RESEARCH REPORT

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The Impact of IXL on Math and ELA Learning in Colorado: A Quasi-Experimental Study

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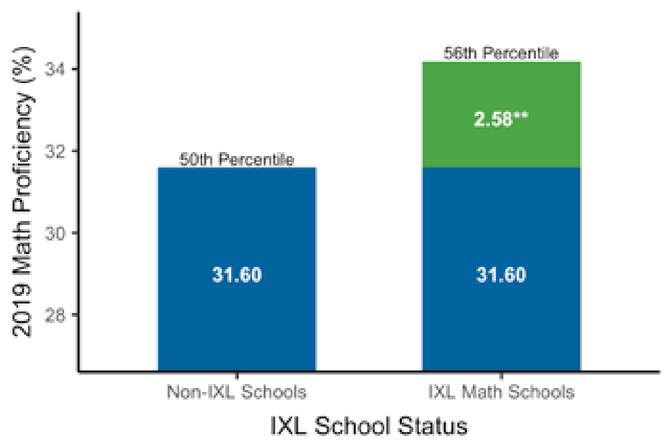
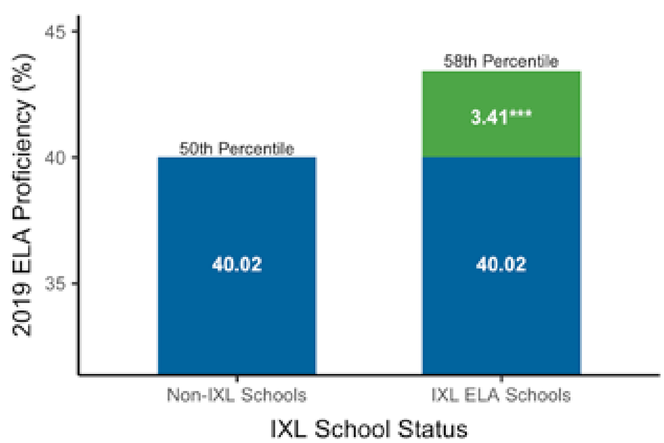
Executive Summary

IXL is a personalized learning platform designed to help students build academic skills in subjects including math and ELA. Previous research has shown that IXL can have a significant positive impact on students' academic performance (Empirical Education, 2013).

The goal of this study was to further evaluate the impact of IXL on learning outcomes in math and ELA. Using a quasi-experimental design with matched treatment and control groups, we analyzed data from 296 public schools in Colorado during the 2018-2019 school year. The analysis of IXL Math included 186 schools (93 treatment, 93 control), and the analysis of IXL ELA included 110 schools (55 treatment, 55 control). IXL adoption in treatment schools ranged from 10% of students in the school to 100% of students. Even with these variable adoption rates, we found positive and statistically significant effects of IXL usage, as measured by the Colorado Measures of Academic Success (CMAS) assessments.

In short, we found that IXL has positive effects on school performance[1]: Colorado schools that used IXL Math or ELA outperformed comparable non-IXL schools on state math and ELA assessments, respectively.





[1] *In all figures: * indicates significance at the .05 level; ** indicates significance at the .01 level; *** indicates significance at the .001 level.*

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Background

Effective educational technology can significantly boost students' learning and lead to meaningful academic gains; however, products vary in the extent to which their effectiveness is supported by rigorous research. In order to help stakeholders make informed decisions about educational technology platforms, the U.S. government established a stringent set of criteria for assessing product effectiveness as part of the Every Student Succeeds Act (ESSA). Based on these criteria, educational technology products are rated on their effectiveness from Tier 1 (the strongest evidence) to Tier 4 (the weakest evidence).

The purpose of the present study was to evaluate the impact of one such educational technology platform, IXL, on student achievement, using a study design that qualifies for ESSA Tier 2 (moderate evidence). IXL provides individualized learning for students in grades PreK-12 and covers four main subject areas: mathematics, English language arts (ELA), science, and social studies. Rooted deeply in learning sciences research (see Bashkov et al., 2021), IXL is used by about 1 in 5 students in the U.S. and by over 12 million students worldwide. The current study investigated the impact of IXL Math and IXL ELA specifically, as these are the two most widely-used IXL subject areas. We conducted a quasi-experimental study for each subject following ESSA criteria for research design, described below.

