Using Computer-Adaptive Curriculum to Increase Performance on NWEA MAP Growth Reading Outcomes

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Executive Summary

Istation is an integrated learning system that provides a computer adaptive test used for universal screening or progress monitoring, reports for teachers and parents to track student's academic progress and provide information to inform instruction and intervention practices, and an adaptive supplemental curriculum. After the student completes the assessment, they are routed into the online curriculum based on their performance on the assessment. Previous research with the Istation Reading curriculum demonstrated that Istation usage led to increased achievement in reading as measured by several assessments, and this research evaluates if usage of Istation leads to academic growth, on the Northwest Evaluation Association Measures of Academic Progress (NWEA MAP) assessment.

Using data from four school districts in three different states, a hierarchical linear model was used to control for socioeconomic status at the school level. In every grade, results indicated that usage of Istation led to growth on the NWEA MAP.

- Students in grades 3 to 5 who approached or exceeded usage recommendations (30–40 minutes per week) for Istation had gains of 5 to 9 points on the NWEA MAP.
- Students in grade 6 who used Istation for an hour or more per month had gains of up to 12 points.
- Students in grade 7 who used Istation for 45 minutes or more per month had gains of up to 16 points.
- Students in grade 8 who used Istation for 25 minutes or more per month saw increases of up to 8 points.

These results demonstrate that using the Istation program with fidelity helps students reach their potential in reading achievement as measured by the NWEA MAP assessment.

Introduction

Istation's Indicators of Progress (ISIP™) Reading measures a student's ability to read in English (Mathes et al., 2022). The assessment measures the essential skills that lead to literacy by assessing phonemic awareness, alphabetic knowledge and skills, vocabulary, fluency, and comprehension.

After students complete ISIP Reading, a computer adaptive test (CAT) that uses the two-parameter model, the system places them into Istation's interactive program (Mathes et al., 2022). The adaptive reading curriculum in English provides students with engaging intervention lessons aimed at increasing student success in the classroom. The curriculum is cyclical and starts instruction with foundational skills for the alphabet, alphabetic principle, print awareness, and other basic skills supported by the science of reading.

Previous research with the Istation Reading curriculum demonstrated that Istation usage led to increased achievement across several assessments, including the Partnership for Assessment of Readiness for College and Careers (PARCC) (Cook & Ross, 2020), the North West Education Association Measures of Academic Progress (NWEA MAP®) (Cook & Ross, 2021), the Renaissance Star Assessment® (Luo et al., 2017), the Developmental Reading Assessment (2nd edition) (DRA2) (Putman, 2017), and the Idaho state assessment (Cook & Ross, 2022).

This research examines the findings from the quantitative analyses comparing students' Istation Reading curriculum usage time and performance on the NWEA MAP reading assessment. It extends the research conducted by Cook and Ross (2021) that focused on grades three and four by focusing on NWEA MAP growth for students in grades three through eight.

These are the main research questions investigated:

1. Can using the Istation Reading curriculum improve NWEA MAP scores?
2. Does Istation usage vary among schools?

3. Are there differences in NWEA MAP scores based on Istation usage and socioeconomic status (SES)?

Methodology

Analytical Sample

All data came from students in four school districts located in California, New Mexico, and Texas. There was a total of 28,264 students in kindergarten through grade eight. This study focuses on grades three through eight. Table 1 shows the demographic characteristics of the sample.

Table 1. *Demographic Composition of Sample by District and Grade*

District and Sample Size	Demographic Characteristic	Percentage
A: N = 1,867	Gender: Female	49%
	Gender: Male	51%
	Race/Ethnicity: White/Non-Hispanic	30%
	Race/Ethnicity: African American or Black	15%
	Race/Ethnicity: Hispanic or Latino origin	35%
	Race/Ethnicity: Asian or Other	20%
B: N = 3,898	Gender: Female	46%
	Gender: Male	54%
	Race/Ethnicity: White/Non-Hispanic	29%
	Race/Ethnicity: African American or Black	2%
	Race/Ethnicity: Hispanic or Latino origin	58%
	Race/Ethnicity: Asian or Other	11%
C: N = 1,770	Gender: Female	53%
	Gender: Male	47%
	Race/Ethnicity: White/Non-Hispanic	2%
	Race/Ethnicity: African American or Black	5%
	Race/Ethnicity: Hispanic or Latino origin	91%
	Race/Ethnicity: Asian or Other	2%
D: N = 20,729	Gender: Female	49%
	Gender: Male	51%
	Race/Ethnicity: White/Non-Hispanic	15%
	Race/Ethnicity: African American or Black	4%
	Race/Ethnicity: Hispanic or Latino origin	78%
	Race/Ethnicity: Asian or Other	3%

