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# Scaling Teachers' Professional Development for ASSISTments Companion Report

## Implementation Analysis of the ASSISTments Intervention

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# Introduction

Math education remains a critical focus for education improvement following learning loss from the COVID-19 pandemic (Carbonari et al., 2024; National Assessment Governing Board, 2024). Rural schools in particular lack support for teachers and students, and they stand to benefit from interventions that could support students' math achievement and teachers' instruction (Fishman, 2015). Educational technology (edtech) platforms can improve math outcomes for students and ameliorate learning loss (Escueta et al., 2017; Hillmayr et al., 2020). However, rural schools tend to be underresourced, and teachers face logistical challenges in receiving training and support when adopting new programs (National Academies of Sciences, Engineering, and Medicine, 2024). Rural schools often have unreliable broadband internet access and limited access to technology (De Mars et al., 2022), limiting the edtech platforms that they can adopt. Rural schools also typically have smaller staff, reduced budgets, few resources, and large distances between schools (Saw, 2024), making access to substitute teachers, training programs, and in-person professional learning challenging or infeasible.

ASSISTments (Heffernan & Heffernan, 2014), a freely available online formative assessment platform that offers supports for students and provides teachers with tools for assigning and tracking data from student work to adjust instruction, has been shown to improve students' math achievement (Feng, Brezack, et al., 2025; Roschelle et al., 2016), particularly in underresourced schools (Fry et al., 2021). To scale this intervention to rural schools most in need of support, a virtual professional learning community (vPLC) was developed to train teachers to use ASSISTments effectively and engage teachers nationwide in discussions about math pedagogy.

During the 2022–24 school years, WestEd conducted a national study of the ASSISTments intervention with a vPLC component to examine its impacts on middle school students' math achievement. The research design and major findings on the efficacy of the intervention on student learning and teacher practices, as well as the fidelity of program implementation, are reported in the main study report (Feng, Li, et al., 2025). This companion report supplements the main study report and provides detailed demographics of participating schools, teachers, and students; additional impact analyses and findings broken down by performance and grade levels; an in-depth review of program implementation from the perspectives of the four steps of formative assessment emphasized in the ASSISTments intervention; and two case studies highlighting successful implementation and achievement.

# Background

## The ASSISTments Platform

ASSISTments is a free, web-based formative assessment platform for teachers and students in grades 3 through 12. The tool is designed for teachers to easily assign students math problems from open education resources (OER) textbooks such as Illustrative Math and EngageNY, existing item banks, or items they have created on their own. In ASSISTments, teachers can choose to assign students such standards-aligned problem sets (regular assignments) or Skill Builders, which are standards-aligned problem sets focusing on a single skill that students complete until they reach a teacher-defined mastery threshold (e.g., three correct answers in a row). Students typically work through the problems independently on paper and enter their answers into ASSISTments. The platform then provides students with immediate feedback on the correctness of their answers (a green check mark for correct answers). Students can also request support while solving problems; ASSISTments offers hints, explanations, and step-by-step scaffolds. For each problem, students can make multiple attempts, and they do not move on to the next problem until they submit a correct response.

Teachers receive detailed class- and student-level reports in color-coded grids showing class-level performance per assignment, the average percentage correct per problem, common wrong answers, and the skills and standards addressed in the assignment, as well as each student's answers to every assigned problem. These data help teachers track the knowledge base of their class, adjust their instruction and pacing, differentiate instruction, form student groups, offer remediation, and better understand their students' needs and challenges. Reports can also be projected for the class in anonymized form to foster whole-class discussions of common wrong answers and drive data-informed problem review.

## The ASSISTments Four Steps of Formative Assessment

For consistent implementation across classrooms, ASSISTments standardizes its use into four steps of formative assessment—a concise routine that connects assigning standards-aligned problems, delivering immediate feedback to students, examining class- and student-level results, and acting on those results in instruction:

1. Assign—Teachers assign students standards-aligned problem sets through ASSISTments (regular assignments or Skill Builders).
2. Practice—Students practice problem-solving independently while receiving immediate feedback on correctness, hints, and step-by-step supports from ASSISTments.
3. Assess—Teachers examine reports to identify classwide patterns, common errors, and performance by skill to inform instructional decision-making.
4. Review—Teachers review selected problems with their class by projecting and analyzing the anonymized data, using data from the reports to inform which problems should be reviewed.

## Introducing vPLC

To use ASSISTments effectively and develop strategies for successful implementation, teachers need both initial training and ongoing support. In prior implementations, teachers convened to attend the initial training workshop in the summer and received continuous support during the school year from a local coach who visited classrooms, observed ASSISTments in action, and guided teachers to use the platform effectively (e.g., Feng, Brezack, et al., 2025; Roschelle et al., 2016). However, there are challenges with conducting in-person visits and coaching in rural districts. Since schools tend to be small and geographically dispersed in such settings, traveling to visit each school is often impractical. Arranging substitutes for teachers to attend in-person professional development can also be difficult. A vPLC offers a way to capture the benefits of in-person sessions while making professional learning far more accessible (McConnell et al., 2013). Research also shows that rural vPLCs are more effective when they are flexible, interactive, and relevant and provide ongoing support (Morrison & Hughes, 2024).

For this study, a vPLC was designed to connect rural teachers and those with limited access to in-person PLCs with peers and learning opportunities. Trained facilitators led the vPLC with the three core goals: supporting teachers' effective use of ASSISTments following the four steps of formative assessment, engaging participants in analysis-of-practice (Taylor et al., 2017), and following and modeling National Council of Teachers of Mathematics' (NCTM) norms of excellent math teaching (NCTM, 2000).

The vPLC consisted of eight 75-minute virtual, facilitated sessions held during the school year, supplemented by asynchronous activities before each session. Each session followed a facilitation guide (https://info.assistments.org/plc-guide) and began with a welcome activity, a story shared by a teacher, and a discussion question. Facilitators then demonstrated an ASSISTments feature or introduced a resource on math pedagogy. Teachers were invited to first respond to a discussion prompt in small groups and share their experiences and suggestions. Then, teachers reported back in a whole-group discussion. Next, the facilitators synthesized the main points. Prior to the end of each session, teachers had opportunities to ask questions and summarize key takeaways. Major themes addressed in the vPLC sessions included transitioning from paper-and-pencil math practice to using ASSISTments; using ASSISTments data, including reports and common wrong answers, to inform instruction; emphasizing the role of mistakes as an important part of the learning process; and encouraging student motivation and engagement in math.

# Overview of the National Impact Study and Main Findings

A national study was designed to scale the ASSISTments intervention—consisting of the ASSISTments platform and the vPLC—and to estimate its impact on middle school students' math achievement, with a focus on rural schools. This section summarizes the study's research methods and primary impact findings as reported in the main research report (see Feng, Li, et al., 2025). The sections that follow expand upon those findings by describing the study sample in greater detail, further examining impacts by baseline achievement and grade levels, detailing teachers' implementation from the perspective of the four steps of formative assessment, and highlighting two case studies of successful implementation.

## Study Design and Sample

The study was a quasi-experimental design study. Middle school math teachers participated in one of two cohorts (school years 2022–23 and 2023–24). The sample included 59 middle school teachers and their 2,855 students from 36 schools in 24 states. Teachers were eligible to participate if they taught general education mathematics classes in grades 6–8.

All participating teachers implemented the ASSISTments intervention, consisting of the ASSISTments platform for students, the ASSISTments teacher interface, and the vPLC for teachers. At the beginning and end of the school year, participating students took the NWEA Map Growth mathematics assessment (NWEA, 2019). This assessment allowed the identification of a matched comparison sample of students who were not participating in teachers' classrooms. NWEA has a large national database, and its team used an algorithm to match each treatment student with up to 51 real students from the database based on school characteristics (locale, percentage of students eligible for free or reduced-price lunch) and student characteristics (pretest scores, test-taking dates, grade level). Once matching was complete, the scores of the matched students were averaged to create one virtual comparison student. The process was repeated for every treatment student to construct a virtual comparison group (VCG).

## Data Sources

Student math achievement was measured by the NWEA MAP Growth mathematics assessment at the beginning of the school year as a baseline and toward the end of the school year as the outcome measure.

Implementation measures included the backend teacher and student ASSISTments system use data. For teachers, the system tracked the assignments that teachers created. The system also tracked which assignments' reports teachers accessed and when they accessed them. For students, the system tracked students' problem-solving actions with time stamps, completed assignments, and time spent in ASSISTments.

Implementation data also included teacher pre- and post-intervention surveys, online instructional logs, teacher interviews, classroom observations, and principal interviews. Teachers completed a pre-intervention survey at the beginning of the school year, a post-intervention survey in the spring, and four log "rounds," each covering 5 days of instruction distributed across the school year. Logs and surveys asked teachers about their background and teaching experience, school context, instructional decisions, and experiences with ASSISTments and the vPLC. The vPLC facilitators also administered a survey about teachers' impressions of the vPLC. Teacher interviews were conducted with all 16 teachers in Cohort 1 and a representative sample of 17 teachers from Cohort 2, during which teachers reflected on their use of ASSISTments, implementation of the four steps of formative assessment, impressions of the vPLC, and the school and district context. Classroom observations were conducted with 10 teachers from eight schools in Cohort 1 and 11 teachers from six schools in Cohort 2. Observers attended math classes in the spring and noted student and teacher behavior and use of ASSISTments. Observers also interviewed teachers following the observations to understand their instructional decision-making. Principal interviews were conducted with 7 principals in Cohort 1 and 10 principals in Cohort 2. Principals shared information about their school context, priorities, use of data, and impressions of ASSISTments.

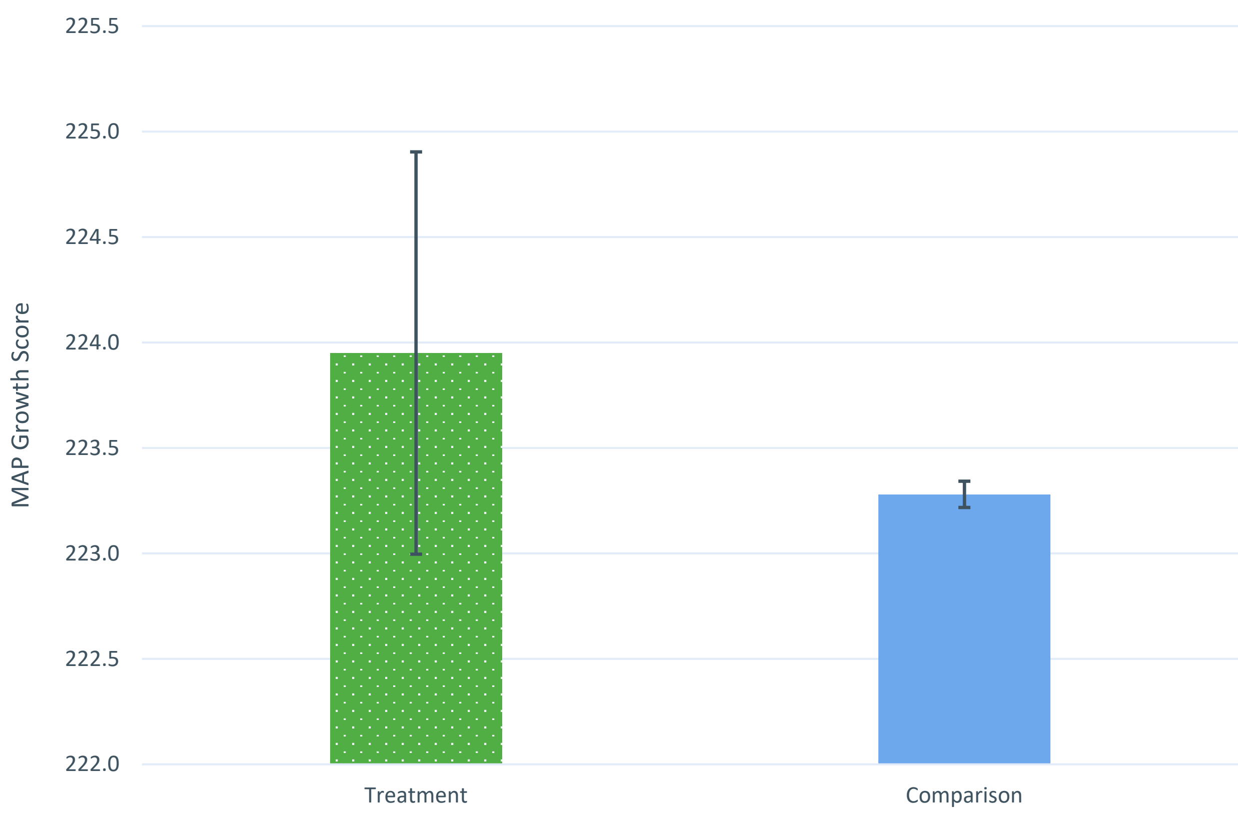
## Major Findings

Key takeaways included the following:

- Overall, students who received the intervention performed comparably to their virtual counterparts.
- Students with lower levels of performance who received the ASSISTments intervention showed significantly greater math achievement gains than their matched virtual peers.