Methodology

STUDY DESIGN

We used a quasi-experimental pretest-posttest control group design, comparing schools that implemented IXL Math and/or IXL ELA during the 2018-2019 school year to schools that did not use IXL at all during this time (Figure 1). Each treatment (IXL) school was matched to a control (non-IXL) school using one-to-one propensity score matching (explained in more detail below), in order to control for baseline performance, grade level, and relevant demographic characteristics. quasi-experimental study for each subject following ESSA criteria for research design, described below.

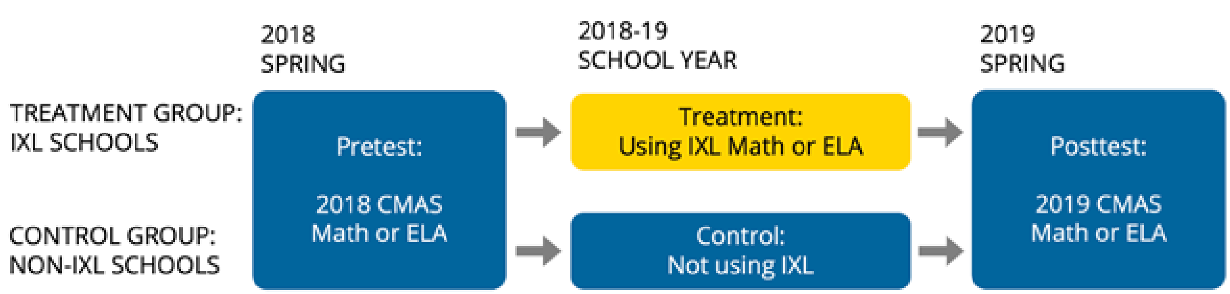

Figure 1. Study Design

PARTICIPANTS

The math analysis included 186 public schools (treatment *n* = 93, control *n* = 93), and the ELA analysis included 110 public schools (treatment *n* = 55, control *n* = 55). All schools served students in grades 3-8 across the state of Colorado. Treatment and control schools were identified based on their usage of IXL Math or IXL ELA during the 2018-2019 school year; usage data were obtained from IXL's internal database.

INTERVENTION

IXL is a powerful, flexible program, designed to be used in or out of the classroom. Both IXL Math and IXL ELA contain thousands of "skills", or hyperspecific topic areas, that students can practice. Some teachers may use IXL to provide differentiated instruction and practice during class time, while others may assign a certain amount of IXL as homework (e.g., reaching proficiency in 2 skills per week). Whether in the classroom or at home, IXL engages each student in a personalized learning experience tailored to their working level. Based on students' response patterns, IXL scaffolds and sequences skills so that students work through problems that are neither too easy nor too difficult. IXL uses its proprietary SmartScore as a numeric indicator of student proficiency within a given skill. The SmartScore ranges from 0 to 100, increasing as students answer more questions correctly, but is not a percent correct score. A SmartScore of 80 indicates proficiency in that skill, and a SmartScore of 100 indicates mastery. As students reach proficiency or mastery in skills, IXL recommends additional skills as next steps to help students further boost their learning.

Because there are so many effective ways to use IXL, we defined treatment schools broadly in order to maximize the generalizability of our findings. Specifically, treatment schools were those in which more than 10% of enrolled students used IXL during the 2018-2019 school year. This threshold ensured that we would not include schools that had IXL subscriptions but no active users. At the same time, we included schools with a wide variety of usage patterns. Table 1 shows descriptive statistics for IXL usage in treatment schools for IXL Math and IXL ELA.

