RESEARCH REPORT

June 2023

The Impact of IXL on Math Learning in Mississippi Middle and High Schools

Mary B. Hargis, Ph.D.

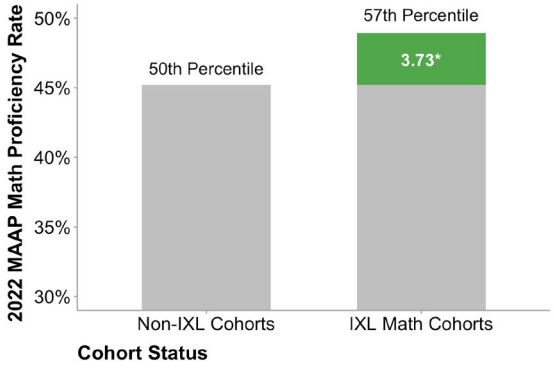
IXL LEARNING 777 Mariners Island Blvd., Suite 600, San Mateo, CA 94404
650-372-4040 | www.ixl.com

Executive Summary

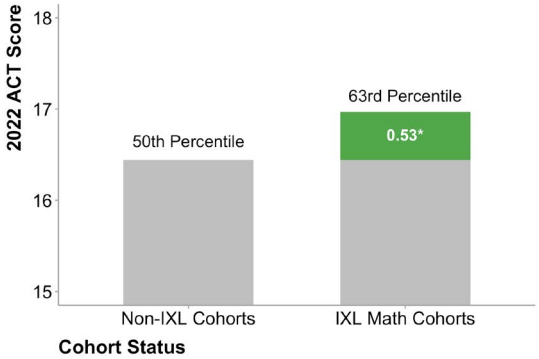
IXL is an end-to-end teaching and learning solution that engages learners in grades Pre-K through 12 with a comprehensive curriculum and personalized recommendations for meeting learning goals. Previous research has shown that IXL has a positive impact on students' academic performance (An, 2023; Bashkov, 2021; Empirical Education, 2013; IXL Learning, 2017; Schonberg, 2022).

The goal of this study was to examine IXL usage among 6th- through 8th-grade and 11th-grade students in Mississippi and its impact on math achievement, as measured by the Mississippi Academic Assessment Program (MAAP) and the ACT. Key findings[1]:

- **IXL implementation improves student achievement among middle school students.** Grade cohorts that used IXL performed better on the MAAP math assessment than grade cohorts that did not use IXL. Specifically, the proficiency rate[2] was more than three percentage points higher for IXL Math cohorts compared to cohorts not using IXL, controlling for prior achievement and demographics.



- **IXL implementation improves student achievement among high school students.** Grade cohorts that used IXL performed better on the ACT math assessment than grade cohorts that did not use IXL. Specifically, ACT scores were more than a half point higher for IXL Math cohorts compared to cohorts not using IXL, controlling for prior achievement and demographics.



[1] *In all figures, * indicates statistical significance at the p < .05 level*

[2] *Proficiency rate: percentage of students in a cohort classified as "Proficient" or "Advanced" on MAAP*

The Impact of IXL on Math Learning in Mississippi Middle and High Schools

Background

IXL is an end-to-end teaching and learning solution that engages learners in grades Pre-K through 12 with a comprehensive curriculum and personalized recommendations for meeting learning goals. It covers four main subject areas: mathematics, English language arts (ELA), science, and social studies. As of this writing, 19% of students in Mississippi and over 14 million students worldwide use IXL. Deeply rooted in learning sciences research (see Bashkov et al., 2021), IXL engages each student in a personalized learning experience tailored to their working level. As a result of this personalization, students can work through problems that are neither too easy nor too difficult, which in turn supports their self-efficacy and motivation for continued learning.

Previous research has demonstrated the benefits of IXL across many states, including Arkansas (An, 2022) and Georgia (Schonberg, 2022), where the use of IXL had a positive impact on students' performance on state assessments. With a changing educational landscape brought on by the COVID-19 pandemic, it is important to continue to assess IXL's impact on students' learning given its popularity.

The goal of the present study was to examine the efficacy of IXL Math across public middle and high schools in Mississippi. We investigated the efficacy of IXL by comparing MAAP and ACT math performance among grade-level cohorts that used IXL Math to those of comparable grade-level cohorts that did not use IXL.

