the factors that contributed to the variability in the students' science scores and, therefore, predict their science performance. Demographic variables included economic status, gifted and talented identification status (G/T), at-risk status, special education status, and gender.

Sample

A total of 345 elementary and middle school teachers participated in the 2013 BCMSSI. Of these, 189 (45.8%) were enrolled in the 60-hour Summer Institute and four follow-up sessions. About 68.8% (130 teachers) completed all 60 hours of professional development. Additionally, 66 middle school teachers and 89 elementary school teachers enrolled in the 30-hour Summer Institute. Of these 56 (84.8%) and 71 (79.7%), respectively, completed the 30-hour summer sessions. **Table 1** displays the demographic

Table 1. Students Demographic Characteristics By Grade

				Grade Level				
	First	***Second***	***Third***	***Fourth***	***Fifth***	***Sixth***	***Seventh***	***Eighth***
Total students	**611**	**635**	**529**	**621**	**298**	**342**	**329**	**1135**
	%	***%***	***%***	***%***	***%***	***%***	***%***	***%***
Gender: Male	52	52	52	49	51	51	52	50
Female	48	48	48	51	49	49	48	50
Race/ethnicity: Black	61	54	33	29	36	32	31	30
Hispanic	33	39	65	67	56	64	55	62
White	4	5	2	2	6	3	10	5
Non-At-Risk	19	22	53	44	55	43	53	40
At-Risk	80	78	47	56	45	57	47	60
Non-Special Ed.	91	92	92	91	91	87	92	92
Special Ed.	9	8	8	9	9	14	8	8
Non-G/T	88	85	80	79	82	91	85	85
G/T	12	15	20	21	19	9	15	15
Non-LEP	92	89	62	55	69	77	87	84
LEP	9	12	38	45	31	23	13	16
Non-Econ. Disadv.	14	15	9	9	12	8	27	21
Econ Disadv.	86	85	91	91	88	92	73	79

composition by grade for students whose teachers participated in the Summer Institute.

Variables of Interest

The variables of interest include students' STAAR science and Stanford 10 environment and science test scores. STAAR is administered to fifth- and eighth-grade HISD students. Stanford 10 environment is administered to first- and second-grade students and Stanford 10 science to third through eighth-grade students. Teacher total summer and follow-up sessions were included in the analysis. Where students had more than one teacher, the average number of teacher hours was used. Demographic variables from PEIMS included gender, LEP, special education, economic status, at-risk for dropout status, and ethnicity were also included in the analysis, and were disaggregated by grade and school levels (elementary and middle schools).

The data met the normality, homoscedasticity and collinearity conditions using the Shaphiro-Wilk test, the normal Q-Q plot and the Detrended normal Q-Q plot on the IBM Statistical Package for Social Sciences (SPSS) software.

How did the students whose teachers participated in the 2013 BCM Summer Institute perform in science?

Stanford 10 and STAAR science test results were used to measure the impact of the BCMSSI on science achievement. The results are presented by elementary and middle school levels for students whose teachers participated in the Summer Institute.

Table 2. Elementary Student 2014 Stanford 10 Performance of BCM 2013 Summer Institute Teachers

	N	***Mean NCE***	***Std.***
Environment			
1st	613	41.7	21.5
2nd	635	44.9	16.1
Science			
3rd	529	50.5	21.4
4th	621	54.3	20.3
5th	298	46.0	20.9

Note: 40 - 60 NCEs is Average (Stanford 10 Manual)

Table 2 shows that at the elementary level, first- through fifth-grade student performance fell within the average range on the Stanford 10 environment science and science subtests (between 40.0 and 60.0 NCEs).

Among the third through fifth-grade, fourth-grade students attained the highest average on the Stanford 10 science subtest (54.3 NCEs) at the elementary level. Second-grade students attained a higher mean NCE than the first-grade students on the environment Science subtest (41.7 NCEs vs. 44.9 NCEs).

Table 3. Middle School Student 2014 Stanford 10 Performance 0f BCM 2013 Summer Institute Teachers

	N	**Mean NCE**	***Std.***
Grade			
6th	325	47.3	22.1
7th	315	52.4	21.6
8th	1088	55.0	19.5

Note: 40 - 60 NCEs is Average (Stanford 10 Manual)

Stanford 10 science subtest results for sixth through eighth-grade middle school students whose teachers participated in the 2013 BCM Summer Science Institute are presented in **Table 3**. The mean NCE at each grade level fell within the Stanford 10 average range (between 40-60 NCEs). The 8th-grade students included in the analysis had the highest performance (55.0 NCEs) compared to sixth- and seventh-grade students (47.3 and 52.4 NCEs, respectively).