Table 1. IXL Math and IXL ELA Usage

IXL usage (per student per week)	IXL Math schools (*n* = 93)				IXL ELA schools (*n* = 55)			
	M	*SD*	Min	Max	*M*	*SD*	Min	Max
Time spent (in minutes)	15.62	12.42	0.21	65.60	5.74	5.80	0.18	28.00
Questions answered	36.34	24.52	0.52	117.77	16.75	15.64	0.66	71.27
Skills proficient	0.81	0.67	0.02	4.02	0.28	0.26	0.01	1.23

PROPENSITY SCORE MATCHING

We conducted one-to-one propensity score matching without replacement using the MatchIt package in R (Ho et al., 2011; R Core Team, 2021) as a preprocessing step prior to analysis. Specifically, to create equivalent treatment and control groups in the absence of random assignment, we used propensity scores to match each treatment school to a control school. A propensity score is the probability that a school would be assigned to the treatment group (over the control group), conditional on a set of school characteristics (i.e., covariates). That is, each control school had a similar or identical propensity score to its corresponding treatment school. The resulting sample (Table 2) contained treatment and control groups with nearly identical characteristics (see Table A1). After matching, many of the covariates' absolute standardized mean differences remained greater than 0.05; as such, all covariates used in matching were also included in the main analyses to adjust for these differences.

Table 2. School Counts Before and After Matching

	IXL Math		IXL ELA	
	Treatment Group	Control Group	Treatment Group	Control Group
All schools	93	1069	55	1138
Matched schools	93	93	55	55
Unmatched schools	0	976	0	1083
Discarded schools	0	0	0	0

COVARIATE AND OUTCOME MEASURES

Achievement Measures. Math and ELA achievement at pretest (2018) and posttest (2019) were measured using the Colorado Measures of Academic Success (CMAS). The CMAS is Colorado's summative assessment for students in grades 3-8 and assesses students' mastery of material aligned to the state's academic standards and readiness for the next grade (for more information, see https://www.cde.state.co.us/assessment/cmas). Our specific measure of achievement was school proficiency rate, defined as the percentage of students in a school who were classified as having "met expectations" or "exceeded expectations" on CMAS Math or CMAS ELA.

Covariates. Per WWC's protocols (WWC, 2018, 2020), we matched treatment and control schools on baseline performance, grade level, and demographic characteristics as follows:

- Baseline performance: school proficiency rate on the 2018 CMAS Math or CMAS ELA
- Grade level: elementary (grades 3-5), elementary/middle (grades 3-8), or middle (grades 6-8)
- School location: "city" or "non-city"
- School size: number of students
- Gender: percent of male students
- Ethnicity: percent of white students
- Socioeconomic status (SES): percent of students eligible for free or reduced lunch
- Special education: percent of students with IEPs

ANALYSIS

After matching, we first checked for baseline equivalence by examining the absolute standardized mean differences (SMDs) between the treatment and control groups' 2018 performance on CMAS Math or CMAS ELA, respectively. Baseline performance was comparable between the two groups for both subjects: the absolute SMD between treatment and control schools for CMAS Math was .10 (or 10% of a standard deviation), and the absolute SMD between treatment and control schools for CMAS ELA was .14 (or 14% of a standard deviation). Given these values were smaller than .25 but greater than .05, we included baseline performance (along with grade level and other demographics) in the regression models as covariates when we examined the effects of IXL Math and IXL ELA.

We specified and tested separate multilevel models for IXL Math and IXL ELA to account for clustering at the district level (i.e., schools within the same district tend to be more similar to one another than schools in other districts). In these models, we regressed the 2019 school proficiency rate on IXL school status (treatment or control) and all covariates (baseline performance, grade level, and demographic characteristics). We included all covariates in the models for two reasons. First and foremost, the absolute SMDs for covariates were slightly greater than .05 after matching, indicating that these differences needed to be accounted for statistically. Second, controlling for variables that are often associated with the outcome measure (e.g., socioeconomic status) allowed for a more precise estimate of the treatment effect. Per WWC guidelines, we computed effect size (Hedges' g) using model-adjusted (i.e., estimated) means and the pooled unadjusted (i.e., observed) standard deviation (WWC, 2020).