Measures

NWEA MAP Reading Assessments

NWEA MAP Reading tests are vertically scaled interim assessments administered in a one-parameter CAT mode. NWEA MAP Reading is constructed to measure student achievements in kindergarten through grade 12 and is aligned with Common Core State Standards (CCSS). NWEA MAP Reading scores are reported with the Rasch Unit (RIT) scale ranging from 100 to 350. There are three benchmarking assessment months: fall, winter, and spring, also known as beginning of the year (BOY), middle of the year (MOY), and end of the year (EOY). This study focuses on grades three through eight.

ISIP Reading

ISIP Reading is a formative assessment and reading screener used by millions of students. It was authored by reading specialists Patricia Mathes, Joseph Torgesen, and Jeannine Herron as a way of providing teachers with assessment results that can be used to inform instruction. Based on the science of reading, it measures phonemic awareness, reading comprehension, listening comprehension, letter knowledge, alphabetic decoding, fluency, and spelling (Mathes et al., 2022).

Curriculum Usage

Istation typically recommends that students who are at or below the 40th percentile of the normative sample on ISIP 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 this study, usage quintiles were calculated by grade based on the actual usage within the sample, and we calculated percentile ranks for the usage variable. Quintile 1 represents the lowest amount of usage, and quintile 5 represents the

highest usage. A dummy variable was also created that placed students in quintiles 1 and 2 into the “Not Meeting Usage” category.

Socioeconomic Status

We defined socioeconomic status at the school level (Level 2) based on the percentage of students who were eligible for the free or reduced priced lunch (FRPL) program according to the National Center for Education Statistics (NCES). NCES divides the percentages into four quartiles: SES 1 are high-poverty schools with 75% or more of the student body eligible for FRPL. SES 2 are mid- to high-poverty schools with 50% to 74.9% of students eligible for FRPL. SES 3 schools are mid- to low-poverty schools with 25% to 49.9% of students eligible for FRPL, and SES 4 schools are low-poverty schools with less than 25% of students eligible for FRPL.

Analytic Approach

Given that the sample consisted of students who were nested in schools, we used a two-level hierarchical linear model (HLM) to explore the research questions. HLM models are used to control for fixed effects at the student level (Level 1) and random effects at the school level (Level-2). Within this framework four nested models were tested. Model 1 is the baseline model that has no predictors, just the random effect for the intercept. Model 2 is an extension of model 1 that includes fixed effects at Level 1 (usage). Model 3 is an extension of model 2 that includes random slopes for Level 1. Lastly, model 4 extends model 3 by including the Level 2 fixed effects (SES).

Results

We first ran correlations with ISIP Reading and NWEA MAP Reading scores at MOY and EOY to determine if there was a significant relationship. Correlation

coefficients ranged from .66 in grade seven to .83 in grade four, indicating a strong relationship between ISIP Reading and NWEA MAP Reading measures.

Table 2. *Pearson Product-Moment Correlations of ISIP Reading and STAAR Reading*

Grade	ISIP MOY & NWEA MAP Winter	ISIP EOY & NWEA MAP Spring
3	0.82	0.82
4	0.83	0.81
5	0.79	0.78
6	0.78	0.72
7	0.76	0.66
8	0.76	0.73

Table 3 shows the total minutes by quintiles and grades. Typically grades three through five have much higher usage compared to students in middle school.

