First Year Implementation of Exact Path Leads to Sizable Growth in NWEA MAP Math Scores

Edmentum Efficacy Research & Learning Engineering
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Abstract

Edmentum offers a personalized learning platform called Exact Path. This quasi-experimental study, designed to meet ESSA Tier 2 evidence and What Works Clearinghouse standards with reservations, aimed to assess the efficacy of Exact Path in a district from the Midwestern United States. The goal was to provide specific recommendations to educators within the district and inform the broader community of policymakers and practitioners about the potential benefits of personalized learning for enhancing student academic achievement. The study found that the use of Exact Path was positively related to Math achievement in NWEA MAP tests, after controlling for students' prior test scores and their socioeconomic status. These findings suggest that Exact Path could be an effective tool for improving student success in this district and potentially other similar contexts. Therefore, these results may have important implications for educators, policymakers, and researchers interested in improving student outcomes through personalized learning.

Rationale

Students from economically disadvantaged backgrounds frequently encounter various challenges within schools, as the financial strain they face often results in reduced access to quality education (Reardon, 2011; Sirin, 2005). The recent COVID-19 pandemic has amplified these concerns, with technology becoming an increasingly integral part of the education landscape (OECD, 2020; United Nations, 2020). Personalized learning has been proposed as a solution to places where access to quality education is uneven (Pane et al., 2015). Personalized learning tailors instruction to students' needs, interests, and learning styles (Tomlinson, 2014; U.S. Department of Education, 2017). The approach may help address disparities in access to quality education by providing all students with equitable opportunity to succeed academically, regardless of their SES background (Pane et al., 2015; Murphy, Redding, & Twyman, 2016). Technology platforms used in personalized learning can provide educators with real-time data on student progress, enabling them to make informed instructional decisions and offer targeted support (Means, Toyama, Murphy, & Baki, 2013; U.S. Department of Education, 2017). However, there is much to learn following the recent pandemic about the efficacy of technology education (Hodges et. al, 2020; Goldhaber et al., 2022). More research is needed to evaluate the efficacy of technology-enhanced learning in various contexts, especially for students with diverse backgrounds and needs (Means et al., 2013).

While personalized learning is a general term, for this project we suggest it is composed of three interrelated concepts. First, a personalized trajectory of learning in a virtual school setting should be grounded in the learning progression of specific disciplinary knowledge, such as Math or Reading (National Research Council, 2001; Wilson, 2007). The underlying content of what a student should learn, and how that content advances over time, should be the same online as in a traditional curriculum, because the learning progression provides a roadmap for instruction and must be aligned with state standards (Pearson, Valencia, & Wixon, 2014; Wilson, 2007). Second, personalized learning accommodates, and provides access to, individual learning paths where students progress through a program of instruction that meets their needs, whether these needs are remedial, grade-level instruction, or enrichment (Means, Bakia, & Murphy, 2014; Pane et al., 2015). An online program may provide instructional flexibility. Third, for a learning path to be truly individualized, the person needs to be fairly, accurately assessed at the onset of their learning so that their location on the underlying learning progression is captured accurately. Assessment provides guidance for instruction; personalized learning platforms typically include an algorithm to recommend where each student should begin their journey in learning progression, such that the instruction students receive is optimally suited to their current achievement level.

Combining advances in education with learning engineering and psychometrics, the Exact Path curriculum offers instruction in Math, Reading, and Language Arts. It is grade agnostic, meaning that the learning path offered to students depends on their performance on an initial assessment. Learning paths accommodate students still struggling with grade-level precursor skills and those best served by above-grade-level enrichment opportunities. Following initial assessment and placement into a learning path, a student moves through their learning trajectory and is further assessed at key touchpoints via computer-adaptive tests. After each assessment, the learning path is further refined based on the student's current level of content knowledge.

