Istation

Using Computer Adaptive Curriculum to Improve Istation Math Outcomes in Special Education Students

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Executive Summary

Istation is an integrated learning system that provides assessments, supplemental curriculum, and detailed reports that can be used for progress monitoring or benchmarking. It provides a computer adaptive test for universal screening, and students are routed into the curriculum based on assessment performance.

Istation recommends that students use the supplemental curriculum 30–40 minutes per week to increase their performance in math. Previous research with the Istation Math curriculum demonstrated that Istation usage increased math performance. This research evaluates if usage of Istation Math curriculum leads to Istation Math growth specifically in special education students.

Using data from Idaho, New Mexico, and Arkansas in the 2022–23 school year, a hierarchical linear model was used to control for socioeconomic status at the school level. Usage was divided into quintiles with quintile 1 indicating the lowest amount of usage and quintile 5 indicating the highest amount of usage. Results indicated that Istation curriculum usage led to Istation Math growth in most grades.

- Second grade special education students in usage quintiles 3–5 had scores that were 14–20 points higher on Istation Math than those in lower usage quintiles.
- Third grade special education students in usage quintiles 4–5 had scores that were 14–16 points higher than those in lower usage quintiles.
- Fifth grade special education students in usage quintile 5 had scores that were 18 points higher than those in lower usage quintiles.

These results demonstrate that using Istation curriculum helps student performance in math as measured by the Istation Math formative assessment. Furthermore, Istation Math growth was observed in special education students who did not meet the usage recommendations, suggesting that the supplemental curriculum for this particular population may be beneficial at any level.

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Introduction

The COVID-19 pandemic undeniably affected educational outcomes across various subjects, with a particularly stark impact observed in mathematics. A recent study showed that while students exhibited some recovery in reading, the rebound in mathematical skills lagged even three years later, particularly for those in first grade at the onset of the pandemic (Patarapichayatham & Locke, 2023). There is a need for innovative digital learning strategies to support students with disabilities in math. A notable gap in data on the educational progress of these students post-pandemic still exists, making it difficult to develop targeted educational interventions (Lambert & Schuck, 2021; Lake, 2022). The trend of learning lags is more pronounced among students with disabilities, who typically face additional barriers to educational achievement (Lake, 2022). Mathematics is a core subject and a critical tool for developing problem-solving skills and logical reasoning. Therefore, addressing the unique learning needs of these students in math education is essential.

Emerging research indicates that digital learning platforms, such as Istation, can have a beneficial impact on the academic achievement of students with disabilities, especially within inclusive educational models (Rizk & Hillier, 2022; Oh-Young & Filler, 2015; Hehir et al., 2016). These technologies may enhance learning while promoting greater student engagement and motivation (Szumski et al., 2017). For example, a previous study in kindergarten through third grade students showed that those using the Istation Math curriculum experienced significant growth on Istation Math, especially when compared to those not using the supplemental curriculum (Patarapichayatham et al., 2021). While this study did not examine special education students in particular, it demonstrates the curriculum's efficacy in enhancing math performance among young learners. Furthermore, the findings emphasize the potential of Istation to bridge academic gaps faced by special education students and to improve their learning outcomes. Despite the recognized potential of digital instructional tools, research is scarce exploring their effectiveness across different

grade levels and student demographics, particularly when comparing special education students to their non-special education peers (Ciampa, 2017; Baglama & Yucesoy, 2018).

Given the unique challenges faced by students with disabilities in math education, the engagement factor of digital curriculum is crucial. Special education, often encompassing a range of educational needs addressed in an Individual Education Plan (IEP), benefits significantly from the rise of digital technologies (Rizk & Hillier, 2022). These technologies offer numerous advantages, such as maximizing independence (Chen et al. 2014), aiding in work-based learning (White & Robertson 2015), and allowing for differentiated instruction (Meyer et al. 2014). Platforms like Istation Math, with their thematic and interactive nature, align well with these benefits. For example, Istation Math incorporates thematic elements like shopping in "Mario's Market" for younger students and secret agent missions for older students. These thematic approaches make learning math more interactive, help reduce cognitive load, and increase motivation. Such engaging digital environments are essential in catering to the diverse learning needs of students with disabilities.