The fifth- and eighth-grade STAAR science performance of students whose teachers participated in the 2013 Summer Science Institute were analyzed using the scale scores and Level II: Satisfactory, Phase-In 1 performance standards.

Table 4. 2014 STAAR Mean Scale Score and Percent Who Met Standards, Fifth and Eighth Grade

	Mean Scale Score	***Std. Deviat.***	***Level II: Satisf. Phase – In 1 Standard***
*5th Grade (n = 4062)	3676 (3720)	460.8	65.5 (67.0)
**8th Grade (n = 2593)	3704 (3750)	697.5	62.1 (64.0)

*5th grade – "Satisfactory" Scale Score: 3500-4306
**8th grade – "Satisfactory" Scale Score: 3500-4327
(Texas Education Agency, 2014)
Comparative HISD data are given in parentheses

Table 4 shows the mean STAAR performance of the fifth- and eighth–grade students and the proportion of students that fell within the Satisfactory performance range. The 2014 mean science scale score for the eighth-grade students was higher than the mean science scale score of the fifth-grade students. In addition, the proportion of the fifth graders who met the Level II: Satisfactory, Phase-In 1 standard on STAAR was higher than the performance of the eighth-grade students (65.5% vs. 62.1%). However, performances for both grades remain below the districts'.

What was the effect of the 2013 BCM Summer Institute on students' science performance?

Paired t-tests were conducted to determine the effect of the BCM Summer Institute on the mean science NCEs of elementary (third to fifth grade) and middle school (sixth to eighth grade) students whose teachers were enrolled in the BCMSSI. **Table 5** and **Table 6** in **Appendix A** (p. 7) display the program effect sizes using Hedges' g.

As depicted in Table 5, the mean difference between the pre- (2013) and posttest (2014) mean science NCEs for third through fifth grades were statistically significant ($p < .001$). The program, however, had a small to moderate effect on the third-grade science (0.20), but a substantively positive effect (0.31) on the fourth-grade science performance. The program had a substantively negative effect (-0.39) on the fifth-grade mean science NCEs.

The mean NCE difference between the science pre and posttest scores for the sixth and eighth grades were statistically significant as shown in Table 6**.** The BCM Summer Institute had a substantively positive effect on the eighth-grade mean science NCE (0.32), but a substantively negative effect on the sixth- and seventh-grade mean science NCEs.

Regression analyses indicated that the 2013 Stanford 10 science NCE and G/T identification were positive predictors of science performance at the third- through eighth-grade levels ($p <. 001$ and .05) (see **Table 7** and **Table 8**, Appendix A, p. 8). At-risk status predicted science performance in all but the third grade. Similarly, special education predicted science performance in all but the seventh grade. Students' economic-disadvantaged status also predicted science performance at the fifth, seventh, and eighth grades. These three variables had negative beta scores indicating lower mean science performance for special education, economic-disadvantaged, and at-risk students compared to their counterparts.

The report also showed that summer PD hours were positive predictors of the 2014 Stanford 10 science performance for BCMSSI students in the fourth, fifth, and eighth grades. Additional professional development hours were positive predictors of BCMSSI students' 2014 Stanford 10 science performance in the third and fourth grade ($p <. 001$ or .05).

Overall, the third through fifth-grade regression model accounted for 58% to 65% of the variance in the 2014 Stanford 10 mean science NCEs. The model also accounted for 52% to 56% of the variance in the 2014 sixth to eighth-grade Stanford 10 mean science NCEs.

Discussion

This study showed that the 2014 Stanford 10 science performance of students whose teachers participated in the 2013 BCMSSI was well within the average performance range (40 – 60 NCEs) for first through eighth-grade students. The BCMSSI had a moderate to substantively positive effect on the 2014 third-, fourth- and eighth-grade Stanford 10 mean science NCEs for students whose teachers were enrolled in the program. More than 60% of the fifth- and eighth-grade students (66% and 62%, respectively) whose teachers participated in the program met state standard, Level II: Satisfactory (Phase-In 1) on the STAAR science test. District-wide, however, 67% and 64% of fifth and eighth-grade students, respectively, met state standards in science.

The study showed that students' performance on the 2013 Stanford science test was the strongest predictor of performance on the 2014 test for third through fifth-grade students whose teachers participated in the BCMSSI. Students' prior science knowledge, in this study, therefore, appeared to be critical for their 2014 Stanford 10 science performance. G/T identification was also a strong predictor of third through fifth-grade BCMSSI students' science performance.

In several grades, at-risk, special education and economic-disadvantaged status were negative predictors of the science performance of students whose teachers participated in the BCMSSI. It is unclear the extent to which the Institute activities, lesson content and strategies were specifically designed to address the needs of these specialized groups.

