RESEARCH REPORT

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The Impact of IXL on Math and ELA Learning in a Nebraska School District

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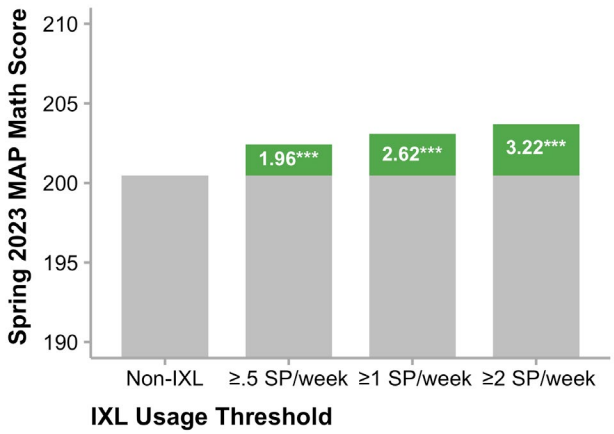
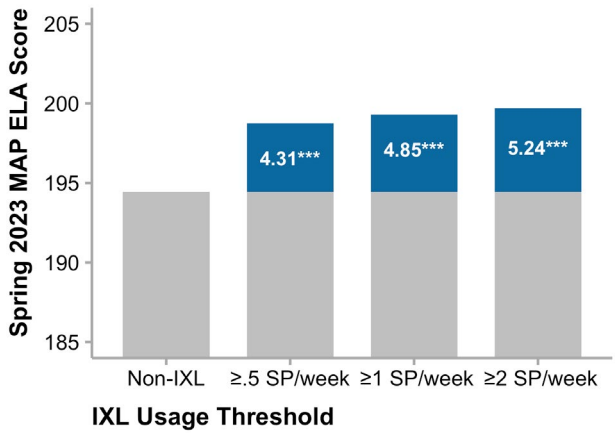
Executive Summary

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 can have a significant positive impact on students' academic performance (Bashkov, 2021; Empirical Education, 2013). The goal of this study was to examine IXL usage among kindergarten through fifth-grade students in a large, urban school district in Nebraska and its impact on math and English language arts (ELA) achievement, as measured by the NWEA MAP Growth assessments. Using a pretest-posttest design, we found[1]:

- **IXL implementation improves student achievement** Students who used IXL performed better on NWEA MAP than students who did not use IXL. Specifically, Spring 2023 MAP scores were about 2-3 points higher for IXL Math students and about 2-5 points higher for IXL ELA students, relative to students not using IXL (see figure below).
    - Higher IXL usage was associated with better NWEA MAP performance in both subjects.
    - The impact of IXL was largest for students who reached IXL's recommended usage target of 2 SP/week[2].





- **All students benefit from IXL.** Subgroup analyses showed that students enrolled in special education services, low-achieving students, and high-achieving students who used IXL all outperformed their peers who had access but did not use IXL.
    - High-achieving students in particular benefited from reaching mastery[3] in IXL skills.

*[1] Note. In all figures, * indicates statistical significance at the p < .05 level; ** indicates p < .01; and *** indicates p < .001*
[2] SP/week = skills proficient (i.e., SmartScore ≥ 80) per week
[3] Skill mastery is defined as reaching a SmartScore of 100 in an IXL skill

The Impact of IXL on Math and ELA Learning in a Nebraska School District

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, IXL is used by 1 in 4 students in the U.S. and by over 14 million students worldwide. IXL is deeply rooted in learning sciences research (see Bashkov et al., 2021) and engages each student in a personalized learning experience tailored to their working level. As a result, students work through problems that are neither too easy nor too difficult, which in turn supports their self-efficacy and motivation for continued learning.

The goal of the present study was to examine the effects of IXL Math and IXL ELA on academic achievement in grades K-5 in a large, urban school district in Nebraska, both overall and for specific student subgroups. For math and ELA separately, we specifically aimed to answer the following research questions:

1. **Overall efficacy of IXL:**
    a. What is the overall effect of IXL on students' academic achievement, as measured by the Spring 2023 NWEA MAP Growth assessment?
    b. Are higher levels of IXL usage associated with higher student academic achievement, as measured by the Spring 2023 NWEA MAP Growth assessment?
    c. Does using IXL with high fidelity (i.e., reaching proficiency in 2 or more skills per subject per week) make a difference?
2. **IXL efficacy by subgroup:**
    a. To what extent do the analyses above hold for students enrolled in special education services, low-achieving students, and high-achieving students?
    b. Does perseverance on IXL skills (i.e., going beyond skill proficiency to reach skill mastery) benefit students? Do low-achieving and high-achieving students benefit from reaching mastery to the same degree?

Methodology

DATA SOURCES

Assessment and Demographic Data

All assessment and demographic data were provided by the participating school district. Math and ELA performance at pretest (Fall 2022) and posttest (Spring 2023) were measured using the NWEA MAP Growth assessments; the outcome measure was student RIT score at posttest. More information about MAP Growth in Nebraska can be found at https://www.nwea.org/state-solutions/nebraska/

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 proficiency within a skill and recommends that students aim to reach proficiency in at least two skills per week (SP/week; An et al., 2022).

PARTICIPANTS

We included data from any students with non-missing pretest, posttest, and demographic data. The base sample size was 9,455 students. Overall, the sample was 51.7% male, < 1% English language learners, and 15.0% students eligible for or receiving special education services. The racial and ethnic makeup of the sample was as follows: 6.0% Asian, 3.3% Black, 10.4% Hispanic, < 1% Native American, 6.1% multiracial/other, and 73.6% White (non-Hispanic). Because analyses differed slightly in their inclusion criteria, analysis-specific sample sizes are reported in the appendices.

In addition to the overall analyses of all students, we also analyzed the impact of IXL on MAP performance among the following student subgroups: students eligible for or receiving special education services, low-achieving students, and high-achieving students[4]. Students were classified as low- or high-achieving based on their Fall 2022 MAP percentile, such that students below the 50th percentile were classified as low-achieving, and students at or above the 50th percentile were classified as high-achieving.

DESIGN SUMMARY

We used a range of quasi-experimental pretest-posttest control group designs to examine the effects of IXL usage during the 2022-23 school year on Spring 2023 MAP scores. In the overall efficacy analyses, we compared students using IXL at several thresholds to students not using IXL, controlling for Fall 2022 MAP performance and key demographics. We also examined the linear relationship between the number of skills in which students reached proficiency and their expected MAP score gains, which can provide useful insights about implementation. In addition, we tested the

[4] Although the efficacy and usage effects of IXL among gifted students were also of interest, there was not sufficient variability in these students' Spring 2023 MAP scores to conduct the analyses within this student subgroup.

effect of meeting IXL's recommended high-fidelity usage criterion of 2 SP/week. Finally (in Research Question 2), we conducted these analyses by student subgroup (special education, low-achieving, and high-achieving). We also analyzed the relative benefit of working beyond proficiency and reaching mastery for low-achieving and high-achieving students in math and ELA. See Appendices A and B for details.

Results

RESEARCH QUESTION 1A: OVERALL EFFICACY OF IXL

IXL Math

Across all usage thresholds (.5, 1, and 2 SP/week), we found that students who used IXL Math outperformed non-IXL-using students on the Spring 2023 NWEA MAP assessment in math (see Figure 1). At the .5 SP/week threshold, students using IXL Math scored about 2 points higher than students not using IXL Math (b = 1.96, p < .001); the effect size (Hedges' g) was .08. At the 1 SP/week threshold, students using IXL Math scored about 2.5 points higher than students not using IXL Math (b = 2.63, p < .001, g = .12). Finally, at the 2 SP/week threshold, students using IXL Math scored about 3 points higher than students not using IXL Math (b = 3.22, p < .001, g = .15). Full model results are reported in Table C1 (Appendix C).

