Impact of the Algebra Nation tutoring program on the performance of students who retake the end-of-course exam

Walter L. Leite, Duygu Cetin-Berber, Zachary K. Collier, A. Corinne Huggins-Manley, Carole R. Beal

College of Education, University of Florida

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Abstract

High failure rates mean many students must repeat Algebra, yet passing rates for repeaters remain low. Online tutoring may be a useful resource for these students. The present analysis examines the impact of Algebra Nation, a free online tutoring platform, on the performance of students who failed the end-of-course (EOC) exam the previous year. Results indicate that higher use of Algebra Nation was associated with greater EOC gains, particularly for students most at risk for repeated failure.

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Background and rationale

Successful completion of Algebra has been identified as an important milestone for college readiness, college enrollment, attainment of a bachelor's degree, and future employment (Adelman, 2006; Gamoran & Hannigan, 2000; Star, et al., 2015; US Department of Labor, 2012)**.** Unfortunately, algebra courses typically have a high failure rate. For example, in the 2016-2017 school year, 38% of Florida students taking the Algebra end-of-course exam (EOC) for the first time failed to achieve a passing score, which is required for students to qualify for high school graduation.

Failure means that many students must retake Algebra (Fong, Jaquet & Finkelstein, 2014). However, the prospects for re-takers are grim: when students fail Algebra once, they are likely to fail it again (Ham & Walker, 1999, Helfand, 2006; Waterman, 2010). In 2017, 73% of Florida students who took the EOC for a second time (or more) failed again. Repeated failures are associated with eventually dropping out of high school. The link between failure in algebra and failure to complete high school appears to be particularly strong for Hispanic students. Thus, there is an urgent need to identify successful intervention strategies for students who do not succeed in their first algebra course.

Theoretical Framework

Recent research suggests that online tutoring systems can be effective and cost-efficient approach to algebra instruction (Bishop, 2006; Jung, 2003; Taplin, Ross, Kerr & Brown, 2013). Studies of online programs have shown benefits relative to traditional classroom instruction (Cavanaugh, Gillan, Bosnick, Hess & Scott, 2008; Hagerty & Smith, 2005; Heid & Blume, 2008;

Heppen et al., 2012; Jaciw, Megan & Boya, 2012; Pane, Griffin, McCaffrey & Karam, 2014; Patrick, & Powell, 2009; Rakes, Valentine, McGatha & Ronau, 2010; Roschelle et al., 2010; Shaw, Jean & Peck, 1997). Students who learn algebra with the support of online resources take more challenging math courses in the future (Heppen, Clements & Walters, 2015). Students also appear more engaged when online resources are used, particularly the lowest-achieving students (Beal, Arroyo, Cohen & Woolf, 2006; Leong & Alexander, 2013; O'Dwyer, Carey & Kleiman, 2007; Yushau, 2006).

Although online programs appear to have potential, to date there has been little investigation of the impact on Algebra re-takers, that is, on students who have already failed once or more and are at high risk for future failure. The goal of the present study was to look at the impact of the Algebra Nation tutoring program on re-takers. Algebra Nation is a free, online tutoring platform developed with state support and widely used in Florida schools. The program includes instructional videos and an interactive module that allows students to practice EOC-type test problems and receive immediate feedback. The "test yourself" module is designed to look like the actual exam, including an integrated calculator and clock/timer. Initial research suggests that use of Algebra Nation is associated with increased passing rates. However, this is the first analysis to focus specifically on re-takers.

Research Questions

The analysis was conducted to learn if more frequent use of Algebra Nation increased the chances that re-takers would pass the EOC relative to minimal use, and if the relation was modified by student characteristics such as gender, ethnicity and economic status (as indicated by eligibility for free or reduced lunch).

