The Impact of Discovery Education Digital Textbook Usage on Students' Achievements

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Discovery Education digital textbook series help accelerating school districts' digital transition in different subjects for K-8 and high school classrooms and related services. We evaluated the impact of using Discovery Education digital textbooks on students' science, english and math achievement in a large school district in southwest United States.

Keyword: Digital learning, statistical evaluation, program implementation

Goal of the Study

Discovery Education (DE) supplies science, math and social studies digital textbook series for K-8 and high school classrooms, and supports schools to make digital transition and conversion.

In a public school district in the south west U.S., Discovery Education is the curriculum adoption in science, social studies and health. The district piloted DE in the spring 2012, and many more schools and teachers used DE resources in 2012-13 and 2013-14. We evaluated the impact of DE on students' science, english and math achievements using teachers' total DE resource usage, 4th and 7th grade science, english and math teachers and their students, as well as students' Standard Based Assessment (SBA) data over the three years of 2011-12, 2012-13 and 2013-14 in our district.

Methods

We linked teachers' DE usage data each year with the students the teachers taught in the year, and students' SBA score. To precisely measure the impact of using DE on students' achievement, we analyzed the impact of science teachers' DE usage on their students' SBA science score, math teachers' DE usage on their students' math score, and English teachers' DE usage on their students' English score. The statistical models we used for this study are t-test, regression and mixed models.

Analysis Results

The DE Usage of Teachers over the Years

Discovery Education collected total resource usage for each teacher in each semester starting January, 2012 to June 2014. The total resource usage is the sum of resources used in science, math and english, and the resource usage in each subject was not given. Hence, each teacher who used DE has one number about their

total DE usage. Because fourth-grade teachers teach all subjects (science, math and english) to their students, fourth-grade teachers' DE usage possibly include all subjects, and the students exposed to DE through these teachers in each subject were actually the same.

DE usage of science teachers was much higher than that of english and math teachers in all three years. For 4th grade, in 2011-12, only the 38 students in one elementary school exposed to DE; in 2012-13 and 2013-14, the students taught by DE using teachers increased to more than 4000. For 7th grade science, in 2011-12, 2425 students were exposed to DE science, and the number about doubled in the following two school years. For 7th grade math, the students exposed to DE was 315 in 2011-12, and increased to about 800 in the last two years; the usage for English teachers was even lower, and fewer students got exposed to DE English than math. See Appendix Table 1-4 for teachers' usage.

Although the DE usage increased both from the amount of resources teachers used and the number of teachers used DE in the 2nd and 3rd year, as well as the number of students exposed to DE through these teachers, even for 4th and 7th grade science, there were still 40% or more science teachers did not use DE in the 3rd year.

Fourth Grade Science Achievement

Figure 1 describes the 4th grade students' mean science scaled scores between DE users, non-users and of teachers across usage quantiles in each year. In the pilot year (2011-12), the students exposed to DE scored two points lower than those who were not; in 2012-13, students exposed to DE scored 3 points higher than students who were not exposed to DE, and the difference is 1.5 points in 2013-14. The differences between DE users and non-users in the three years are all statistically significant. In the 2nd and 3rd year, students exposed to DE outperformed those who did not, students of teachers with any DE usage all had higher science scores than students of teachers who did not use DE. However, students of the highest DE user teachers (the 4th quartile users) did not scored the highest. In 2012-13, students of quartile 2, 3, and 4 usage teachers performed about same, and in 2013-14, students of quartile 3 usage teacher scored the highest.

Seventh Grade Science Achievement

Figure 2 describes the 7th grade mean science scaled scores between DE users, non-users and of teachers in each DE usage quantile over the three years. In the pilot year 2011-12, 7th grade students exposed to DE scored one point higher in science than those who did not. In 2012-13, students exposed to DE still scored significantly higher (1.1 points), and in 2013-14, the gap became wider, users scored about 2.5 points higher than non-users. The differences are all statistically significant. Similar to 4th grade, the students of 4th quartile teachers did not have the highest science score.

Figure 3 gives the science predicted score of students with each teachers' DE usage quantile and non-users. Considering the influence of students' demography and reading achievement on their science achievement. Controlling the influence of students' demography and reading achievement, non-users scored lower than users with teacher usage quantile 2, 3 and 4 in 2011-12, and scored significantly lower than users with any teacher usage quantile in 2012-13 and 2013-14. Students with teachers' DE usage quantile 3 scored the highest in all the three years.

Figure 1. Fourth Grade Science.