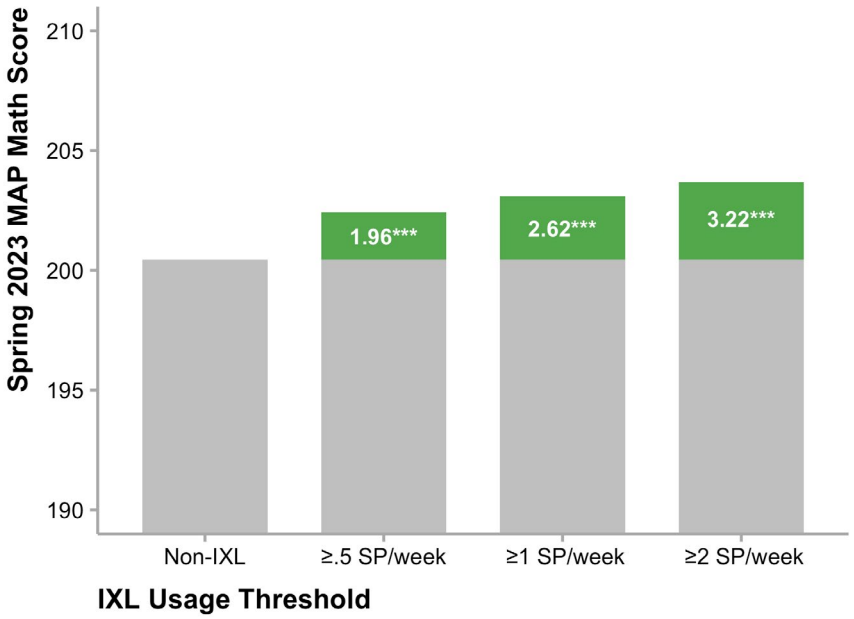


Figure 1. The efficacy of IXL Math

IXL ELA

Similar to IXL Math, we found significant, positive effects of IXL ELA at each usage threshold (see Figure 2). At the .5 SP/week threshold, students using IXL ELA scored about 4 points higher than

students not using IXL ELA (*b* = 4.31, *p* < .001); the effect size (Hedges' *g*) was .21. At the 1 SP/week threshold, students using IXL ELA scored nearly 5 points higher than students not using IXL ELA (*b* = 4.84, *p* < .001, *g* = .25). Finally, at the 2 SP/week threshold, students using IXL ELA scored more than 5 points higher than students not using IXL ELA (*b* = 5.24, *p* < .001, *g* = .27). Full model results are reported in Table C2 (Appendix C).

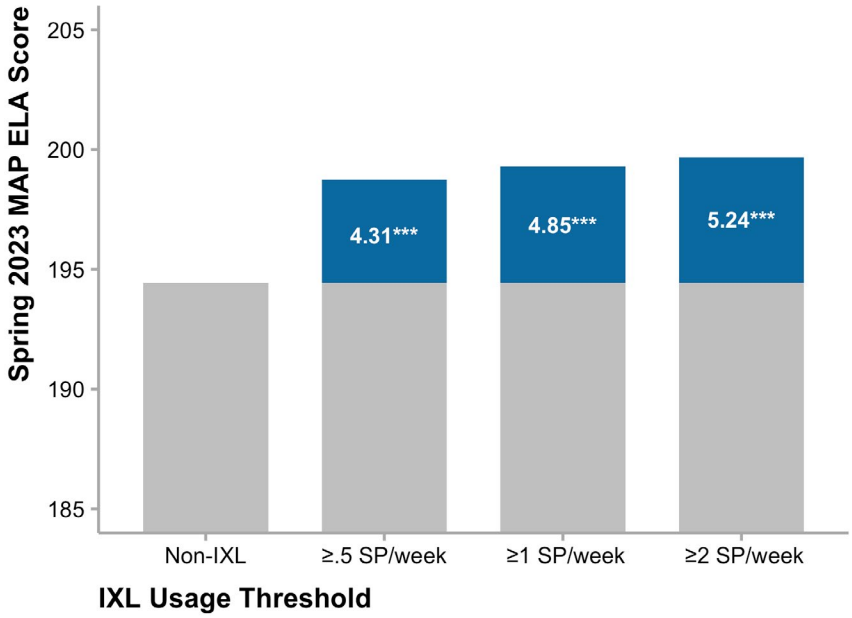


Figure 2. The efficacy of IXL ELA

RESEARCH QUESTION 1B: USAGE EFFECTS OF IXL

IXL Math

We found that IXL Math usage (SP/week) was positively and significantly associated with Spring 2023 NWEA MAP scores in math (*b* = 1.29, *p* < .001, β = .05). That is, a typical student's MAP score would be expected to increase by about 1.3 points for each additional IXL Math skill they reached proficiency in each week. Full model results are reported in Table C3 (Appendix C).

IXL ELA

As in the IXL Math analysis, we found that IXL ELA usage (SP/week) was positively and significantly associated with Spring 2023 NWEA MAP scores in ELA (*b* = 1.33, *p* < .001, β = .05). That is, a typical student's MAP score would be expected to increase by about 1.3 points for each additional IXL ELA skill they reached proficiency in each week. Full model results are reported in Table C4 (Appendix C).

RESEARCH QUESTION 1C: IMPLEMENTATION FIDELITY

In both math and ELA, we found that students who met or exceeded the 2 SP/week threshold outperformed students who may have used IXL but did not meet this recommended target. Specifically, students who met the 2 SP/week threshold in math scored about 2.5 points higher than

students who did not meet this threshold (b = 2.37, p < .001, g = .10). In ELA, students who met the 2 SP/week threshold scored about 2 points higher than students who did not meet this threshold (b = 1.77, p < .001, g = .08). Full model results are reported in Tables C5 (math) and C6 (ELA) in Appendix C.

RESEARCH QUESTION 2A: EFFICACY AMONG SUBGROUPS

Overall Efficacy

Within each student subgroup, we found that the impact of IXL Math increased with higher usage thresholds (see Figure 3, top row); effect sizes ranged from .11 to .26. This pattern of results also held for each subgroup in the ELA analysis, such that the impact of IXL ELA increased with higher usage thresholds (see Figure 3, bottom row); effect sizes for subgroups ranged from .12 to .48. Detailed results are reported in Appendix D (Tables D1 and D2).