Method

Sample. The sample for this study included 8,746 students who failed the Algebra I EOC in the 2014-2015 academic year and re-took the exam in 2015-2016. Demographic information was provided by the Florida Dept. of Education. Consistent with prior work, re-takers were more likely to be male (50.4%) and eligible for free/reduced lunch (73.4%) than students taking the EOC for the first time (44.7% male, 58.2% eligible for free/reduced lunch). The proportion of students who were of Hispanic/Latino origin was similar for re-takers and first-time-takers (30%). Sample sizes are shown in Table 1.

Data sources. Data about students' use of Algebra Nation during the school year, as indicated by the total number of logins, video views, and use of the test-yourself practice module, was provided by the platform developer. Each usage indicator was binned into one of three frequency categories (e.g., fewer than five logins, between five and 30, and more than 30 logins). This categorization of the indicators was performed because the total counts of usage are strongly positively skewed and non-linearly related to the outcome. Sample sizes for the usage categories are included in Table 1.

The primary outcome metric was the student's score on the Algebra I end-of-course (EOC) exam at the end of the school year. Scores were provided by the Florida Dept. of Education. Data from different sources were aligned and then identifying information was removed before the dataset was made available for the analysis.

Analytic strategy.

We used two multilevel models (Snijders & Bosker, 2012) to address the research questions. The first model focused on Algebra Nation logins as the measure of usage, whereas the second model focused on indicators of video views and test-yourself module usage. Two separate models were used because video views and test-yourself module usage were expected to partially mediate the

relationship between logins and the outcome, so including all at the same model would only provide the effect of logins that was not mediated by video views and test-yourself module usage.

Before inclusion in the models, the three-category indicators of logins, video views, and test-yourself module use were converted into two dummy-coded variables each, with the first dummy variable indicating between five and 30 counts, and the second dummy variable indicating more than 30 counts, whereas the reference category was fewer than five counts. A dummy indicator of year was included, where zero was for the 2014-2015 and one was for the 2015-2016 school year. The longitudinal dataset for this study had a long format with data for the 2014-2015 and 2015-2016 academic years stacked.

We included only dummy indicators of logins in the first model to obtain total effects of logins, which combine direct and indirect effects of logins. In the second model, we estimated effects of video views and test-yourself module use regardless of the number of logins used. The implication of not including logins in the second model is that if two students watched the same number of videos and responded to the same number of test-yourself module questions, they were considered to have the same level of Algebra Nation usage despite possible differences in the number of times they logged in to Algebra Nation.

The multilevel models included random intercepts of students, fixed effects of schools, year, AN usage categories, and student demographics. The fixed effects of schools were obtained by effect-coding the school identification number. Effect-coding rather than dummy-coding schools produces an intercept that is the mean across all schools, rather than the mean of a reference school. We chose to use fixed effects rather than random effects of schools because fixed cluster effects controls for all potential confounding variables at the cluster level, and

require fewer assumptions than random effects of schools (Allison, 2009). The model also included two-way interactions between year and Algebra Nation usage indicators, year and demographic indicators, usage indicators and demographic indicators, and three way interactions between year, usage indicators and demographic indicators.

Results

Multilevel model of the relationship between Algebra Nation logins and EOC scores

Table 2 shows the coefficients estimated with the multilevel model with login indicators. The model revealed a significant positive main effect for year, indicating that EOC scores increased an average of 12.71 points from the 2014-2015 to the 2015-2016 school year.

Students of Hispanic or Latino origin had EOC scores that were 3.99 points lower than students not of Hispanic or Latino origin. The results of interaction effects showed that students of Hispanic or Latino origin were predicted to have EOC scores that were 3.62 points higher in 2015-2016 than 2014-2015.

With regard to Algebra Nation usage, there were no effects involving gender, race, free/reduced lunch eligibility for students with between 5 and 30 logins. On the other hand, students who logged in more than 30 times during the year had EOC scores that were 7.79 points higher on average than students with fewer than five logins, after controlling for free/reduced lunch eligibility, year, ethnicity, race, gender and school. In addition, students who were eligible for free/reduced lunch and who had logged in to Algebra Nation more than 30 times during the school year had EOC scores that were 9.24 points higher than comparable students with fewer Algebra Nation logins.

