



**MEROLA
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**Case Study: Impact of Discovery Education Science Techbook™
on Student Achievement in Collier County, FL**

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Author:

Stacey S. Merola, Ph.D.
President and Principal Scientist
Merola Research LLC
2 Wisconsin Circle, Suite 700
Chevy Chase, MD 20815
Tel: 703-447-7883
Email: Stacey_merola@merolaresearch.com

EXECUTIVE SUMMARY

ABSTRACT

During the 2011-2012 school year, the Discovery Education Science Techbook™ was implemented in Collier County Public Schools (CCPS). Professional development was provided to all teachers during the summer of 2011 to train them in the use of Science Techbook and teachers subsequently chose whether to use Science Techbook in their classrooms or not. Data related to the results on the Florida Comprehensive Assessment Test (FCAT) in science for fifth and eighth-grade students were analyzed to assess whether there were differences in student science achievement when teachers used Science Techbook versus when they did not. The findings indicate that the relationship between Science Techbook use and science achievement is mediated by teacher experience. Science Techbook is effective in improving student achievement in science when it is used by teachers that already have a pedagogical foundation gained through prior years of teaching. Students whose teachers had one or more years of teaching experience and used Science Techbook scored higher on the FCAT than students whose teachers had similar levels of experience but had not used Science Techbook. This result was not evident for students in classes with beginning teachers, indicating that beginning teachers may need to be provided with alternate training when implementing Science Techbook.

DISCOVERY EDUCATION SCIENCE TECHBOOK DIGITAL TEXTBOOK

Science Techbook is a computer-based instructional resource that incorporates the use of virtual labs, explorations, e-books, digital images, audio clips, video clips, songs, and an interactive digital glossary to enable teachers to implement lessons that are aligned with the states' science standards, engage students and address different learning styles. Science Techbook provides teachers with an instructional framework and model lessons they can use. Science Techbook also includes a real-time assessment component that helps teachers monitor individual and class mastery of the content, and provides targeted remediation resources for students in need of additional support.

Science Techbook approaches the learning of scientific thinking and practice through a 5E inquiry model of instruction that is centered on essential questions in science and culminates with a scientific explanation. The BSCS 5E Instructional Model or the 5E, consists of five phases: Engagement, Exploration, Explanation, Elaboration, and Evaluation.¹ During the engagement

¹ Bybee, R.W., Taylor, J.A., Gardiner, A., Van Scotter, P., Powell, J.C., Westbrook, A., & Landes, N. (2006). *The BSCS 5E Instructional Model: Origins and Effectiveness*.

phase, instructors assess the prior knowledge of their students and help them become engaged with new material through short activities. Students in the Exploration phase perform activities designed to provide them with a common understanding of current concepts, processes and skills. In the Explanation phase, students demonstrate their understanding of material learned during the Engagement and Exploration phases. In this process, teachers introduce a concept, students explain their understanding of it, and then teachers can provide additional Explanations. During the Elaboration phase teachers work with students to challenge their understanding and deepen their knowledge through new experiences. Finally, in the Evaluation phase, teachers evaluate student progress and students assess their understanding of the material.

To facilitate teachers' adoption of the Science Techbook digital textbook, Discovery Education provided professional development training to build teachers capacity to (a) navigate the Science Techbook website; (b) employ the 5E model of instruction in their classrooms; (c) create student-centered classrooms that incorporate the use of learning stations; and (d) use Science Techbook to differentiate instruction for students with different learning styles and needs. Professional development training also allowed teachers to develop activities that allow students to explore the resources available within Science Techbook on their own.

STUDY DESCRIPTION

In 2011, Collier County Public Schools, located in Naples, Florida adopted Science Techbook for use in all elementary and middle schools. During the summer of 2011, Discovery Education Professional Development Specialists trained 1,802 of Collier County Public School's elementary and middle school teachers in the use of Science Techbook. All teachers were provided with training; however, teachers chose whether to use Science Techbook or not during the 2011-2012 school year. Additional professional development training was offered throughout the academic year. During the 2011-2012 school year 46% (n=103) of 5th grade teachers and 66% (n=46) of 8th grade science teachers used Science Techbook.