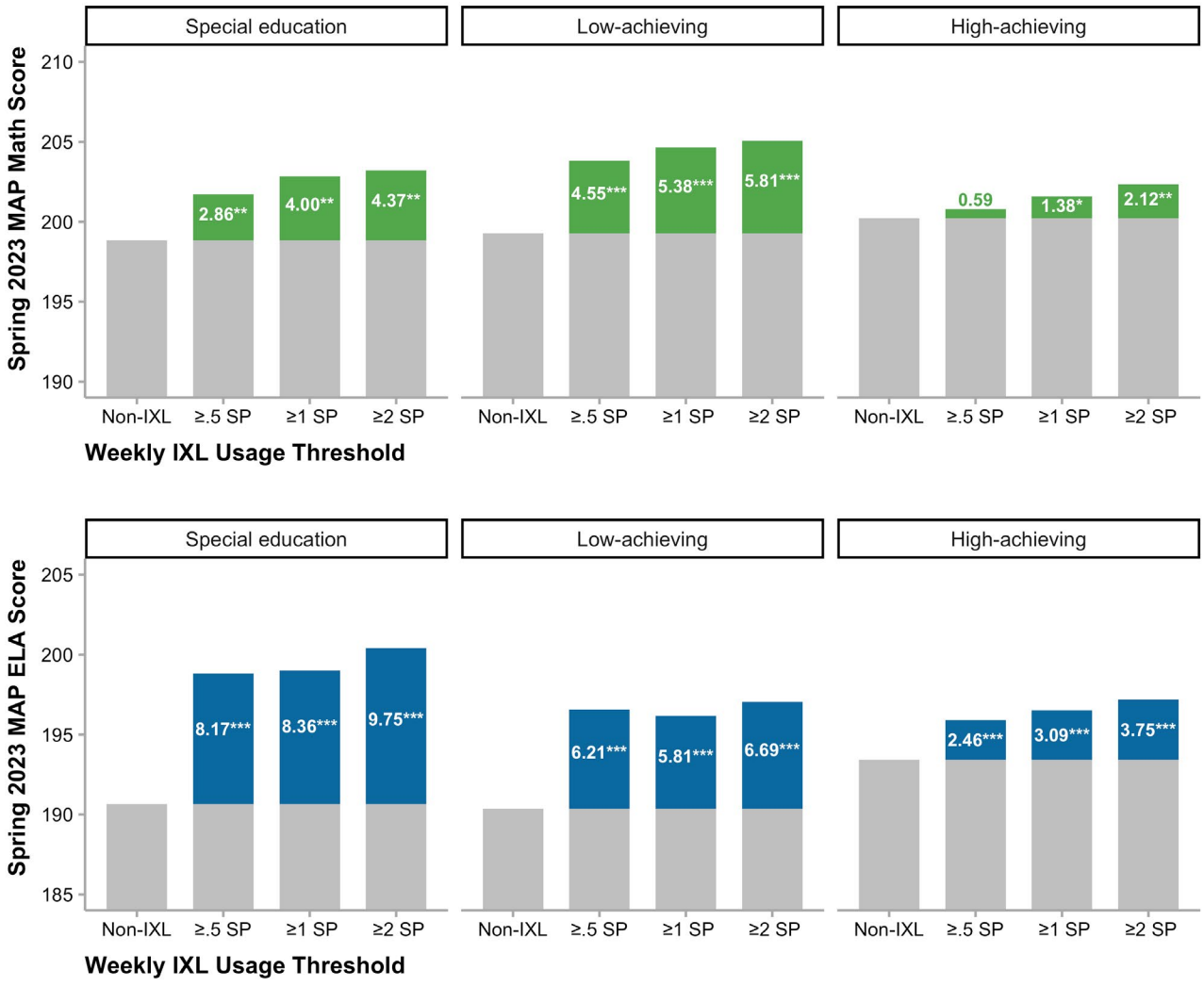


Figure 3. The efficacy of IXL Math and IXL ELA among student subgroups

Usage

As in the overall analyses, we found positive, statistically significant effects of IXL usage (SP/week) within each student subgroup. Effects of IXL Math SP/week among student subgroups ranged from *b* = 1.21 to *b* = 1.99, and effects of IXL ELA SP/week among student subgroups ranged from *b* = 1.11 to *b* = 1.90. Detailed results are reported in Appendix D (Tables D3-D4).

Implementation Fidelity

Within each student subgroup, we found similar effects of implementation fidelity as in the overall analyses: students who used IXL with fidelity (i.e., ≥ 2 SP/week) outperformed those who did not. In math, effect sizes ranged from .09 to .19; in ELA, effect sizes ranged from .07 to .17. Detailed results are reported in Appendix D (Tables D5-D6).

RESEARCH QUESTION 2B: ADDED BENEFIT OF SKILL MASTERY

In both the math and ELA analyses, we found a significant two-way interaction between achievement status and the ratio between skills mastered and skills proficient (Figure 2). For high-achieving students, Spring 2023 MAP scores were positively associated with the extent to which students persevered (i.e., by achieving skill mastery) while practicing on IXL Math (p = .01) and IXL ELA (p = .001). However, for low-achieving students, Spring 2023 MAP scores were not affected by the extent to which they practiced beyond proficiency to reach mastery in math (p = .44) or ELA (p = .98); that is, low-achieving students benefited similarly from reaching proficiency or mastery in more math and ELA skills. All model results are reported in Appendix D (Tables D7-D8).

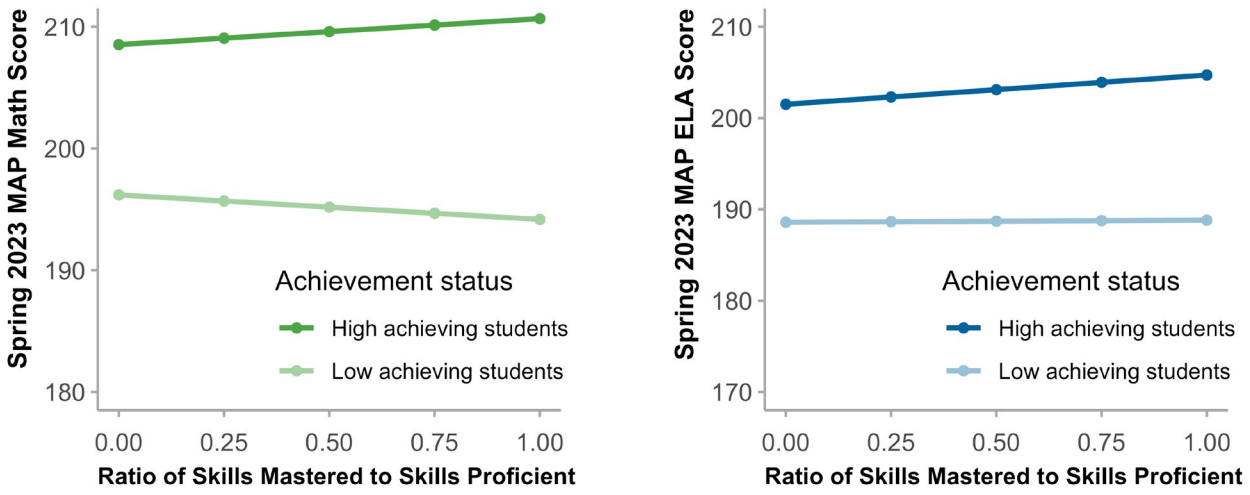


Figure 4. The effects of attaining depth of knowledge on IXL. A ratio of skills mastered to skills proficient closer to 0 indicates that a student more often stopped practicing after reaching proficiency, while a ratio closer to 1 indicates that a student worked to reach mastered in more of the skills in which they already reached proficiency.

Discussion and Recommendations

In this study, we investigated the impact of IXL Math and IXL ELA on academic achievement in a large, urban school district in Nebraska. We found that students who used IXL Math or IXL ELA outperformed non-IXL students on the Spring 2023 NWEA MAP assessments, controlling for baseline performance and key demographics. Increased IXL usage was associated with larger achievement gains, and the magnitude of IXL's effects was greater when IXL was implemented with fidelity. Furthermore, the impact of IXL was consistent across student subgroups, including students receiving special education services, low-achieving students, and high-achieving students. In addition, we found that persistent effort on skills to achieve mastery (beyond proficiency) further benefitted high-achieving students' performance on NWEA MAP assessments in both math and ELA. These results add to the large body of work showing that IXL is a highly effective way to boost student learning (e.g., An, 2022a, 2022b; Hargis, 2023; IXL Learning, 2017; Schonberg, 2022; Xiong, 2022).