Multilevel model of the relationship between Algebra Nation video views and use of the test-yourself module and EOC scores

Table 3 shows the coefficient results of the multilevel model with indicators of video views and test-yourself too use. With regard to main effects, mean EOC scores were 9.46 points higher in 2015-2016 than in 2014-2015, controlling for Algebra Nation student video views, test-yourself module responses, free/reduced lunch eligibility, ethnicity, race, gender and schools. Students who were eligible for free/reduced lunch had EOC test scores that were 7.77 points lower than those of more affluent students. Male students had EOC scores that were 5.32 points lower on average than female students. There were no main effects associated with race, ethnicity, video views or test-yourself responses.

Looking at interactions, students of Hispanic or Latino origin had EOC scores that were 10.49 points higher in 2015-2016 than comparable students in 2014-2015.

With regard to Algebra Nation usage, male students who used the test-yourself module between 5 and 30 times scored 4.66 points higher on the EOC than males who with lower usage. Students who were eligible for free/reduced lunch and who used the test-yourself module more than 30 times had scores 15.80 points higher than comparable students with lower use of the test-yourself module.

Students who were eligible for free/reduced lunch and who watched between 5 and 30 videos had scores 6.75 points higher on average than similar students who logged in fewer than 5 times during the school year. However, this interaction varied by year: students who were eligible for free/reduced lunch and watched between 5 and 30 videos had scores 9.72 points *lower* in 2015-2016 than comparable students in 2014-2015.

Educational Significance of Study

Both models indicated that, for re-takers, students' scores did increase from the previous year. However, scores of male students, those eligible for free/reduced lunch, and those of

Hispanic/Latino origin showed smaller increases than was observed for students in general. Using Algebra Nation more than 30 times in the school year had a positive impact on these students. The positive impact was observed for two measures of Algebra Nation usage: frequency of logging in, and using instructional resources such as viewing video and completing practice problems. The results indicate that failing Algebra once does not have to mean future failure; interventions such as Algebra Nation can help get struggling students back on track.

References

Adelman, C. (2006). The Toolbox Revisited: Paths to Degree Completion From High School. Through College. Washington, D.C.: U.S. Department of Education.

Allison, P. D. (2009). Fixed effects regression models. Los Angeles, CA: Sage.

Bakia, M., Mislevy, J., Heying, E., Patton, C., Singleton, C., Krumm, A. (2013). Supporting K–12 Students in Online Learning: A Review of Online Algebra I Courses. Menlo Park, CA: SRI International.

Beal, C. R., Arroyo, I., Cohen, P. R., & Woolf, B. P. (2010). Evaluation of AnimalWatch: An intelligent tutoring system for arithmetic and fractions. Journal of Interactive Online Learning, 9, 65-77.

Bishop, T. (2006). Research highlights cost effectiveness of online education. Sloan Consortium.

Cavanaugh, C., Gillan, K. J., Bosnick, J., Hess, M., & Scott, H. (2008). Effectiveness of interactive online algebra learning tools. Journal of Educational Computing Research, 38(1), 67-95.

Fong, A. B., Jaquet, K., & Finkelstein, N. (2014). Who Repeats Algebra I, and How Does Initial Performance Relate to Improvement When the Course Is Repeated? REL 2015-059. Regional Educational Laboratory West.

Hagerty, G., & Smith, S. (2005). Using the web-based interactive software ALEKS to enhance college algebra. Mathematics and Computer Education, 39(3), 183-194.

Ham, S., & Walker, E. (1999). Getting to the right algebra: The Equity 2000 initiative in Milwaukee Public Schools. MDRC.

Helfand, D. (2006). A formula for failure in LA schools. Los Angeles Times, 125(58), A1.

