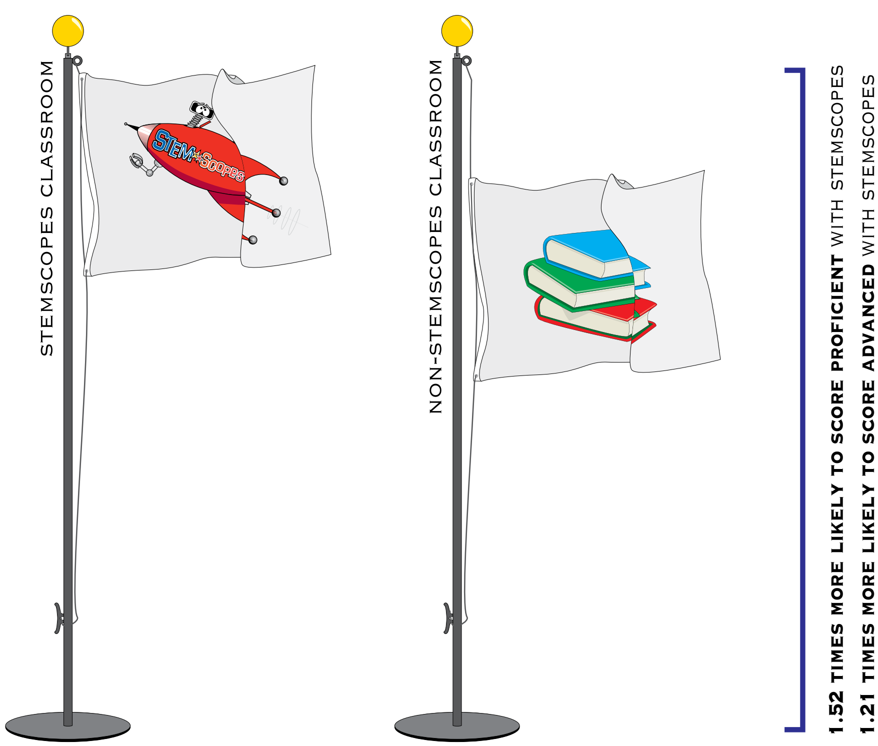
Evidence Supporting the Efficacy of the STEMscopes™ Science Curriculum: Two-Year Comparison of Science Scores in a Medium-Sized District in Texas

The Study

The STEMscopes™ research team collected and analyzed science proficiency and demographic data across two academic school years (2010-2011 and 2011-2012) for 6,493 eigth grade students from 38 classrooms in 12 schools in a medium-sized Texas school district.

The science teachers started using the STEMscopes™ curriculum in the second school year of the study, and we compared students' science scores in the first year of the study—no STEMscopes™ in the classroom—to proficiency in the second year of the study—when students learned science with STEMscopes™.

The research team investigated two questions: (1) whether a student was more likely to be proficient on the Texas state science assessment in the second year, when the teacher used the STEMscopes™ science curriculum and (2) whether a student was more likely to be considered advanced in science based on the Texas state science assessment in the second year, when the teacher used STEmscopes™ science curriculum. Students in the 2010-2011 school year were assessed using TAKS, and students in the 2011-2012 school year were assessed using STAAR™. Therefore, proficiency was based on the appropriate cutoff scores for each assessment (as explained by the TEA™ STAAR-TAKS Bridge document). The team also took into account student demographics, such as gender, ethnicity, English language proficiency, and whether a student qualified for free or reduced lunch, and the fact that students were in different classrooms with different teachers.



What We Found

The team found that being in a STEMscopes™ classroom made students **1.52 times more likely to score proficient on the science exam** and **1.21 times more likely to score advanced on the science exam** when compared to students who did not have STEMscopes™ in their science classroom.

Profile:

School Years: 2010-2011; 2011-2012
Grade Level: 8th
No. of Students: 6,493
Asessment Tool: TAKS STAAR™

Demographics (10-11 / '11-12):

Gender (fem.): 51/51%
Caucasian: 46/45%
Latino: 30/30%
Asian: 12/11%
African Amer.: 9/10%
Multiracial: 4/4%
LEP: 4/4%
Free/Red. Lunch: 28/27%
SPED: 6/4%
GT: 11/12%
At-Risk: 23/21%
Retained: 1/1%

Not only is STEMscopes™ aligned to the Texas Essential Knowledge and Skills (TEKS), but also STEMScopes provides hands-on activities to get students involved in their own science learning.

The results of this study provide empirical evidence that learning science using STEMscopes™ makes students more likely to be proficient and advanced as measured by the Texas state science assessments.

RICE

STEM SCOPES™

Two-Year Comparison of Science Proficiency in a Medium-Size District

Description of the Study

The purpose of this study was to determine if students in classrooms utilizing STEMscopes™ were more likely to be proficient in science, as measured by the Texas state science assessment, than students in classrooms without STEMscopes™. STEMscopes™ is a comprehensive, online K-12 science curriculum that is fully aligned to the Texas science standards (the Texas Essential Knowledge and Skills) and that combines online content, activities, and teacher materials with hands-on experiments and explorations. STEMscopes™ uses an inquiry-based approach to science, in which the teacher guides students towards the discovery of concepts and skills instead of using explicit direct instruction (Crawford, 2007). The online component of STEMscopes™ serves as both a support and a guide to teachers, as well as a platform through which students can interact with the material and get feedback on their progress.