These findings are a result of the district's strong implementation of IXL, with students' average usage of IXL (Table A1) being slightly lower than IXL's recommendation of reaching proficiency in two skills per week (An et al., 2022). Nevertheless, students who did reach proficiency in at least two IXL skills per week performed better than students who used IXL but did not reach this threshold. These results are consistent with other research showing that interventions are more effective when they are carried out with fidelity (see Finney et al., 2021; Noell et al., 2002). As such, we recommend that educators encourage students to strive for proficiency in at least two skills per week.

In addition to the overall benefit to achieving proficiency in IXL skills, continuing to practice skills beyond proficiency in order to achieve mastery was associated with even better performance for students who were high achievers at baseline. These findings suggest that teachers using IXL would likely serve high-performing students better by encouraging them to spend their time and effort achieving mastery to solidify their knowledge rather than focusing on stopping at proficiency. Lower-performing students, on the other hand, may benefit more from gaining proficiency in relatively more skills as opposed to mastery in fewer skills in a given amount of practice time.

Although the day-to-day educational disruptions caused by the COVID-19 pandemic have largely subsided, students will continue to recover from learning loss following the pandemic (NAEP, 2022). With its personalized guidance and first-of-its-kind assessment suite, IXL can play a key role in helping students and teachers close learning gaps. IXL recognizes content areas where students may be struggling and engages them with material at the appropriate level. By meeting students where they are, IXL can help students "catch up" by providing support for relearning missed or forgotten material. This combination of personalized learning and remediation has been suggested as a highly effective approach for both recovering from pandemic-related learning loss as well as boosting subsequent learning gains (Kaffenberger, 2021). The results of this study support this hypothesis: students who used IXL made significantly larger gains than students who did not use IXL, and the impact of IXL was especially high for low-achieving students and students receiving special education services. Thus, IXL continues to be a powerful platform in supporting student learning, helping students to both recover from pandemic-related educational challenges and unlock their full academic potential.

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Appendix A: Detailed Methodology

RESEARCH QUESTION 1A: OVERALL EFFICACY OF IXL

Design

In this study, we used a quasi-experimental pretest-posttest control group design to compare the Spring 2023 MAP scores of students who used IXL during the 2022-23 school year to the scores of students who did not use IXL during this time (Figure A1).

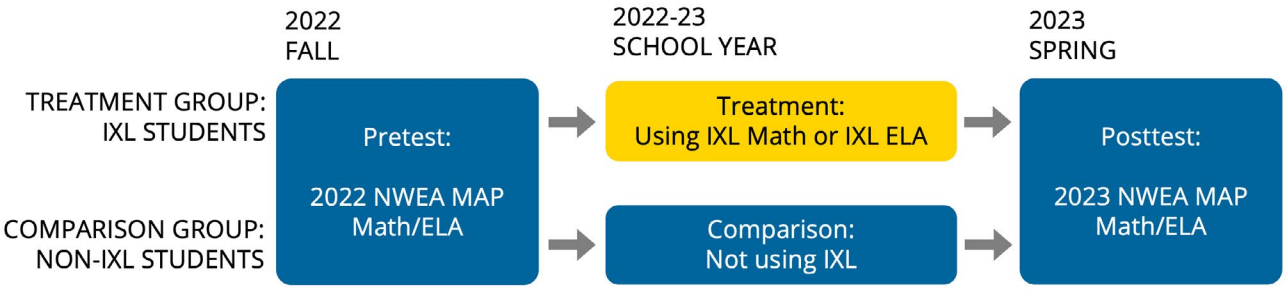

Figure A1. Study design

Participants

Our criteria for inclusion in the treatment (IXL) group was based on the number of skills in which students reached proficiency per week. Within each subject, we examined the efficacy of IXL at three different usage thresholds: .5, 1, and 2 SP/week. IXL students were those who, on average, met the given usage criterion during the 2022-23 school year. We defined comparison students as those who did not use IXL during the 2022-23 school year.

Analysis

For the analysis of all students as well as each student subgroup, we specified and tested separate multilevel models for each subject (IXL Math and IXL ELA) to account for clustering at the school level (i.e., students within a school tend to be more similar to each other than students in other schools). Model specification details are presented in Appendix B.

RESEARCH QUESTION 1B: USAGE EFFECTS OF IXL

Participants

In these analyses, we included all students who had complete data and nonzero IXL usage during the study period. After removing outliers[5], the final sample consisted of 8,619 students for the IXL Math analysis and 8,436 students for the IXL ELA analysis; descriptive statistics for these students' IXL usage during the study period can be found in Table A1.

[5] Students who had IXL usage greater than 3 *SD* above the mean were identified as outliers and removed prior to analysis (IXL Math outlier n = 603, or 6.5% of the initial sample; IXL ELA outlier n = 756, or 8.2% of the initial sample).

Table A1. IXL Math and IXL ELA Usage During the 2022-23 School Year

Weekly IXL usage	IXL Math (*n* = 8,619)				IXL ELA (*n* = 8,436)			
	M	*SD*	Min	Max	*M*	*SD*	Min	Max
Time spent (in minutes)	11.96	10.39	0.12	53.95	10.14	9.09	0.12	47.61
Questions answered	39.35	32.53	1.07	177.56	38.45	32.73	1.02	177.56
Skills proficient	1.07	0.95	0.05	5.17	0.90	0.83	0.05	4.20

Analysis

For the analysis of all students as well as each student subgroup, we specified and tested separate multilevel models for each subject (IXL Math and IXL ELA) to account for clustering at the school level (i.e., students within a school tend to be more similar to each other than students in other schools). We examined SP/week[6] as the IXL usage indicator of interest; further model specification details are presented in Appendix B.

RESEARCH QUESTION 1C: IMPLEMENTATION FIDELITY

Design

We used a quasi-experimental pretest-posttest design to compare the Spring 2023 MAP scores of students who reached 2 SP/week (on average) during the 2022-23 school year to the scores of students who used IXL but did not meet this threshold, controlling for baseline performance and demographic characteristics.

Analysis

For math and ELA separately, we followed the same analytic procedures as described in the Analysis section of Research Question 1a. Here, we used a binary variable indicating high-fidelity group status (i.e., 1 = reached 2 SP/week, 0 = did not reach 2 SP/week) as the IXL predictor of interest. Further model specification details are presented in Appendix B.

RESEARCH QUESTION 2A: IXL EFFICACY AMONG STUDENT SUBGROUPS

Participants

In these analyses, we used the same inclusion criteria as described in Research Questions 1a-1c. Each student subgroup (students eligible for or receiving special education services, low-achieving students, and high-achieving students) was analyzed separately; the sample size for each analysis is reported in the corresponding table in Appendix D.

[6] We also examined questions per week and time spent per week as usage indicators and found that they were significant predictors of Spring 2023 MAP performance, controlling for baseline and demographics. For simplicity, we report only the SP/week usage models in this report.

Design and Analysis

For this research question, we used the same design and analyses reported for Research Questions 1a-1c. We conducted overall efficacy, usage, and implementation fidelity analyses in math and ELA for each of the following subgroups: students eligible for or receiving special education services, low-achieving students, and high-achieving students. Model specification details are presented in Appendix B.

