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Cost and Cost Effectiveness of ASSISTments Online Math Support

Analysis From a Randomized Controlled Study in Middle School

Mingyu Feng, WestEd

Gary Weiser, Bill and Melinda Gates Foundation

Kelly Collins, WestEd

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INTRODUCTION

The landscape of K–12 education has seen a notable increase in sophistication and interest in the adoption of artificial intelligence (AI) and technological innovations, paralleling the growing accessibility and prevalence of technology. Many districts in the United States are investing a considerable amount of funding in education technologies as primary or supplemental programs with the objective of improving student learning and classroom instruction. Over the past years, there has been a rise in one-to-one technology programs, and more families have access to computers and the internet (Escueta et al., 2020). By March 2021, amid the global COVID-19 pandemic, 90 percent of educators reported that there was at least one device for every middle and high school student in their district (Klein, 2021). Schools envision technology programs as a crucial means to address the substantial academic content learning loss resulting from the pandemic (Engzell et al., 2021).

In a rigorous evaluation of ASSISTments as an online homework support conducted in the state of North Carolina, WestEd reported that the program demonstrated a significant long-term impact on student learning and increased student scores on the state standardized assessment as compared with a control group that continued with existing math practices 1 year after the implementation was finished (Feng et al., 2023). Naturally, education interest holders want to know what it takes to cause this improvement.

Understanding the cost of various educational technology programs is important for districts, policymakers, and families to make informed decisions about adopting instructional interventions and prioritizing investments that align with educational goals and objectives. Cost analysis provides invaluable insights into resource allocation, budget planning, and the overall financial sustainability of educational initiatives. Understanding the cost implications enables districts to maximize the efficiency and effectiveness of resource utilization, ensuring that every dollar spent translates into meaningful educational outcomes. Cost is also a practical consideration that can dramatically shape how knowledge about effective practices is translated into action in schools. Overreliance on effectiveness alone may encourage adoption of interventions that are too expensive to sustain with fidelity (Bakia et al., 2011; Harris, 2009; Hollands et al., 2015). In addition to questions of impact and efficiency, policymakers and administrations require information regarding affordability and sustainability.

It is important to note that, from an economics perspective, the term “cost” represents something conceptually distinct from “money paid” or “price.” Cost denotes the value of resources, no matter the format or who pays. For example, a teacher training program might be offered to a district at zero cost, but the time invested by teachers as they participate holds value; that time could have been allocated to other productive endeavors, thereby incurring a cost. These costs can then be matched with associated estimates of impact to create CERs. These ratios can be used by decision-makers to evaluate the relative value of interventions.

In this report, we describe the methods and findings from the cost and cost-effectiveness analysis (CEA) based on the ASSISTments study in North Carolina. During this study, the research team investigated the impact of ASSISTments in seventh-grade classrooms across 41 school districts. Of particular interest was studying what resources and support it took to implement the program in middle school classrooms, as well as the cost per student. In addition, this report briefly overviews the study and its findings regarding the impact of the program on student learning and presents findings on the cost of the ASSISTments program, in comparison to a benchmark range of costs associated with other technology-based programs (Lipsey et al., 2012).

Cost-Effectiveness of Similar Programs

Research has long been urged to incorporate discussions of program costs and cost-effectiveness for school administrators to better judge what is most suitable for their district (Levin et al., 1987). Policymakers examining education programs find the potential returns per dollar invested and the total up-front cost particularly important (Kraft, 2020). However, research discussing the CEA of education programs, especially edtech, is still rare today. We identified the CEA of some programs in our literature review. Additional examples of studies and related resources are available at https://www.cbcse.org/publications.