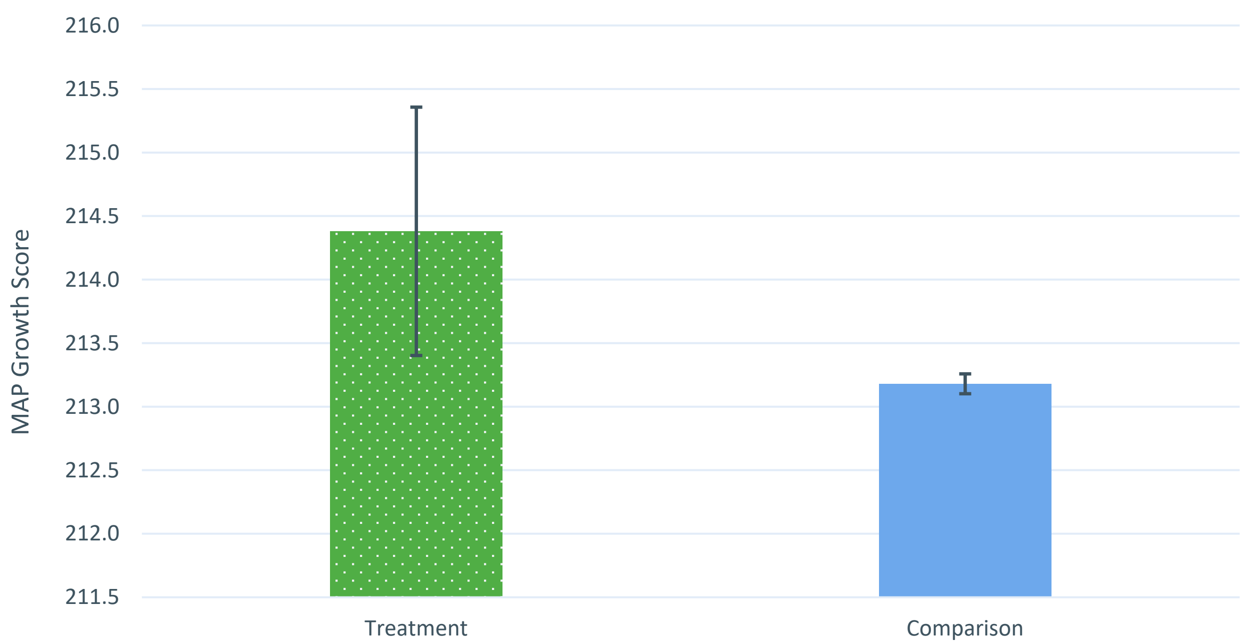
As reported in the final evaluation report for the study (Feng, Li, et al., 2025), the main impact findings did not show evidence of a significant overall intervention effect; however, there were notable gains for students who began the school year with baseline scores below the 50th percentile. Across the full sample, treatment students and those in the VCG did not differ significantly on their end-of-year MAP Growth test scores after controlling for students' baseline math performance and student- and school-level covariates ($p$ = 0.172; Figure 1). On average, students who received the intervention scored 223.95 on the end-of-year test, while students in the comparison group scored 223.28, corresponding with a score difference of less than one point (0.67).

### Figure 1. Full Sample: Treatment Group Versus Comparison Group, With 95 Percent Confidence Intervals




However, among only students with lower levels of performance (those who scored below the 50th percentile on the baseline math achievement measure), students who received the ASSISTments intervention outperformed their peers in the comparison group on the MAP Growth assessment at the end of the school year. On average, students with lower levels of performance in the treatment group scored 214.38 compared to 213.18 for the matched comparison students, a difference of 1.20 points. This difference is statistically significant ($p$ = .020) and corresponds to an effect size of 0.10 (Figure 2). The low-performing subgroup consisted of 1,626 students. These results indicate that the intervention specifically benefited students who started the school year with lower math achievement than their peers. The section Further Examination of the Impact of ASSISTments explores possible reasons for this boost for students with lower levels of performance.

**Figure 2. Students With Lower Levels of Performance: Treatment Group Versus Comparison Group Split by Prior Achievement, With 95 Percent Confidence Intervals**



# Taking a Closer Look at the Characteristics of the Participating Schools and Teachers

## Schools

One focus of this national study was to scale the intervention's potential benefits to rural teachers and students. The intervention successfully reached rural teachers: Half of the participating schools (18) were rural.

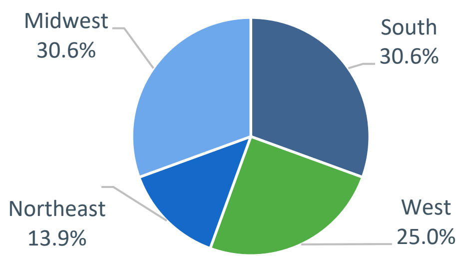
The study also aimed to expand the ASSISTments intervention nationwide, and that aspect of the effort was successful as well. Participating schools were distributed across the Midwest, South, West, and Northeast (Figures 3A and 3B), making the study truly national in scope. Unlike prior implementations that were limited to a single state (Feng, Brezack, et al., 2025, focused on North Carolina; Roschelle et al., 2016, focused on Maine), this broader sample reflects a wider cross-section of U.S. students, so the findings are more generalizable, giving greater confidence that similar effects could be expected for students with lower levels of performance in other parts of the country.

Most participating schools were public (Figure 4A) and served students from elementary through middle grades (Figure 4B), and 23 were eligible for Title I.

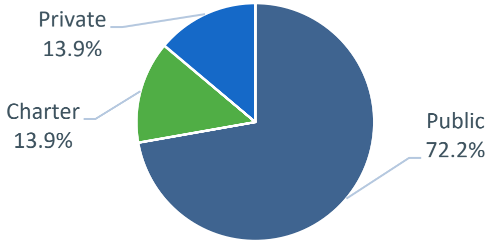
## Figure 3A. School Locations

*Note*. Green pin = rural.

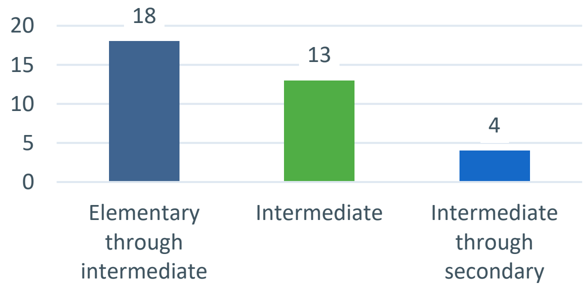
## Figure 3B. Schools by Census Region




## Figure 4A. Schools by School Type



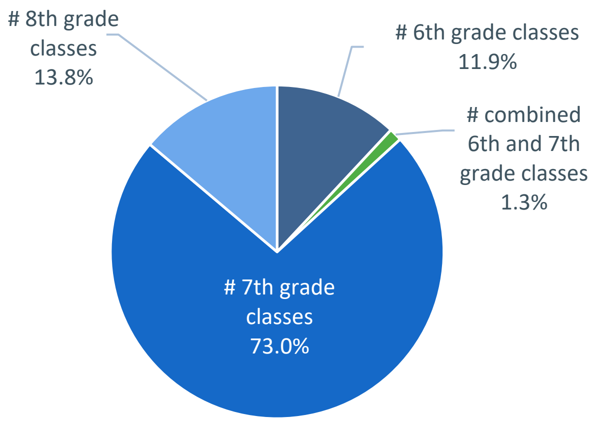

## Figure 4B. Grade Levels Served by Participating Schools



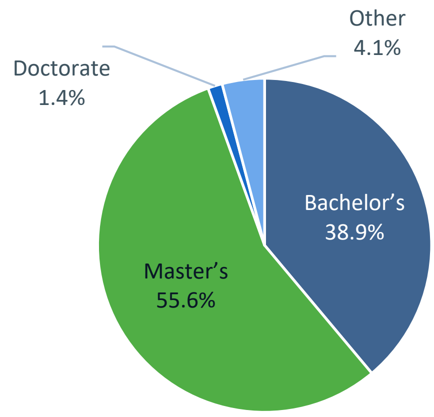

## Teachers

Teachers enrolled in the study primarily taught 7th grade (Figure 5A) and taught, on average, 3.4 class sections (range: 1–7). Most teachers (91%) taught math using Illustrative Math, Eureka/EngageNY, and/or Open Up Resources. Teachers were, overall, quite experienced; on average, teachers had 14 prior years of experience (range: 0–45), including 12 years teaching math (range: 0–41). Most teachers had a master's (55.6%) or a bachelor's (38.9%) degree (Figure 5B). Teachers had some support for math instruction: Most received math professional development once per quarter (38.9%), and more than half (55.6%) had a math coach or support specialist.

### Figure 5A. Classes Taught by Grade Level




### Figure 5B. Teachers' Highest Degree




# Further Examination of the Impact of ASSISTments

This section takes a closer look at the intervention's impact. While the main impact findings indicate that the program was particularly beneficial for students with lower levels of performance, this section considers whether its effects extend further. Specifically, this further examination explores variation in student learning outcomes across quartiles of student prior performance (beyond the simple low- versus high-performing distinction). It also explores how the observed gains compare with national averages and whether impacts differed for rural students and across grade levels. This part of the study also investigates differential effects, including whether effects varied between teachers who used ASSISTments alone and those who incorporated ASSISTments as part of a broader set of edtech tools. Together, these analyses provide a more comprehensive understanding of the intervention's effects on students' math achievement.