RESEARCH QUESTION 2B: ADDED BENEFIT OF SKILL MASTERY

Participants

The goal of these analyses was to examine the extent to which students benefited from progressing beyond proficiency in a skill to achieve mastery, especially with respect to students' status as low- or high-achieving. In order to maximize the number of students in the analysis who used IXL with at least partial fidelity, we included any students from the larger usage analysis (Research Question 1b) who averaged at least .75 SP/week during the study period. The final sample consisted of 4,445 students for the IXL Math analysis and 3,692 students for the IXL ELA analysis.

Analysis

We followed similar analytic procedures described previously, with the following changes. First, we calculated the ratio of skills mastered (SM) to skills proficient (SP)[7]. Including this ratio as a predictor allowed us to model the potential benefit of continuing beyond proficiency to reach mastery. In this analysis, a ratio closer to zero indicates that a student more often stopped practicing skills after reaching proficiency, whereas a ratio closer to one indicates that a student worked all the way to mastery (i.e., SmartScore of 100) in most of the skills in which they reached proficiency (i.e., SmartScore of 80). To assess whether the effect of progressing to mastery on assessment scores depended on a students' initial academic standing, we included an interaction term between achievement status (low-achieving or high-achieving based on being below vs. above the 50th percentile at baseline) and the ratio of SM to SP. Further model specification details are provided in Appendix B.

[7] Analyzing both skills mastered and skills proficient as separate predictors was not possible in this model as reaching mastery requires first reaching proficiency.

Appendix B: Model Specification

For each analysis, we specified and tested separate multilevel models in each subject (IXL Math and IXL ELA) to account for clustering at the school level (i.e., students within a school tend to be more similar to each other than students in other schools). In each model, we regressed Spring 2023 NWEA MAP score on the IXL predictor variable of interest (which varied by analysis) and covariates. Specifically, we controlled for the following covariates: baseline performance (Fall 2022 MAP score), grade level, gender, race, special education status[8], and gifted (High-Ability Learner, or HAL) status. In addition, the models for Research Question 2b controlled for SP/week as a measure of students' overall usage of the IXL platform.

The IXL predictor variable of interest for each analysis was as follows:

- **Research Question 1a (overall efficacy):** binary-coded IXL student status (i.e., 1 = reached tested usage threshold, 0 = did not use IXL)
- **Research Question 1b (usage):** SP/week
- **Research Question 1c (implementation fidelity):** binary-coded IXL student status (i.e., 1 = reached 2 SP/week, 0 = did not reach 2 SP/week)
- **Research Question 2a (subgroup efficacy):** same predictors as Research Questions 1a-1c
- **Research Question 2b (added benefit of skill mastery):** Achievement status * SM:SP ratio

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. In analyses that use a continuous IXL predictor variable (e.g., SP/week in Research Question 1b), we report a standardized regression coefficient (β) to gauge the practical significance of IXL usage relative to the effects of the covariates. In analyses using a categorical IXL predictor (e.g., high-fidelity status in Research Question 1c) , we report Hedges' *g* as the measure of effect size. For broad-scope educational assessments, moderate effect sizes range from about 0.10–0.20, and effect sizes of about 0.20 or higher are considered large (Kraft, 2020; Lipsey et al., 2012).

[8] This covariate was not included in the special education subgroup analyses, as it was unnecessary given the sample.

Appendix C: Overall Analysis Results

Table C1. **Full Model Predicting Spring 2023 MAP Math Score from Use of IXL Math and Covariates**

Predictor	*b*	*SE*	95% CI	β	*t*	*p*
(Intercept)	200.46	0.53	199.42 – 201.49	-0.06	377.684	<.001
Grade 1[1]	0.77	0.37	0.04 – 1.50	0.03	2.060	.039
Grade 2[1]	0.62	0.41	-0.19 – 1.43	0.03	1.493	.135
Grade 3[1]	0.93	0.49	-0.03 – 1.88	0.04	1.901	.057
Grade 4[1]	0.88	0.56	-0.21 – 1.97	0.04	1.580	.114
Grade 5[1]	3.39	0.62	2.17 – 4.61	0.14	5.444	<.001
Race: White[2]	0.68	0.21	0.27 – 1.09	0.01	3.260	.001
Special education[3]	-1.73	0.27	-2.26 – -1.19	-0.02	-6.289	<.001
Gender: male[4]	1.29	0.18	0.94 – 1.63	0.03	7.333	<.001
Gifted[5]	4.12	0.32	3.48 – 4.75	0.05	12.683	<.001
BOY MAP math score[6]	0.83	0.01	0.81 – 0.84	0.89	102.429	<.001
≥ .5 SP/week[7,8]	**1.96**	**0.42**	**1.13 – 2.79**	**0.02**	**4.617**	**<.001**
≥ 1 SP/week[7,9]	**2.62**	**0.47**	**1.69 – 3.56**	**0.03**	**5.518**	**<.001**
≥ 2 SP/week[7,10]	**3.22**	**0.60**	**2.03 – 4.45**	**0.05**	**5.328**	**<.001**

Note. Dependent variable: score on the Spring 2023 MAP assessment in math. *b* = unstandardized regression coefficient, *SE* = standard error, CI = confidence interval, β = standardized regression coefficient, BOY = beginning-of-year.

[1] Dummy coded; kindergarten as reference group.
[2] Dummy coded; non-White students as reference group.
[3] Dummy coded; non-special education students as reference group.
[4] Dummy coded; female students as reference group.
[5] Dummy coded; non-gifted students as reference group.
[6] Grand-mean centered.
[7] Dummy coded; students reaching 0 SP/week as reference group.
[8] Treatment *n* = 6,027; comparison *n* = 363.
[9] Treatment *n* = 3,785; comparison *n* = 363.
[10] Treatment *n* = 1,628; comparison *n* = 363.

Table C2. **Full Model Predicting Spring 2023 MAP ELA Score from Use of IXL ELA and Covariates**

Predictor	*b*	*SE*	95% CI	β	*t*	*p*
(Intercept)	194.44	0.54	193.38 – 195.49	-0.12	361.095	<.001
Grade 1[1]	0.42	0.42	-0.39 – 1.24	0.02	1.013	.311
Grade 2[1]	4.05	0.47	3.12 – 4.97	0.19	8.539	<.001
Grade 3[1]	3.16	0.55	2.08 – 4.24	0.15	5.730	<.001
Grade 4[1]	2.70	0.61	1.50 – 3.89	0.13	4.427	<.001
Grade 5[1]	2.89	0.67	1.58 – 4.19	0.14	4.336	<.001
Race: White[2]	0.32	0.23	-0.13 – 0.77	0.01	1.404	.160
Special education[3]	-2.94	0.31	-3.55 – -2.34	-0.05	-9.512	<.001
Gender: male[4]	-0.04	0.20	-0.42 – 0.34	0.00	-0.192	.847
Gifted[5]	2.41	0.36	1.71 – 3.12	0.03	6.740	<.001
BOY MAP ELA score[6]	0.71	0.01	0.69 – 0.72	0.87	89.609	<.001
≥ .5 SP/week[7,8]	**4.31**	**0.41**	**3.50 – 5.12**	**0.05**	**10.395**	**<.001**
≥ 1 SP/week[7,9]	**4.85**	**0.47**	**3.92 – 5.76**	**0.08**	**10.324**	**<.001**
≥ 2 SP/week[7,10]	**5.24**	**0.61**	**4.03 – 6.42**	**0.10**	**8.548**	**<.001**

Note. Dependent variable: score on the Spring 2023 MAP assessment in ELA. *b* = unstandardized regression coefficient, *SE* = standard error, CI = confidence interval, β = standardized regression coefficient, BOY = beginning-of-year.