Many of the interventions that have demonstrated significant effect sizes in the large-scale, rigorous studies were characterized as high-dosage tutoring, generally defined as one-on-one tutoring or tutoring in very small groups at least three times a week, and these interventions are costly. The high-impact tutoring program Saga can range in cost from $3,200 to $4,800 per student to deliver one hour of tutoring day in school every day at a 2:1 student-tutor ration (Guryan et al., 2023). Another program that taught social-cognitive skills and provided intensive two-on-one academic tutoring for disadvantaged male youths had an effect size of 0.67 for increasing math grades and had a cost of around $4,400 per student (Cook et al., 2014). Comparatively, an intervention consisting of an AI-assisted tutoring model had a marginal cost of around $700 per student (Thomas et al., 2024), which is significantly more affordable.

Early childhood development programs present varying costs and benefits. For example, Success for All was found to have the highest educational benefits per dollar compared to similar programs, such as the Perry Preschool Program and the Abecedarian Project, with a cost of $612 per student compared to $8,929 and $10,496, respectively (Borman & Hewes, 2002). Success for All also demonstrated superior cost-effectiveness in math, with an effect of 0.05 per $1,000, compared to

Perry Preschool's 0.03 and Abecedarians 0.01 (Borman & Hewes, 2002). Finally, a study for ROOTS, a math intervention program for kindergarten students at risk, calculated cost-effectiveness ratios (CERs) per student with different district scenarios and group sizes, resulting in a range of $267 to $3,201. This highlights how variables such as school setting and circumstances can greatly shape how an intervention may be worthwhile for some schools but not for others (Clarke et al., 2020).

Technology-based programs often demonstrate lower costs per student compared to traditional interventions. For instance, gamified learning applications like From Here to There had a cost of $39 per student, with an average effect of 0.135 on algebraic achievement, leading to a CER of $291. Similarly, DragonBox, with a cost of $55 per student and an average effect of 0.269 on algebraic achievement, had a CER of $206 (Finster et al., 2023). And for curricula, while the Cognitive Tutor Algebra I curriculum was more expensive, with a cost of $97 per student compared to $28 for other Algebra I curricula in 2012 (Daugherty et al., 2012, as cited in Finster et al., 2023), it was also significantly more effective (Pane et al., 2014, as cited in Finster et al., 2023). Edgenuity, another learning program, had a higher cost compared to the study's teacher-developed program, but it had a higher effectiveness based on student pass rates, resulting in a nearly equivalent CER of $895.36 compared to $899.04 (Proffitt, 2014).

STUDY OVERVIEW

The ASSISTments North Carolina Replication Study, conducted by WestEd, was a randomized controlled trial spanning from 2018 to 2020. This study aimed to replicate the findings of a previous study conducted in Maine (Roschelle et al., 2016) and examine the efficacy of ASSISTments in advancing seventh-grade students' math learning in a population more representative of the diversity of the U.S. population. A follow-up study focusing on eighth-grade students was conducted to examine the possible long-term impact of ASSISTments 1 year after the intervention ended. Due to the absence of seventh-grade student achievement data because of the cancellation of the state standardized test in spring 2020, the follow-up study utilized students' eighth-grade scores on the North Carolina End of Grade (EOG) math test in spring 2021 as the measure of student learning.

Setting and Participants

Sixty-three schools from 41 districts across North Carolina took part in the study, including 48 Title I schools and schools from various rural, town, suburban, and urban communities. These schools encompassed various grade spans, including K–8, 6–8, and 8–12. In total, 102 seventh-grade mathematics teachers were enrolled in the study.

Study Design

During the 1st year of the replication study, schools were randomly assigned to either intervention or business-as-usual comparison conditions. All seventh-grade math teachers in the intervention schools implemented ASSISTments over 2 consecutive school years. During the "warm-up" 1st year (2018/19), intervention teachers learned to use ASSISTments. They then continued using ASSISTments during the 2nd year (2019/20) with a new cohort of seventh-grade students, with this group of students serving as the analytic sample for the replication study and the follow-up study.

The follow-up study aimed to identify the long-term impact of the ASSISTments platform by examining the eighth-grade performance of students from the analytic sample. These students maintained their original conditions, and their scores on the 2021 North Carolina eighth-grade EOG mathematics test were used as the measure of eighth-grade performance. During the follow-up school year in 2020/21, no program support or interventions were provided to Grade 8 teachers or students by the developers or the research team.