Figure 2. Seventh Grade Science.

Figure 3. The 7th Grade Students' Predicted Science Scaled Scores Controlling the Effects of Other Factors.

Seventh Grade English and Math Achievement

One important fact with our data is that we have only teachers' total resource usage, but not the resource usage in each subject. For 7th grade, different subjects are taught by different teachers, thus 7th grade english or math teachers probably only look at the subject they teach, when they log into DE. Hence for 7th grade, we can associate english or math teachers' DE resource usage to their students' english or math achievement, and avoid the bias caused by the high correlation between achievements in different subjects, because one teacher teaches all subjects to the same students. For example, the correlation of science scaled score and math scaled score for 4th graders exposed to DE is 0.81, and the correlation of science and English is 0.78, and the correlation of english and math is 0.75. 4th grade teachers teach all subjects, but each teacher has only one number about total DE resource usage. It is not appropriate to use these teachers' total DE usage to investigate the effect of DE usage on specific subjects.

Figure 4 describes 7th grade students' mean English scaled scores between students who were exposed to DE and those who were not, as well as students in each usage quartile. The English scores of students taught by teachers who used DE are all significantly lower than students from English teachers who did not used DE. Number of students exposed to DE even decreased from 489 students in 2012-13 to 414 students in 2013-14. It appears there is not a pattern for the association between English teachers' DE usage by quartile and students' English score.

Figure 5 compares the mean math scaled score between students exposed to DE math and those who were not, and scaled scores of students in each teachers' usage quartile. Similar to English, the mean math scores of students who were exposed to DE math were significantly lower than those who were not. This 4th quartile anomaly may be because teachers of struggling students are more likely to try new resources in an effort to meet student needs. Usage by english and math teachers drops off across the years.

Figure 4. Seventh Grade English Language Arts.

Figure 5. Seventh Grade Math.

Conclusion and the Next Step

According to these analyses, we conclude that DE is effective in 4th and 7th grade science. It shows that there is not a linear relationship that students science scaled score increases with their teachers' resource usage level getting higher; it is not the case that every unit of DE resource usage of teachers directly converted into added points in students' science scaled score. Other factors such as how teachers used DE resources, teachers' science background and teaching experience, time spend in teaching science in the classroom....., are also important elements affect students' science achievement, while these factors are not included in the study. This is probably why the correlation between teachers' usage and their score is so low, see Figure 6-9 in Appendix for the scatter plots and correlation.

Further qualitative analysis is needed to examine the information of high user teachers, and why students of these highest user teachers did not scored the highest, how teachers use DE, and their opinion about better implementing DE in our district.

Our summarized conclusions are listed below:

Our analyses show the students of DE user teachers outperformed those of non-users in science in both 4th and 7th grades in the 2nd and 3rd year of implementation.

There is not a linear relationship between teacher usage and student scores as 3rd quartile users' students out score all other quartiles.

Confounding factors such as teachers' science background, teaching experience and time spent in science class may have an effect on DE usage and student performance.

The low or decreased usage, along with students' achievement comparison in english and math between users and non-users suggest that DE did not show its effectiveness in improving students' english and math achievement.

Usage data collection should be re-evaluated as DE's strategy appears to minimize usage, for example, the usage of DE techbook should be included, and teachers' re-use of downloaded DE material should be counted.

Over all, there is a minimal but statistically significant impact of Discovery Education on science performance. However, the potential by the resource has not been maximized. Even for 7th science teachers, who had the most DE usage, there were still 29% or 40% science teachers did not log in DE at all in the 2nd and 3rd year, respectively. More professional Development should be provided to get these teachers use DE.

References

Discovery Education homepage, <http://www.discoveryeducation.com/>, retrieved on March 6, 2015.

Appendix

Table 1

(a) 4th grade teachers' total resource usage quartiles over the years and number of students involved in each usage quartile

	2011-12		2012-13		2013-14	
	Range	Number of students	Range	Number of students	Range	Number of students
Quartile 1	$> 5 \leq 9$	11	$> 3 \leq 32$	1062	$> 3 \leq 36$	1045
Quartile 2	$> 9 \leq 10$	8	$> 32 \leq 59$	1145	$> 36 \leq 82$	1174
Quartile 3	$> 11 \leq 14$	7	$> 59 \leq 106.5$	1247	$> 82 \leq 179$	1163
Quartile 4	$> 14 \leq 17$	12	$> 106.5 \leq 1129$	1219	$> 179 \leq 2647$	1074
Total		38		4673		4456