[1] Dummy coded; kindergarten as reference group.
[2] Dummy coded; non-White students as reference group.
[3] Dummy coded; non-special education students as reference group.
[4] Dummy coded; female students as reference group.
[5] Dummy coded; non-gifted students as reference group.
[6] Grand-mean centered.
[7] Dummy coded; students reaching 0 SP/week as reference group.
[8] Treatment *n* = 5,213; comparison *n* = 445.
[9] Treatment *n* = 3,129; comparison *n* = 445.
[10] Treatment *n* = 1,295; comparison *n* = 445.

Table C3. Full Model Predicting Spring 2023 MAP Math Score from IXL Math Skills Proficient and Covariates

Predictor	*b*	*SE*	95% CI	β	*t*	*p*
(Intercept)	199.99	0.46	199.10 – 200.89	-0.06	436.476	<.001
Grade 1[1]	-0.10	0.31	-0.70 – 0.50	0.00	-0.325	.745
Grade 2[1]	1.23	0.34	0.55 – 1.90	0.05	3.565	<.001
Grade 3[1]	1.31	0.41	0.51 – 2.11	0.05	3.225	.001
Grade 4[1]	1.24	0.47	0.32 – 2.15	0.05	2.652	.008
Grade 5[1]	4.22	0.52	3.20 – 5.24	0.18	8.080	<.001
Race: White[2]	0.81	0.18	0.46 – 1.15	0.01	4.565	<.001
Special education[3]	-2.10	0.22	-2.53 – -1.66	-0.03	-9.411	<.001
Gender: male[4]	1.18	0.15	0.88 – 1.48	0.02	7.785	<.001
Gifted[5]	4.72	0.30	4.13 – 5.31	0.06	15.628	<.001
BOY MAP math score[6]	0.80	0.01	0.79 – 0.81	0.86	115.443	<.001
IXL Math Skills Proficient[6,7]	**1.29**	**0.09**	**1.11 – 1.47**	**0.05**	**14.239**	**<.001**

Note. Dependent variable: Score on the Spring 2023 MAP assessment in math. *b* = unstandardized regression coefficient, *SE* = standard error, CI = confidence interval, β = standardized regression coefficient, BOY = beginning-of-year.

[1] Dummy coded; kindergarten as reference group.
[2] Dummy coded; non-White students as reference group.
[3] Dummy coded; non-special education students as reference group.
[4] Dummy coded; female students as reference group.
[5] Dummy coded; non-gifted students as reference group.
[6] Grand-mean centered.
[7] Weekly average amount.

Table C4. Full Model Predicting Spring 2023 MAP ELA Score from IXL ELA Skills Proficient and Covariates

Predictor	*b*	*SE*	95% CI	β	*t*	*p*
(Intercept)	194.37	0.45	193.48 – 195.25	-0.08	428.746	<.001
Grade 1[1]	-1.02	0.33	-1.67 – -0.37	-0.05	-3.082	.002
Grade 2[1]	3.60	0.38	2.85 – 4.35	0.16	9.374	<.001
Grade 3[1]	2.36	0.45	1.48 – 3.23	0.11	5.280	<.001
Grade 4[1]	2.66	0.50	1.68 – 3.63	0.12	5.352	<.001
Grade 5[1]	3.29	0.54	2.23 – 4.34	0.15	6.110	<.001
Race: White[2]	0.73	0.19	0.35 – 1.11	0.01	3.803	<.001
Special education[3]	-2.37	0.25	-2.85 – -1.89	-0.04	-9.655	<.001
Gender: male[4]	0.00	0.16	-0.32 – 0.32	0.00	0.009	.993
Gifted[5]	2.31	0.32	1.68 – 2.93	0.03	7.218	<.001
BOY MAP ELA score[6]	0.70	0.01	0.69 – 0.72	0.86	105.215	<.001
IXL ELA Skills Proficient[6,7]	**1.33**	**0.11**	**1.11 – 1.55**	**0.05**	**11.770**	**<.001**

Note. Dependent variable: Score on the Spring 2023 MAP assessment in ELA. *b* = unstandardized regression coefficient, *SE* = standard error, CI = confidence interval, β = standardized regression coefficient, BOY = beginning-of-year.

[1] Dummy coded; kindergarten as reference group.
[2] Dummy coded; non-White students as reference group.
[3] Dummy coded; non-special education students as reference group.
[4] Dummy coded; female students as reference group.
[5] Dummy coded; non-gifted students as reference group.
[6] Grand-mean centered.
[7] Weekly average amount.

Table C5. Full Model Predicting Spring 2023 MAP Math Score from Use of IXL Math with High Fidelity and Covariates

Predictor	*b*	*SE*	95% CI	β	*t*	*p*
(Intercept)	200.46	0.53	199.42 – 201.49	-0.06	377.684	<.001
Grade 1[1]	0.77	0.37	0.04 – 1.50	0.03	2.060	.039
Grade 2[1]	0.62	0.41	-0.19 – 1.43	0.03	1.493	.135
Grade 3[1]	0.93	0.49	-0.03 – 1.88	0.04	1.901	.057
Grade 4[1]	0.88	0.56	-0.21 – 1.97	0.04	1.580	.114
Grade 5[1]	3.39	0.62	2.17 – 4.61	0.14	5.444	<.001
Race: White[2]	0.68	0.21	0.27 – 1.09	0.01	3.260	.001
Special education[3]	-1.73	0.27	-2.26 – -1.19	-0.02	-6.289	<.001
Gender: male[4]	1.29	0.18	0.94 – 1.63	0.03	7.333	<.001
Gifted[5]	4.12	0.32	3.48 – 4.75	0.05	12.683	<.001
BOY MAP math score[6]	0.83	0.01	0.81 – 0.84	0.89	102.429	<.001
≥ 2 SP/week[7,8]	**3.22**	**0.60**	**2.03 – 4.45**	**0.05**	**5.328**	**<.001**

Note. Dependent variable: score on the Spring 2023 MAP assessment in math. *b* = unstandardized regression coefficient, *SE* = standard error, CI = confidence interval, β = standardized regression coefficient, BOY = beginning-of-year.

[1] Dummy coded; kindergarten as reference group.
[2] Dummy coded; non-White students as reference group.
[3] Dummy coded; non-special education students as reference group.
[4] Dummy coded; female students as reference group.
[5] Dummy coded; non-gifted students as reference group.
[6] Grand-mean centered.
[7] Dummy coded; students reaching < 2 SP/week as reference group.
[8] Treatment *n* = 1,628; comparison *n* = 7,827.

