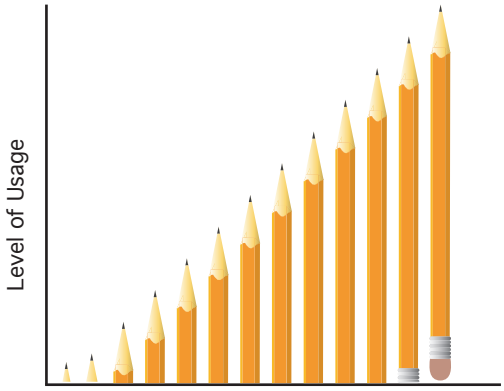
More STEMscopes™, More Learning

Analysis of the Level of Usage of STEMscopes™ and Students' 5th Grade STAAR™ Scores

As part of a broader analysis of the use of STEMscopes™ in a one large, urban district in Texas, we investigated how the extent of STEMscopes™ use among 34 schools in this district was associated with student science achievement. Specifically, we analyzed whether different levels of usage at the school-level were associated with 5th grade students' STAAR™ scores.

Analysis:

The user analytics data served as a measure of dosage or intensity of implementation at 34 STEMscopes™ school. Levels of usage were measured at the school level (based on the user analytics data that we collect through the website) in five different ways based on the user analytics data.



Students' scores on 5th grade STAAR™ were better with more exposure to STEMscopes™.

User Analytics Variables

1. Total number of visits to any learning objectives content
2. Total number of visits to any of the 5E+ I/A steps
3. Total number of learning objectives taught
4. Total number of days visited
5. Total visit time span in days (number of days between first and last visit)

Using multilevel regression analysis, the five user analytics variables were entered as school-level predictors of students' science achievement, controlling for school- and student-level factors.

Results:

There was a positive association between students and:

1. Total number of learning objectives taught
2. Total number of days visited
3. Total visit time span in days (number of days between first and last visit)

Conclusion:

Students in STEMscopes™ schools that used more content and spent more time on the STEMscopes™ website had higher science achievement scores, even after controlling for important school- and student-level differences.

The more exposure students had to STEMscopes™, the better they performed on their state science achievement test.

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STEMscopes™

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Analysis of the Level of Usage of STEMscopes and Students' 5th Grade STAAR™ Scores

Description of the Study

The purpose of this study was to examine the level of usage among STEMscopes™ schools in a large, urban district to determine if varying levels of use of STEMscopes™ was associated with student proficiency in science, as measured by the Texas state science assessment, than students in classrooms that did not use STEMscopes™.

STEMscopes™ is a comprehensive, online K-12 science curriculum that is 100% 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. 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.

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 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). The 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 to make it the 5E+I/A model. 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 work reported here represents part of a broader, ongoing study of the science curriculum. Data collection for the broader study employed a mixed methods design with a quantitative and qualitative component (Creswell, 2009), but here we report only the quantitative component from our analysis of the impact of curriculum utilization on student learning. For the purposes of this study, we utilized fifth grade student and teacher data acquired from the participating school

STEMscopes™ PREK-12

district for the 2011-2012 school year. Learning analytics were used to measure how the teachers interacted with the curriculum.

Learning analytics applies methods, theories, and statistical models to the analysis of educational datasets (Bienkowski, Feng, & Means, 2012). The STEMscopes™ analytics platform allows us to analyze data about page visits to STEMscopes™ content by districts, schools, and users, both teachers and students. In other words, we are able to see what online use of the curriculum looks like 'behind the scenes' by viewing and analyzing what pages and content viewers are 'clicking on' and in what order. In this report we define "visit" as a click to any page in STEMscopes™ that corresponds to a science topic (or unit covered) within the 5E framework embedded within the curriculum. We collected teacher analytics data from the STEMscopes™ website for the participating teachers and aggregated these data at the school-level.[2]

Sample

Data on school characteristics, student demographics, and student science scores on the state assessment called the STAAR™ exam were collected for all fifth grade students in the district for the 2011-2012 school year. Here, we report on results for students at a smaller sample of schools that were active STEMscopes™ users. Table 1 describes our sample of 34 STEMscopes™ schools and their 3,079 students. Of these schools, 16 had adopted STEMscopes™ in the fall of 2011 and the remaining 18 had adopted the curriculum in the early spring of 2012. Of the 34 schools, 14 had new principals in the 2011-2012 school year, and 16 met Adequate Yearly Progress requirements for the year. Two were Montessori magnet programs. Raw scores on the state science test ranged from 0 to 44 points; students received a passing score if they scored a 29 or higher and were considered advanced with a score of 41 or higher.