Heid, M. K., & Blume, G. W. (2008b). Algebra and function development. In M. Heid & G. Blume (Eds.), Research on technology and the teaching and learning of mathematics: Research syntheses (Vol. 1), pp. 55-80. Charlotte, NC: Information Age.

Heppen, J. B., Clements, M., & Walters, K. (2015). Turning to online courses to expand access: A rigorous study of the impact of online algebra I for eighth graders. In J. Middleton, J. Cai & S. Whang (Eds.), Large-Scale Studies in Mathematics Education (pp. 95-132). Springer International Publishing.

Jaciw, A. P., Megan, T., & Boya, M. (2012, Sept.). Conditions for the effectiveness of a tablet-based algebra program. Paper presented at the meeting of the Society for Research on Educational Effectiveness, Washington DC.

Jung, I. (2003). Cost-effectiveness of online education. In M. Moore & W. Anderson (Eds.), Handbook of Distance Education (pp. 717-726). Erlbaum.

Leong, K. E., & Alexander, N. (2013). Exploring attitudes and achievement of web-based homework in developmental algebra. The Turkish Online Journal of Education Technology, 12(4), 75-79.

O'Dwyer, L. M., Carey, R., & Kleiman, G. (2007). A study of the effectiveness of the Louisiana Algebra online course. Journal of Research on Technology in Education, 39(3), 289-306.

Pane, J. F., Griffin, B. A., McCaffrey, D. F., & Karam, R. (2014). Effectiveness of Cognitive Tutor Algebra I at scale. Educational Evaluation and Policy Analysis, 36(2), 127-144.

Patrick, S., & Powell, A. (2009). A Summary of Research on the Effectiveness of K-12 Online Learning. International Association for K-12 Online Learning.

Rakes, C. R., Valentine, J. C., McGatha, M. B., & Ronau, R. N. (2010). Methods of instructional improvement in algebra: A systematic review and meta-analysis. Review of Educational Research, 80(3), 372-400.

Roschelle, J., Schechtman, N., Tatar, D., Hegedus, S., Hopkins, B., Empson, S., Knudsen, J. & Gallagher, L. (2010). Integration of technology, curriculum, and professional development for advancing middle school mathematics: Three large-scale studies. American Educational Research Journal, 47(4), 833–878.

Shaw, N., Jean, B., & Peck, R. (1997). A statistical analysis on the effectiveness of using a computer algebra system in a developmental algebra course. The Journal of Mathematical Behavior, 16(2), 175-180.

Snijders, T. A. B., & Bosker, R. J. (2012). *Multilevel analysis: An introduction to basic and advanced multilevel modeling (2nd ed.).* Thousand Oaks, CA: Sage Publications.

Taplin, R. H., Kerr, R., & Brown, A. (2013). Who pays for blended learning? A cost–benefit analysis. The Internet and Higher Education,18, 61-68.

US Department of Labor, Bureau of Labor Statistics, Career Outlook, “Education Matters”, March 2016, http://www.bls.gov/careeroutlook/2016/data-on-display/education-matters.htm, June 10, 2016.

Waterman, S. (2010). Pathways report: Dead ends and wrong turns on the path through algebra. Palo Alto. CA: Noyce Foundation.

Yushau, B. (2006). The effects of blended e-learning on mathematics and computer attitudes in pre-calculus algebra. The Mathematics Enthusiast, 3(2), 176-183.