Results

Descriptive statistics of the schools' CMAS performance (proficiency rates) at pretest and posttest for math and ELA are shown in Table 3. Overall, IXL schools' performance improved from pretest to posttest, whereas non-IXL schools' performance worsened slightly or remained the same. We present our regression results separately for each subject next.

Table 3. Observed (Unadjusted) Mean CMAS Proficiency Rates (%)

	Math		ELA	
	Treatment Schools	Control Schools	Treatment Schools	Control Schools
2018 CMAS (pretest)	31.99 (16.77)	30.25 (16.86)	40.23 (18.70)	42.88 (18.15)
2019 CMAS (posttest)	33.26 (16.56)	29.66 (16.68)	43.05 (17.74)	42.76 (18.06)

Note. Standard deviations appear in parentheses.

EFFICACY OF IXL MATH

IXL Math schools outperformed non-IXL schools on CMAS Math at posttest (see Table B1 for detailed results). The estimated treatment effect for IXL Math—controlling for baseline performance, grade level, and key demographic characteristics—was positive and statistically significant ($b = 2.58$, $p = .01$, Hedges' $g = 0.16$; see Table 4 for model-adjusted means). This effect size (0.16) corresponds to a percentile gain of 6 points during the one-year intervention period between pretest and posttest.

Table 4. Model-adjusted Means for Outcome Math Proficiency Rates

Group	Estimated Mean	*SE*	*df*	Lower 95% CI	Upper 95% CI
Treatment	32.34	0.88	28.2	30.54	34.14
Control	29.76	0.84	44.0	28.06	31.46

Note. SE = standard error; *df* = degrees of freedom; CI = confidence interval. Degrees of freedom calculated using the Satterthwaite approximation method.

EFFICACY OF IXL ELA

IXL ELA schools outperformed non-IXL schools on CMAS ELA at posttest. Model-adjusted means are presented in Table 5; full results appear in Table B2. The treatment effect was positive and statistically significant ($b = 3.41$, $p = .001$), with an effect size (Hedges' g) of 0.19. This effect size corresponds to a percentile gain of 8 points during the one-year intervention period between pretest and posttest.

Table 5. Model-adjusted Means for Outcome ELA Proficiency Rates

Group	Estimated Mean	*SE*	*df*	Lower 95% CI	Upper 95% CI
Treatment	44.36	0.78	30.6	42.77	45.94
Control	40.94	0.81	42.4	39.30	42.58

Note. SE = standard error; *df* = degrees of freedom; CI = confidence interval. Degrees of freedom calculated using the Satterthwaite approximation method.

Conclusion

The aim of this quasi-experimental study was to examine the effectiveness of IXL Math and IXL ELA in grades 3-8. Following WWC guidelines, our analyses established baseline equivalence between treatment and control groups and controlled for grade level as well as demographic characteristics. Results showed that usage of IXL Math and IXL ELA had a positive and statistically significant effect on schools' state assessment proficiency rates in both math and ELA, consistent with prior findings of the efficacy of both IXL Math (e.g., Empirical Education, 2013) and IXL ELA (e.g., IXL Learning, 2020; Mao et al., 2020). By using a rigorous design that meets the standards for ESSA Tier 2 (moderate evidence), this study adds to the growing body of evidence showing that these products are effective in boosting students' learning and performance in their respective domains.

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Appendix A

Table A1. Background Information for Treatment and Control Schools

	ELA		Math	
	Treatment Schools	Control Schools	Treatment Schools	Control Schools
Pretest and posttest	*N* = 55	*N* = 55	*N* = 93	*N* = 93
2018 % proficient	40.23 (18.70)	42.88 (18.15)	31.99 (16.77)	30.25 (16.86)
2019 % proficient	43.06 (17.74)	42.76 (18.06)	33.26 (16.56)	29.66 (16.68)
School characteristics				
School size (N students)	491.76 (247.89)	458.75 (253.04)	514.72 (286.34)	520.26 (208.43)
School location				
City	40%	25%	47%	44%
Non-city	60%	75%	53%	56%
Demographics				
Race (% white)	42.68 (28.50)	47.81 (27.60)	42.88 (26.24)	41.21 (26.65)
Gender (% male)	50.95 (3.65)	51.21 (2.99)	51.77 (6.12)	51.51 (2.38)
% Students with disabilities	11.24 (4.53)	10.45 (3.89)	11.57 (4.32)	11.87 (3.85)
% Free/reduced lunch	54.82 (28.10)	49.05 (28.37)	52.80 (27.64)	54.24 (27.95)