The Intervention and Comparison

ASSISTments was introduced to the intervention group as an online tool for math homework. Many teachers also used the platform to support classwork. The tool provided students with instant feedback on their math work, while teachers received real-time data and progress reports on student learning. The ASSISTments platform contains textbook-based problems from the schools' existing textbooks and curricula, as well as additional prebuilt content for teachers to assign. In addition, upon request, the ASSISTments development team also built practice problems created by the intervention teachers into the platform.

Along with the ASSISTments platform, intervention teachers received intensive professional development and continuous support. They participated in 2-day in-person professional development sessions before the start of each school year and received continuous support from a local coach throughout the school year. The local coach provided personalized guidance, recommendations, and assistance during three in-person visits and was available for support via phone and email. Intervention teachers were expected to assign ASSISTments assignments for 20–30 minutes at least twice a week and were instructed to regularly review data reports of student work on assignments.

Comparison group teachers were asked to maintain their regular curriculum use and teaching practices regarding homework and to participate in professional development as usual. They were asked to continue using existing technology tools but were not provided access to ASSISTments or ASSISTments-related professional development.

Teachers in both the intervention group and the comparison group in the study were expected to follow the North Carolina Standard Course of Study. They all participated in their district-provided professional development and continued with their existing curricula as usual.

Effectiveness of ASSISTments

An intent-to-treat approach was used to conduct the impact analysis. The final study sample included all qualified[1] students from the original 63 schools, totaling 9,073 students (4,495 in intervention schools and 4,578 in comparison schools). Following the preregistered analysis plan (https://osf.io/exqpn), the outcome analysis focused on the students who enrolled in regular eighth-grade courses and took the eighth-grade EOG math test (EOG-MA08). This final analytic sample consisted of 5,991[2] students (2,961 intervention group and 3,030 comparison group students).

The analysis revealed that intervention group students scored higher (0.8 points) than comparison students on the EOG-MA08 test, with this difference being statistically significant (estimated mean score for intervention = 535.13, comparison = 534.33; $p = 0.011$). This treatment impact corresponds to an effect size of 0.10 (Hedges's *g*), suggesting significant positive impact on students' math learning in the long term, sustained 1 year after the completion of the program implementation.

Resources Supporting the Use of ASSISTments

We briefly describe in the following section the resources that supported the use of ASSISTments during the 2018–20 school years at a high level. The sections on Methods and Data Collection and on Analysis and Findings describe the details of the technical methodology of cost analysis.

Hardware. The ASSISTments platform is web-based. In North Carolina, teachers and students leveraged existing devices and networks available in school or at home to implement ASSISTments. No specialized hardware or software was provided to use the platform beyond the computers already provided to students by the state.

1 To ensure the study sample is unbiased, we only consider a student as qualified if the student had sixth-grade (from the 2018/19 school year) EOG scores and if they were enrolled in one of the 63 participating schools as a sixth-grade student during the 2018/19 school year or as a seventh-grade student during the 2019/20 school year if their school did not serve sixth grade. Students who joined a study school after the study started were excluded.

2 Another big group of 1,962 students (936 intervention group and 1,026 comparison group students) took the End of Course Math 1 test (EOC-MA1). These students typically performed in the top 25 percent and enrolled in high-school-level courses during eighth grade.

Teachers' Time. School adoption of ASSISTments for this study also required administrative planning and training for teachers. Direct district resources supporting the implementation of ASSISTments included

- modest annual technology support for account setup;
- a short instructional time to introduce the platform to students;
- teacher participation in about 2 days per year of professional development; and
- coaching and feedback for teachers during the school year. A local coach traveled to participating schools. The coach visited each teacher on average three times in a school year. Each session is estimated at 1.5 hours of teacher time per teacher.