Table 1

Sample sizes of groups included in the analysis

		Sample size
Logins	less than 5 times	3784
	between 5 and 30 times	4244
	more than 30 times	718
Video views	less than 5 times	2443
	between 5 and 30 times	3036
	more than 30 times	1226
Test-yourself tool responses	less than 5 times	1924
	between 5 and 30 times	1008
	more than 30 times	200
Gender	Female students	4340
	Male students	4406
Race	White students	5189
	Non-white students	3557
Ethnicity	Hispanic/Latino origin	2598
	Non-Hispanic/Latino origin	6148
Reduced/free lunch	Eligible	6444
	Not Eligible	2302

Table 2

Parameter estimates for multilevel models for the relationship between Algebra Nation Login and Algebra I End-of-Course Assessment Scores

	Estimate	*Std. Error*	*df*	*t*	*p*
Intercept	**471.433**	1.572	8177	299.870	2e-16 ***
2015-2016 school year	**12.713**	1.888	7405	6.734	1.77e-1***
Between 5 and 30 AN logins	2.436	1.893	7825	1.287	0.198
More than 30 logins	**7.790**	2.974	7864	2.620	0.009**
Eligible for free/reduced lunch	-1.421	1.372	7852	-1.036	0.300
Hispanic/Latino origin	-**3.998**	1.326	7718	-3.014	0.003**
White student	2.313	1.254	7672	1.845	0.065
Male student	-0.159	1.077	7864	-0.147	0.883
2015-2016 & Between 5 and 30 logins	2.796	2.548	7771	1.097	0.273
2015-2016 & More than 30 logins	-5.714	5.093	8022	-1.122	0.262
2015-2016 &free/reduced lunch	0.545	1.676	7507	0.325	0.745
2015-2016 & Between 5 and 30 Logins & free/reduced lunch	-3.135	2.258	7820	-1.388	0.165
2015-2016 & Hispanic/Latino origin	**3.625**	1.671	7516	2.170	0.030*
2015-2016 & White student	-0.153	1.596	7458	-0.096	0.924

2015-2016 & Male student	0.201	1.379	7508	0.146	0.884
Between 5 and 30 logins & free/reduced lunch	-0.229	1.727	7867	-0.133	0.895
More than 30 logins & free/reduced lunch	-4.590	2.739	7889	-1.676	0.094
Between 5 and 30 logins & Hispanic/Latino origin	-0.330	1.697	7825	-0.194	0.846
Between 5 and 30 logins & Hispanic/Latino origin	-3.614	2.884	7885	-1.253	0.210
Between 5 and 30 logins & White student	1.353	1.600	7781	0.846	0.398
More than 30 logins & White student	0.763	2.647	7849	0.288	0.773
Between 5 and 30 logins & Male student	-0.587	1.380	7859	-0.425	0.671
More than 30 logins &Male student	-0.756	2.180	7879	-0.347	0.729
2015-2016 & Between 5 and 30 logins & free/reduced lunch	-3.135	2.258	7820	-1.388	0.165
2015-2016 & More than 30 logins & Eligible for free/reduced lunch	**9.242**	4.486	7960	2.060	0.039*
2015-2016 & Between 5 and 30	-0.341	2.302	7855	-0.148	0.882

logins & Hispanic/Latino origin					
2015-2016 & More than 30	-2.711	4.697	7938	-0.577	0.564
logins & Hispanic/Latino origin					
2015-2016 & Between 5 and 30	-1.513	2.178	7854	-0.695	0.487
logins & White student					
2015-2016 & More than 30	2.283	4.368	8012	0.523	0.601
logins & White student					
2015-2016 & Between 5 and 30	-0.138	1.892	7804	-0.073	0.942
logins & Male student					
2015-2016 & More than 30	-0.259	3.703	7878	-0.070	0.944
logins & Male student					

Note. Statistically significant coefficients are in bold. Significant codes: *** 0.001; ** 0.01; * 0.05. Fixed effects of schools are not shown.