Therefore, this study aims to evaluate the impact of Istation curriculum usage on Istation Math outcomes of special education students across second through fifth grade in Idaho, New Mexico, and Arkansas. Specifically, the study aims to address the following questions:

- Does using the Istation Math curriculum improve scores on the Istation formative assessment in special education students?
- Are Istation Math scores different based on Istation curriculum usage and socioeconomic status?

Methodology

Analytical Sample

The data are from students across Idaho, New Mexico, and Arkansas. This study focused on kindergarten through second grade special education students (n=1,091). Of those that had demographic data (n=678), the largest racial/ethnic group was White (52.8%), followed by Hispanic (28.5%), American Indian/Alaska Native (9.6%), Black/African American (5.3%), and two or more races (2.1%).

Measures

This study used the Istation Math formative assessment gain score as the outcome measure. Istation Math is a computer-adaptive universal screener. Istation is an integrated learning system that provides assessments, supplemental curriculum, and detailed reports that can be used for progress monitoring or benchmarking. Students are routed into the curriculum based on assessment performance.

This study focused on students who took the Istation Math assessment during the 2022-23 academic year. Istation Math assesses the domains of computational and algebraic thinking, geometry, number sense, and measurement and data analysis (Ketterlin-Geller, 2021).

Istation usage guidelines recommend that students who score at or below the 40th percentile of the normative sample on Istation assessments use the Istation curriculum for 40 minutes per week and that students who score above the 40th percentile use the curriculum for 30 minutes per week for implementation fidelity. Usage quintiles were calculated for special education students by grade level based on the total usage (minutes), with quintile 1 representing the lowest amount of usage and quintile 5 representing the highest usage.

Socioeconomic status categorizations were developed at the school level using National Center for Education Statistics and U.S. Census Bureau data. Tertiles were created for school socioeconomic status, with tertile 1 consisting of schools with the lowest socioeconomic status and tertile 3 with the highest socioeconomic status.

Analytical Approach

Due to the sample having students nested in schools, a hierarchical linear model (HLM) was used to examine the efficacy of Istation curriculum usage on Istation assessment gain scores, which were calculated as the difference between beginning-of-year (BOY) and end-of-year (EOY) scores. Furthermore, socioeconomic status was calculated at the school level to account for shared school characteristics and contextual effects. Three nested models were tested. Model 1 is the baseline model that consists of only the random effect for the intercept. Model 2 is an extension of model 1 that includes fixed effects at Level 1, which included BOY score and usage quintiles. Model 3 is an extension of model 2 that includes Level 2 fixed effects (school socioeconomic status). Models that included random slopes for Level 1 (usage) resulted in insignificant improvement of model fit. Therefore, model 3 was interpreted for each grade.

Results

Table 1 shows the total minutes by quintiles and grades for special education students using the supplemental curriculum for Istation Math.

Table 1. *Istation Math Usage Quintiles and Total Time across School Year by Grade*

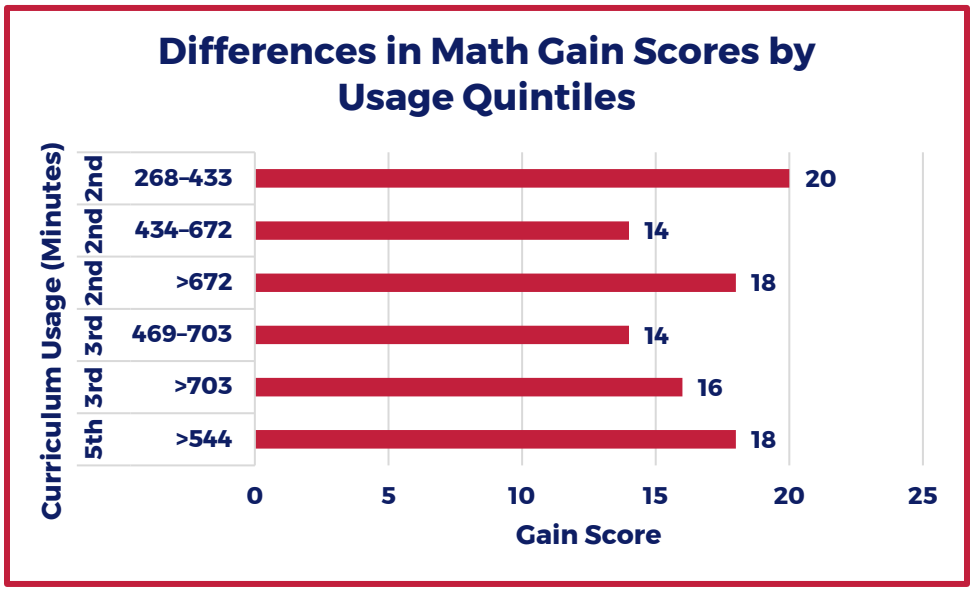
Usage Quintile	Usage Percentile Rank	2nd Grade	3rd Grade	4th Grade	5th Grade
1	≤20	≤143	≤170	≤121	≤93
2	21–40	144–267	171–310	122–224	94–176
3	41–60	268–433	311–468	225–358	177–339
4	61–80	434–672	469–703	359–532	340–544
5	>80	>672	>703	>532	>544