The study lacked a direct measure of teacher instructional practices. Consequently, teachers' BCM Summer and Follow-up participation hours were used as proxies. The study was also limited by the lack of a matched comparison group, that is, students of teachers who were motivated to enroll in the BCMSSI, but did not enroll or enrolled and did not participate. A repeated-measures design was used to determine the program effect using paired t-test, which provides a robust analysis considering data limitations.

Future analysis should include longitudinal tracking of science interest and knowledge, particularly for elementary student groups. Additional professional development follow-up may be required to continue to improve students' science performance.

Close monitoring of the instructional practices BCMSSI teachers used to support their students, to examine students' thinking, and to inform and analyze science instruction against the science TEKS and learning objectives is recommended to better inform BCMSSI follow-up and future summer programs, and to measure teacher effect. Future BCMSSI may focus on specific strategies designed to meet the specialized learning needs of disadvantaged student are at-risk, economic-disadvantaged, and special education programs.

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For additional information contact the HISD Department of Research and Accountability at 713-556-6700 or e-mail Research@Houstonisd.org.

Appendix A

Table 5. Elementary Paired T-Test Analysis of 2013–2014 Student Cohort With Stanford 10 Science Data in 2012–2013

Grade Level	**Test Year**		**Sample**	**Mean**	**Std. Dev.**	**Mean Diff.**	**t**	**p**	**Effect Size (Hedges' g)**
3	Pretest	2013	378	44.2	21.0	4.2	5.1	.000*	**0.20**
	Posttest	2014	378	48.4	20.0				
4	Pretest	2013	484	50.3	19.7	6.3	8.4	.0.00*	**0.31**
	Posttest	2014	484	56.6	20.4				
5	Pretest	2013	292	55.5	22.2	-9.1	-7.9	.000*	**-0.39**
	Posttest	2014	292	46.4	24.2				

Note: *p < .001

Table 6. Middle-School Paired T-Test Analysis of 2013–2014 Student Cohort With Stanford 10 Science Data in 2012–2013

Grade Level	**Test Year**		**Sample**	**Mean**	**Std. Dev.**	**Mean Diff.**	**t**	**p**	**Effect Size (Hedges' g)**
6	Pretest	2013	325	54.1	20.3	-6.9	-7.7	.000*	**-0.33**
	Posttest	2014	325	47.2	22.1				
7	Pretest	2013	315	54.1	21.4	-1.5	-1.9	.063	**-0.07**
	Posttest	2014	315	52.5	19.0				
8	Pretest	2013	1088	48.7	21.2	6.3	13.9	.000*	**0.32**
	Posttest	2014	1088	55.0	19.5				

Note: *p < .001

Table 7. Linear Regression Modeling for Elementary School Students (3rd to 5th Grades), 2014

Variable	2014 Stanford 3rd Grade Science NCEs		2014 Stanford 4rd Grade Science NCEs		2013 Stanford 5rd Grade Science NCEs	
	n = 378	***R^2= 58%***	*n = 484*	***R^2 = 65%***	*n = 292*	***R^2 = 59%***
	β	*p*	*β*	*p*	*β*	*p*
Economic-Disadvantaged	.003	.925	.014	.674	-.138	.002*
2013 Stanford Science NCEs	.615	.000**	.576	.000**	.426	.000**
Summer PD	.057	.126	.207	.000**	-.156	.000**
Additional PD	.094	.018*	.094	.000**	.066	.115
At risk status	.036	.348	-.101	.003*	-.179	.000**
Special Ed	-.138	.000**	-.075	.032*	-.119	.005*
G/T	.119	.003*	.135	.000**	.203	.000**

Note: *p < .05, ** p< .001

Table 8. Linear Regression Modeling for Middle School Students (6th to 8th Grades), 2014

Variable	2014 Stanford 6rd Grade Science NCEs		2014 Stanford 7rd Grade Science NCEs		2013 Stanford 8rd Grade Science NCEs	
	n = 325	***R^2 = 53%***	*n = 315*	***R^2 = 52%***	*n = 1088*	***R^2 = 56%***
	β	*p*	*β*	*p*	*β*	*p*
Economic-Disadvantaged	-.044	.261	-.113	.002*	-.045	.034*
2013 Stanford Science NCEs	.503	.000**	.564	.000**	.523	.000**
Summer PD	-.026	.484	.063	.068	-.050	.014*
Additional PD	-.025	.511	.026	.052	0.15	.458
At risk status	-.157	.002*	-.135	.002*	-.151	.000**
Special Ed	-.172	.000**	-.017	.645	-.106	.000**
G/T	.097	.020*	.167	.000**	.133	.000**

Note: *p < .05, ** p< .001