(b) 4th grade teachers' total resource usage quartiles over the years and number of teachers in each usage quartile

	2011-12		2012-13		2013-14	
	Range	Number of teachers	Range	Number of teachers	Range	Number of teachers
Quartile 1	$> 5 \leq 9$	2	$> 3 \leq 32$	43	$> 3 \leq 36$	64
Quartile 2	$> 9 \leq 10$	1	$> 32 \leq 59$	43	$> 36 \leq 82$	63
Quartile 3	$> 11 \leq 14$	1	$> 59 \leq 106.5$	65	$> 82 \leq 179$	20
Quartile 4	$> 14 \leq 17$	1	$> 106.5 \leq 1129$	67	$> 179 \leq 2647$	63
Total user teachers		5		218		200
Non-user teachers		439		168		169
Percentage of non-users		99%		44%		46%

Table 2

(a) 7th grade science teachers' resource usage quartiles over the years and number of students involved in each usage quartile

	2011-12		2012-13		2013-14	
	Range	Number of students	Range	Number of students	Range	Number of students
Quartile 1	$> 1 \leq 4$	1030	$> 11 \leq 65.5$	812	$> 14 \leq 57$	650
Quartile 2	$> 4 \leq 8$	330	$> 65.5 \leq 122.5$	1524	$> 57 \leq 162$	1030
Quartile 3	$> 8 \leq 19$	755	$> 122.5 \leq 298$	1553	$> 162 \leq 400$	1365
Quartile 4	$> 19 \leq 171$	310	$> 298 \leq 1941$	1083	$> 400 \leq 4153$	987
Total		2425		4972		4032

(b) 7th grade science teachers' resource usage quartiles over the years and number of teachers in each usage quartile

	2011-12		2012-13		2013-14	
	Range	Number of teachers	Range	Number of teachers	Range	Number of teachers
Quartile 1	$> 5 \leq 9$	14	$> 3 \leq 32$	22	$> 3 \leq 36$	21
Quartile 2	$> 9 \leq 10$	7	$> 32 \leq 59$	22	$> 36 \leq 82$	20
Quartile 3	$> 11 \leq 14$	10	$> 59 \leq 106.5$	22	$> 82 \leq 179$	20
Quartile 4	$> 14 \leq 17$	10	$> 106.5 \leq 1129$	22	$> 179 \leq 2647$	20
Total user teachers		41		88		81
Non-user teachers		96		39		54
		70%		29%		40%

Table 3

7th grade English teachers' resource usage quartiles over the years and number of students involved in each quartile

	2011-12		2012-13		2013-14	
	Range	Number of students	Range	Number of students	Range	Number of students
Quartile 1	$> 1 \leq 2$	165	$> 4 \leq 16$	235	$> 6 \leq 19$	121
Quartile 2	$> 2 \leq 3.5$	25	$> 16 \leq 39.5$	49	$> 19 \leq 31$	202
Quartile 3	$> 3.5 \leq 25$	34	$> 39.5 \leq 98$	131	$> 31 \leq 43$	62
Quartile 4	$> 25 \leq 65$	64	$> 98 \leq 1941$	74	$> 43 \leq 1133$	29
Total		288		489		414

Table 4

7th grade math teachers' resource usage quartiles over the years and number of students involved in each quartile

	2011-12		2012-13		2013-14	
	Range	Number of students	Range	Number of students	Range	Number of students
Quartile 1	$> 1 \leq 2$	108	$> 2 \leq 12$	341	$> 2 \leq 16$	311
Quartile 2	$> 2 \leq 7$	114	$> 12 \leq 21$	128	$> 16 \leq 41$	215
Quartile 3	$> 7 \leq 25$	68	$> 21 \leq 79$	265	$> 41 \leq 162$	294
Quartile 4	$> 25 \leq 100$	25	$> 79 \leq 638$	34	$> 162 \leq 1744$	70
Total		315		768		890

Figure 6. 4th and 7th students' science score vs. their science teachers' DE resource usage in all three years. $r = -0.064$.

Figure 7. 4th and 7th grade students' science Score versus their science teachers' DE resource usage in, with 11 highest user teachers removed, $r = 0.001$.

Figure 8. The Reading score of all 7th grade students exposed to DE English versus their teachers' DE usage in the three years ($r = 0.04$).

Figure 9. The math score of all 7th grade students exposed to DE math versus their teachers' DE usage in the three years ($r = 0.07$).