Next, the relationship between Istation Math scores and time spent in the curriculum was examined. Students in higher Istation usage quintiles generally scored higher on Istation Math across kindergarten through second grade. The tables below show the results for each regression model.

Istation Math

Figure 1 shows the graphical representation of increases in Istation Math gain scores by total minutes of usage per school year.

Figure 1. *Differences in Istation Math Gain Scores for Grades 2 to 5 by Istation Total Usage*



Second Grade

Table 2 shows the results for the HLM model for second grade special education students (n=375). Students in the 3rd Istation Math usage quintile or above (>268 total minutes/school year) had an increase of 14 to 20 points in EOY Istation Math scores compared to students in the lowest usage quintile, the referent group. Ten percent (10%) of the variability in scores was due to schools (ICC = .10), leaving 90% of the variability due to students. The significance of the error variance suggests that there was variability in scores across schools after accounting for school-level socioeconomic status. There were no relationships with school socioeconomic status, but the significance of the error variance suggests that there was variability in scores across schools after accounting for school-level socioeconomic status.

Table 2. *Istation Math Two-Level HLM for Second Grade, Coefficients and Standard Errors (SE)*

Fixed Effects	Model 1	Model 2	Model 3
Intercept	31.33* (2.29)	68.94* (27.13)	68.92* (27.20)
Baseline Score		-0.11 (0.06)	-0.12 (0.06)
Usage 2 (21-40)		4.20 (5.83)	4.55 (5.85)
Usage 3 (41-60)		20.26* (5.89)	20.33* (5.97)
Usage 4 (61-80)		13.54* (5.86)	13.69* (5.93)
Usage 5 (>80)		18.64* (5.87)	18.24* (5.90)
School SES 2			6.31 (4.88)
School SES 3			4.09 (7.30)
Error Variance			
Level-1	1066.04* (88.78)	1036.50* (86.92)	1033.43* (87.07)
Level-2 Intercept	128.47* (75.23)	106.91* (70.05)	113.51* (74.24)
Model Fit: AIC	3712.1	3686.7	3678.2
Model Fit: BIC	3723.9	3718.1	3717.5

Note. * $p < 0.05$; ICC = .10
Values based on Stata 18.0 Mixed. Entries show parameter estimates with standard errors in parentheses. Estimation Method = REML; Satterthwaite degrees of freedom.

Third Grade

Table 3 shows the results for the HLM model for third grade special education students (n=287). Students in the 4th Istation Math usage quintile or above (>469 total minutes/school year) had an increase of 14 to 16 points in EOY Istation Math scores, compared to students in the lowest quintile of usage. Twenty-three percent (23%) of the variability in scores was due to schools (ICC = .23), leaving 77% of the variability due to students. A significant positive relationship was observed for the 2nd tertile of school socioeconomic status ($\beta = 14.05$, $p < 0.05$). This suggests that schools with mid-level socioeconomic status tend to have special education students in third grade who exhibit greater individual improvement on Istation Math. The significance of the error variance suggests that there was variability in scores across schools after accounting for school-level socioeconomic status.