Study Design and Methodology

DATA SOURCES

Assessment Data

All assessment and demographic data were obtained from the Mississippi Department of Education. Among middle school students, math performance at pretest (Spring 2021) and posttest (Spring 2022) was measured by the MAAP assessment, which is administered to students in grades 3 through 8. The present study focused on students in grades 6 through 8. The outcome measure was the percentage of students within a grade-level cohort reaching proficiency in MAAP math (i.e., the proficiency rates on the math exam). Among high school students, math performance at pretest (Spring 2021) and posttest (Spring 2022) was measured by the ACT, which is administered to 11th grade students. The outcome measure was the average ACT score within each grade-level cohort. More information about the assessments can be found on the Mississippi Department of Education website.

IXL Usage Data

IXL usage data were obtained from IXL's database. When students use IXL, they practice problems organized within "skills," or specific topic areas within a subject. IXL uses a proprietary *SmartScore* to measure a student's progress toward proficiency and mastery within a skill. The SmartScore ranges from 0-100 and increases as students answer questions correctly. However, it is not a percent correct score; a SmartScore of 100 is always possible. A SmartScore of 80 indicates proficiency in a skill, and a SmartScore of 100 indicates mastery. IXL recommends that students should aim to reach proficiency in at least two skills per week (SP/week; An et al., 2022).

Study Design

The purpose of this study was to evaluate the impact of IXL on student math performance in Mississippi. The study adopted a quasi-experimental pretest-posttest control group design (see Figure 1). To control for pretest performance and demographic characteristics, we used one-to-one propensity score matching (described in more detail below) to match each IXL cohort to a similar cohort that did not use IXL.

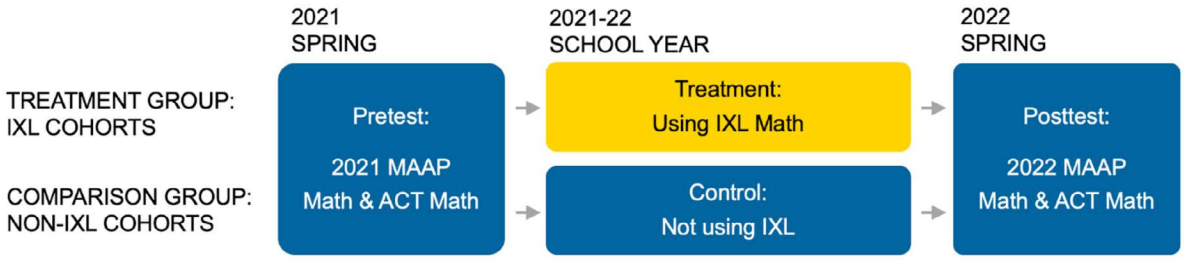


Figure 1. Study design

Participants

We defined IXL cohorts broadly in order to maximize the generalizability of our findings. IXL or treatment cohorts were those in which students used IXL at all during the study period (i.e., the 2021-22 school year). We defined comparison cohorts as those in which students did not use IXL at all during the study period. Using these criteria, we obtained a sample of 272 study cohorts for the middle school analysis (treatment n = 136, comparison n = 136) and 40 study cohorts for the high school analysis (treatment n = 20, comparison n = 20) after propensity score matching. Descriptive statistics for treatment cohorts' IXL usage during the study period can be found in Table 1.

Table 1. IXL Math Usage During the 2021-22 School Year

Weekly IXL usage	Grades 6-8 (n = 136)				Grade 11 (n = 20)			
	M	*SD*	Min	Max	*M*	*SD*	Min	Max
Time spent (in minutes)	18.61	16.62	0.27	70.49	7.70	5.85	0.14	22.10
Questions answered	33.52	29.62	0.91	145.03	13.44	10.92	0.61	38.26
Skills proficient	0.87	0.85	0.01	4.75	0.33	0.29	0.03	1.13

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 pre-processing step prior to analysis. A *propensity score* is the probability that a school cohort would be assigned to the treatment (i.e., IXL) group over the comparison group and is calculated using a combination of demographic characteristics (i.e., covariates). In the absence of random assignment, propensity scores can be used to match comparison cohorts to treatment cohorts and create equivalent treatment and comparison groups. In a comparison of unmatched groups (e.g., IXL cohorts compared to all non-IXL cohorts), non-IXL cohorts could be very different from IXL cohorts on some dimensions. In contrast, using propensity score matching allows us to compare the performance of pairs of IXL and non-IXL cohorts that are very similar to each other. This comparison allows for a clearer attribution of the effect of IXL and broader generalization of the findings to other cohorts that are not yet using IXL. Comparison cohorts were identified from 501 non-treatment cohorts (middle school) and 163 non-treatment cohorts (high school) in the state that had non-missing assessment and demographic data. After matching, the resulting treatment and comparison groups had extremely similar demographic characteristics (see Tables A1 and A2, Appendix A).