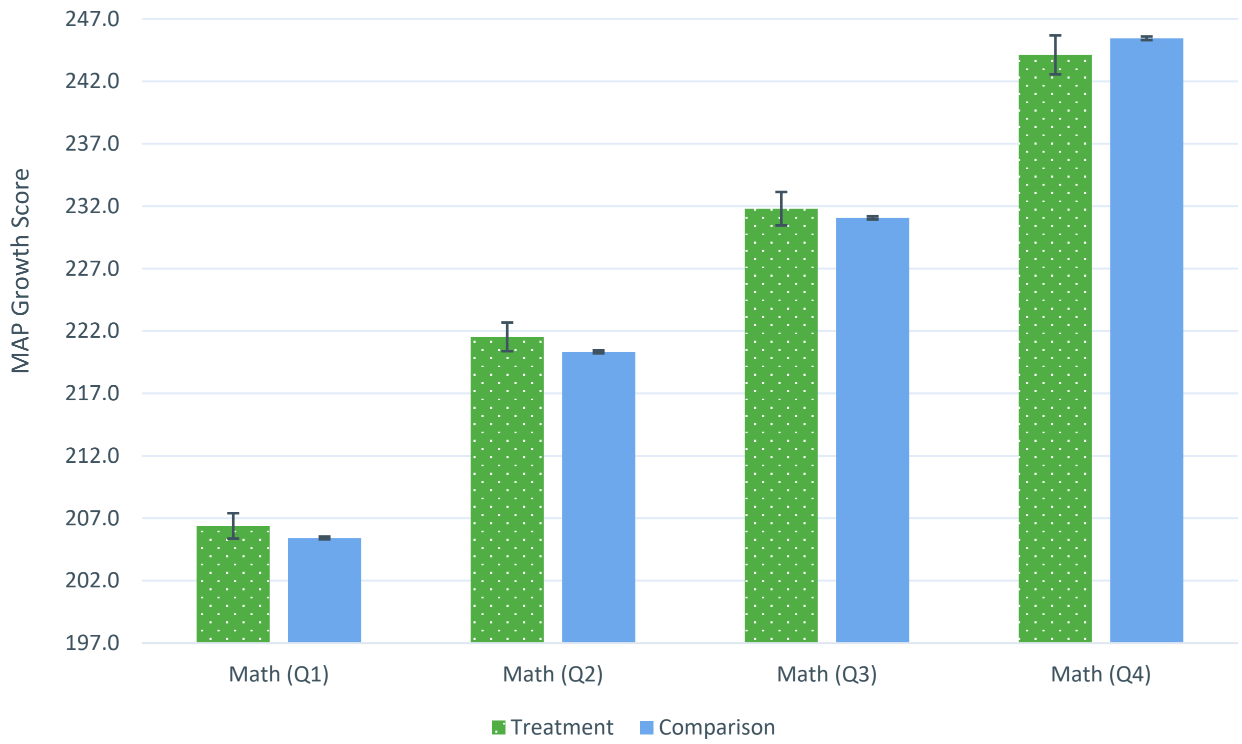
The following are key takeaways regarding the impact of ASSISTments:

- Students with lower levels of performance, especially those between the 25th and 50th percentiles at baseline, showed the most growth.
- Although treatment students with lower levels of performance improved relative to their peers, their scores remained below national norms.
- Rural students with low baseline math achievement demonstrated higher gains after receiving the intervention compared to rural students with high baseline achievement.
- The intervention was particularly effective for 6th grade students.
- More than half of teachers who implemented the intervention had the majority of their students outperform the comparison group.
- Students in classrooms where ASSISTments was used as the sole math edtech tool may have benefited more than those in classrooms where ASSISTments was used as part of a suite of math edtech tools.

## Impact by Prior Achievement Quartiles

Given that the intervention increased math achievement for students with lower levels of performance, researchers examined more closely how prior achievement related to the intervention's effect. Students were divided into 4 quartiles based on the baseline MAP Growth math assessment scores (Figure 6): Students in Quartile 1 (Q1) scored below the 25th percentile on the baseline, Q2 included those who scored between the 25th and 50th percentiles, Q3 included those between the 50th and 75th percentiles, and Q4 scored between the 75th and 100th percentiles. Unlike the earlier analysis that grouped all students with lower levels of performance together, this quartile approach provides a more nuanced view. The results again showed that the intervention primarily benefited students in the lower half of the achievement distribution, while students with higher levels of performance did not show such comparative effects. Specifically, students in Q1 ended the year with math scores marginally higher than those in the comparison group ($p = 0.068$; effect size = 0.10). Students in Q2 demonstrated significantly higher math achievement ($p = 0.045$; effect size = 0.16). By contrast, students in Q3 and Q4 did not differ significantly from their peers in the comparison group ($p = 0.288$ and 0.104, respectively). This analysis indicates that the intervention was most effective for students in the 2nd quartile (25th–50th percentiles), who started the school year with below-average prior achievement but not the lowest levels.

**Figure 6. Prior Achievement Quartiles, Comparing Treatment Group With Comparison Group, With 95 Percent Confidence Intervals**



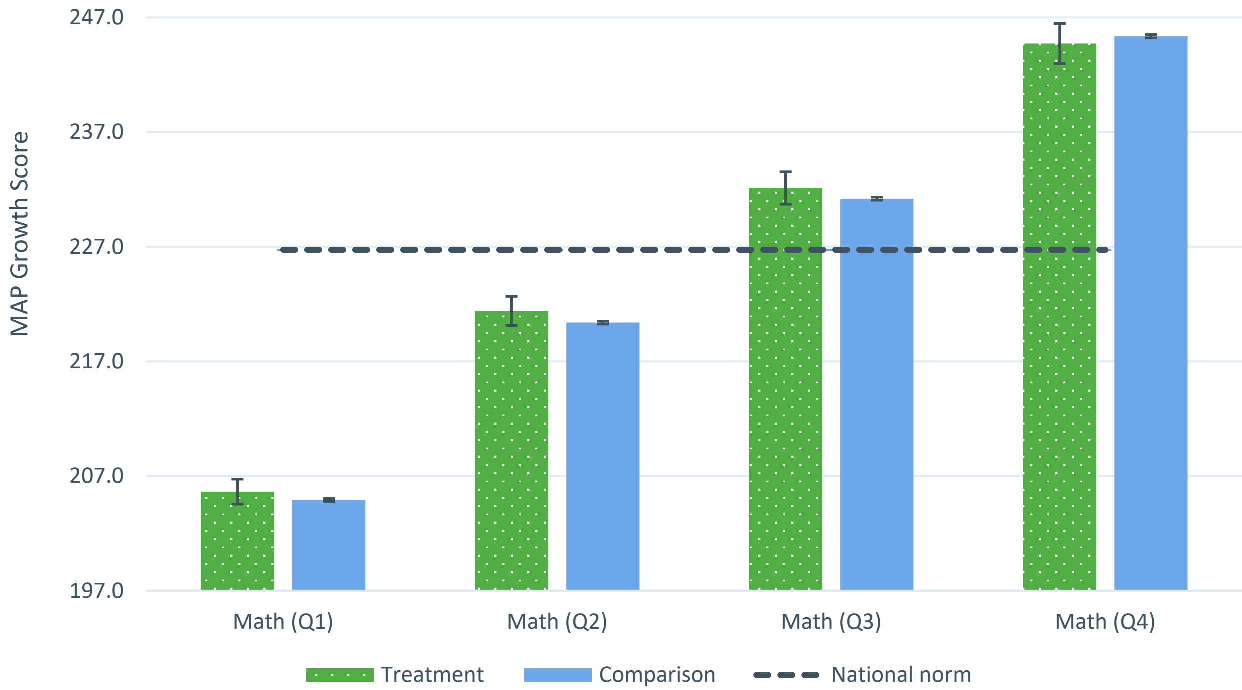

## Participant Performance Compared With National Norms

This study drew on a national sample of students from across the United States. To understand how the findings might generalize more broadly, the research team compared students' math achievement to nationwide norms of the MAP Growth assessment provided by NWEA. Specifically, students' end-of-year performance was compared with NWEA national achievement norms for 7th grade because the majority of the sample was in 7th grade, and NWEA norming data are available per grade level.

On average, students in both the treatment group and VCG scored below the national mean. However, when the results were disaggregated by quartiles, students in the top 2 quartiles scored above the national average (226.73; Figure 7), while students in the bottom 2 quartiles scored below it. This pattern suggests that, overall, the study sample's performance aligned reasonably well with the national distributions: Students with higher levels of performance exceeded the norm, and students with lower levels of performance lagged behind.

Although students in the bottom 2 quartiles in the treatment group demonstrated relative improvement compared to their peers in the comparison group, their end-of-year scores remained below the national average. This suggests that while the intervention provided meaningful benefits for students with lower levels of performance, additional support may be needed to fully close the gap with their peers with higher levels of performance either within the study or relative to national norms.

**Figure 7. Treatment Group Versus Comparison Group by Quartiles and National Norms, With 95 Percent Confidence Intervals (7th Grade)**



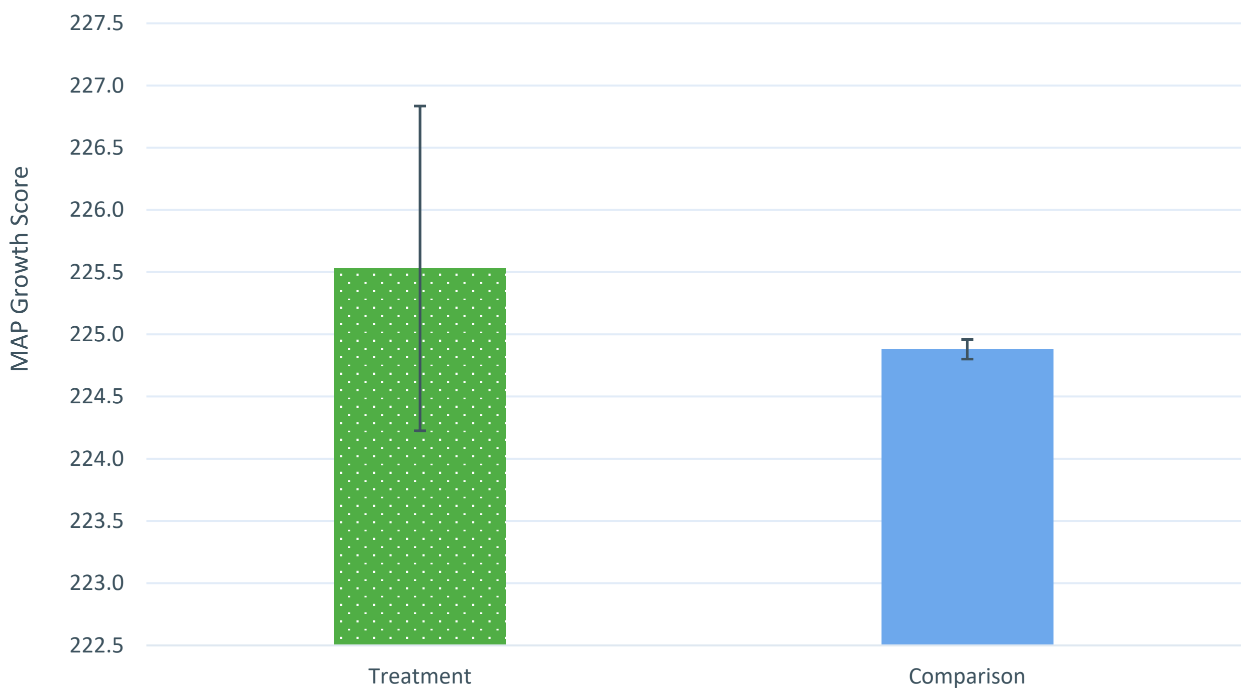

***Note*. Norming data are from the 2020 (prepandemic) spring test, 7th grade.**

## Impact for Students in Rural Schools

A main focus of this study was bringing edtech with scalable teacher training to rural schools. Rural schools face unique challenges in implementing high-quality math instruction given their geographic isolation and limited opportunities for teacher collaboration (Dille & Røkenes, 2021). Approximately half of the students in the sample (1,423 students) attended rural schools, allowing the study to examine whether the potential benefits of the intervention extended to this subsample.

The analyses showed that, as with the full sample, students in rural schools did not significantly outperform their matched virtual students in the comparison group (Figure 8). However, students with lower levels of performance in rural schools showed meaningful gains and significantly outperformed their comparison students. Specifically, among the 733 rural students who scored below the 50th percentile at baseline, those in the intervention group averaged 215.51 on the end-of-year math assessment compared to 214.26 in the comparison group—a significant difference of 1.26 points ($p = 0.049$), corresponding to an effect size of 0.11. As with the full sample, this effect was driven primarily by students in the 2nd achievement quartile: The 421 students in rural schools who scored between the 25th and 50th percentiles at baseline significantly outperformed the comparison group by 1.53 points ($p = 0.050$; effect size = 0.21). Thus, in addition to benefiting students with lower levels of performance overall, the intervention was particularly effective for students with lower levels of performance in rural schools.