Table 3. *Usage Quintiles and Total Time across School Year by Grade*

Usage Quintile	Percentile rank for usage	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8
1	≤20	<555	<657	<545	<391	<239	<171
2	21-40	555-968	657-980	545-826	391-563	239-318	171-221
3	41-60	969-1389	981-1317	827-1154	564-738	319-404	222-283
4	60-80	1390-1872	1318-1804	1155-1677	739-1022	405-569	284-398
5	>80	>1872	>1804	>1677	>1022	>569	>398

Next, we ran the nested models specified above to evaluate the relationship between NWEA MAP Reading scores and the time spent in the Istation Reading curriculum. In general students with a higher Istation usage quintile scored higher on the NWEA MAP Reading measure across all grades. In the grade summaries below the tables will show the results from each model, and we will report on the model with the best fit according to the Akaike information criterion (AIC) and Bayesian information criterion (BIC) values, where a lower value indicates a better model fit.

Istation usage varied significantly among schools. Figures 1 and 2 show the graphical representation of increases in NWEA scores by Istation total minutes of usage per school year.

Figure 1. *Differences in NWEA MAP Reading Scores for Grades 3 5o 5 by Istation Total Usage*

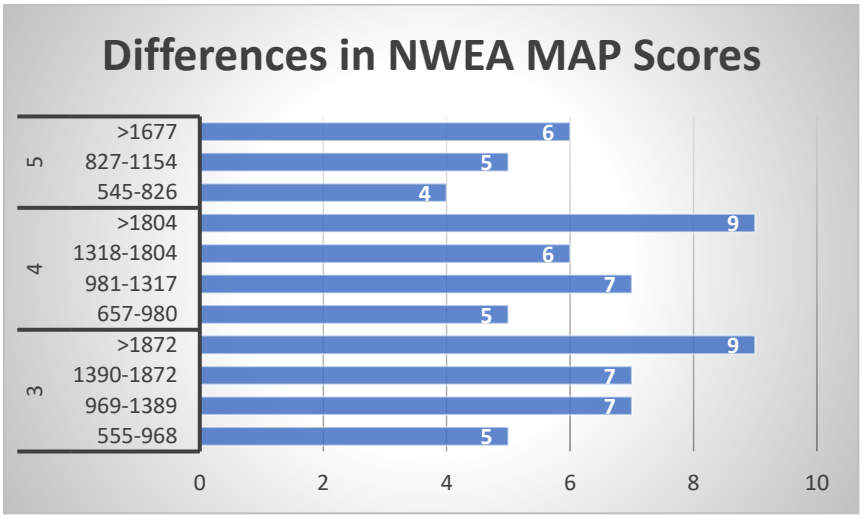
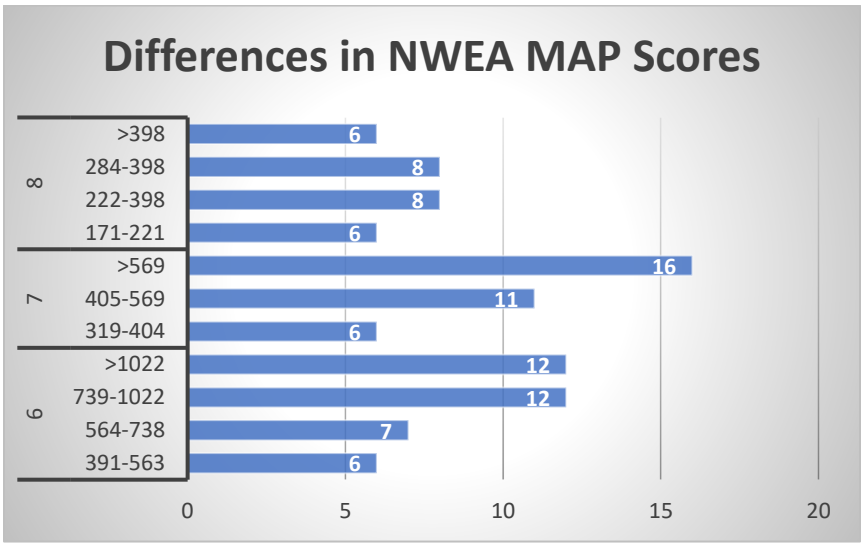


Figure 2. *Differences in NWEA MAP Reading Scores for Grades 6 to 8 by Istation Total Usage*



Grade 3

Table 4 shows the results for the two-level HLM model for grade three. Students who were in the 2nd ISIP usage quintile or above (>555 total minutes/school year) saw an increase of 5 to 9 points in EOY NWEA MAP Reading scores. Sixteen percent (16%) of the variability in scores was due to schools (ICC = .16), leaving 84% of the variability due to students. Looking at the SES variable in model 4, we see what one would expect

as NWEA scores increase significantly based on a higher SES category compared to the reference group (lowest SES category). The increase in NWEA MAP scores for SES 3 and SES 4 ranged from 9 to 25 points. The significance of the error variance suggests that there was variability in scores across schools after accounting for usage and SES. There was also variability in usage across schools.