Analysis

We specified and tested one multilevel model for middle schools to account for clustering at the school and district levels (i.e., grade cohorts within a school tend to be more similar to each other than grade cohorts in other schools, and schools within a district tend to be more similar to each other than schools in other districts). We also specified and tested a multilevel model for high school cohorts that accounted for clustering at the district level (as there was only one 11th-grade cohort per school). In these models, we regressed 2022 MAAP grade-level proficiency rates (for the middle school analysis) and ACT scores (for the high school analysis) on IXL cohort status (treatment or comparison) and covariates (pretest performance and demographic characteristics). We included covariates in the models because the absolute standardized mean differences (SMDs) for some covariates were greater than .05 after matching, indicating that these differences needed to be accounted for statistically. Specifically, we controlled for the following demographic characteristics at both the middle and high school levels: percentage of female students, percentage of White students, and student-teacher ratio. In the middle school analysis, we also controlled for grade level.

Following What Works Clearinghouse guidelines (WWC, 2022), each effect is accompanied by a test of statistical significance using a probability (*p*) value and a measure of effect size. The *p*-value is the probability of observing the current or more extreme data, assuming the effect is zero (Cohen, 1994). The smaller the *p*-value, the less likely it is that the result occurred at random; *p*-values less than .05 are considered statistically significant. Effect size is reported using Hedges' *g* and indicates the difference between treatment and comparison groups on an outcome measure in standard deviation units. For broad-scope educational assessments, moderate effect sizes range from about 0.10–0.20 (Kraft, 2020; Lipsey et al., 2012). Where applicable, we also report percentile gain, which is the expected change in IXL cohorts' percentile rank relative to non-IXL cohorts at the 50th percentile and is based on the effect size. Given that these analyses are at the grade cohort level, the effect sizes should be interpreted at the grade cohort level as well.

Results

Middle School (Grades 6-8)

We found that grade-level cohorts that used IXL Math outperformed comparable non-IXL cohorts on the 2022 MAAP math assessment. Specifically, the proficiency rate was more than three percentage points higher for IXL Math cohorts relative to cohorts not using IXL (Figure 2). The estimated treatment effect for IXL Math was positive and statistically significant (b = 3.73, p = .015; see Table B1 in Appendix B for full model results). The effect size (Hedges' g) was 0.18, which corresponds to a percentile gain of seven points.

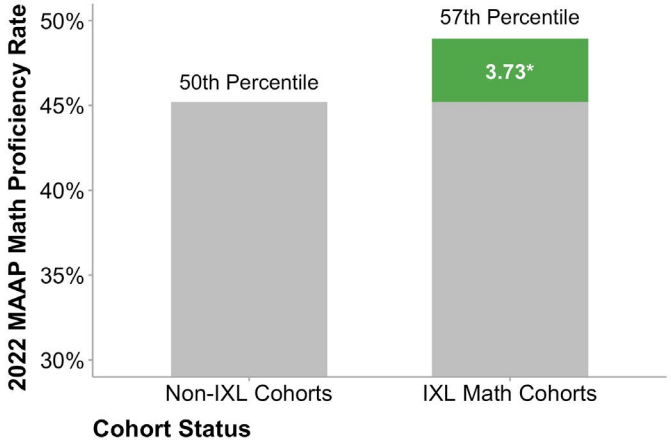


Figure 2. The efficacy of IXL Math among middle school students

High School (Grade 11)

We found that grade-level cohorts that used IXL Math outperformed comparable non-IXL cohorts on the 2022 ACT math assessment. Specifically, the average ACT score was more than a half point higher for IXL Math cohorts relative to cohorts not using IXL (Figure 3). The estimated treatment effect for IXL Math was positive and statistically significant (b = 0.53, p = .01; see Table B2 in Appendix B for full model results). The effect size (Hedges' g) was 0.34, which corresponds to a percentile gain of 13 points.