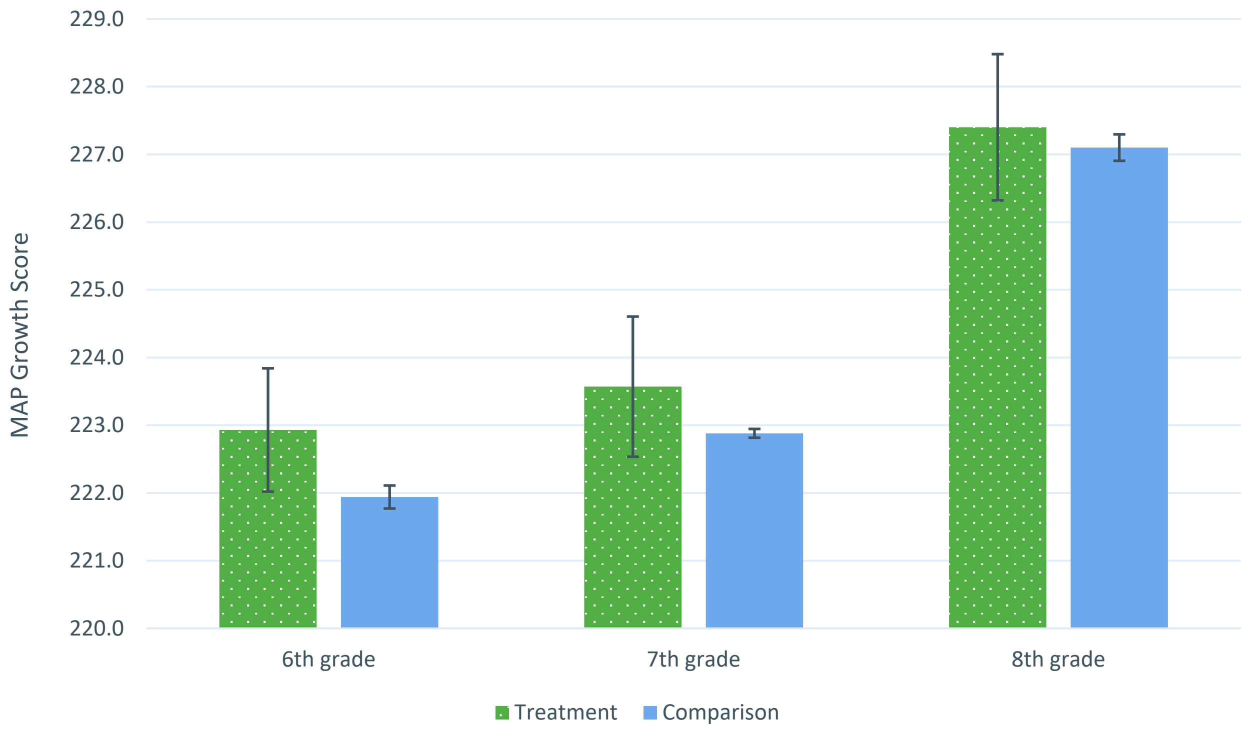
**Figure 8. Rural Sample Only: Treatment Group Versus Comparison Group Split by Prior Achievement, With 95 Percent Confidence Intervals**




## Differential Impact by Grade Level

The study included students across three grade levels in middle school. Researchers therefore examined whether the effects varied by grade. As mentioned above, the study sample was predominantly composed of 7th graders ($N = 2{,}121$), with smaller groups of 6th graders ($N = 383$) and 8th graders ($N = 351$). The analysis revealed that students in 6th grade significantly outperformed their comparison group ($p = 0.026$; effect size = 0.07), whereas no evidence of significant differences was detected for students in 7th grade ($p = 0.204$) or 8th grade ($p = 0.594$) (Figure 9). These results suggest that the intervention may be particularly beneficial when introduced earlier in middle school.

### Figure 9. Treatment Group Versus Comparison Group by Grade, With 95 Percent Confidence Intervals

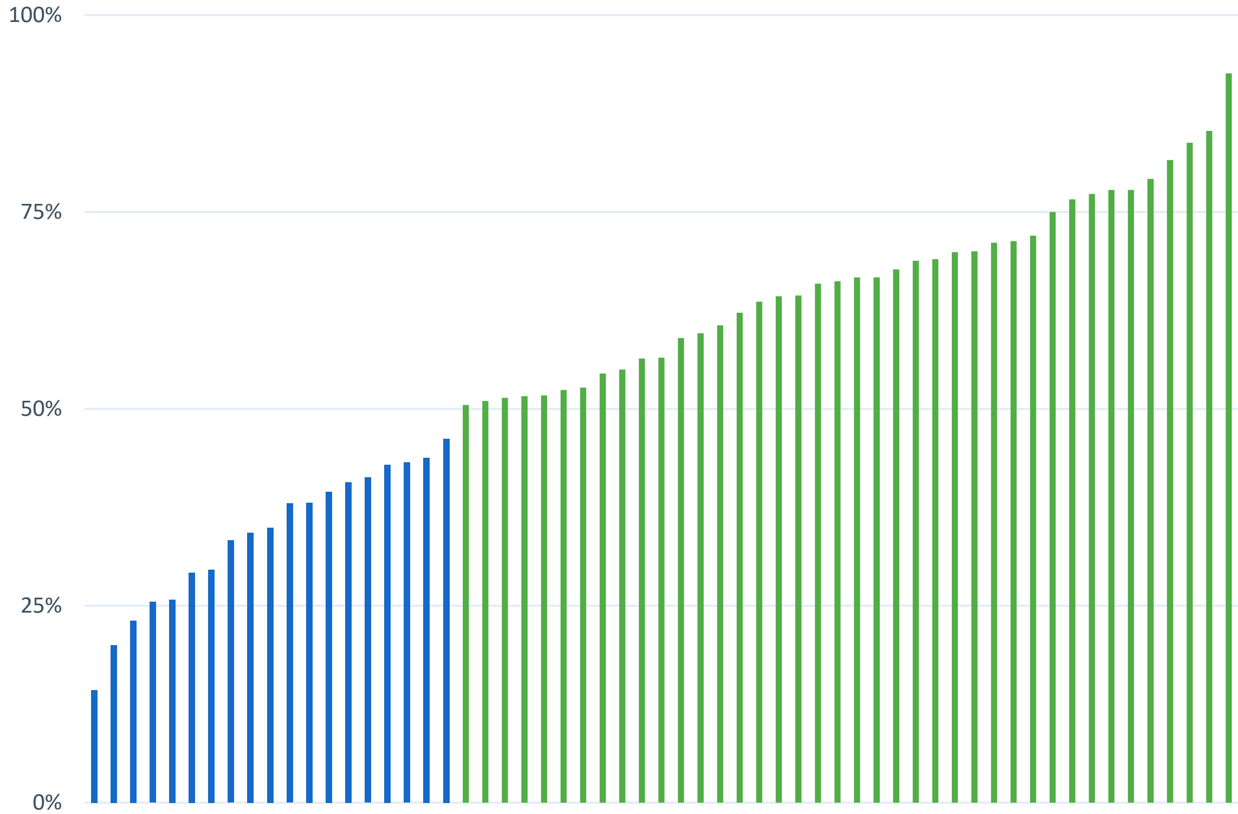



## Variation in Impacts Across Teachers

Across teachers, the intervention has shown benefits for students with lower levels of performance, rural students with lower levels of performance, and younger students. However, intervention effects can vary by teacher. To examine this variation, the performance of students taught by each participating teacher was compared with the performance of their VCG counterparts. Specifically, researchers calculated the percentage of students taught by each teacher who performed better than their matched VCG peers on the end-of-year math assessment. A result above 50 percent indicates that a majority of the teacher's students scored higher than expected under business-as-usual conditions.

Figure 10 shows the percentage of students associated with each teacher who outperformed their VCG, plotted by teacher. Of note, 40 of the 59 teachers had 50 percent or more of their students outperform their VCG counterparts. For the remaining 19 teachers, fewer than half of their students outperformed their virtual comparison. These findings suggest that in most classrooms that received the intervention, more than half of students demonstrated greater growth than would have been expected without the intervention, indicating that the intervention supported positive outcomes for many teachers' students.

**Figure 10. Percentage of Students Who Outperformed Comparison, by Teacher**




***Note*. Green indicates that more than 50 percent of students outperformed the VCG.**

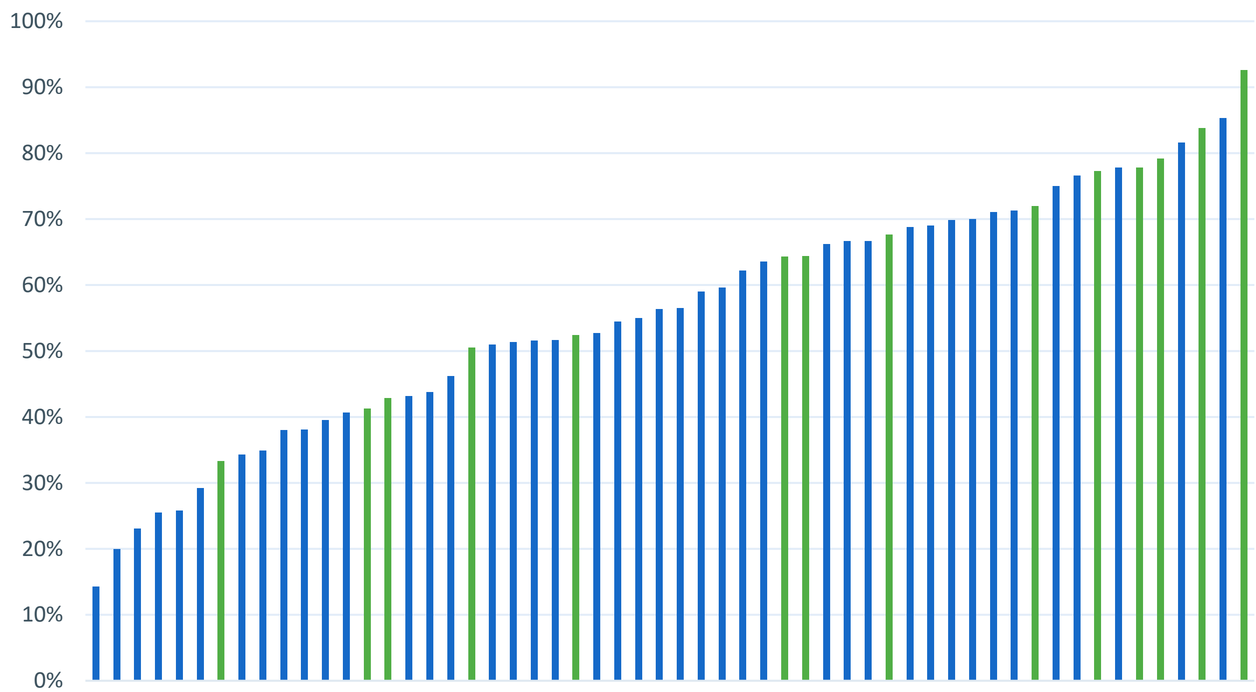
## Impact When Using ASSISTments by Itself Versus as Part of a Suite of Tools: Early Trends

Most teachers in the study reported using at least one other platform in addition to ASSISTments for independent practice (see Implementation Findings below). Thirteen teachers, however, used ASSISTments alone—that is, with no other math edtech programs—according to teachers' responses to the post-intervention survey. Researchers examined whether there were differences in ASSISTments platform usage patterns and student math learning between the teachers who used only ASSISTments and those who incorporated ASSISTments into a broader suite of math edtech tools.

Teachers who relied solely on ASSISTments showed slightly higher engagement in the vPLC (average attendance and assignment completion score of 3.77, versus 3.47, on a 1–4 scale), and their students used ASSISTments more than did students in classes with other edtech platforms. On average, their students spent 517.1 minutes on ASSISTments across the school year compared with 310.6 minutes in classrooms with multiple tools. They also completed more problems (536.9 versus 291.6), completed more assignments (51.9 versus 32.1), worked in ASSISTments more days per week (2.1 versus 1.8), and spent more minutes per week in the platform (19.3 versus 13.9).