Table C6. Full Model Predicting Spring 2023 MAP ELA Score from Use of IXL ELA with High Fidelity and Covariates

Predictor	*b*	*SE*	95% CI	β	*t*	*p*
(Intercept)	193.79	0.44	192.93 – 194.65	-0.08	442.505	<.001
Grade 1[1]	-0.33	0.31	-0.94 – 0.28	-0.01	-1.063	.288
Grade 2[1]	3.95	0.36	3.24 – 4.65	0.17	10.915	<.001
Grade 3[1]	2.50	0.42	1.67 – 3.32	0.11	5.927	<.001
Grade 4[1]	2.33	0.47	1.41 – 3.24	0.10	4.997	<.001
Grade 5[1]	2.20	0.50	1.22 – 3.18	0.10	4.396	<.001
Race: White[2]	0.86	0.18	0.50 – 1.22	0.02	4.695	<.001
Special education[3]	-3.02	0.23	-3.47 – -2.56	-0.05	-12.936	<.001
Gender: male[4]	0.03	0.16	-0.27 – 0.34	0.00	0.218	.827
Gifted[5]	2.43	0.31	1.83 – 3.04	0.03	7.884	<.001
BOY MAP ELA score[6]	0.72	0.01	0.71 – 0.74	0.88	116.189	<.001
≥ 2 SP/week[7,8]	**1.77**	**0.25**	**1.29 – 2.26**	**0.03**	**7.163**	**<.001**

Note. Dependent variable: score on the Spring 2023 MAP assessment in ELA. *b* = unstandardized regression coefficient, *SE* = standard error, CI = confidence interval, β = standardized regression coefficient, BOY = beginning-of-year.

[1] Dummy coded; kindergarten as reference group.
[2] Dummy coded; non-White students as reference group.
[3] Dummy coded; non-special education students as reference group.
[4] Dummy coded; female students as reference group.
[5] Dummy coded; non-gifted students as reference group.
[6] Grand-mean centered.
[7] Dummy coded; students reaching < 2 SP/week as reference group.
[8] Treatment *n* = 1,295; comparison *n* = 8,159.

Appendix D: Subgroup Analysis Results

Table D1. Summary of Student Subgroup Models Predicting Spring 2023 MAP Math Score from Use of IXL Math and Covariates

Predictor	*b*	*SE*	95% CI	β	*t*	*p*
Special education						
≥ .5 SP/week[1]	2.86	1.10	0.73 – 5.00	0.03	2.612	.009
≥ 1 SP/week[2]	4.00	1.19	1.69 – 6.32	0.06	3.351	.001
≥ 2 SP/week[3]	4.37	1.66	1.20 – 7.55	0.08	2.630	.009
Low-achieving						
≥ .5 SP/week[4]	4.55	0.86	2.88 – 6.23	0.07	5.294	<.001
≥ 1 SP/week[5]	5.38	0.98	3.49 – 7.28	0.10	5.512	<.001
≥ 2 SP/week[6]	5.81	1.38	3.17 – 8.47	0.12	4.203	<.001
High-achieving						
≥ .5 SP/week[7]	0.59	0.48	-0.36 – 1.55	0.00	1.217	.224
≥ 1 SP/week[8]	1.38	0.54	0.32 – 2.46	0.02	2.538	.011
≥ 2 SP/week[9]	2.12	0.67	0.80 – 3.48	0.03	3.153	.002

Note. Dependent variable: score on the Spring 2023 MAP assessment in math. *b* = unstandardized regression coefficient, *SE* = standard error, CI = confidence interval, β = standardized regression coefficient. This table summarizes the estimates for the overall efficacy of IXL at each threshold (.5, 1, or 2 SP/week) in each student subgroup, controlling for baseline performance and all other covariates.

[1] Treatment *n* = 727; comparison *n* = 71.
[2] Treatment *n* = 415; comparison *n* = 71.
[3] Treatment *n* = 142; comparison *n* = 71.
[4] Treatment *n* = 1,064; comparison *n* = 110.
[5] Treatment *n* = 561; comparison *n* = 110.
[6] Treatment *n* = 175; comparison *n* = 110.
[7] Treatment *n* = 4,963; comparison *n* = 253.
[8] Treatment *n* = 3,224; comparison *n* = 253.
[9] Treatment *n* = 1,453; comparison *n* = 253.

Table D2. Summary of Student Subgroup Models Predicting Spring 2023 MAP ELA Score from Use of IXL ELA and Covariates

Predictor	*b*	*SE*	95% CI	β	*t*	*p*
Special education						
≥ .5 SP/week[1]	8.17	0.99	6.23 – 10.09	0.13	8.260	<.001
≥ 1 SP/week[2]	8.36	1.10	6.22 – 10.48	0.16	7.611	<.001
≥ 2 SP/week[3]	9.75	1.38	7.10 – 12.40	0.20	7.064	<.001
Low-achieving						
≥ .5 SP/week[4]	6.21	0.79	4.64 – 7.75	0.11	7.879	<.001
≥ 1 SP/week[5]	5.81	0.88	3.99 – 7.55	0.13	6.606	<.001
≥ 2 SP/week[6]	6.69	1.26	4.09 – 9.11	0.15	5.301	<.001
High-achieving						
≥ .5 SP/week[7]	2.46	0.50	1.50 – 3.44	0.03	4.970	<.001
≥ 1 SP/week[8]	3.09	0.57	1.99 – 4.20	0.05	5.474	<.001
≥ 2 SP/week[9]	3.75	0.68	2.43 – 5.08	0.08	5.499	<.001

Note. Dependent variable: score on the Spring 2023 MAP assessment in ELA. *b* = unstandardized regression coefficient, *SE* = standard error, CI = confidence interval, β = standardized regression coefficient. This table summarizes the estimates for the overall efficacy of IXL at each threshold (.5, 1, or 2 SP/week) in each student subgroup, controlling for baseline performance and all other covariates.

[1] Treatment *n* = 600; comparison *n* = 103.
[2] Treatment *n* = 326; comparison *n* = 103.
[3] Treatment *n* = 117; comparison *n* = 103.
[4] Treatment *n* = 1,106; comparison *n* = 188.
[5] Treatment *n* = 592; comparison *n* = 188.
[6] Treatment *n* = 193; comparison *n* = 188.
[7] Treatment *n* = 4,107; comparison *n* = 257.
[8] Treatment *n* = 2,537; comparison *n* = 257.
[9] Treatment *n* = 1,102; comparison *n* = 257.

Table D3. Summary of Student Subgroup Models Predicting Spring 2023 MAP Math Score from IXL Math Skills Proficient and Covariates

Predictor	*b*	*SE*	95% CI	β	*t*	*p*
Special education						
IXL Math Skills Proficient[1,2,3]	1.94	0.31	1.33 – 2.55	0.08	6.185	<.001
Low-achieving						
IXL Math Skills Proficient[1,2,4]	1.99	0.25	1.49 – 2.48	0.12	7.796	<.001
High-achieving						
IXL Math Skills Proficient[1,2,5]	1.21	0.09	1.03 – 1.39	0.03	13.046	.002

Note. Dependent variable: Score on the Spring 2023 MAP assessment in math. *b* = unstandardized regression coefficient, *SE* = standard error, CI = confidence interval, β = standardized regression coefficient. This table summarizes the estimates for usage effects of IXL in each student subgroup, controlling for baseline performance and all other covariates.

[1] Grand-mean centered.
[2] Weekly average amount.
[3] *n* = 1,271.
[4] *n* = 2,056.
[5] *n* = 6,563.

