Elevating Math Scores: The Ongoing Success of MAP Accelerator

Key findings

- Students who engaged with MAP Accelerator during the 2021-22 school year at the recommended dosage of 30+ minutes per week exceeded growth projections by 26% to 38%, depending on grade. This result was consistent with findings from 2020-21.

- In a separate analysis, in which we compared students to themselves a year before, we found that those who increased their usage of MAP Accelerator from the first year to the second year saw a corresponding improvement in their achievement growth. The results of this analysis cannot be simply attributed to individual factors like motivation, thereby bringing us closer to the causal effect of MAP Accelerator.

- All trends were consistent across grades and student demographic subgroups, such as race/ethnicity, gender, and the proportion of students in a school eligible for free/reduced-price lunch.

Overview

MAP Accelerator is a web-based learning platform that aims to help school districts and teachers differentiate mathematics instruction by using students' MAP Growth test results. MAP Growth, developed by NWEA, is a computerized adaptive test administered to students multiple times per year. MAP Growth math results are automatically imported into MAP Accelerator, enabling students to receive personalized learning paths based on their test scores.

MAP Accelerator was first launched during the 2019-2020 COVID-affected school year. In order to evaluate whether MAP Accelerator was effective, we conducted a correlational study[1] aimed at evaluating the relationship between the use of the tool and student learning outcomes. In this initial study, we found that students in classrooms that engaged with MAP Accelerator at the recommended dosage of 30+ minutes per week exceeded growth projections by 9% to 43%, depending on grade. This pattern was consistently observed across grades and student demographic subgroups, such as race/ethnicity, gender, and the proportion of students in a school eligible for free/reduced-price lunch.

While the findings from 2020-2021 are promising, they provide only weak causal evidence that using MAP Accelerator directly improves student performance. Although we accounted for factors like prior achievement and reading ability, this non-experimental

[1] Weatherholtz, K., Grimaldi, P., and Millwood Hill, K. (2022). Use of MAP Accelerator associated with better-than-projected gains in MAP Growth scores. Mountain View, CA: Khan Academy. http://khan.co/MATechReport2022
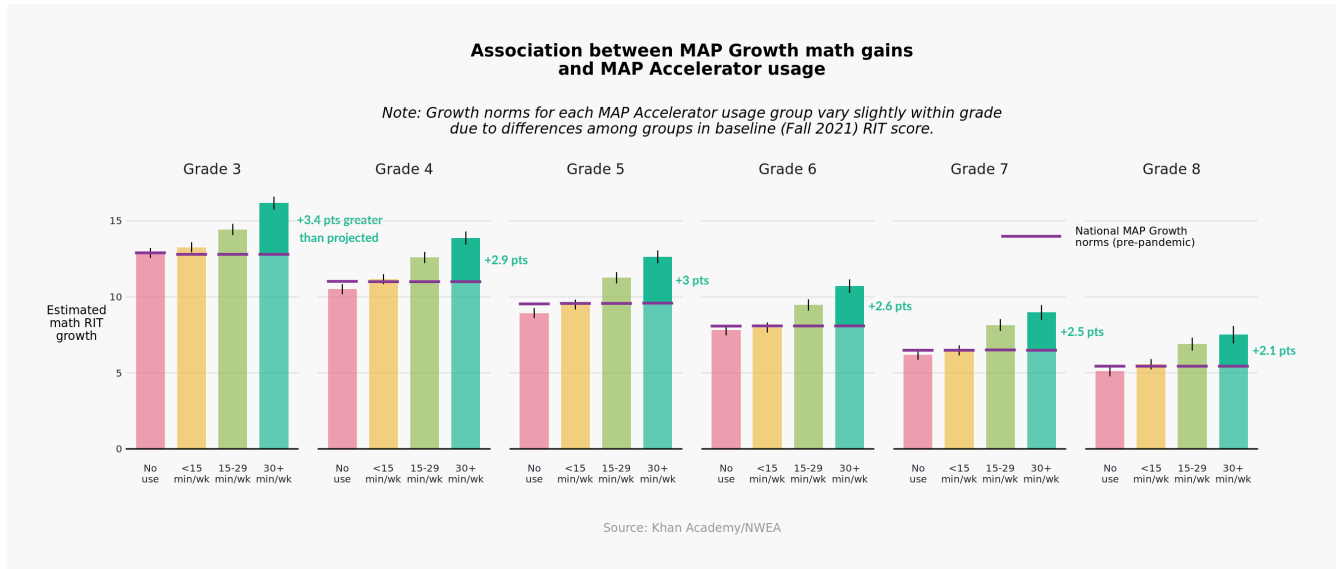
Figure 1: Association between MAP Growth math gains and MAP Accelerator usage

methodology may miss hidden issues (i.e., confounds) that could affect the results. Furthermore, the unusual circumstances of the 2020-2021 school year due to COVID-19 make it difficult to apply these findings to less disrupted school years. We address these concerns in the present study. We repeated our analysis using data from the less COVID-disrupted 2021-2022 school year and found similar results. Additionally, we conducted a new analysis that examines learning across multiple years to address any student level confounds that the previous analysis may have missed. These new findings with a more rigorous methodology provide evidence of MAP Accelerator's robust association with improved student learning outcomes.