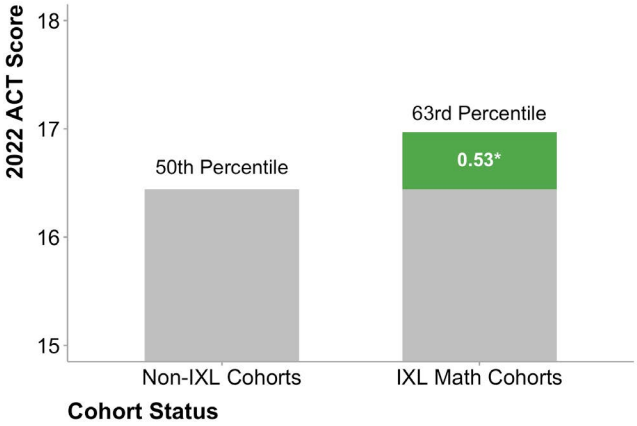


Figure 3. The efficacy of IXL Math among high school students

Discussion and Recommendations

In this study, we investigated the impact of IXL Math on academic achievement in public schools in Mississippi. We found that middle school grade-level cohorts that used IXL Math outperformed comparable cohorts that did not use IXL on the 2022 MAAP math assessment, controlling for pretest performance and demographics. Likewise, we found that high school grade-level cohorts that used IXL Math outperformed comparable cohorts that did not use IXL on the 2022 ACT math assessment, controlling for pretest performance and demographics. These results add to the large body of work showing that IXL is a highly effective way to improve student learning (e.g., An, 2022, 2023; IXL Learning, 2017; Schonberg, 2022; Xiong, 2022).

IXL recommends that students aim to reach proficiency in at least two skills per week in each subject. In these samples, students' usage of IXL was lower than this recommendation. Nonetheless, we found strong effects of IXL usage on performance, demonstrating that IXL is a powerful educational tool even when used in smaller doses. Because interventions are more effective when they are carried out with fidelity (see Finney et al., 2021; Noell et al., 2002), and previous studies illustrate the benefit associated with meeting this guideline (e.g., An et al., 2022), we anticipate that students would achieve even greater gains when IXL is used as recommended.

IXL's impact is especially visible in the aftermath of the COVID-19 pandemic and its adverse effects on student learning (Engzell et al., 2021). Specifically, IXL has been proven to be an effective solution in combating learning loss related to the COVID-19 pandemic (Hargis, 2023; Schonberg, 2021, 2022). In addition to the current work, studies on thousands of schools across the United States have found that schools using IXL had higher achievement on state assessments than schools not using IXL (see ixl.com/research). The current study provides even more evidence to support the use of IXL Math, as teachers work with students to recover from learning loss and strive for future learning gains.

References

An, X. (2022). *The impact of IXL on math and ELA learning in Arkansas.* (pp. 1-12). https://www.ixl.com/materials/us/research/The_Impact_of_IXL_in_Arkansas.pdf

An, X. (2023). *The impact of IXL among early elementary students in a South Carolina school district.* (pp. 1-15). https://www.ixl.com/materials/us/research/The_Impact_of_IXL_Among_Early_Elementary_Students_(SC).pdf

An, X., Schonberg, C., & Bashkov, B. M. (2022). *IXL implementation fidelity and usage recommendations* (pp. 1-18). https://www.ixl.com/materials/us/research/IXL_Implementation_Fidelity_and_Usage_Recommendations.pdf

Bashkov, B. M. (2021). *Assessing the impact of IXL Math over three years: A quasi-experimental study* (pp. 1-12). https://www.ixl.com/materials/us/research/IXL_Math_3-Year_QED_ESSA_Tier_2.pdf

Bashkov, B. M., Mattison, K., & Hochstein, L. (2021). *IXL design principles: Core features grounded in learning science research* (pp. 1-18). https://www.ixl.com/research/IXL_Design_Principles.pdf

Empirical Education. (2013). *A study of student achievement, teacher perceptions, and IXL Math* (pp. 1-12). https://www.empiricaleducation.com/pdfs/IXLfr.pdf

Engzell, P., Frey, A., & Verhagen, M. D. (2021). Learning loss due to school closures during the COVID-19 pandemic. *Proceedings of the National Academy of Sciences, 118(17).* https://www.pnas.org/doi/full/10.1073/pnas.2022376118

Finney, S. J., Wells, J. B., & Henning, G. W. (2021). *The Need for Program Theory and Implementation Fidelity in Assessment Practice and Standards* (Occasional Paper No. 52; pp. 1–19). University of Illinois and Indiana University, National Institute for Learning Outcomes Assessment (NILOA).

Hargis, M. B. (2023). *The impact of IXL on math learning in New Jersey* (pp. 1-12). https://www.ixl.com/materials/us/research/The_Impact_of_IXL_on_Math_Learning_in_New_Jersey.pdf

Noell, G., Gresham, F., & Gansle, K. (2002). Does treatment integrity matter? A preliminary investigation of instructional implementation and mathematics performance. *Journal of Behavioral Education, 11,* 51–67.