During the academic year 2021-2022, Exact Path assigned lessons in groups of three to four. Students are expected to complete a set of lessons, take a progress check, and move further along the learning progression. As researchers embedded in the organization, we wished to better understand how Exact Path usage promotes positive student outcomes. The following research questions guided the design and analyses used in this study.

- To what extent, if any, does Exact Path usage affect student Math achievement outcomes as measured by NWEA Measures of Academic Progress (MAP) scores during the academic year 2021-2022?

Methods

Data and Sample

We used student data from a large, urban, school district in the Midwest in our study. Our sample consisted of students from 46 schools within the district that were Exact Path partners during the 2021-2022 academic year. The district provided data through a data-sharing agreement. The data contained students' demographic information in grades K–12 for school years 2021–2022. Our sample consisted of all the students for whom the Exact Path curriculum was made available by instructor choice, and students who had valid MAP test scores in the 2021–2022 school year. All the students in the sample were assigned a learning path via the NWEA diagnostic. Classroom implementation was up to the school and teacher. We observed students between the MAP testing windows from MAP Fall 2021 to MAP Spring 2022.

Given the limited sample size of MAP and Exact Path math data for kindergarten, and 6th through 12th graders, our study focused on students from 1st through 5th grade. There were 2003 students in the Math analytic sample. A majority (76.3%) of the students were identified as qualified for free/reduced lunch; about half were female, and 41.7% were Hispanic or Latino. Table 1 provides specific information.

Table 1. Demographic Characteristics of the Analytic Sample (1-5): Number, and Proportion n=2,003).

Demographic Characteristics	**Math (*n*=2,003)**
Free/reduced lunch	1528 (76.3%)
Female	998 (49.8%)
Male	1005 (50.2%)
American Indian - Alaska Native	77 (3.8%)
Asian	31 (1.5%)
Black - African American	420 (21.0%)
Hispanic or Latino	836 (41.7%)
Pacific Islander	25 (1.2%)
White	384 (19.2%)
Two or More Races	230 (11.5%)
Special education	246 (12.3%)
English language learner	752 (37.5%)

Research Design

To investigate the research question—whether Exact Path was related to higher academic achievement. The study used a nonrandomized control group, pretest-posttest quasi-experimental design. The design meets What Works Clearinghouse (WWC) 5.0 standards with reservations (U. S. Department of Education, Institute of Education Sciences, & What Works Clearinghouse, 2022). According to the WWC, a quasi-experimental design (QED) uses a non-random process to form the intervention and control conditions. The WWC allows groups to be formed using a variety of methods as long as the groups are mutually exclusive. That is, units (e.g., students or schools) can only be analyzed as a member of a particular group. Further, in a quasi-experimental study, the WWC accepts assignment to the intervention based on observed characteristics. In this study, assignment to experimental conditions was carried out at the individual student level. Intervention group students used Exact Path Math (5 skills or more); control student didn't use Exact Path Math (0 skill). Propensity score matching was used to create intervention and control groups and baseline equivalence was determined by prior test scores and SES. The intervention effects were determined by estimating the differences in outcomes between the intervention and control groups.

Outcome Measures

The Measures of Academic Progress (MAP), developed by the Northwest Evaluation Association (NWEA), are a series of computer-adaptive assessments designed to measure student growth and performance in key academic areas (NWEA, 2021). The outcome measures for the study are the Spring 2022 MAP tests in Math. The reliability coefficients for all subjects and grades for the MAP test ranged from 0.84 to 0.97 (NWEA, 2019), indicating that the assessments provide consistent results when measuring student knowledge and skills in these subject areas. Prior achievement and socioeconomic status (indicated by eligibility for free or reduced-price lunch) were used as control variables for the outcome measures in this study.

Propensity Score Matching: Establishing Equivalence at Baseline

This study used a nonrandomized control group, pretest-posttest quasi-experimental design. Students whose used Exact Path in the *intervention group*; students who didn’t use Exact Path were in the *control group*. We established baseline equivalence for intervention and control groups based on propensity score matching within each grade level. Demonstrating the similarity of the groups before an intervention is a critical part of quasi-experimental studies.