Note. Background information reported in the table is averaged across schools. Where applicable, standard deviations (SDs) appear in parentheses. These values are the observed (unadjusted) means and SDs; model-adjusted means can be calculated using the intercepts and b coefficients reported in the regression tables in Appendix B.

Appendix B

Table B1. Full Regression Results: Math

Predictor	*b*	*SE*	95% CI			β	*t*	*p*
(Intercept)	31.60	1.18	29.31	–	33.85	0.09	26.67	<.001
Gender: % male[1]	-0.13	0.10	-0.33	–	0.05	-0.04	-1.34	.181
Race: % white[1]	0.08	0.04	-0.01	–	0.17	0.13	1.90	.061
% Economically disadvantaged[1]	-0.05	0.05	-0.14	–	0.04	-0.08	-1.05	.295
% Students with disabilities[1]	-0.09	0.14	-0.35	–	0.19	-0.02	-0.68	.497
School size (N students)[1]	0.00	0.00	0.00	–	0.01	0.05	1.55	.124
School type: elem./middle[2]	-1.28	1.18	-3.50	–	1.02	-0.08	-1.08	.280
School type: middle[2]	-1.36	1.42	-4.05	–	2.07	-0.08	-0.95	.342
School location: non-city[3]	-1.93	1.25	-4.30	–	0.44	-0.12	-1.55	.128
2018 math proficiency[1]	0.76	0.04	0.68	–	0.85	0.76	18.17	<.001
IXL Math school	**2.58**	**0.91**	**0.46**	–	**4.32**	**0.08**	**2.83**	**.005**

Note. Dependent variable: Percentage of students reaching proficiency on 2019 CMAS Math. *b* = unstandardized regression coefficient, *SE* = standard error, CI = confidence interval, β = standardized regression coefficient.

[1] Grand mean-centered.

[2] Dummy coded; elementary schools as reference group.

[3] Dummy coded; location "City" as reference group.

Table B2. **Full Regression Results: ELA**

Predictor	*b*	*SE*	95% CI	β	*t*	*p*
(Intercept)	40.02	1.28	37.66 – 42.36	-0.07	31.34	<.001
Gender: % male[1]	-0.17	0.16	-0.46 – 0.12	-0.03	-1.11	.270
Race: % white[1]	0.06	0.04	-0.02 – 0.14	0.10	1.46	.150
% Economically disadvantaged[1]	-0.02	0.05	-0.11 – 0.07	-0.03	-0.39	.697
% Students with disabilities[1]	-0.25	0.16	-0.54 – 0.04	-0.06	-1.59	.115
School size (N students)[1]	0.00	0.00	-0.01 – 0.00	-0.03	-0.96	.340
School type: elem./middle[2]	0.41	1.12	-1.77 – 2.48	0.02	0.37	.714
School type: middle[2]	-0.39	1.45	-3.20 – 2.29	-0.02	-0.27	.791
School location: non-city[3]	1.84	1.27	-0.48 – 4.16	0.10	1.45	.157
2018 ELA proficiency[1]	0.82	0.04	0.74 – 0.90	0.84	19.56	<.001
IXL ELA school	**3.41**	**0.98**	**1.56 – 5.22**	**0.10**	**3.49**	**.001**

Note. Dependent variable: Percentage of students reaching proficiency on 2019 CMAS ELA. *b* = unstandardized regression coefficient, *SE* = standard error, CI = confidence interval, β = standardized regression coefficient.

[1] Grand mean-centered.

[2] Dummy coded; elementary schools as reference group.

[3] Dummy coded; location "City" as reference group.