In 2011, prior to the implementation of the Science Techbook, 46% of Collier 5th grade students and 43% of 8th grade student passed the FCAT. Based on these passing rates, Collier 5th and 8th grade students ranked 46th and 43rd, respectively, from among the 73 school districts in the state of Florida. In 2012, passing rates in science increased for both 5th and 8th graders and Collier ranked higher among the state's school districts. In 2012, 47% of 5th grade students and 47% of 8th grade students passed the FCAT. Fifth grade passing rates became the 44th highest in the state and 8th grade passing rates were the 31st highest in the state and exceeded the overall state passing rate. The current study was conducted to investigate the impact of using Science

Techbook digital textbook on Collier County Public Schools students' scores on the FCAT and their likelihood of passing the FCAT at the proficiency level or higher.

Collier County Public Schools provided Discovery Education with 2010 and 2012 FCAT Science score data for 5th and 8th grade students in the district. Student FCAT scores were compared based on gender, race/ethnicity, whether they were ever identified as Limited English Proficient (LEP), eligibility for free or reduced price lunch, the years of experience their teacher had teaching in the district, and whether or not their teacher used Science Techbook. Ordinary Least Square (OLS) regression and logistic regression analyses were conducted to investigate the impact of using Science Techbook on student science FCAT scores and their likelihood of passing the FCAT at the proficient level or above. OLS techniques, instead of means tests were used for these analyses in order to account for differences in student demographics and teacher experience levels between Science Techbook users and non-users.

WHO IS USING DISCOVERY EDUCATION SCIENCE TECHBOOK DIGITAL TEXTBOOK?

Administrative data maintained by Discovery Education indicate that approximately 87% of all K-8 teachers that received training during the summer continued to use Science Techbook within their classrooms during the 2011-2012 academic year. From the period starting September 1, 2011 and ending April 13, 2012, on average, the 103 5th grade teachers who used Science Techbook in their classrooms logged into the service 59.82 times, or an average of twice per academic week. During that same time period, the 46 8th grade teachers who used Science Techbook in their classrooms logged into the system an average of 64.43 times or about twice per academic week.

STUDENT AND TEACHER CHARACTERISTICS – 5th GRADE

At the 5th grade, student demographic characteristics were similar between teachers who used Science Techbook and those who did not (Exhibit 1). The students in the two groups of classes were similar in terms of eligibility for free or reduced price lunch, gender composition, and whether they had ever been identified as Limited English Proficient. The one exception was that Science Techbook-using teachers had a greater percentage of Hispanic or African-American students in their classes on average compared to non-Science Techbook using teachers (56% versus 52%).

Fifth-grade teachers that used Science Techbook during the 2011-2012 school year were less experienced on average than those that did not use Science Techbook (Exhibit 1). Fifth-grade teachers that used Science Techbook had an average of 6.60 years of experience in 2011-2012,

compared to 7.33 years of experience on average for teachers that did not use Science Techbook.

Exhibit 1. 5th Grade Student and Teacher Characteristics, 2011-2012 School Year

Student Characteristics					
Variable	Science Techbook User (n=1913)		Non-User (n=1278)		Difference
	Mean	SD	Mean	SD	
Free or Reduced Price Lunch Eligibility	0.65	0.48	0.62	0.49	0.03
Female Student	0.50	0.50	0.50	0.50	0.00
Race/Ethnicity (Hispanic or African-American)	0.56	0.50	0.52	0.50	0.04*
Ever identified as LEP	0.08	0.27	0.08	0.27	0.00
Teacher Characteristics					
Teacher Years of Experience as of 2012	Techbook User (n=103)		Non-User (n=120)		Difference
	Mean	SD	Mean	SD	
Teacher Years of Experience as of 2012	6.61	5.93	7.33	7.60	-0.72**

Source: US Dept. of Education, Common Core Data, 2011 and Collier County Public Schools, 2013. Significance levels:***p < 0.001, ** p<0.01, p < 0.05 (two-tailed test)

STUDENT AND TEACHER CHARACTERISTICS – 8th GRADE

Eighth-grade students whose teachers used Science Techbook had similar demographic characteristics to those whose teachers did not use Science Techbook (Exhibit 2). The students in the two groups of classes were similar in terms of eligibility for free or reduced price lunch, race/ethnicity, gender, and whether they had ever been identified as Limited English Proficient.