Students of the two groups of teachers performed similarly at baseline (only ASSISTments: 721 students, average score = 218.4; ASSISTments plus other tools: 1,992 students, average score = 216.1; $p = 0.366$, difference = 2.32 points). However, interestingly, teachers who used ASSISTments alone had marginally higher end-of-year scores (225.9 versus 223.4, $p = 0.051$, difference = 2.55 points; Figure 11), and a higher percentage of their students outperformed their VCG counterparts (average 63%, range 33–93%) than did the students of teachers who used multiple edtech programs for independent math practice (average 54%, range 14–85%). While these trends should be interpreted with caution, they suggest that when ASSISTments serves as a unique tool for independent practice, its effects may be amplified. Conversely, when ASSISTments is implemented alongside other technologies, its effects may be attenuated.

**Figure 11. Percentage of Students Who Outperformed Comparison, by Teacher**




***Note*. Green indicates teachers who used only ASSISTments; blue indicates teachers who used ASSISTments as part of a suite of tools.**

# A Deep Dive Into Context and Implementation

This section describes how teachers implemented the ASSISTments intervention in their classrooms. It begins by examining the broader context in which teachers were working and then takes a deep dive into the ways teachers enacted ASSISTments' four steps of formative assessment—assigning independent practice, having students practice problem-solving with feedback, assessing ASSISTments data, and reviewing problems with the class (see the earlier subsection on The ASSISTments Four Steps of Formative Assessment). Next, teachers' perspectives on the vPLC are explored. Finally, key implementation factors that appeared to be related to the observed outcomes are highlighted.

The following are key takeaways about implementation:

- Teachers worked in resource-limited schools with a focus on data-driven decision-making, and they often used ASSISTments within a suite of other edtech tools.
- Due to ASSISTments and the vPLC, teachers enhanced their methods of assigning independent practice by shifting to short, in-class assignments in ASSISTments and fostering equitable learning opportunities.
- Teachers consistently reviewed ASSISTments reports to better understand individual and class performance and to inform teaching plans to target support for students with lower levels of performance.
- The intervention led to more frequent and targeted problem review: Teachers used ASSISTments reports to address misconceptions and engage in data-driven discussions about common errors.
- Teachers had positive impressions about the vPLC, noting its role in improving their use of ASSISTments; fostering changes in instructional practices; and building a community, particularly among isolated teachers in rural settings.

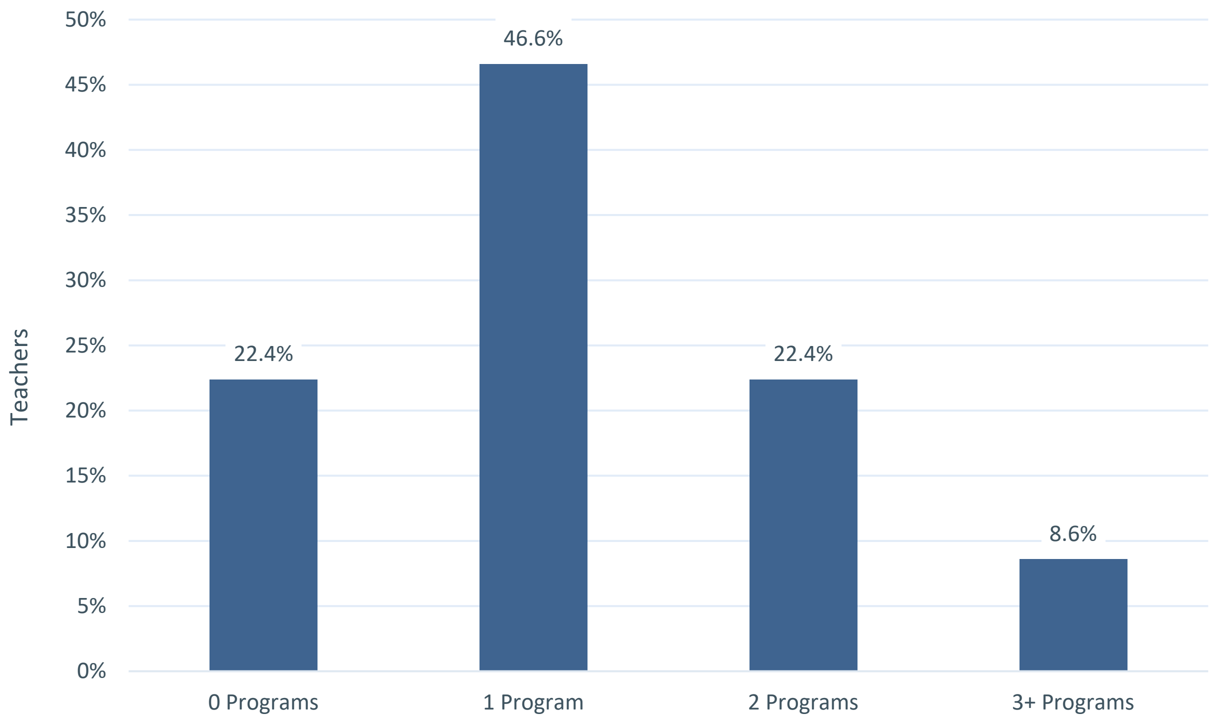
## Broader Context

Analysis of interviews showed that teachers in the study worked in schools that were often underresourced, prioritized improving math performance, and were committed to data-informed decision-making. Specifically, in half of the study schools, teachers—particularly those in small rural schools—felt isolated, without strong professional support or peer networks. In nearly all schools, principals reported limited resources in the community; many students lacked access to computers at home. More than half of schools' administrators expressed concern about improving students' math performance, and all schools emphasized the use of data for decision-making through, for example, regular data meetings in which teachers review exit tickets, report cards, and student test scores. Within this context, ASSISTments could play a critical role in supporting math learning by providing students with immediate feedback and supports for problem-solving, while the vPLC could offer an important professional learning community for teachers in small schools where they lacked access to other teacher colleagues. ASSISTments' data-driven formative assessment approach also aligned well with schools' existing emphasis on data-informed practices.

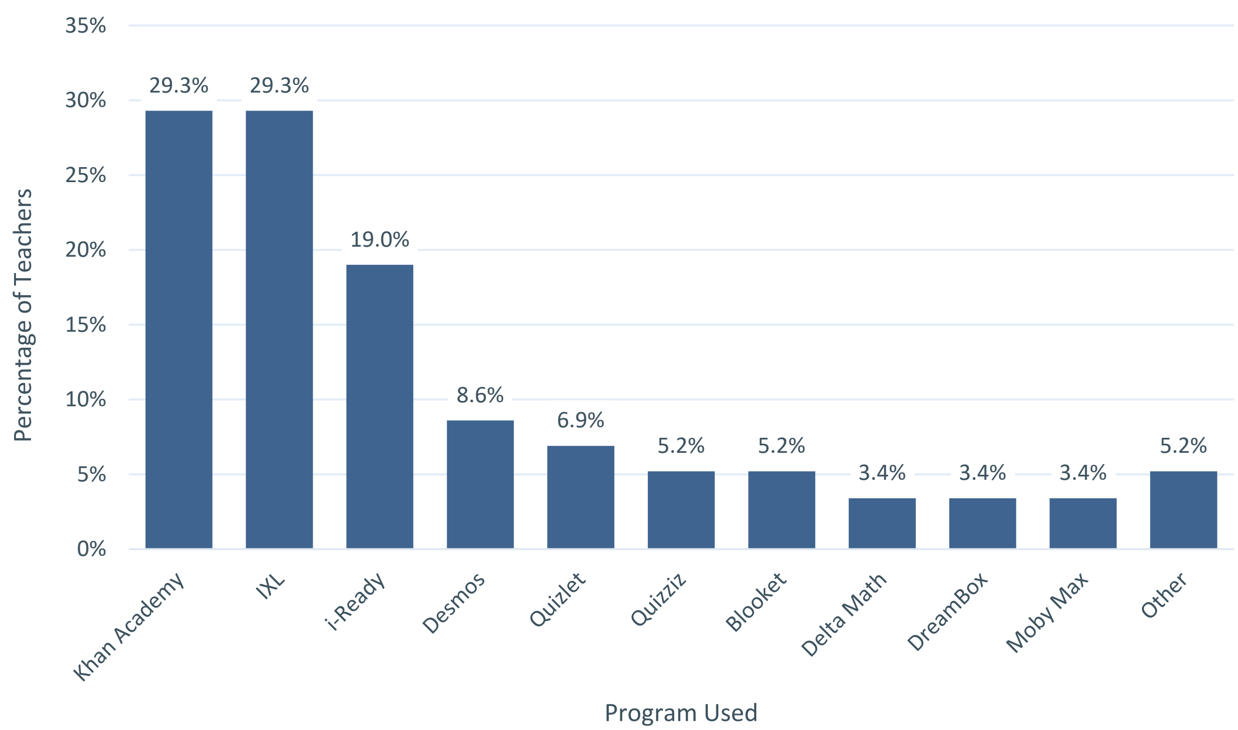
Some participating teachers had prior exposure to ASSISTments, but very few had experience with vPLCs or similar professional development. Specifically, four teachers participated in both study cohorts and attended the vPLC for both years, and only two other teachers had attended professional development that resembled the vPLC. Beyond these cases, teachers entered the study without prior training of this type. Some participating teachers had never used ASSISTments before, while some had been using it for 1 or more years. Although a few teachers had tried the platform in their classrooms, most had not previously received systematic training to guide their implementation and use of ASSISTments following the four steps of formative assessment or had opportunities to discuss best practices with other ASSISTments users.

Teachers also frequently used other math edtech programs alongside ASSISTments. According to the post-intervention survey, most teachers reported using one (46.6%) or more (31.0%) other programs for independent practice (Figure 12A). The most commonly used programs were Khan Academy (29.3%) and IXL (29.3%; Figure 12B). Nearly 88 percent of teachers reported that at least one of these other programs that they used tracked students' learning and provided some form of data. This suggests that while ASSISTments could play a crucial role in meeting teachers' needs for data-informed decision-making, it may not have been their primary source of this support. Still, ASSISTments offers unique features—such as the vPLC, Skill Builders, hints and scaffolds, reports of common errors among students—that distinguish it from the other tools teachers used, and for the 22.4 percent of teachers who did not use any other program, ASSISTments represented a substantial enhancement of typical math instructional practices.

## Figure 12A. Number of Non-ASSISTments Programs Used




## Figure 12B. Names of Non-ASSISTments Programs Used



## ASSISTments for Formative Assessment: The Four Steps

The ASSISTments intervention emphasizes the four steps of formative assessment. Teachers learned about these steps in vPLCs and were expected to use ASSISTments to facilitate these steps in their instruction. The steps aim to help teachers better understand their students and tailor their instruction to the needs of their class. The four steps may be especially beneficial for with lower levels of performance because ASSISTments provides them with the supports needed to complete independent practice successfully. Teachers could also use the platform's data to engage in targeted problem review for commonly missed problems and to provide differentiated instruction or support to students who struggle. Examining how teachers enacted the four steps in their classrooms sheds light on implementation practices that may drive the promising math achievement gains observed for students with lower levels of performance.