Table 3. *Istation Math Two-Level HLM for Third Grade, Coefficients and Standard Errors (SE)*

Fixed Effects	Model 1	Model 2	Model 3
Intercept	26.13* (2.79)	74.12* (33.30)	72.56* (33.20)
Baseline Score		-0.12 (0.07)	-0.13 (0.07)
Usage 2 (21-40)		9.35 (6.53)	8.62 (6.52)
Usage 3 (41-60)		2.76 (7.22)	1.85 (7.21)
Usage 4 (61-80)		14.56* (6.89)	14.19* (6.85)
Usage 5 (>80)		16.17* (7.23)	15.54* (7.24)
School SES 2			14.05* (6.87)
School SES 3			6.91 (8.17)
Error Variance			
Level-1	1033.07* (98.64)	972.00* (94.05)	971.65* (94.44)
Level-2 Intercept	207.55* (96.26)	303.53* (115.32)	283.81* (115.60)
Model Fit: AIC	2844.9	2827.5	2815.7
Model Fit: BIC	10183.9	10188.5	10189.1

Note. * $p < 0.05$; ICC = .23
Values based on Stata 18.0 Mixed. Entries show parameter estimates with standard errors in parentheses. Estimation Method = REML; Satterthwaite degrees of freedom.

Fourth Grade

Table 4 shows the results for the HLM model for fourth grade special education students (n=233). No significant relationships were observed for Istation Math curriculum usage on gain scores in this group. However, a significant positive relationship was observed for the 2nd tertile of school socioeconomic status ($\beta = 16.53$, $p < 0.05$). Similar to third grade students, this suggests that schools with mid-level socioeconomic status also tend to have special education students in fourth grade who exhibit greater individual improvement on Istation Math. Fifteen percent (15%) of the variability in scores was due to schools (ICC = .15), leaving 85% of the variability due to students. The significance of the error variance suggests that there was variability in scores across schools after accounting for school-level socioeconomic status.

Table 4. *Istation Math Two-Level HLM for Fourth Grade, Coefficients and Standard Errors (SE)*

Fixed Effects	Model 1	Model 2	Model 3
Intercept	19.46* (3.26)	20.66 (35.36)	28.44 (35.41)
Baseline Score		-0.02 (0.07)	-0.05 (0.08)
Usage 2 (21-40)		6.27 (8.86)	4.85 (8.84)
Usage 3 (41-60)		7.86 (8.98)	6.78 (8.87)
Usage 4 (61-80)		5.68 (9.10)	2.06 (9.04)
Usage 5 (>80)		16.06 (8.83)	15.14 (8.68)
School SES 2			16.53* (7.71)
School SES 3			15.23 (10.19)
Error Variance			
Level-1	1418.53* (154.02)	1384.15* (155.94)	1392.41* (156.71)
Level-2 Intercept	217.31* (131.24)	295.58* (161.34)	240.94* (152.42)
Model Fit: AIC	2379.4	2365.9	2352.3
Model Fit: BIC	2389.7	2393.5	2386.8

Note. * $p < 0.05$; ICC = .15
Values based on Stata 18.0 Mixed. Entries show parameter estimates with standard errors in parentheses. Estimation Method = REML; Satterthwaite degrees of freedom.

Fifth Grade

Table 5 shows the results for the HLM model for fifth grade special education students (n=196). Students in the 5th Istation Math usage quintile or above (>544 total minutes/school year) had an increase of 18 points in EOY Istation Math scores. Twenty percent (20%) of the variability in scores was due to schools (ICC = .20), leaving 80% of the variability due to students. The significance of the error variance suggests that there was variability in scores across schools after accounting for school-level socioeconomic status. There were no relationships with school socioeconomic status, but the significance of the error variance suggests that there was variability in scores across schools after accounting for school-level socioeconomic status.

Table 5. *Istation Math Two-Level HLM for Fifth Grade, Coefficients and Standard Errors (SE)*

Fixed Effects	Model 1	Model 2	Model 3
Intercept	10.95* (2.92)	112.53* (51.67)	113.79* (51.84)
Baseline Score		-0.23* (0.11)	-0.24* (0.11)
Usage 2 (21-40)		3.05 (7.28)	2.27 (7.36)
Usage 3 (41-60)		14.74* (7.34)	14.60 (7.41)
Usage 4 (61-80)		14.21 (7.92)	13.51 (8.08)
Usage 5 (>80)		18.07* (8.02)	18.42* (8.28)
School SES 2			5.70 (7.31)
School SES 3			1.43 (9.93)
Error Variance			
Level-1	884.21* (102.13)	834.50* (98.71)	829.46* (97.92)
Level-2 Intercept	152.20* (87.35)	187.96* (98.12)	212.37* (104.52)
Model Fit: AIC	1910.9	1889.9	1881.2
Model Fit: BIC	1920.7	1916.13	1913.9

Note. * $p < 0.05$; ICC = .20
Values based on Stata 18.0 Mixed. Entries show parameter estimates with standard errors in parentheses. Estimation Method = REML; Satterthwaite degrees of freedom.