As with the fifth-grade teachers, eighth-grade teachers that used Science Techbook during the 2011-2012 school year were less experienced on average than those that did not use Science Techbook (Exhibit 2). Eighth-grade teachers that used Science Techbook had an average of about 7 years of experience in 2011-2012, compared to 8.5 years of experience on average for teachers that did not use Science Techbook.

Exhibit 2. 8th Grade Student and Teacher Characteristics, 2011-2012 School Year

Student Characteristics					
Variable	Science Techbook User (n=2486)		Non-User (n=749)		Difference
	Mean	SD	Mean	SD	
Free or Reduced Price Lunch Eligibility	0.59	0.49	0.60	0.49	-0.01
Female Student	0.48	0.50	0.48	0.50	0.00
Race/Ethnicity (Hispanic or Black)	0.54	0.50	0.55	0.50	-0.01
Ever identified as LEP	0.05	0.22	0.05	0.21	0.00
Teacher Characteristics					
Variable	Science Techbook User (n=46)		Non-User (n=24)		Difference
	Mean	SD	Mean	SD	
Teacher Years of Experience as of 2012	6.95	6.73	8.52	8.00	-1.57**

Source: US Dept. of Education, Common Core Data, 2011 and Collier County Public Schools, 2013.
Significance levels:***p < 0.001, ** p<0.01, p < 0.05 (two-tailed test)

IS USE OF DISCOVERY EDUCATION SCIENCE TECHBOOK™ RELATED TO INCREASES IN STUDENT ACHIEVEMENT?

We find that the relationship between use of Science Techbook and student achievement is mediated by teacher experience. By itself, Science Techbook usage was not associated with significant differences in FCAT scores between students whose teachers used Science Techbook versus those who did not. Similarly, there were no absolute differences in the rates of achieving proficient status or higher on the FCAT between the two groups. Instead, the effectiveness of Science Techbook is dependent on teachers' prior years of teaching experience. After differences in student demographics were taken into consideration, students whose teachers had more than one year of prior teaching experience and used Science Techbook had higher scores on the FCAT and were more likely to score at the proficient level or higher than students whose teachers had equal experience and did not use Science Techbook. The magnitude of this relationship varied by grade level.

Exhibit 3. 5th and 8th Grade Student FCAT Test Scores and Percent Proficient or Higher

5 th Grade Students					
Variable	Science Techbook User (n=1913)		Non-User (n=1278)		Difference
	Mean	SD	Mean	SD	
Student Science Test Score	319.16	59.94	318.95	60.02	0.21
Proficient Level Score or Higher	0.47	0.50	0.48	0.50	-0.01
8 th Grade Students					
Variable	Science Techbook User (n=2486)		Non-User (n=749)		Difference
	Mean	SD	Mean	SD	
Student Science Test Score	311.22	66.38	313.42	66.02	-2.20
Proficient Level Score or Higher	0.44	0.50	0.43	0.50	0.01

Source: Collier County Public Schools, 2013. Significance levels:***p < 0.001, ** p<0.01, p < 0.05 (two-tailed test)

KEY FINDINGS AT 5TH GRADE

At the fifth grade, OLS regression results indicated that the relationship between Science Techbook digital textbook use and science achievement was mediated by teacher experience. For teachers that used Science Techbook in their classrooms, OLS regression results indicated that each year of teaching experience related to almost a point increase in student science FCAT scores (Exhibit 4). Given that Science Techbook users had an average of 6.60 years of teaching experience, this suggests that on average FCAT scores were 4.36 points higher among students of Science Techbook users than for students with similar teachers who did not use Science Techbook.

In order to explore the relationship between years of teaching experience, use of Science Techbook, and science achievement further, students with beginning teachers and more experienced teachers were analyzed separately. Teachers with one year or less of experience were identified as beginning teachers, and analyzed separately from the more experienced teachers. After taking into account student demographics, logistic regression results indicated that students whose teachers had more experience and were Science Techbook users were 30% more likely to score at the proficient level or higher on the FCAT, compared to students whose teachers were not Science Techbook users, but had similar levels of experience.