Table 2

Parameter estimates for multilevel models for the relationships between Algebra Nation Video Views, Test Yourself Module Responses, and EOC Scores

	Estimate	*Std. Error*	*df*	*t*	*p*
Intercept	**478.536**	3.262	2274.3	146.709	2e-16***
2015-2016 school year	**9.459**	4.563	1976.1	2.073	0.038*
Between 5 and 30 video views	-1.594	3.815	2291	-0.418	0.676
More than 30 video views	-1.467	4.423	2340.3	-0.332	0.740
Between 5 and 30 test-yourself module responses	1.390	3.810	2246.1	0.365	0.715
More than 30 test-yourself module responses	8.989	7.198	1864.9	1.249	0.212
Eligible for free/reduced lunch	**-7.771**	2.815	2276.7	-2.761	0.006**
Hispanic/Latino origin	-3.625	2.929	2278.4	-1.238	0.216
White student	4.124	2.678	2295.9	1.540	0.124
Male Student	**-5.324**	2.264	2372.1	-2.351	0.019*
Between 5 and 30 video views & Between 5 and 30 test-yourself module responses	-1.722	3.052	2210.3	-0.564	0.573
More than 30 video views & Between 5 and 30 test-yourself module responses	-4.591	3.372	2280.3	-1.362	0.173
Between 5 and 30 video views &	0.364	6.477	2024.1	0.056	0.955

More than 30 test-yourself module responses					
More than 30 video views & More than 30 test-yourself module responses	-6.398	6.520	2081.6	-0.981	0.327
2015-2016 & Between 5 and 30 video views	6.335	5.613	2155.6	1.129	0.259
2015-2016 & More than 30 video views	9.710	6.931	2213.2	1.401	0.161
2015-2016 & Between 5 and 30 test-yourself module responses	6.855	5.739	2057.4	1.194	0.232
2015-2016 & More than 30 test-yourself module responses	-6.525	10.052	1613.4	-1.644	0.100
2015-2016 & Eligible for free /reduced lunch	5.857	3.953	2108.3	1.482	0.139
2015-2016 & Hispanic/Latino origin	**10.491**	4.187	2262.1	2.506	0.012*
2015-2016 & White student	-5.072	3.797	2138.7	-1.336	0.182
2015-2016 & Male student	4.069	3.412	2218.1	1.193	0.233
Between 5 and 30 video view and Eligible for free/reduced lunch	**6.754**	3.263	2292.3	2.070	0.039*
More than 30 video views & Eligible for free/reduced lunch	6.668	3.738	2306.8	1.784	0.075

Between 5 and 30 video views & Hispanic/Latino origin	1.997	3.412	2270.5	0.585	0.559
Between 5 and 30 video views & Hispanic/Latino origin	-0.837	3.932	2289.8	-0.213	0.831
Between 5 and 30 video views & White student	-4.231	3.112	2305.3	-1.360	0.174
More than 30 video views & White student	-0.289	3.588	2306	-0.081	0.936
Between 5 and 30 video views & Male student	2.708	2.702	2343.6	1.002	0.316
More than 30 video views & Male student	-0.420	3.079	2363.6	-0.136	0.891
Between 5 and 30 test-yourself module responses & Eligible for free/reduced lunch	0.078	2.838	2350.9	0.027	0.978
More than 30 test-yourself module responses & Eligible for free/reduced lunch	-8.619	4.800	2124.3	-1.796	0.073
Between 5 and 30 test-yourself module responses & Hispanic/Latino origin	-4.348	2.978	2276.2	-1.460	0.144
More than 30 test-yourself module responses & Hispanic/Latino origin	0.626	5.324	1998	0.118	0.906

Between 5 and 30 test-yourself module responses & White student	4.878	2.760	2313.8	1.768	0.077
More than 30 test-yourself module responses & White student	3.852	5.117	2161.5	0.753	0.452
Between 5 and 30 test-yourself module responses & Male student	**4.665**	2.369	2328.4	1.969	0.049*
More than 30 test-yourself module responses & Male student	1.762	4.487	2196.5	0.393	0.695
2015-2016 & Between 5 and 30 video views & Between 5 and 30 test-yourself module responses	-5.990	4.502	2117.3	-1.331	0.183
2015-2016 & More than 30 video views & Between 5 and 30 test-yourself module responses	1.636	5.176	2185.8	0.316	0.752
2015-2016 & Between 5 and 30 video views & More than 30 test-yourself module responses	3.199	8.712	1899.6	0.367	0.714
2015-2016 & More than 30 video views & More than 30 test-yourself module responses	5.822	10.286	2053.9	0.566	0.571
2015-2016 & Between 5 and 30 video views & Eligible for free/reduced lunch	**-9.716**	4.676	2169.6	-2.078	0.038*