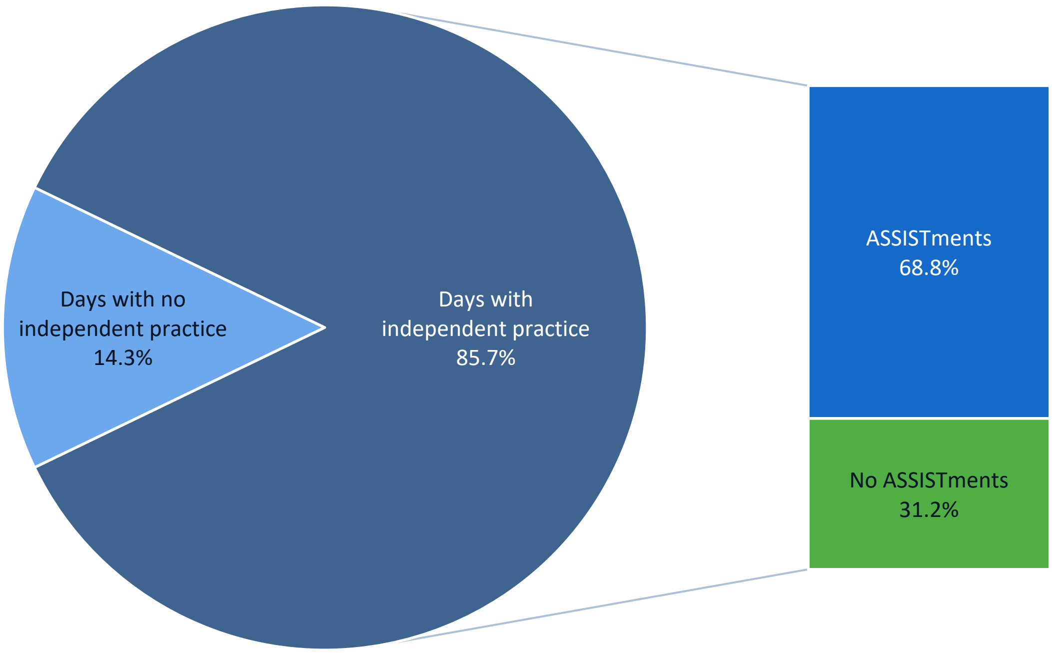
### Step 1: Assign Independent Practice

To begin, teachers' practices around assigning math practice and students' assignment completion evolved as a result of using ASSISTments and participating in the vPLC. Many teachers reported in interviews that both the platform and the vPLC influenced how they structured and assigned independent practice for their students.

Throughout the school year, teachers consistently implemented Step 1 and frequently assigned math practice assignments through ASSISTments. According to teacher self-reported online logs, students engaged in independent practice on nearly every reported day (85.7%) (Figure 13). More than two thirds of those days (68.8%) included work completed at least partially in ASSISTments. Post-intervention survey data further indicated that, across the year, teachers on average estimated that 42.7 percent of independent practice was completed in ASSISTments compared with 34.2 percent in other computer-based programs and 35.6 percent on paper.

System use data confirmed these reports: On average, teachers made ASSISTments assignments during 24.5 weeks of the school year, totaling 69.5 assignments. Taken together, these disparate data sources indicate that teachers regularly implemented independent practice in class, with a substantial portion of the assignments completed in ASSISTments. The assignments not only provided students with opportunities to practice their math skills and receive support when solving problems but also generated valuable data that teachers could use to adapt their instruction and advance to subsequent steps of the formative assessment cycle.

## Figure 13. Logged Days With Independent Practice



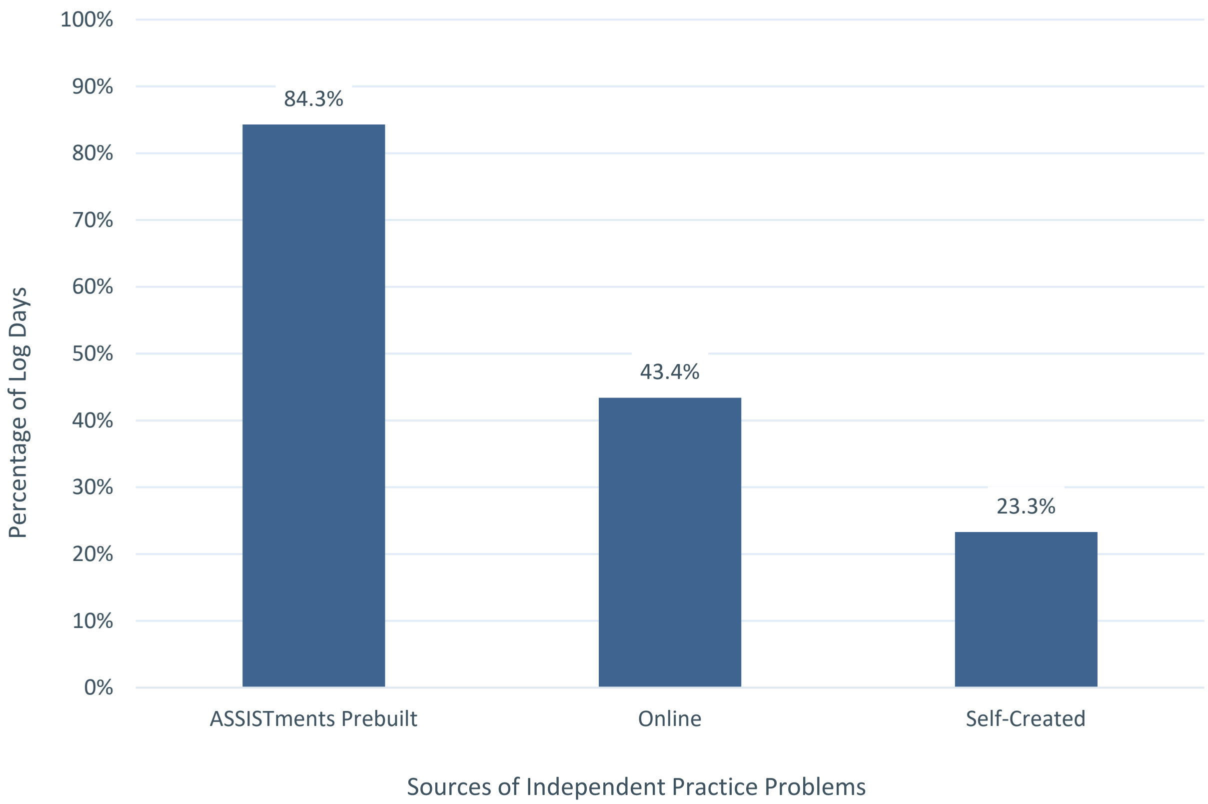

Interestingly, most math practice was assigned as classwork (82.4% of logged days) rather than homework (only 36.2% of logged days had homework due). Post-intervention survey data confirmed this trend: Across the school year, 54.9 percent of independent practice work was completed as classwork compared with 34.6 percent as homework. Regardless of assignment type, more than half of math work was done at least partially in ASSISTments—62.8 percent of classwork (24.3% in ASSISTments only and 45.7% in ASSISTments plus another method) and 55.2 percent of homework. Further, system use data showed that most of these assignments (70%) were regular assignments rather than Skill Builders. Regular classwork assignments assigned in ASSISTments could have allowed teachers to quickly gauge their class's understanding of recent math lessons and allowed them to tailor subsequent instruction, particularly in ways that could have supported the learning of students with lower levels of performance. Teachers could assign classwork at the beginning of class to examine whether their class had retained prior material or at the end of class to gauge what students had learned that day. The latter appeared to be more common according to the log data: Teachers most often reported using ASSISTments at the end of class as a cooldown or exit ticket to assess understanding after a lesson (59.0% in-class independent practice, 27.9% cooldown or exit ticket, 8.2% warmup). Indeed, during the interviews, some teachers mentioned assigning fewer problems or making problems that are more targeted and individualized or tailored specifically to the students' needs.

> I've watched a lot of teachers that try to do 20, 30 questions and it gets really redundant for the kids. And so I think my view on that really changed with the ASSISTments that the three questions if they've mastered it, they're done. ... That was a big eye-opener. … It's fast and gives me that picture that I need that formative piece that I need so I can continue to drive my instruction forward.

This discrepancy in homework versus classwork frequency was likely driven in part by students' limited internet or device access at home, a common challenge in rural areas (Showalter et al., 2023). On 39.6 percent of logged days, teachers reported that students' internet or device access affected their decisions to assign independent practice outside of class. Similarly, almost half of teachers (47.4%, post-intervention survey) indicated that their students' ability to connect to the internet influenced their decisions to assign homework in ASSISTments. For students living in rural areas, where connectivity and device access are often limited, using ASSISTments for in-class assignments provided a more equitable way to ensure that all students practiced solving standards-aligned math problems with support. Classwork may therefore represent a key mechanism through which the benefits of the ASSISTments intervention reached rural students who are most in need of educational supports.

The vPLC was critical for providing teachers with guidance about best practices for assigning independent practice. Teachers made extensive use of the available resources in ASSISTments, which they learned about during the new user training and in the vPLC, either from the facilitators or from other teachers in breakout rooms. They drew heavily on the prebuilt content within the platform: on 84.3 percent of logged days with at least some independent practice in ASSISTments, compared with 43.4 percent for other online sources and 23.3 percent from teacher-created worksheets or problems (Figure 14). Overall, teachers reported feeling comfortable using ASSISTments to assign independent practice (average 4.69 on a 1–5 scale with 1 = uncomfortable and 5 = extremely comfortable) and said that it was easy to locate the curriculum content they needed in the platform (93.5%).

**Figure 14. Frequency of Sourcing Independent Practice Problems From Various Sources**




## Step 2: Have Students Practice With Feedback

Interestingly, most teachers reported that the way their students completed independent practice changed as a result of the intervention (teacher interviews). Teachers noted that students completed their work at higher rates than with prior methods, were more motivated, felt more confident, worked more independently, and engaged in more deliberate practice—changes they largely attributed to the immediate feedback provided by ASSISTments. Indeed, students' assignment completion rates were relatively high according to system use data: In 64 percent of classes most students (at least 75% of a class) completed at least two thirds of their assigned problems. System data further showed that across the school year, on average, students worked in ASSISTments for 350.8 minutes, completing 36.0 assignments containing 342.4 problems. Students engaged with ASSISTments almost twice per week (1.9 days) for about 15 minutes each week.

> The biggest difference is that immediate feedback. First of all, you [students] didn't go on for days thinking you were right when you weren't. So that has been a big game changer for me.

Clearly, the intervention affected teachers' practices related to assignments and students' completion of their independent practice assignments. Many of these changes could have been especially beneficial for students with lower levels of performance: Students' completion of fewer, more targeted problems with ASSISTments' immediate feedback could help build confidence in students and allow them to experience more success compared to their completion of traditional paper-based practice or other platforms that assign more problems without ASSISTments' supportive features.

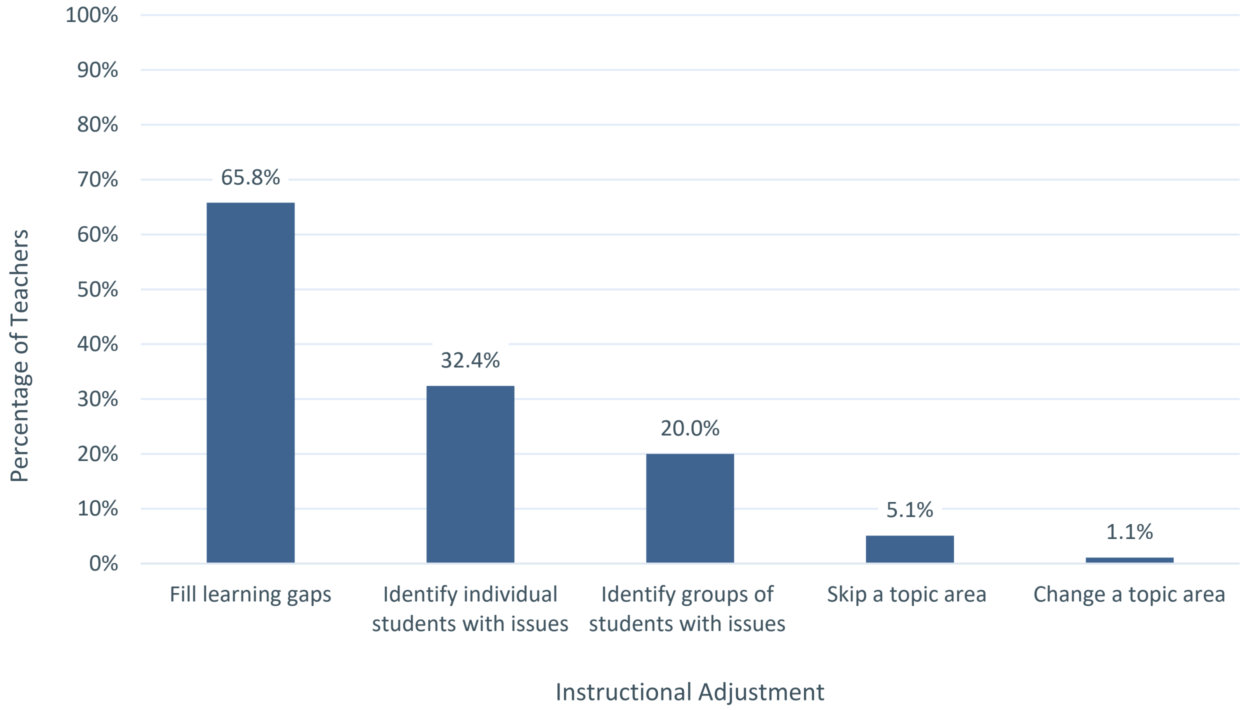
## Step 3: Assess ASSISTments Data

Teachers frequently viewed and used ASSISTments data to guide their instruction and make data-informed decisions. Many of these practices could be particularly beneficial for students with lower levels of performance because they allow teachers to identify the knowledge gaps and challenges of students and provide individualized support. Most teachers reported that the way they used data from independent practice changed as a result of the intervention (teacher interviews). Almost all teachers found ASSISTments data extremely or moderately helpful for addressing students' challenges with the content (93.0%, post-intervention survey), and 92 percent of teachers reviewed at least half of the ASSISTments assignment reports for their classes (system data). On days when teachers used ASSISTments or other edtech platforms with reporting features, they reviewed the reports more than half of the time (57.3% of logged days).