Exhibit 4. Predicting 5th Grade Student Science Scores Using Student Demographics, Teacher Experience, and Use of Discovery Education

Variables	Model 1		Model 2		Model 3		Model 4	
	Estimate	S.E.	Estimate	S.E.	Estimate	S.E.	Estimate	S.E.
<i>(Constant)</i>	356.65***	1.83	355.50***	2.13	345.58***	2.48	347.48***	2.61
Ever LEP	-59.83***	3.52	-59.79***	3.52	-58.83***	3.49	-58.98***	3.49
Female	-7.74***	1.85	-7.72***	1.85	-7.82***	1.83	-7.86***	1.83
Free or Reduced Price Lunch Eligible	-28.29***	2.30	-28.30***	2.30	-26.50***	2.29	-26.07***	2.30
Hispanic or African American	-19.82***	2.25	-19.91***	2.25	-18.17***	2.25	-17.99***	2.24
Science Techbook User			1.99	1.89	2.65	1.88	-1.94	2.70
Teacher Years Experience					1.07***	0.14	0.77***	0.19
Science Techbook User x Teacher Years Experience							0.66*	0.28
<i>Residual Variance</i>	8652172.19		8649158.49		8495123.69		8480111.53	
<i>R-Square</i>	0.24		0.24		0.25		0.26	
<i>N</i>	3,180		3,180		3,180		3,180	

Note: Significance levels:***p < 0.001, ** p<0.01, p < 0.05 (two-tailed test)

KEY FINDINGS AT 8TH GRADE

The analyses completed with the 5th grade students were replicated using data from the 8th grade students and a similar pattern emerged. Once again the relationship between use of Science Techbook and science achievement was mediated by teacher experience. At the 8th grade, for teachers that used Science Techbook in their classrooms, each year of teaching experience was linked to over a two-point increase in student science FCAT scores after taking into account student characteristics (Exhibit 5). Given that 8th grade Science Techbook users had an average of 6.95 years of teaching experience, this suggests that on average FCAT scores were 16.54 points higher for students of experienced teachers than for students with similar teachers who did not use Science Techbook. This was a larger impact than at 5th grade, which might be due to science being taught more frequently during the week in 8th grade.

Logistic regression analyses of the likelihood of a student scoring at the proficient level or higher on the FCAT were performed separately for students in classes with beginning teachers and students with more experienced teachers. After taking into account student demographics, students whose teachers had more experience and were Science Techbook users were again 30% more likely to score at the proficient level or higher on the FCAT compared to students whose teachers were not Science Techbook users, but had similar levels of experience.

Exhibit 5. Predicting 8th Grade Student Science Scores Using Student Demographics, Teacher Experience, and Use of Discovery Education

Variables	Model 1		Model 2		Model 3		Model 4	
	Estimate	S.E.	Estimate	S.E.	Estimate	S.E.	Estimate	S.E.
<i>(Constant)</i>	350.94***	1.99	352.80***	2.13	336.24***	3.18	349.83***	3.63
Ever LEP	-68.12***	4.84	-68.10***	3.52	-69.61***	4.78	-67.67***	4.74
Female	-7.34***	2.07	-7.32***	1.85	-7.97***	2.04	-7.96***	2.02
Free or Reduced Price Lunch Eligible	-31.21***	2.47	-31.22***	2.30	-27.30***	2.47	-26.78***	2.45
Hispanic or African American	-25.48***	2.46	-25.48***	2.25	-22.04***	2.45	-21.88***	2.42
Discovery Education User			-2.42	2.45	-0.028	2.42	-19.14***	3.48
Teacher Years Experience					1.492	0.15	-.161	0.26
DE User x Teacher Years Experience							2.38***	0.31
<i>Residual Variance</i>	11075599.26		11072224.02		10747837.71		10559469.91	
<i>R-Square</i>	0.22		0.22		0.24		0.26	
<i>N</i>	3,225		3,225		3,225		3,225	

Note: Significance Levels: *** p < 0.001, ** p < 0.01, * p < 0.05, + p < 0.10 (two tailed test)