The specific way that STEMscopes™ delivers inquiry-based instruction is by building on the Biological Science Curriculum Study's 5E inquiry model (Bybee et al., 2006). 5E refers to five steps: engagement, exploration, explanation, elaboration, and evaluation. Engagement refers to how teachers activate students' prior knowledge about and interest in a new topic, building connections between what they know and what they are learning. Exploration is the step where students take part in activities and experiments that allow them to experience and learn new concepts and skills. Explanation requires students to explain those new concepts and skills learned during the explore phase. Elaboration challenges them to deepen their conceptual understanding through new, but related, experiences. Finally, in the evaluation phase, students' knowledge is assessed to inform teachers of their progress towards mastery.

The STEMscopes™ pedagogical model adds two key steps: intervention and acceleration. Intervention means that STEMscopes™ provides teachers with the tools both to identify where students are struggling and to provide them with additional opportunities to learn and practice those learning objectives. Acceleration refers to the activities that STEMscopes™ provides for those students that have demonstrated mastery of a particular learning objective. For example, students can undertake a problem-based learning challenge, or connect science to art through a creative project. These two tools help teachers differentiate their instruction and address students' individual learning needs (Zuiker & Whitaker, 2014).

Design

The STEMscopes research team collected and analyzed two years of science performance and demographic data on 6,493 8th grade students from 38 classrooms in 12 schools in a medium-sized Texas school district (2010-2011 and 2011-12). The science teachers started using the STEMscopes curriculum in the second school year of the study, and the study compared science performance in the first year of the study (2010-2011) to performance in the second year of the study (2011-2012).

The research team conducted two analyses using these data. First, we analyzed the student data to see whether a student was more likely to be proficient on the Texas state science assessment in the second year, when the teacher used the STEMscopes science curriculum. Second, we analyzed the student data by determining whether a student was more likely to be considered advanced in science based on their scores on the Texas state science assessment in the second year, when the teacher used the STEMscopes science curriculum. The team also took into account several student demographic factors, such as gender, ethnicity, English language proficiency, and whether a student qualified or free or reduced lunch, and the fact that students are in different classrooms with different teachers.

Sample

Data from this school district included student assessments on the Texas state science assessment for both school years as well as student demographic information. Descriptive statistics on the study sample are represented below. While different students were represented each year, the two samples were very similar with regard to the demographic information.

Table 1. Descriptive Statistics for Students in Sample

	2010-2011	2011-2012
	% students	*% students*
Gender (female)	51%	51%
Caucasian	46%	45%
Latino	30%	30%
Asian	12%	11%
African American	9%	10%
Multiracial	4%	4%
Low-English Proficiency	4%	4%
Free/Reduced Lunch	28%	27%
Special Ed Classification	6%	4%
Talented/Gifted	11%	12%
At-Risk for Dropout	23%	21%
Retained	1%	1%

Analyses

Logistic regressions were conducted to compare the two groups of students (one group from the two school year prior to implementing STEMscopes, and one group from the academic year when STEMscopes was implemented in all of the classrooms) on their science proficiency (whether they were considered proficient in science based cutoff scores on the state science assessment). All analyses were conducted within a multilevel framework using the software HLM7 to control for the non-independence of the data, with students nested within classrooms. First, demographic covariates (gender, ethnicity, English proficiency, free or reduced lunch, special education placement, risk of school dropout, and grade retention) were dummy-coded and entered as predictors of science proficiency to control for their effects on academic achievement. The random effects of the demographic covariates were fixed to zero (i.e., the effects of the demographic covariates on science proficiency was not allowed to vary across classrooms). Second, STEMscopes (i.e., year group) was entered as a predictor of science proficiency. The random effect of this variable was freely estimated (i.e., the effect of STEMscopes on science proficiency was allowed to vary across classrooms). Coefficients with a p-value < .05 were considered statistically significant and odds ratios for these coefficients were calculated to determine the associations between the predictors and science proficiency.

Results of the Study

All demographic covariates predicted science proficiency with the exception of grade retention. STEMscopes significantly predicted science proficiency ($\beta = 0.427$, $SE = 0.136$, $p = .003$). The odds ratio associated with this coefficient is 1.52 ($0.427312^e = 1.52$). This finding indicated that in the second academic year, when STEMscopes was being implemented in the classrooms, students were 1.52 times more likely to be proficient in science compared to the previous school year when STEMscopes was not being implemented.

Conclusions

The team found that being in a STEMscopes classroom not only was a statistically significant predictor of proficiency on the science exam, but also that it was a *positive* predictor of proficiency. Specifically, the students in the study who had the STEMscopes curriculum in 8th grade were *1.5 times more likely* to be proficient on the Texas 8th grade science test.

References

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