Table 1: School and Student Descriptive Statistics for STEMscopes™ Sample

	School Mean	Std. Deviation
Raw Science Scores	30.95	2.30
Percent of students passing	65%	0.13
Percent of students scoring advanced	8%	0.10
Total teaching experience	11.37	5.13
Number of 5th grade students	90.56	29.99

Student Demographics	Percent
Female	52.5%
Asian	3.2%
African American	19.0%
Latino	73.0%
White	4.0%
Special Education	10.4%
Gifted & Talented	18.3%

Analyses

Analyses were conducted within schools that utilized STEMscopes™ to determine if different levels of usage at the school level (based on the user analytics data) were associated with students' science achievement. The user analytics data served as a measure of dosage or intensity of implementation. The 34 schools that accessed the STEMscopes™ website and teacher dashboard at any point during the school year were included in these analyses. The seven schools that did not access the STEMscopes™ website and dashboard at any time during the year were excluded. Levels of usage were measured at the school level[1] in five different ways based on the user analytics data. Raw counts of visits and days visited were calculated based on teachers' use of the curriculum and were then aggregated at the school-level.

The user analytics data served as a measure of dosage or intensity of implementation at each STEMscopes™ school. The 34 schools in this district that accessed the STEMscopes™ website and teacher dashboard during the 2011-2012 school year were included in analyses. Levels of usage were measured at the school level[2] in five different ways based on the user analytics data:

- Total number of visits to any learning objectives content
- Total number of visits to any of the 5E+ I/A steps

[1] Because we were not able to attach students to specific teachers, we aggregated all of the learning analytics data to the school level.
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- Total number of learning objectives taught
- Total number of days visited
- Total visit time span in days (number of days between first and last visit)

When examining these variables for normality (an assumption necessary for multilevel regression analysis), we determined that three of the five variables met criteria for normality. However, two of the variables (the total number of visits to any learning objectives content and the total number of visits to any of the 5E+ I/A steps) were positively skewed. Therefore, we conducted a logarithmic transformation of these variables. Descriptive statistics from these two transformed variables and the other three user analytics variables are provided in Table 2.

Table 2. Descriptive Statistics for User Analytics Variables

	Mean	SD	Minimum	Maximum
Total number of visits to any scope content	2.64	0.88	0.30	4.13
Total number of visits to the 5E+ I/A steps	2.46	0.94	0.00	4.10
Total number of scopes taught	37.38	26.32	1.00	102.00
Visit time span in days	111.21	66.55	1.00	183.00
Total number of days visited	24.97	18.14	1.00	71.00

Using multilevel regression analysis, the five user analytics variables were entered as school-level predictors of students' science achievement, controlling for school- and student-level covariates. Separate models were analyzed for each user analytics variable.

Results of the Study

Results from these models can be found in Table 3 below. The total number of visits to any learning objective content or to any of the 5E+ I/A steps was not significantly associated with students' science achievement. The total number of objectives taught, the total number of days visited, and the total visit time span in days were positively associated with students' science achievement, controlling for other differences. Other school-level variables that were associated with student science achievement were AYP status and whether or not the school was a Title 1 schools; schools that AYP had higher student science scores, and Title 1 schools had lower student science scores. For the student-level variables, boys, Asian students, and students considered gifted and talented had higher scores science scores. Students with an economic disadvantage, a special education classification, or who were considered bilingual or ESL had lower science scores.

Table 3. Results from HLM Models Examining STEMscopes™ Usage Levels

	Science Achievement		
	B	*SE*	*p*-value
STEMscopesTM Usage Predictors			
Total number of visits to any scope content	0.65	0.32	0.054
Total number of visits to the 5E+ I/A steps	0.05	0.33	0.880
Total number of scopes taught	0.03*	0.01	< .01
Visit time span in days	0.01*	0.01	< .01
Total number of days visited	0.05*	0.02	< .05
School-Level Predictors			
Average Teacher Experience	-0.14	0.14	0.322
Average Teacher Experience in District	0.03	0.14	0.854
New Principal	0.80	0.61	0.203
Title 1 School	-4.39*	2.02	< .05
Meets AYP	2.23*	0.68	< .01
Montessori	-0.18	1.67	0.917
Average Number of Classrooms	-0.04	0.22	0.861
Average Number of Students	-0.01	0.01	0.611
Average Number of New Teachers	-0.51	0.58	0.392
Student-Level Predictors			
Female	-1.58*	0.27	< .001
African American	-0.47	0.60	0.437
White	0.40	0.81	0.627
Asian	2.18*	0.89	< .01
Other Race/Ethnicity	-2.55	1.60	0.121
Free or Reduced Lunch	-0.10	0.53	0.074
Other Economic Disadvantage	-1.60*	0.56	< .01
Limited Engish Proficiency (LEP)	-0.06	0.41	0.876
Bilingual (BIL)	-3.41*	0.39	< .001
English as a Second Language (ESL)	-4.06*	1.02	< .001
Special Education	-7.96*	0.60	< .001
Gifted/Talented	5.99*	0.36	< .001

Note. Science achievement scores represent raw scores (0-44). For ethnicity, Hispanic is the reference group. Models were run separately for each usage predictor.

Conclusion

Students in STEMscopes™ schools that used more content and spent more time on the STEMscopes™ website had higher science achievement scores, even after controlling for important school- and student-level differences.

References

Bienkowski, M., Feng, M., & Means, B. (2012). *Enhancing Teaching and Learning through Educational Data Mining and Learning Analytics: An Issue Brief*. Washington, DC: SRI International.

Creswell, J. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches*. Thousand Oaks, CA: SAGE Publications.