CHANGES FROM 2011 TO 2012

Chow tests² were performed to compare whether there were changes across 2010-11 and 2011-12 in the relationship between teacher years of experience and student science achievement. In 2011, student demographics and teacher experience were the most important predictors of 5th grade student performance in science, with students whose teachers had more years of experience scoring higher on the science FCAT on average. A similar pattern was evident for 8th grade students in 2011. Chow tests were conducted to assess whether in 2012 there was a detectable change in the relationship between teacher experience and student performance on the science FCAT. Chow test results indicate that the relationship between teacher years of experience and student science achievement changed between 2010-11 and 2011-12. In 2012, teacher experience was important when combined with Science Techbook, which provides further support for the idea that the implementation of Science Techbook in the district was instrumental in improving the effectiveness of experienced teachers.

CONCLUSIONS

Use of Science Techbook by more experienced teachers is associated with increases in student achievement. Though experienced teachers were less likely to use Science Techbook in their classrooms, when they did, their students attained higher scores on the science FCAT when compared to the students of experienced teachers who did not use Science Techbook. The students of experienced teachers that use Science Techbook were also more likely to pass the FCAT at the proficient level or above than the students of experienced teachers that did not use Science Techbook. Thus, the use of Science Techbook appears to bolster the effectiveness of experienced teachers.

A similar relationship was not evident among the beginning teachers who used Science Techbook. This finding can be understood within the context of what research has shown about the effectiveness of novice teachers, in general, and specifically in science. A number of studies have confirmed that, on average, brand new teachers are less effective than those with some experience (Clotfelder, Ladd and Vigdo 2007a, 2007b; Harris and Sass, 2007, Kane, Rockoff and Staiger 2006; Sass, 2007)³. Sanders, Borko and Lockard (1993)⁴ attribute the diminished

² Chow, Gregory C. (1960). "Tests of Equality Between Sets of Coefficients in Two Linear Regressions". *Econometrica* **28** (3): 591–605.

³ Clotfelder, Charles T., Helen T. Ladd, and Jacob L. Vidor. (2007a) "How and Why Do Teacher Credentials Matter for Student Achievement?". CALDER Working Paper 2. Washington, DC: The Urban Institute.; Clotfelder, Charles T., Helen T. Ladd, and Jacob L. Vidor. (2007b). "Teacher Credentials and Student Achievement in High School: A Cross-Subject Analysis with Student Fixed Effects." CALDER Working Paper 11. Washington, DC: The Urban Institute; Harris, Douglas N., and Tim Sass. (2007). "Teacher Training, Teacher Quality, and Student Achievement." CALDER

effectiveness of new teachers to the fact that new teachers lack the general pedagogical skills to teach the science and to anticipate potential student problems in learning. Shulman (1986)⁵ has also noted that new teachers lack knowledge about the curriculum of the school, the types of strategies for teaching science that are likely to work with different students, and the ability to evaluate and maximize the utility of a variety of tools for science instruction. Thus, given the overwhelming amount of knowledge and skills that a new teacher must acquire, it is easy to understand why Science Techbook may not have been used effectively by the novice teachers in Collier County. This finding has implications for the implementation of Science Techbook digital textbook in that additional professional development or training focused on building pedagogical knowledge and skills may need to be provided to beginning teachers for them to effectively use Science Techbook.

Working Paper 3. Washington, DC: The Urban Institute; Kane, Thomas J., Jonah E. Rockoff, and Douglas O. Staiger. (2006). "What Does certification Tell Us About Teacher Effectiveness? Evidence from New York City." Working Paper 12155. Cambridge, MA: National Bureau of Economic Research., Sass, Tim R. (2007). "The Determinants of Student Achievement: Different Estimates for Different Measures." Paper presented at the first annual CALDER research conference, Washington, DC, October 4.

⁴ Sanders, Linda R., Hilda Borko, and J. David Lockard. (1993). Secondary Science Teachers' Knowledge Base When Teaching Science Courses In and Out Of Their Area of Certification. *Journal of Research in Science Teaching*, 3, 723-736.

⁵ Shulman, Lee S. (1986). Those Who Understand: Knowledge Growth in Teaching. *Educational Researcher*, Vol. 15, No. 2, pp. 4-14.