Analysis 1: Replication

We replicated our main analysis from the 2020-2021 study, aiming to measure the relationship between time spent on MAP Accelerator and growth in math achievement from fall 2021 to spring 2022. The study covered 278 U.S. districts, 1,367 schools, and 329,957

students in grades three through eight.

We compared students in four usage groups: 30+ minutes/week (n = 18,009), 15-29 min/wk (n = 34,737), <15 min/wk (n = 142,580), or No use (n = 134,631). These students were compared on their scores from the MAP Growth test, referred to as "RIT" scores. We modeled the relationship between fall to spring RIT growth and MAP Accelerator usage using mixed-effect regression. We controlled for fall 2021 RIT scores, grade, gender, race/ethnicity, the proportion of students in a school eligible for free/reduced-price lunch, district percent English language learner, and random effects for class, school, and district.

Figure 1 shows the model adjusted marginal means for RIT growth. Students who used MAP Accelerator for 30+ min/wk exceeded their expected growth projections, as determined by normative data[2] by 26% to 38%. This general trend was consistently observed regardless of student race/ethnicity, gender, and school eligibility for free/reduced lunch (results not shown). Overall, the results closely matched the 2020-2021 findings.

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[2]Thum, Y.M., & Kuhfield, M. (2020). NWEA 2020 MAP Growth Achievement Status and Growth Norms for Students and Schools. NWEA
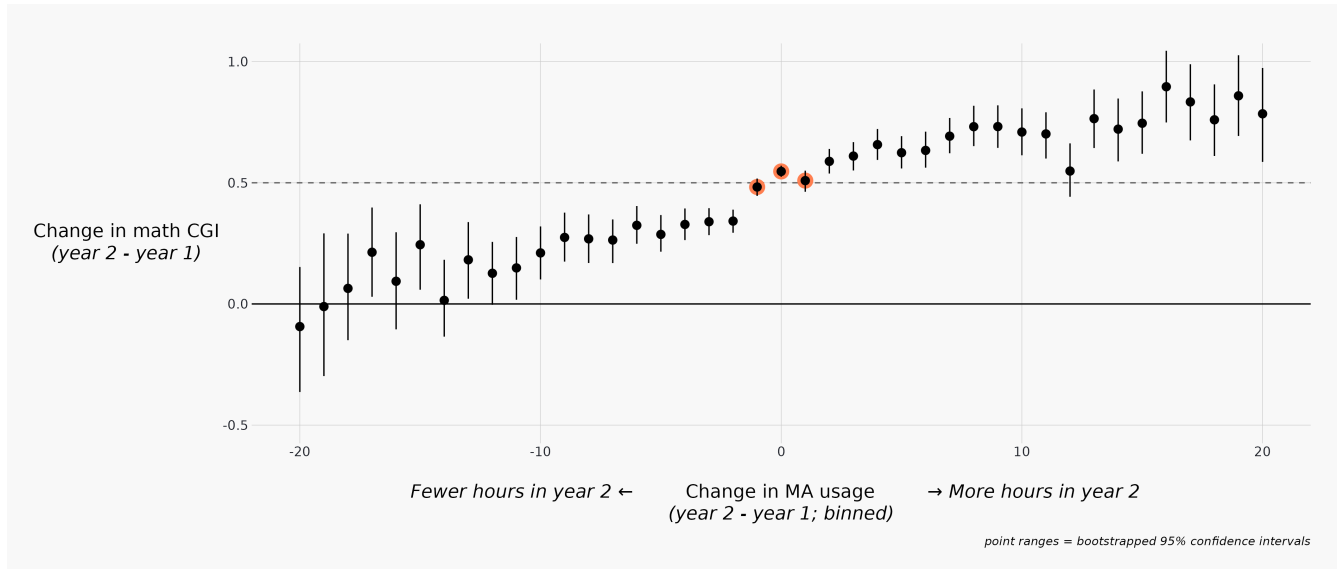
Figure 2: Association between the year-over-year change in math CGI as a function of the year-over-year change in MAP Accelerator usage.

Analysis 2: Year-over-year change

A limitation of Analysis 1 is that without random assignment to MAP Accelerator usage groups, we cannot rule out the influence of student-level confounding and self-selection artifacts that might better explain the results. For example, more motivated students might be more likely to use MAP Accelerator, and their improved performance might be due to their motivation to succeed, rather than the use of MAP Accelerator. We address this limitation in Analysis 2 by investigating changes in MAP Growth performance and MAP Accelerator usage year over year.

The logic of the analysis is straightforward – if the use of MAP Accelerator improves student learning, then changes in usage from Year 1 to Year 2 should result in corresponding changes in MAP growth scores from Year 1 to Year 2. For example, if a student increases, decreases, or maintains their usage from Year 1 to Year 2, their growth scores should increase, decrease, or stay the same, respectively. In this manner, students act as their own control, helping to reduce the concern that self-selection biases may have driven our previous findings.