Table 4. *Two-Level HLM for Grade 3, Coefficients and Standard Errors (SE)*

Fixed Effects	Model 1	Model 2	Model 3	Model 4
Intercept	191.37* (1.21)	185.88*(1.46)	186.20*(1.72)	181.10*(3.05)
Usage 2 (21-40)		6.23*(1.15)	4.80* (1.81)	5.11*(1.82)
Usage 3 (41-60)		6.68* (1.19)	6.14* (1.84)	6.73* (1.83)
Usage 4 (61-80)		6.98* (1.20)	6.46* (1.85)	7.25* (1.84)
Usage 5 (>80)		9.88* (1.23)	8.50* (1.89)	9.32* (1.87)
SES 2				1.52 (3.09)
SES 3				8.75* (3.26)
SES 4				25.17* (6.39)
Error Variance				
Level-1	257.96* (6.97)	251.78* (6.80)	240.31* (6.62)	241.11* (6.66)
Level-2 Intercept	47.94* (12.92)	51.94* (13.68)	47.45* (14.28)	20.73* (8.39)
Usage				19.84* (5.45)
Model Fit: AIC	23405.7	23349.7	23305.6	23139.5
Model Fit: BIC	23410.6	23361.2	23318.7	23157.2

Note: *Statistically significant, p<.05; ICC = .16
Values based on SAS Proc Mixed. Entries show parameter estimates with standard errors in parentheses. Estimation Method = ML; Satterthwaite degrees of freedom

Grade 4

Table 5 shows the results for grade four. Results for model 4 show that in grade four students who were in the second through fifth usage quintiles (>657 total minutes per school year) saw an increase of 5 to 9 points in NWEA MAP Reading scores which was statistically significant. Sixteen percent (16%) of the variability was due to schools (ICC = .16). Similar to grade three, students in the higher SES 3 and SES 4 categories had much higher gains compared to those in the lowest SES category (reference group) with score increases ranging from 10 to 24 points. The significance of the error variance

implies that there was variability in scores across schools after accounting for usage and SES. Furthermore, Istation curriculum usage varies across schools.

Table 5. *Two-Level HLM for Grade 4, Coefficients and Standard Errors (SE)*

Fixed Effects	Model 1	Model 2	Model 3	Model 4
Intercept	201.85* (1.19)	197.65* (1.48)	195.32* (1.87)	188.85* (3.56)
Usage 2 (21-40)		3.74* (1.01)	5.05* (1.85)	4.86* (1.84)
Usage 3 (41-60)		5.57* (1.06)	7.10* (1.87)	6.99* (1.85)
Usage 4 (61-80)		4.00* (1.09)	5.61* (1.90)	5.66* (1.87)
Usage 5 (>80)		7.42* (1.21)	8.61* (2.03)	8.66* (1.98)
SES 2				3.87 (3.48)
SES 3				9.62* (3.68)
SES 4				24.29* (5.09)
Error Variance				
Level-1	242.45* (6.31)	238.54* (6.21)	224.44* (5.97)	224.51* (5.98)
Level-2 Intercept	45.20* (11.74)	52.95* (13.74)	49.54* (14.78)	20.31* (7.63)
Usage			26.78* (6.45)	26.41* (6.38)
Model Fit: AIC	24953.4	24918.5	24851.9	24835.4
Model Fit: BIC	24957.9	24929.2	24864.1	24852.2

Note: *Statistically significant, p<.05; ICC =.16
Values based on SAS Proc Mixed. Entries show parameter estimates with standard errors in parentheses. Estimation Method = ML; Satterthwaite degrees of freedom

Grade 5

In grade five, students who were in the second, third, and fifth ISIP usage quintiles (545–1154 and ≥1677 total minutes per school year) saw a statistically significant improvement in NWEA MAP Reading scores as shown in model 4 (see Table 6). On average these students had gains of 4 to 6 points. Students who were in the fourth SES category saw an increase of about 19 points compared to the lowest SES category (reference group). Istation curriculum usage varied across schools, and 11% of the variance was explained by the school level characteristics (ICC = .11).