By using data, most teachers were able to better gauge their class's understanding on a topic, identify challenging problems or misconceptions, and identify struggling students (teacher interviews). When teachers reviewed the reports provided by ASSISTments, they often adjusted their teaching plans accordingly (after reviewing an ASSISTments report: 46.2% of logged days). Most commonly, teachers used ASSISTments reports to adjust their instruction by reteaching certain topics and filling learning gaps (65.8% of changes made; Figure 15). Sometimes, teachers used the data to select individual students (32.4%) or groups of students (20.0%) to address issues and provide support as needed.

> I would look at the Skill Builder results. ... Using that really helped me kind of focus my instruction. I geared it more toward the students that needed extra help while I let the kids that had shown their mastery move on. And that changed, that was a big difference from the first year that I was teaching.
>
> I feel like it helps me to identify specifically what I need to do, whereas before I wasn't able to directly pinpoint where the problem was. ASSISTments helps me to identify exactly where the problem is occurring.

## Figure 15. Adjustments to Instruction Based on ASSISTments Reports




## Step 4: Review

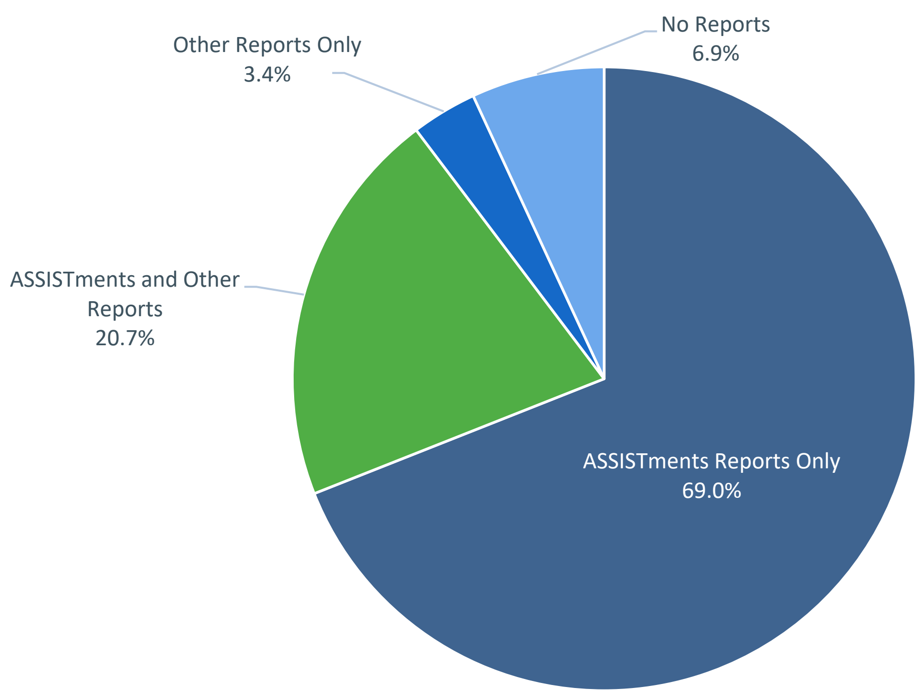
Most teachers reported that their approach to problem review changed as a result of the intervention (teacher interviews). Nearly all teachers (94.8%; post-intervention survey) reviewed math independent practice problems in front of the class during the school year. Specifically, on 47.3 percent of logged days when students had homework due or completed classwork, teachers engaged in problem review with the whole class. A handful of teachers who had not previously reviewed independent practice problems with their students began doing so for the first time after receiving the intervention (teacher interviews).

In addition, the way in which teachers conducted problem review also shifted. After participating in the vPLC, some teachers reported engaging in problem reviews that were more targeted; focusing discussions on mistakes, missed problems, and misconceptions; or facilitating deeper conversations with their students (teacher interviews). This change was likely driven by their use of ASSISTments data to decide which problems to review with the class: Many teachers (74.1%, post-intervention survey) indicated that they used ASSISTments reports to determine which problems to review. Teachers also frequently projected these reports for the class—89.7 percent reported doing so during the school year (post-intervention survey; Figure 16: sum of ASSISTments Reports Only and ASSISTments and Other Reports)—which occurred on 32.6 percent of logged days when teachers reviewed reports. Projecting the reports anonymously in front of the whole class allows teachers to highlight patterns of errors without singling out individual students and can help make the class discussion more inclusive, build a culture of collective learning, and shift the focus from "who got it wrong" to "what we can learn as a group."

Together, these patterns suggest that the intervention supported teachers in making problem review more frequent, targeted, and data driven. Such practices could have specifically benefited students with lower levels of performance because teachers were able to focus their review on problems that these students most often struggled with during independent practice in ASSISTments. Students with lower levels of performance can benefit from seeing in the project reports that others struggled with the same problems, which reinforces that errors are a natural and useful part of learning and can motivate their efforts. See further discussion in the section An Emerging Theme: ASSISTments Supported Self-Regulated Learning.

> I think at the start of the year I used to just go over each problem and now I'm like, okay, let's pick an important one. [I] can't spend 20 minutes just going over the cool down from the day before. This one a lot of students got wrong, so I think this would be the most important one. So yeah, that's definitely changed.

## Figure 16. Teachers Projecting Reports for the Class



## Benefits of vPLC on Teacher Practices and Community Building

The following appear to be the main benefits of the vPLC for teachers:

- learning about ASSISTments features
- effectively implementing the four steps of formative assessment with ASSISTments
- incorporating new pedagogical strategies into math instruction
- fostering community building, especially for teachers who lack other teacher peers, which could particularly benefit teachers at rural schools

Teachers found the vPLC to be useful for their instructional practices overall, likely contributing to the observed intervention effects. Most teachers (87%) participated fully in the vPLC, which included a new ASSISTments user training (if needed), monthly live sessions, and online assignments. Overall, teachers responded quite positively about the vPLC, noting that attending the vPLC saved them time and was valuable for new and veteran teachers (teacher interviews). Some teachers identified the facilitation and environment created by the facilitators as the highlight of their vPLC experience, and they appreciated the vPLC structure, such as time spent on discussions in breakout rooms with peer teachers (vPLC survey). About half of teachers rated the vPLC as comparable to or better than other professional development they had experienced. For a few teachers, the vPLC was their first professional development they had attended outside of their own school.

The vPLC had specific benefits for teachers' use of ASSISTments, formative assessment, and pedagogy more broadly. Teachers reported that the vPLC helped them to learn about ASSISTments features—including data reports, resources from different curricula, state practice tests, Skill Builders, instructional recommendations, and common student errors—and to use the tools more effectively with their students (teacher interviews). As described above in ASSISTments for Formative Assessment: The Four Steps, almost all teachers mentioned that the vPLC changed the way that they used ASSISTments and engaged in the four steps of formative assessment (teacher interviews). For example, some began assigning fewer, more targeted problems to emphasize quality over quantity. Many teachers said that the vPLC contributed to changes in their instructional practices beyond formative assessment (teacher interviews). About half of teachers agreed that the discussions and materials were directly relevant to their classroom practice (vPLC survey). Overall, the vPLC emerged as a critical component in supporting instructional improvement.

Beyond noting instructional benefits, most teachers mentioned that the vPLC also fostered a sense of community (teacher interviews). Teachers consistently described the vPLC as a positive experience whereby they could connect with colleagues across the country. Most teachers cited the opportunities to connect with colleagues doing similar work as one of the main benefits. Some highlighted the unique value of engaging with teachers nationwide (vPLC survey). The following are representative reflections from two teachers:

> It was great to connect with other teachers in the country using the same program to bounce ideas off of to be more successful and effective with my teaching.
>
> I think the trainings and the vPLC helped me to grow not only as an ASSISTments user but also as a teacher.

The vPLC appeared to be especially beneficial for rural teachers and teachers who did not have other grade-level peers in their schools (e.g., they were the only 7th grade math teacher). These teachers highlighted the community-building aspect more than did teachers who had same-grade-level teaching partners, and they reported feeling slightly better prepared to use ASSISTments with their students (logs and surveys; no peers: 4.95 out of 5 on average, range: 4.40–5; peers: 4.63 on average, range: 3.60–5). Given the benefits, the vPLC may help explain the positive intervention effects observed for students with lower levels of performance in rural schools. Without this virtual, flexible training, rural teachers likely would not have experienced similar improvement in using ASSISTments and formative assessment practices or in being part of a professional community. See the following representative quote:

> I'm at a small school and I'm the only seventh grade teacher. … I don't have a chance to collaborate with people who also teach seventh grade math, just some new perspectives [from the vPLC].

## Implementation Factors Contributing to Outcomes

Based on the evidence presented, the research team identified a list of potential factors associated with successful ASSISTments implementation that may contribute positive student math learning outcomes.

Context factors:

- reliable access to technology in school
- supportive school and administrative environment

Teacher factors:

- consistent vPLC attendance and active participation
- sole use of ASSISTments as the primary math edtech tool (rather than as part of a suite of tools)
- data-driven instructional practices
- small-group instruction or differentiated support tailored to students' needs

## Perceived Benefits and Implementation Challenges

Teachers generally viewed ASSISTments positively, reporting that it was easy to use, was well aligned with their curriculum, and provided valuable tools for formative assessment (teacher interviews). They especially appreciated features such as immediate feedback and Skill Builders. Other features, including instructional recommendations and the option for students to redo assignments, were also cited as beneficial.

At the same time, teachers and students faced some implementation challenges and experienced usability issues. Some teachers initially struggled to locate and assign problems they desired, and others wished for greater flexibility to edit the problems. Some had difficulty integrating ASSISTments with their learning management systems. A few teachers preferred that students complete work on paper, while others encountered small errors in math problems within the platform or felt that the prebuilt content was not well aligned with their curriculum. Students also reported usability challenges, such as struggling to enter answers in the required formats or to take pictures of drawn work and upload them to the platform, and many lacked access to devices for using ASSISTments at home.

Despite these challenges, teachers responded positively overall to the intervention, with many perceiving clear benefits both for their instructional practices and their students' learning.

# An Emerging Theme: ASSISTments Supported Self-Regulated Learning

The following are key takeaways about self-regulated learning:

- The vPLC discussions and ASSISTments features support self-regulated learning. Teachers reported that students became more accountable, independent, and persistent in their math work.
- Students engaged in all phases of self-regulated learning. ASSISTments provided opportunities for preparation (planning and strategy use), performance (working through problems), and appraisal (using immediate feedback to evaluate learning).

- Classroom norms and student perceptions around mistakes shifted. The vPLC and ASSISTments encouraged students to see mistakes as learning opportunities, boosting confidence and motivation.