For Analysis 2, we used NWEA's conditional growth index (CGI) as our outcome measure. Briefly, CGI is a standardized form of the fall to spring growth in RIT scores. Created using pre-pandemic normative data, CGI shows growth conditioned on students from the same starting RIT score, and more importantly, grade level. CGI is better suited for this analysis than RIT gains, as changes in RIT differ between grade levels, creating challenges for direct comparisons in student growth across years. In contrast, CGI scores allow for year-over-year comparisons, which are adjusted based on grade.

In this analysis, a total of 102,446 students took Fall and Spring MAP Growth assessments in both Year 1 (2020-2021 SY) and Year 2 (2021- 2022 SY). Approximately 49% of these students increased their usage from Year 1 to Year 2, while 36% reduced their usage, and 15% experienced no change. Figure 2 illustrates the un-adjusted, empirical relationship between change in MAP Accelerator usage and change in CGI. As seen in Figure 2, students who increased their usage of MAP Accelerator in Year 2 compared to Year 1 generally exhibited greater growth in Year 2. Conversely, students who reduced their usage from Year 2 to Year 1 showed the opposite pattern. Note that CGI, on average, increased by 0.5 standard deviations from

Year 1 to Year 2 (indicated by the dotted horizontal line), reflecting partial rebound from Year 1 COVID loss[3].

In order to estimate the relationship between changes in MAP Accelerator usage over time and changes in CGI, we analyzed the data using fixed effect ordinary least squares[4]. Concretely, we modeled the relationship between CGI and time spent on MAP Accelerator each school year, while treating student, year, and teacher as fixed effects. This approach enabled us to effectively control for unique student attributes that do not vary over time, year-specific influences, and teacher-related effects when examining the relationship between usage and outcomes. Importantly, this means that we could control for the potential unobservable confounds that we could not control for in our previous analysis, bringing us closer to establishing a causal link between MAP Accelerator usage and learning outcomes.

Figure 3 shows the marginal predictions derived from the fixed effects model. As seen on Figure 3, increases in the amount of time spent on MAP Accelerator were associated with corresponding increases in CGI improvements. According to the predictions of the model, a hypothetical student who increased their usage of MAP Accelerator by 1 hour from Year 1 to Year 2 would be expected to increase their CGI by an additional +0.018, 95% CI [+0.016,+0.019] over baseline, whereas a student that increased their usage by 18 hours[5] would be expected to increase their CGI by an additional +0.33, 95% CI [+0.29,+0.36] over baseline. Subsequent analyses found that this effect held regardless of how much time students spent in Year 1, gender, ethnicity, school eligibility for free or reduced priced lunch levels, and English language learner rates in the district (not shown here).
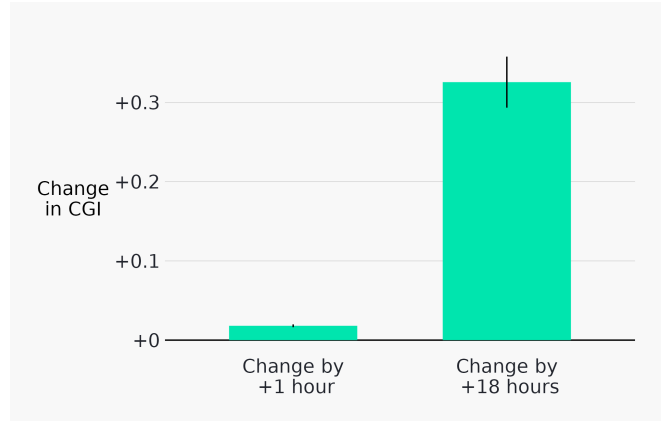

Figure 3: Estimated change in CGI by change in number of hours of MAP Accelerator use.

Conclusion

The results from this 2021-2022 study replicate our previous 2020-2021 findings – students who used MAP Accelerator at the recommended dosage showed gains that exceeded normative growth based on pre-pandemic trends. Moreover, we conducted an additional year-over- year analysis, and saw that changes in student usage of MAP Accelerator were associated with changes in their MAP Growth performance. Together, these findings suggest a robust association between MAP Accelerator usage and learning, and mitigate concerns that the previous results were limited to COVID-disrupted contexts or the result of self-selection biases from motivated or unique students. However, despite these improvements, the absence of a randomized experimental design still leaves room for potential unobserved factors that might provide a better explanation for the results. Nevertheless, in sum, the results provide compelling support for the continued use of MAP Accelerator as a way to promote positive growth in student achievement.

[3]Kuhfeld, M. & Lewis, K. (2022). Student achievement in 2021-22: Cause for hope and continued urgency. NWEA.
[4]Bergé, L. (2018) Efficient estimation of maximum likelihood models with multiple fixed-effects: the R package FENmlm. *CREA Discussion Papers*
[5]Note that very few students (< 1%) actually increased their usage by this amount. The average change in usage was +1.1 hours