Table 6. *Two-Level HLM for Grade 5, Coefficients and Standard Errors (SE)*

Fixed Effects	Model 1	Model 2	Model 3	Model 4
Intercept	208.8*(1.17)	205.38* (1.45)	203.83* (1.79)	201.36* (3.50)
Usage 2 (21-40)		3.28* (1.03)	4.04* (1.82)	3.85* (1.80)
Usage 3 (41-60)		3.79* (1.13)	4.76* (1.87)	4.58* (1.84)
Usage 4 (61-80)		2.43*(1.18)	3.55 (1.93)	3.22 (1.90)
Usage 5 (>80)		3.93* (1.33)	5.50* (2.10)	5.50* (2.06)
SES 2				-.009 (3.38)
SES 3				6.71 (3.62)
SES 4				19.23*(6.07)
Error Variance				
Level-1	232.19* (6.41)	230.64* (6.37)	219.59* (6.24)	219.67* (6.23)
Level-2 Intercept	39.49* (10.78)	42.59* (11.60)	32.23* (11.64)	17.33* (6.92)
Usage				22.01* (6.71)
Model Fit: AIC	22070.7	22063.3	22023.9	22013.6
Model Fit: BIC	22075.0	22073.4	22035.4	22029.4

Note: *Statistically significant, p<.05; ICC = .11
Values based on SAS Proc Mixed. Entries show parameter estimates with standard errors in parentheses. Estimation Method = ML; Satterthwaite degrees of freedom

Grade 6

Students in grade six and above typically don't use the product as much compared to students in the lower grades. Model 4 with the SES variables did not converge, thus model 3 will be interpreted. Students in grade 6 who were in the second through fifth usage quintiles (>391 total minutes/school year) saw an increase of 6 to 12 points in NWEA MAP Reading scores . Usage quintiles four and five both gained about 12 points on average. The significant error variance suggests that there was variability in usage across schools.

Table 7. *Two-Level HLM for Grade 6, Coefficients and Standard Errors (SE)*

Fixed Effects	Model 1	Model 2	Model 3
Intercept	209.87* (1.64)	201.86* (1.13)	201.77* (1.72)
Usage 2 (21-40)		5.88* (1.21)	6.34* (2.21)
Usage 3 (41-60)		8.12* (1.24)	7.31* (2.21)
Usage 4 (61-80)		12.06* (1.26)	12.12* (2.18)
Usage 5 (>80)		12.17* (1.34)	12.29* (2.26)
Error Variance			
Level-1	261.22* (8.52)	249.32* (8.14)	242.82* (7.98)
Level-2 Intercept	21.00* (13.25)	3.33 (3.02)	2.58 (3.85)
Usage			9.53* (4.36)
Model Fit: AIC	15919.5	15826.9	15807.8
Model Fit: BIC	15920.4	15829.1	15810.1

Note: *Statistically significant, p<.05; ICC = .07
Values based on SAS Proc Mixed. Entries show parameter estimates with standard errors in parentheses. Estimation Method = ML; Satterthwaite degrees of freedom (Only had SES 2 and 3). Model 4 did not converge.

Grade 7

A similar trend was observed for students in grade seven (see Table 8) in that students in ISIP usage quintiles 3–5 (>319 total minutes/school year) saw statistically significant improvements in NWEA MAP Reading scores. Results from Model 4 shows that on average the gains ranged from 6 to 16 points. Students who used the product more than 569 total minutes per school year saw the largest increase of 16 points. Furthermore, students in the third SES category saw gains of about 9 points in NWEA reading scores. There was variability in Istation curriculum usage across schools.