In addition to supporting teachers' use of ASSISTments and formative assessment, the vPLC also highlighted pedagogical practices that could strengthen students' self-regulated learning. Self-regulated learning refers to students managing their own learning progress through preparing to work and selecting strategies, performing their work using those strategies, and appraising the outcomes of their work (Winne & Hadwin, 1998; Zimmerman, 2000). Some teachers shared that what they learned from the vPLC inspired them to establish new classroom norms that could support students' self-regulated learning (teacher interviews). For example, projecting ASSISTments reports anonymously during problem review reinforced the idea of using mistakes productively (appraising the outcomes of work) as a critical part of the learning process, which is emphasized in the vPLC. Completing assignments in ASSISTments also naturally engages students in the three phases of self-regulated learning: A student can prepare to complete a problem set in ASSISTments by forming a plan and selecting strategies (e.g., using paper and referencing class notes), perform the task by solving each problem and entering their answers into ASSISTments, and appraise outcomes by using the immediate feedback to evaluate each response and assess their overall performance.

Most of the teachers who were interviewed mentioned that the intervention supported their students' self-regulated learning. They mentioned both features of the ASSISTments platform (e.g., immediate feedback) and vPLC discussions (e.g., about creating a classroom environment in which mistakes are accepted as learning opportunities) as contributing factors. Specifically, teachers shared that the intervention supported their students to become more accountable for their work, exert greater effort when completing independent practice assignments, exhibit stronger motivation and positive affect, and develop healthier beliefs about making mistakes (Brezack et al., 2025). These changes could make students more effective at completing independent practice assignments, increase their confidence, and contribute to learning gains—particularly for students with lower levels of performance who may still be developing self-regulated learning skills and confidence in their math abilities.

Many teachers also reported that their students had become more self-directed in math. Students increasingly worked independently, took on more responsibility and ownership of their work, and engaged in reflection, constituting all phases of self-regulated learning: overseeing and planning their work (preparation), undertaking the work (performance), and evaluating the outcomes (appraisal). For example, one teacher explained as follows:

> [Initially] they'd be calling me over immediately and like, "I need help." So I think as they got more comfortable with ASSISTments and the features that it has, they were able to do the multiple attempts on their own. … And that's why I find

> ASSISTments so helpful is because it's taking it off of me and it's making it their responsibility and their learning.

Teachers further noted that their students exhibited greater *persistence* and engagement in deliberate practice, which are related to the performance phase of self-regulated learning. Students put in more *effort* and more diligently completed their math work. One teacher explained in the following way:

> [ASSISTments is] stopping them and it's making them think through it and making sure that they're answering it correctly before allowing it to move on … instead of just clicking through a multiple choice assessment, it does, I feel like, make them think more critically.

Some teachers shared that the intervention improved their students' confidence with and *motivation* regarding their math work, positively influencing how the students approached, carried out, and reflected on their work. One teacher shared the following:

> [In the vPLC] they told me that there was a way to reset [Skill Builders]. … That has been helping me with the kids that have really low self-esteem that they say that they're not good for math. … I reset the program and they're like, "Oh, now I understand it." ... It was very interesting to see how that boost their confidence.

Finally, some teachers noticed that the intervention influenced their students' perceptions about making *mistakes* in math. Students became more open to seeing errors as part of the learning process, shaping how they responded to mistakes during the appraisal phase of self-regulated learning. One teacher shared the following:

> I was really proud of them for not being upset when they got it wrong, because we learned that mistakes allow thinking to happen, that's just math. So they were able to kind of be like, "Well, what did I do wrong here?" And kind of self-assess in a way, and look back and reflect on what they had done to see what they could do to improve for the next time. … We had some really good discussion when we would view the reports as a class.

Notably, teachers raised these points about self-regulated learning during interviews even though these themes were not explicitly prompted. This suggests that both the ASSISTments platform and the vPLC may have naturally encouraged practices that foster students' development of self-regulation.

# Success Cases: Connecting Implementation With Outcomes

The following are key takeaways from the success cases:

- Two teachers who had students with lower levels of performance were able to implement the intervention effectively and help those students achieve significant growth.
- Both teachers used ASSISTments reports to form small groups to provide differentiated support.
- The data-driven differentiated support provided by ASSISTments could improve outcomes for students with lower levels of performance.

To better understand how the intervention contributed to positive outcomes for students with lower levels of performance, the research team conducted two case studies focusing on teachers who successfully implemented ASSISTments. The two teachers were selected based on (a) evidence of their students' growth beyond that of the VCG and (b) the percentage of each teacher's students who had lower levels of performance at baseline. This allowed the study to examine and understand implementation features that occurred in classrooms where most students showed high growth relative to their VCG—particularly for classrooms with a large proportion of students with lower levels of performance, consistent with the overall findings that these students benefited most from the intervention.

The research team first ranked all teachers in the study based on the percentage of each teacher's students who outperformed their VCG at the end of the school year. The research team identified 14 teachers who were in the top (4th) quartile of comparative growth, with between 70 and 93 percent of students outperforming their VCG. The percentage of each teacher's students who started the year in the bottom 50 percentile of baseline scores was then calculated to identify a second group of teachers in whose classes over 75 percent of students had lower levels of performance. The intersection of the two groups yielded two teachers whose implementation data were further examined for the case studies.

Both teachers shared important commonalities in the ways they used ASSISTments to foster growth in math, particularly for students with lower levels of performance (based on teacher interviews, classroom observations, and principal interviews). Specifically, both teachers

- used ASSISTments data to form small groups to differentiate instruction and offer support,
- made instructional adjustments and refinements in their use of ASSISTments based on what they learned in the vPLC,
- leveraged ASSISTments and its reports differently than they did in their use of other edtech tools, and
- experienced a substantial shift in their instructional practices since starting to use ASSISTments.

## Teacher 1: Data-Driven Small Groups

Teacher 1 had more than 20 years of teaching experience and had been using ASSISTments for the past 3–4 years. At the beginning of the school year, 93.8 percent of Teacher 1's students performed below the 50th percentile on the baseline math test. After the intervention, 75.0 percent of Teacher 1's students outperformed their VCG. They primarily used ASSISTments for in-class cooldowns, test preparation, and strengthening of weaker skills. Notably, this teacher used ASSISTments data reports immediately after cooldowns to form small groups for targeted instruction. They explained their process as follows:

> Sometimes I would say, take 5 minutes, we're gonna upload this problem or do this problem in ASSISTments. And then I would review the reports, and then based on that, I would make my small groups for the day or for the end of class.

Teacher 1 would sometimes assign different problems to different students, further differentiating their instruction. The teacher shared that they learned to effectively engage in data-driven instruction as a result of vPLC discussions about reviewing ASSISTments reports:

> Over time it [report reviewing] did change because I learned more [in the vPLC] and how to use it to better benefit my kids. So yeah, it did change from the ... beginning of the year or when I first started using [ASSISTments].

For Teacher 1, ASSISTments held a distinctive position in class. Although they also used DreamBox and Khan Academy for lessons, Teacher 1 relied on ASSISTments reports specifically to determine how to group students and to guide classroom discussions of common errors:

> The DreamBox, because it is adaptive, everybody was at a different place. … I didn't use it as much, their reports as much, but with ASSISTments, I was able to dig down

> as either an individual or as a whole group to see what misconceptions were or what I needed to change as far as teaching.

Although Teacher 1 had been using ASSISTments for a few years, experience during this study represented a major shift in their instructional practices and attitudes compared with their prior approaches: "Back in 2019, I was not a computer fan. Everything was paper and pencil."

In sum, Teacher 1's participation in the vPLC improved their ability to use data and reports, enabling them to effectively form data-driven small groups and provide differentiated instruction. ASSISTments provided a unique source of actionable data to customize instruction and represented a large improvement in instructional practices compared to other edtech tools.

## Teacher 2: Real-Time Tailored Support

Teacher 2 had 10 years of teaching experience and was in their 2nd year of using ASSISTments. At the beginning of the year, all of Teacher 2's students performed below the 50th percentile on the math assessment. At the end of the year, 70.0 percent of the students outperformed their VCG. Teacher 2 often used ASSISTments for in-class practice problems as cooldowns or exit tickets. This was a shift from their prior use of ASSISTments before participating in the study; through the vPLC, Teacher 2 learned to select a few targeted problems for students to complete during independent practice time. They also learned in the vPLC about Skill Builders and then began using Skill Builders with students for more focused practice and repetition on specific skills in which their students were weak. Reflecting on this change, Teacher 2 described ASSISTments as "definitely [a] step up from what we were doing the years prior to ASSISTments."

Importantly, during independent practice time, Teacher 2 would gather small groups of students together as they completed their math work. During these small-group work sessions, Teacher 2 would share the ASSISTments reports in real time, allowing the teacher to identify misconceptions and provide differentiated, data-driven support. Teacher 2 described this process as follows:

> I can bring five [students] over to my table at a time and I can watch them as they're working and I can show them what I'm seeing, what they're seeing. … Those reports were not just [for] me, we were looking at those together, whether it's 1, 2, 5, 10 students at a time.

The principal also commented that Teacher 2 provided differentiated support to students:

> [Students] all worked independently and in small groups at some point throughout the classroom to make sure that every child was getting what they needed, exactly where they were. … [Teacher 2] does an excellent job at meeting our higher

performing students, moderately performing students, and lower performance students where they are.

Teacher 2 also projected reports during class while students worked on their assignments. They tailored the projected sections based on perceived student needs. For example, in the reports, sometimes they would anonymize student names or hide the color coding, which indicated scores on problems and assignments, if the teacher thought the names or color coding would discourage students. Like Teacher 1, Teacher 2 used data from ASSISTments to differentiate instruction by assigning specific problems to individual students who needed to correct their work, increasing the precision in assigning tailored work at both the class and individual levels. In these ways, ASSISTments enabled Teacher 2 to engage in more targeted, data-driven, small-group instruction to support students at all levels of achievement.

As in the Teacher 1 case, ASSISTments held a unique place in Teacher 2's instructional toolkit. While Teacher 2 also used DreamBox for lessons and occasionally used Khan Academy, Demos, and Delta Math for independent practice, they rarely checked DreamBox's data, and they found its reports difficult to use. By contrast, they made consistent use of the ASSISTments reports, which represented a major shift from their earlier reliance on textbook and paper-and-pencil assignments. Teacher 2 noted that ASSISTments reports also offered a vast improvement in reviewing student work, saving Teacher 2 time and providing actionable insights to change their instructional practice: The reports allowed them "in real time and for the next day or the next week, [to] modify lessons using data just in a more efficient way." Teacher 2's effective use of ASSISTments data for providing differentiated support and tailored instruction could have allowed students with lower levels of performance to receive the support they needed to improve their math achievement across the school year.

# Conclusions

This rigorous, national, quasi-experimental study of the ASSISTments plus vPLC intervention offers several important insights into the intervention's impact on middle school students' math achievement. While no significant differences in math achievement were detected between the intervention group overall and the matched comparison students, the intervention did produce meaningful gains among students with lower levels of performance in particular and with students in rural schools. The findings underline the intervention's potential for narrowing achievement gaps across students.

The vPLC emerged as a vital support, particularly for rural teachers who were often isolated at work. By fostering a professional community, emphasizing data-driven decision-making, and promoting effective use of ASSISTments for formative assessment, the vPLC enhanced teachers' ability to differentiate instruction and address their students' needs.

Implementation data provided a rich picture of classroom practices and yielded insight into the various ways that teachers implemented the intervention. Teachers most often used ASSISTments for in-class independent practice to gauge student knowledge—frequently at the end of lessons—and relied on the reports to inform instructional decision-making. In addition, teachers observed benefits of the intervention on students' self-regulated learning, such as working more independently, developing stronger confidence in math, persisting through challenges, and learning from mistakes. Two case studies further illustrated different ways in which ASSISTments reports could be used to identify student needs and differentiate support.

Overall, these findings suggest that interventions like ASSISTments, when combined with structured teacher supports such as the vPLC, could strengthen teacher instructional practices and improve student math learning, especially among students with low levels of achievement and those in rural settings.

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