2015-2016 & More than 30 video views & Eligible for free/reduced lunch	-9.520	5.693	2178.3	-1.672	0.095
2015-2016 & Between 5 and 30 video views & Hispanic/Latino origin	-8.525	4.951	2247.9	-1.722	0.085
2015-2016 & More than 30 video views & Hispanic/Latino origin	-10.326	6.007	2252.7	-1.719	0.086
2015-2016 & Between 5 and 30 video views & White student	7.905	4.562	2215.5	1.733	0.083
2015-2016 & More than 30 video views & White student	-0.900	5.528	2152.6	-0.163	0.871
2015-2016 & Between 5 and 30 video views & Male student	-6.382	4.099	2270.5	-1.557	0.120
2015-2016 & More than 30 video views & Male student	0.125	4.829	2252.6	0.026	0.979
2015-2016 & Between 5 and 30 test-yourself module responses & Eligible for free/reduced lunch	-2.120	4.361	2329	-0.486	0.627
2015-2016 & More than 30 test-yourself module responses & Eligible for free/reduced lunch	**15.798**	7.025	1833.2	2.249	0.025*
2015-2016 & Between 5 and 30	1.652	4.505	2198.9	0.367	0.714

test-yourself module responses & Hispanic/Latino origin					
2015-2016 & More than 30 test-yourself module responses & Hispanic/Latino origin	-10.715	7.874	1844.9	-1.361	0.174
2015-2016 & Between 5 and 30 test-yourself module responses & White student	-5.524	4.314	2327.7	-1.281	0.200
2015-2016 & More than 30 test-yourself module responses & White student	8.093	7.407	2041.9	1.093	0.275
2015-2016 & Between 5 and 30 test-yourself module responses & Male student	-2.679	3.757	2192.1	-0.713	0.476
2015-2016 & More than 30 test-yourself module responses & Male student	4.711	6.700	1977.1	0.703	0.482

Note. Statistically significant coefficients are in bold. Significant codes: *** 0.001; ** 0.01; * 0.05. Fixed effects of schools are not shown.

Appendix 1. Sample sizes by combinations of demographic variables and Algebra Nation usage

Usage variable	Demographic variable	less than 5 times	between 5 and 30 times	more than 30 times
Logins	Female	1818	2158	364
	Male	1966	2086	354
Video-views	Female	1165	1544	638
	Male	1278	1492	588
Test-yourself tool	Female	964	499	98
	Male	960	509	102
Logins	White	2292	2490	407
	Non-white	1492	1754	311
Video views	White	1463	1786	698
	Non-white	980	1250	528
Test-yourself tool	White	1137	621	125
	Non-white	787	387	75
Logins	Hispanic/Latino	1113	1268	217
	Non-Hispanic/Latino	2671	2976	501
Video-views	Hispanic/Latino	671	938	388
	Non-Hispanic/Latino	1772	2098	838
Test-yourself tool	Hispanic/Latino	575	292	62
Logins	Eligible for	2793	3117	534

	reduced/free lunch			
less than 5 times	Not eligible for reduced/free lunch	991	1127	184
Video views	Eligible for reduced/free lunch	1815	2259	894
	not eligible for reduced/free lunch	628	777	332
Test-yourself tool	Eligible for reduced/free lunch	1414	701	124
	Not eligible for reduced/free lunch	510	307	76