Baseline equivalence was established for intervention and control students without any missing baseline or outcome data. Baseline equivalence was estimated for each grade level. According to What Works Clearinghouse’s criteria (2022), a study can meet baseline equivalence if: (a) the baseline difference between intervention and control groups is less than 0.05 standard deviations or (b) the baseline difference is less than or equal to 0.25 standard deviations and the baseline measure(s) are included as covariates(s) in the analysis model. To ensure that the intervention and control groups have similar baseline characteristics, participants were matched based on prior test scores and students’ socioeconomic status (What Works Clearinghouse, 2022). In this study, students’ socioeconomic status (SES) was indicated by students’ free/reduced lunch status.

Baseline Equivalence

As illustrated in Table 2, prior to the study, equivalence between the control and intervention groups was determined by prior test scores (MAP Fall 2021 scores) and SES. Means and standard deviation are reported for each baseline measure for both the intervention and control groups. For all grade levels, differences between the intervention and control group's baseline characteristics were less than .25 standard deviations. In line with the What Works Clearinghouse (WWC) guidelines (2022), some baseline differences are greater than .05 standard deviations, but less than or equal to .25 standard deviations, both baseline and SES are included as covariates in the outcome estimate.

Table 2. Pre-Intervention Sample Sizes and Characteristics after Matching (N=1148)

Matched	**Control**			**Intervention**			**Intervention vs. Control**		
Baseline	***Mean***	***SD***	***N***	***Mean***	***SD***	***N***	***Total N***	***Effect Size***	***p-Value***
1	156.13	12.91	61	156.39	13.06	61	122	0.02	0.91
2	169.92	14.94	83	170.00	15.12	83	166	0.01	0.90
3	176.88	16.79	122	177.16	16.33	122	244	0.02	0.64
4	189.96	16.26	167	189.14	15.52	167	334	0.05	0.61
5	195.71	13.57	141	196.69	14.14	141	282	0.07	0.55
Full Sample	182.10	19.83	574	182.20	19.73	574	1148	0.01	0.93

Analysis Model

A linear regression model was applied to examine intervention impacts on student outcomes after baseline equivalence was achieved. The average intervention effect of Exact Path instructional usage on student achievement was estimated by calculating the differences between intervention and control groups on the MAP scores in fall 2021 and MAP scores in spring 2022 using regression analysis. We conducted our impact analyses using the following linear regression model fit to the data separately for each grade level:

$$Outcome_i = \beta_0 + \beta_1(Baseline)_i + \beta_2(Treatment)_i + \beta_3(SES)_i + e_i$$

where $Outcome_i$ represents the student's MAP achievement in spring 2022; Baseline represents the baseline measure of the outcome variable, which is the student's MAP achievement in fall 2021; Intervention is a binary variable that indicates whether the student was in the intervention group or the control group.

Results

Use of Exact Path Positively Impacted Math Achievement

The main finding for the full sample showed that Exact Path users had statistically significantly higher outcomes than students who didn't use Exact Path (p<.001) after controlling prior test score and socioeconomic status. The analyses presented in Table 3 also indicate that there were statistically significant and positive intervention effects in Grades 1, 2, and 5, with students who used Exact Path showing significantly higher MAP Math scores in these grades. The effect sizes for these grade levels were found to be.44, .39, and .20, respectively. Positive effects were also observed 3 and 4 as well, although they were not statistically significant at the .05 level.