Training and Coaching. The ASSISTments team and the local coach provided training on ASSISTments implementation to intervention teachers, traveling statewide to visit schools and coach teachers. They also spent time preparing training and coaching materials and addressing teacher questions via emails or phone calls. Trainers' and coaches' time accounts for another major source of the cost for implementing the program.

METHODS AND DATA COLLECTION

The cost analysis was performed in three main steps: (a) identifying the ingredients required to obtain the study results, including all pertinent expenditures such as personnel, equipment, materials, and training; (b) determining the costs of these components; and (c) calculating both the total program costs and the average cost per participant.

Identifying Ingredients

We employed the "ingredients method" (Belfield et al., 2018). This methodology involves systematically identifying all the resources necessary for implementing the ASSISTments program during the study period. The ingredients approach includes collecting detailed information about the components of an intervention and its alternatives in order to understand the type and quantity of resources required to achieve the desired impact. Given that various educational alternatives often require common resources such as classroom space, technical infrastructure, or teacher time, our focus was primarily on the program's direct costs and changes in cost in contrast to the business-as-usual control condition. We opted not to include estimates of the value of classroom space, technical infrastructure, or overhead rates (Hollands & Bakir, 2015).

The "ingredients" necessary beyond business-as-usual math instruction are critical to characterizing what Belfield and Brooks Bowden (2019) call the "treatment contrast"—not merely the difference in outcomes but also the difference in resource use between the intervention and comparison groups. This approach accounts for the opportunity costs of all resources required to implement ASSISTments regardless of whether they involve new expenditures, in-kind contributions, or reallocation of existing resources. As mentioned earlier, teachers in both conditions participated in regular professional learning provided by schools or districts, and they continued with their existing curricula. Consequently, our analysis solely focused on the additional costs associated with implementing ASSISTments as a supplemental program.[3]

We collaborated with Worcester Polytechnic Institute (WPI), the ASSISTments developers and teacher professional development team, and the local coach to compile a list of the necessary ingredients to implement ASSISTments. This list was further refined through observations of ASSISTments in practice over the 2 years of the replication study. We also clarified implementation details by interviewing school leaders, local coaches, and teachers.

The collection of cost data occurred concurrently with the implementation of the intervention to increase the reliability of capturing all the resources used for ASSISTments. We then analyzed the collected data to establish a range of quantities for each resource required, as well as average resource requirements.

To organize all of the ingredients used and ascertain their costs, we used *CostOut* (Hollands et al., 2015) to identify the price of these ingredients in the local context where implementation occurred. The key ingredients for the ASSISTments intervention during the study were placed into four categories (as recommended by Belfield et al., 2018). The ASSISTments platform itself is a free product for all teachers and students to use. Even outside the context of this research, neither districts nor schools need to pay for the software. Therefore, the cost of the platform itself is not included in the list.

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[3] Many schools in the study also utilized other supplemental programs in their math classrooms, such as iXL, MobyMax, and Khan Academy. ASSISTments may have been used to replace other programs during the study. However, the data of the cost of implementing other supplemental math programs was not collected systematically during the study and thus was not included in the analysis.

1. **Personnel**
   a. A WPI ASSISTments supervisor who oversaw local coaches and other implementation support staff
   b. A local coach who could support teachers in the implementation region throughout the duration of the ASSISTments program[4]
   c. Program staff (including WPI and the local coach) who supported summer professional development sessions
   d. Technical support personnel who maintained the ASSISTments platform and enacted content updates to fit the curriculum needs of teachers
   e. Teachers during ad hoc preparation for the use of the ASSISTments platform
2. **Training**
   a. Training for the local coach by the WPI coordinator so that they were prepared to support the teachers in their implementation region
   b. Summer professional development performed by the local coach (and the WPI coordinator) ahead of implementation regarding how implementation teachers could use the ASSISTments platform effectively[5]
3. **Facilities**
   a. Facility space used for training teachers during summer professional development
4. **Materials**
   a. Resources such as student or teacher guides that may be used over the course of implementation[6]

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4 This ingredient considers the cost of the local coach's time during program implementation but neither their own training by WPI nor their time during summer professional development. Such a breakdown allows for consideration of alternative implementation scenarios in which the time of the local coach is still a necessary ingredient for implementation, but other training costs can be offset by freely available district resources. See footnote 5.