Table D4. Summary of Student Subgroup Models Predicting Spring 2023 MAP ELA Score from IXL ELA Skills Proficient and Covariates

Predictor	*b*	*SE*	95% CI	β	*t*	*p*
Special education						
IXL ELA Skills Proficient[1,2,3]	1.90	0.39	1.13 – 2.66	0.06	4.860	<.001
Low-achieving						
IXL ELA Skills Proficient[1,2,4]	2.17	0.31	1.56 – 2.76	0.07	7.099	<.001
High-achieving						
IXL ELA Skills Proficient[1,2,5]	1.10	0.11	0.88 – 1.33	0.05	9.665	<.001

Note. Dependent variable: Score on the Spring 2023 MAP assessment in ELA. *b* = unstandardized regression coefficient, *SE* = standard error, CI = confidence interval, β = standardized regression coefficient. This table summarizes the estimates for usage effects of IXL in each student subgroup, controlling for baseline performance and all other covariates.

[1] Grand-mean centered.
[2] Weekly average amount.
[3] *n* = 1,227.
[4] *n* = 1,961.
[5] *n* = 6,472.

Table D5. Summary of Student Subgroup Models Predicting Spring 2023 MAP Math Score from Use of IXL Math with High Fidelity and Covariates

Predictor	*b*	*SE*	95% CI	β	*t*	*p*
Special education						
≥ 2 SP/week[1]	4.37	1.66	1.20 – 7.55	0.08	2.630	.009
Low-achieving						
≥ 2 SP/week[2]	5.81	1.38	3.17 – 8.47	0.12	4.203	<.001
High-achieving						
≥ 2 SP/week[3]	2.12	0.67	0.80 – 3.48	0.03	3.153	.002

Note. Dependent variable: score on the Spring 2023 MAP assessment in math. *b* = unstandardized regression coefficient, *SE* = standard error, CI = confidence interval, β = standardized regression coefficient. This table summarizes the estimates for the effect of IXL usage with fidelity in each student subgroup, controlling for baseline performance and all other covariates.

[1] Treatment *n* = 142; comparison *n* = 1,279.
[2] Treatment *n* = 175; comparison *n* = 2,102.
[3] Treatment *n* = 1,453; comparison *n* = 5,725.

Table D6. Summary of Student Subgroup Models Predicting Spring 2023 MAP ELA Score from Use of IXL ELA with High Fidelity and Covariates

Predictor	*b*	*SE*	95% CI	β	*t*	*p*
Special education						
≥ 2 SP/week[1]	3.02	0.91	1.24 – 4.80	0.04	3.308	.001
Low-achieving						
≥ 2 SP/week[2]	3.49	0.71	2.10 – 4.88	0.04	4.904	<.001
High-achieving						
≥ 2 SP/week[3]	1.47	0.25	0.99 – 1.95	0.03	5.981	<.001

Note. Dependent variable: score on the Spring 2023 MAP assessment in ELA. *b* = unstandardized regression coefficient, *SE* = standard error, CI = confidence interval, β = standardized regression coefficient. This table summarizes the estimates for the effect of IXL usage with fidelity in each student subgroup, controlling for baseline performance and all other covariates.

[1] Treatment *n* = 117; comparison *n* = 1,308.
[2] Treatment *n* = 193; comparison *n* = 2,560.
[3] Treatment *n* = 1,102; comparison *n* = 5,599.

Table D7. Full Model Predicting Spring 2023 MAP Math Score from IXL Math Skills Mastered: Skills Proficient, Achievement Status, and Covariates

Predictor	*b*	*SE*	95% CI	β	*t*	*p*
(Intercept)	156.67	1.53	153.68 – 159.68	-0.01	102.090	<.001
Grade 1[1]	17.46	0.57	16.34 – 18.57	0.29	30.678	<.001
Grade 2[1]	29.20	0.55	28.11 – 30.28	0.52	52.723	<.001
Grade 3[1]	38.46	0.57	37.35 – 39.57	0.69	67.830	<.001
Grade 4[1]	47.45	0.59	46.29 – 48.60	0.85	80.349	<.001
Grade 5[1]	59.19	0.61	57.99 – 60.39	0.95	96.831	<.001
Race: White[2]	1.57	0.33	0.91 – 2.22	0.03	4.682	<.001
Special education[3]	-3.82	0.44	-4.69 – -2.96	-0.05	-8.616	<.001
Gender: male[4]	2.83	0.28	2.29 – 3.37	0.06	10.241	<.001
Gifted[5]	13.37	0.46	12.48 – 14.26	0.20	29.353	<.001
IXL Math Skills Proficient[6,7]	1.71	0.16	1.40 – 2.03	0.07	10.698	<.001
High-achieving[8]	12.34	1.43	9.53 – 15.14	0.25	8.617	<.001
SM/SP ratio	-2.02	1.65	-5.26 – 1.20	0.02	-1.225	.221
High-achieving * SM:SP ratio	**4.16**	**1.71**	**0.81 – 7.52**	**0.02**	**2.426**	**.015**

Note. Dependent variable: score on the Spring 2023 MAP assessment in Math. *b* = unstandardized regression coefficient, *SE* = standard error, CI = confidence interval, β = standardized regression coefficient, SM = skills mastered, SP = skills proficient.

[1] Dummy coded; kindergarten as reference group.
[2] Dummy coded; non-White students as reference group.
[3] Dummy coded; non-special education students as reference group.
[4] Dummy coded; female students as reference group.
[5] Dummy coded; non-gifted students as reference group.
[6] Grand-mean centered.
[7] Weekly average amount.
[8] Dummy coded; low-achieving students as reference group

Table D8. Full Model Predicting Spring 2023 MAP ELA Score from IXL ELA Skills Mastered: Skills Proficient, Achievement Status, and Covariates

Predictor	*b*	*SE*	95% CI	β	*t*	*p*
(Intercept)	154.83	1.37	152.55 – 157.50	0.00	113.010	<.001
Grade 1[1]	14.53	0.67	13.22 – 15.83	0.29	21.763	<.001
Grade 2[1]	30.09	0.66	28.81 – 31.38	0.64	45.766	<.001
Grade 3[1]	38.49	0.68	37.15 – 39.83	0.81	56.293	<.001
Grade 4[1]	44.13	0.74	42.69 – 45.58	0.83	59.872	<.001
Grade 5[1]	51.08	0.78	49.54 – 52.61	0.88	65.157	<.001
Race: White[2]	0.89	0.37	0.17 – 1.60	0.02	2.416	.016
Special education[3]	-4.21	0.50	-5.20 – -3.23	-0.07	-8.369	<.001
Gender: male[4]	-0.50	0.31	-1.11 – 0.10	-0.01	-1.639	.101
Gifted[5]	8.68	0.54	7.64 – 9.74	0.14	16.187	<.001
IXL ELA Skills Proficient[6,7]	1.70	0.22	1.27 – 2.12	0.07	7.863	<.001
High-achieving[8]	12.92	1.14	10.69 – 15.14	0.30	11.364	<.001
SM/SP ratio	0.23	1.34	-2.40 – 2.86	0.04	0.172	.863
High-achieving * SM:SP ratio	**2.97**	**1.40**	**0.24 – 5.72**	**0.02**	**2.125**	**.034**

Note. Dependent variable: score on the Spring 2023 MAP assessment in ELA. *b* = unstandardized regression coefficient, *SE* = standard error, CI = confidence interval, β = standardized regression coefficient, SM = skills mastered, SP = skills proficient.

[1] Dummy coded; kindergarten as reference group.
[2] Dummy coded; non-White students as reference group.
[3] Dummy coded; non-special education students as reference group.
[4] Dummy coded; female students as reference group.
[5] Dummy coded; non-gifted students as reference group.
[6] Grand-mean centered.
[7] Weekly average amount.
[8] Dummy coded; low-achieving students as reference group.