Schonberg, C. (2021). *The impact of IXL on Math and ELA learning in Kansas.* (pp. 1-14). https://www.ixl.com/materials/us/research/Impact_of_IXL_in_Kansas.pdf

Schonberg, C. (2022). *The impact of IXL on math and ELA learning in Georgia.* (pp. 1-14). https://www.ixl.com/materials/us/research/The_Impact_of_IXL_in_Georgia_(2022).pdf

What Works Clearinghouse. (2022). *What Works Clearinghouse procedures and standards handbook, version 5.0.* U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance (NCEE). This report is available on the What Works Clearinghouse website at https://ies.ed.gov/ncee/wwc/Handbooks

Xiong, Y. (2022). *The impact of IXL on ELA learning in Iowa* (pp. 1-11). https://www.ixl.com/materials/us/research/Impact_of_IXL_in_Iowa.pdf

Appendix A: Demographics

Table A1. Descriptive Statistics of Achievement and Demographics Among Middle School Students

	IXL Cohorts *n* = 136	Non-IXL Cohorts *n* = 136
Achievement		
Pretest % proficient (2021)	36.81 (19.05)	38.55 (20.89)
Posttest % proficient (2022)	46.35 (19.31)	44.23 (21.02)
Demographics		
Grade		
6	54	63
7	50	39
8	32	34
Student-teacher ratio	12.95 (1.83)	13.21 (2.15)
Race: % White	47.08 (30.78)	48.78 (29.43)
Gender: % female	48.80 (2.78)	48.99 (2.79)

Note. Numbers in parentheses show standard deviations.

Table A2. **Descriptive Statistics of Achievement and Demographics Among High School Students**

	IXL Cohorts *n* = 20	Non-IXL Cohorts *n* = 20
Achievement		
Pretest ACT score (2021)	16.65 (1.60)	16.38 (1.59)
Posttest ACT score (2022)	17.08 (1.51)	16.33 (1.60)
Demographics		
Student-teacher ratio	14.29 (2.56)	14.43 (2.48)
Race: % White	36.15 (28.78)	33.98 (30.52)
Gender: % female	48.75 (2.31)	49.00 (1.49)

Note. Numbers in parentheses show standard deviations.

Appendix B: Efficacy Analysis Results

Table B1. **Full Middle School IXL Math Efficacy Model Predicting MAAP Proficiency**

Predictor	*b*	*SE*	95% CI	β	*t*	*p*
(Intercept)	45.21	1.60	42.12 – 48.35	-0.02	28.20	<.001
Percent proficient (2021)[1]	0.74	0.05	0.64 – 0.84	0.74	14.93	<.001
Grade: 6[2]	-2.24	1.70	-5.54 – 1.05	-0.06	-1.32	.189
Grade: 7[2]	-4.22	1.82	-7.77 – -0.71	-0.10	-2.32	.021
Student-teacher ratio[1]	0.03	0.40	-0.73 – 0.80	0.00	0.09	.932
Race: % White[1]	0.08	0.03	0.01 – 0.14	0.12	2.30	.023
Gender: % female[1]	0.55	0.27	0.03 – 1.08	0.07	2.05	.042
Used IXL Math	**3.73**	**1.52**	**0.79 – 0.09**	**0.09**	**2.45**	**.015**

Note. Dependent variable: percentage of students reaching proficiency on the 2022 MAAP math assessment. *b* = unstandardized regression coefficient, *SE* = standard error, CI = confidence interval, β = standardized regression coefficient.
[1] Grand-mean centered. [2] Dummy coded; Grade 8 as reference group.

Table B2. **Full High School IXL Math Efficacy Model Predicting ACT Scores**

Predictor	*b*	*SE*	95% CI	β	*t*	*p*
(Intercept)	16.44	0.13	16.25 – 16.68	-0.16	128.85	<.001
ACT score (2021)[1]	0.84	0.09	0.67 – 1.00	0.84	9.51	<.001
Student-teacher ratio[1]	-0.04	0.04	-0.12 – 0.03	-0.07	-1.09	.285
Race: % White[1]	0.01	0.00	0.00 – 0.02	0.12	1.46	.153
Gender: % female[1]	0.05	0.05	-0.03 – 0.15	0.07	1.13	.265
Used IXL Math	**0.53**	**0.18**	**0.19 – 0.88**	**0.34**	**2.92**	**.006**

Note. Dependent variable: score on the 2022 ACT math assessment. *b* = unstandardized regression coefficient, *SE* = standard error, CI = confidence interval, β = standardized regression coefficient.
[1] Grand-mean centered.