Table 8. *Two-Level HLM for Grade 7, Coefficients and Standard Errors (SE)*

Fixed Effects	Model 1	Model 2	Model 3	Model 4
Intercept	210.43* (2.32)	203.59* (2.30)	203.82* (2.29)	200.92* (1.86)
Usage2 (21-40)		2.27* (1.14)	1.78 (1.38)	1.91 (1.36)
Usage3 (41-60)		6.02* (1.15)	5.88* (1.38)	5.79* (1.35)
Usage4 (61-80)		11.84* (1.18)	11.53* (1.40)	11.39* (1.37)
Usage5 (>80)		16.67* (1.27)	16.06* (1.51)	15.97* (1.47)
SES 3				9.04* (2.50)

Error Variance				
Level-1	287.00* (8.79)	260.23* (7.97)	259.16* (7.98)	259.48* (8.02)
Level-2 Intercept	40.09* (24.32)	36.04* (20.02)	33.59* (19.23)	9.17 (5.71)
Usage				1.38 (1.78)
Model Fit: AIC	18234.1	18032.4	18033.0	17909.6
Model Fit: BIC	18234.7	18033.7	18034.6	17910.3

Note: *Statistically significant, p<.05; ICC = .12
Values based on SAS Proc Mixed. Entries show parameter estimates with standard errors in parentheses. Estimation Method = ML; Satterthwaite degrees of freedom. Only had SES categories 2 and 3.

Grade 8

Students in grade eight saw statistically significant increases in NWEA MAP Reading scores for usage quintiles 2–5 (>171 total minutes/school year). The increases in NWEA MAP Reading scores ranged from 6 to 8 points, as seen in model 4. In this model the third SES category was not statistically significant.

Table 9. *Two-Level HLM for Grade 8, Coefficients and Standard Errors (SE)*

Fixed Effects	Model 1	Model 2	Model 3	Model 4
Intercept	215.35* (2.26)	209.14* (2.38)	209.27* (2.35)	208.65* (2.15)
Usage 2 (21-40)		8.26* (1.24)	6.67* (2.76)	6.18* (2.76)
Usage 3 (41-60)		10.33* (1.23)	9.12* (2.75)	8.32* (2.73)
Usage 4 (61-80)		10.65* (1.29)	8.98* (2.77)	8.33* (2.74)
Usage 5 (>80)		7.78* (1.32)	7.64* (2.88)	6.18* (2.83)
SES 3				4.93 (2.14)
Error Variance				
Level-1	275.39* (8.58)	263.94* (8.22)	254.13* (7.97)	253.55* (8.00)
Level-2 Intercept	38.42* (22.58)	39.13* (22.52)	17.33 (17.62)	1.91 (5.01)
Usage		na	19.37* (8.32)	18.26* (7.40)
Model Fit: AIC	17536.6	17457.1	17415.7	17193.0
Model Fit: BIC	17537.2	17458.5	17417.3	17193.7

Note: *Statistically significant, p<.05; ICC = .12
Values based on SAS Proc Mixed. Entries show parameter estimates with standard errors in parentheses. Estimation Method = ML; Satterthwaite degrees of freedom. Only had SES categories 2 and 3.

Conclusion

This research shows that it is important for grades 3–5 to meet the recommended usage criteria as students in this category saw larger gains on the NWEA MAP Reading end-of-year outcome, even when controlling for SES at the school level. This is important as it provides evidence that using the Istation program, including progress monitoring and Istation Reading curriculum, will help students in various schools attain greater reading achievement. Students who approached or exceeded usage recommendations had greater gains on the NWEA MAP than those that had lower usage. While there was a linear relationship with growth on the MAP and Istation usage, we note that Istation does not recommend exceeding usage guidelines.

Although students in middle school (grades 6-8) may not be meeting the recommended usage criteria, this study finds that students benefit significantly from using the Istation curriculum. Students in grades six through eight saw significant improvements in NWEA MAP Reading EOY scores if they used Istation for approximately 45 to 60 minutes a month in grades 6 and 7, and for 25 minutes a month in grade 8. Usage of technology for remediation or supplemental curriculum may be more challenging in middle school because of students' changing instructors for subjects and other potential scheduling hurdles. However, this study demonstrates that finding a regular time that students can access ISIP and the instructional content may help them improve their reading achievement as measured by the NWEA MAP.

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