Table 3. Post-Intervention Outcomes and Estimated Effects (N=1148)

Math	Control		Intervention		Intervention vs. Control			
Outcome	**Mean**	**SD**	**Mean**	**SD**	**Total N**	**Effect Size**	**P Value**	**Improvement Index**
1	169.34	10.23	173.83	10.00	122	0.44***	0.00	+17
2	182.75	8.98	186.22	8.63	166	0.39**	0.01	+15
3	189.63	8.68	190.71	8.74	244	0.12	0.30	+5
4	198.08	10.46	199.90	10.60	334	0.17	0.08	+7
5	203.50	12.47	206.05	11.99	282	0.20*	0.04	+8
Full Sample	191.77	10.39	194.13	10.29	1148	0.23***	0.00	+9

Note: * = significant at $p < .05$; ** = significant at $p < .01$; *** = significant at $p < .001$. P-value reported in two decimal places.

Specifically, for instance, the effect size of Exact Path for grade 1 was 0.44 ($p < 0.001$). In terms of practical significance, this effect translates into an improvement index of +17, showing the expected change in percentile rank if a control student had received the intervention. For students in 1st grade, a student at the 50th percentile at pretest, for example, could be expected to shift into the 67th percentile had she received the intervention.

Limitations

There are a few limitations to this study. First, this study was not an experimental research study with Exact Path assigned randomly to students, thus causality cannot be fully inferred from the study's results. As a result, we chose to examine the study's research questions using a quasi-experimental design that meets the What Works Clearinghouse (WWC) 5.0 standards with reservations (U.S. Department of Education, Institute of Education Sciences, & What Works Clearinghouse, 2022). Additionally, the district in which this study was conducted was in its first year of implementation, and regardless of efficacy findings, implementation can take years to be fully integrated with routine practice (Datnow & Castellano, 2000; Sanetti & Collier-Meek, 2019). Future research should investigate additional years of use and it would be helpful to know which classrooms did not use Exact Path at all. It would be worthwhile to compare results between curriculum users, non-compliers, and "never takers." Third, in this study, the sample sizes are small. While effects were positive, in some grades the effects were not statistically significant at the .05 level, and sample size corresponds to statistical power.

Conclusion

Our research investigated the effectiveness of Exact Path on students' Math achievement, as measured by NWEA MAP, in the 2021-2022 academic year. The quasi-experimental design demonstrated that students who used Exact Path had significantly better Math MAP scores for the full sample and in Grades 1, 2 & 5, with small to medium effect sizes. Positive effects in Math were observed in Grades 3 and 4 as well.

By following the guidelines of the What Works Clearinghouse (WWC), the study ensures the validity of its findings and provides evidence-based recommendations for improving student achievement. The research concludes that Exact Path works well in elementary schools (1-5) and highlights the potential of Exact Path as a valuable tool in supporting students' Math learning, academic growth, and success. This study was conducted at the level of rigor needed to meet WWC 5.0 standards with reservations (WWC, 2022). Baseline equivalence was established. The measure is used to establish baseline equivalence and as the Math achievement outcome meets WWC standards for validity and reliability. The baseline and outcome measures are not over-aligned to the Exact Path intervention. The study had no confounds.

The study also meets criteria set forth by Every Student Succeeds Act (U.S. Department of Education, 2016). The Department of Education considers a quasi-experimental study to be "well-designed and well-implemented" if it receives a *Meets WWC Design Standards with Reservations* rating or is of equal quality (U.S. Department of Education, 2016). The study also meets the ESSA criteria for statistically significant positive effects. These two aspects of the study mean it qualifies as providing Moderate Evidence (Level 2) of Exact Path's effectiveness.

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Appendix

Table I. Number of Students in the Intervention Group Completing Math Lessons

Skills Completed	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Full Intervention
5 skills	42	44	70	94	80	330
6 skills	15	19	29	36	39	138
7 skills	1	14	15	20	12	62
8 skills	3	4	3	10	6	26
9 or more skills	0	2	5	7	4	18
Total	61	83	122	167	141	574

Table II. Skills Completed Varied Across Grades in the Intervention Group (Math)

Math	Total # of Skills Completed	Average # of Skills Completed
Grade 1	331	5.43
Grade 2	482	5.81
Grade 3	703	5.76
Grade 4	972	5.82
Grade 5	807	5.72
Full Sample	3295	5.74