Discussion

This study's findings underscore the Istation curriculum's significant impact on the academic performance of special education students in mathematics. This aligns with the increasing emphasis on inclusive educational models and the role of IEPs in enhancing learning outcomes for students with disabilities. The use of adaptive digital systems like Istation, which offer personalized instruction and timely feedback, is particularly beneficial in catering to the diverse needs of these students.

The study's results highlight a significant and positive correlation between using the Istation Math curriculum and improved formative assessment scores among special education students, evident across various grade levels. This finding indicates the curriculum's broad applicability and effectiveness in catering to the diverse learning needs inherent within special education. Notably, the most significant academic gains were observed among students who engaged more intensively with the curriculum, suggesting a dose-response relationship. This implies that the depth and consistency of interaction with the digital curriculum are critical factors in maximizing its educational impact. The curriculum's interactive and adaptive design is conducive to supporting special education students' unique learning trajectories. This pattern of results underscores the importance of integrating structured, responsive digital curricula in special education settings, emphasizing the need for sustained and meaningful engagement to achieve optimal educational outcomes.

The study reveals that the impact of socioeconomic status on the effectiveness of the Istation curriculum is inconsistent across all grades, pointing to a complex interaction between curriculum efficacy and various contextual factors at the school level. This variability suggests that external factors, such as the availability of resources, implementation strategies, and the presence of supportive student systems, might significantly influence the curriculum's impact. This finding calls for a nuanced approach to integrating technology-based learning tools in educational settings,

particularly in diverse socio-economic contexts. It highlights the need for educational stakeholders to consider these contextual variables when adopting digital learning tools. Tailoring the integration of such technologies to suit each school's specific needs and circumstances could be crucial for maximizing their educational benefits. This insight emphasizes the importance of understanding and addressing the broader environmental and institutional factors that can affect the success of digital curricula in improving educational outcomes for special education students.

The absence of a significant impact of the Istation curriculum on fourth-grade students presents a unique case for further investigation. This may suggest variations in the instructional approach or engagement levels that are particularly pertinent to this age group, as fourth grade is when mathematics becomes more abstract. Students in special education may need more 1:1 instruction during this critical year. This finding also highlights the importance of customizing digital learning tools to align with grade-specific curricular goals and understanding students' developmental and cognitive characteristics at different educational levels. This aspect of the study calls for a deeper exploration into how digital educational tools can be fine-tuned to maximize their educational impact and relevance for each grade level, particularly in special education settings.

The study reinforces the potential of digital learning platforms like Istation in supporting the educational needs of special education students. However, this potential hinges on the availability of such technologies and their effective integration into the educational process. This requires a comprehensive approach that includes educator training, ensuring accessibility for all students, and aligning the technology with individualized learning plans. This approach ensures that technology-enhanced learning is not merely an addition to the educational landscape but a vital, integrated component that enriches and diversifies the learning experience for special education students. Therefore, the focus should be on creating an environment where digital tools are available and effectively utilized to enhance learning outcomes in a meaningful way.

Conclusion

Utilizing Istation's digital curriculum with special education students underscores the potential of educational technology. This study contributes to a growing body of literature recognizing the importance of personalization and adaptability in educational tools, particularly for students with disabilities. The positive relationship between digital curriculum usage and academic performance among special education students highlights the value of such technologies in fostering inclusive educational practices.

Future research must explore how digital tools can be calibrated to maximize their impact across various educational contexts and for students with diverse learning needs. This study provides a foundation for such research, offering a positive perspective on the role of technology in creating more equitable and accessible learning environments for special education students. The insights from this research are valuable in guiding future educational policies and practices.

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