5 This ingredient includes the nonfacilities resource costs of implementing the professional development for the program (including planning and coordination) and all costs of attendance for teachers (including time, food, lodging, and travel costs). Facility costs for training have their own line item. During the study, costs were offset by the developer, WPI, as an incentive to districts and teachers but would need to be borne by future implementers outside of the context of an efficacy study. As with footnote 1, this breakdown allows for consideration of other implementation models that vary in the unit need of these ingredients.

6 During study implementation, all resources for implementers were provided digitally (with negligible costs); however, the same may not be true of the business-as-usual condition. Consideration of this ingredient supports further clarification of the treatment contrast between implementation conditions.

Opportunity costs. Another aspect of cost is the "opportunity cost" associated with resources that could have been spent differently if the ASSISTments intervention had not been implemented. For example, if implementing ASSISTments resulted in teachers spending more (or less) planning time to review student work while preparing for future math instruction compared to their peers in the comparison group, this could represent a cost of teacher time that might otherwise have been spent on other important lesson planning tasks.

Instruments. To measure self-reported differences in teacher instructional behavior, we used teachers' implementation logs in conjunction with a postimplementation survey. Statistically significant differences were observed in the amount of time dedicated to homework practices in the classroom and in planning time to support instruction. However, when aggregating across in-class homework-based practices, we observed that intervention and comparison group teachers spent approximately equal amounts of time on English language arts instruction. From these findings, there is no incremental cost of teacher time for ASSISTments above business-as-usual instruction.

Costs were also classified according to (a) who is responsible for paying the cost, (b) whether the cost was a start-up cost or a maintenance cost, and (c) whether the cost was an annual expense.

Pricing Ingredients

For each ingredient, we examined receipts and reports from WPI, invoices from the local coach, our own expenditure in coordinating the implementation of the intervention, and reports from teachers during the postimplementation survey. Some materials were grouped by class (i.e., increase with the number of classes participating) and some by years of implementation (i.e., decrease when we consider a light implementation that does not entail a warm-up year).

ANALYSIS AND FINDINGS

Incremental Cost of Implementing ASSISTments

Table 1 summarizes our estimation of the incremental cost of implementing the ASSISTments program per participant, broken down by each ingredient and its contribution to the overall implementation cost. In total, we estimate that it costs about $207,794.34 above business-as-usual expense to implement ASSISTments in all intervention schools for the efficacy study. Since treatment was implemented at the classroom level across the whole school within the targeted grade level, these costs were applied to all the students in the intervention schools (n = 4,495[7] in 63 schools) regardless of whether they completed outcome assessments (see section on Sensitivity Analysis for alternative calculation). Consequently, our estimate amount corresponds to about $46.23 for each student.

Table 1. Ingredients and Costs for the ASSISTments Program by Participant (n = 4,495)

Ingredient	Description	Quantity	Unit	Adj. price	Total cost	% of total cost
Facilities						
Professional development facilities expenses	Year 1 cost	1	Unit	250	$250.00	0.1%
Professional development facilities expenses	Year 2 cost	1	Unit	250	$250.00	0.1%
Other inputs						
Teacher professional development stipends	Year 1 cost	34	Person	400	$13,600.00	6.5%
Teacher professional development stipends	Year 2 cost	36	Person	400	$14,400.00	6.9%
Personnel						
Local coach during implementation	Year 1 cost—includes hours for coaching, communication, and liaising between teachers and WPI staff	446	Hour	100	$44,600.00	21.5%
Local coach during implementation	Year 2 cost—includes hours for coaching, communication, and liaising between teachers and WPI staff	573	Hour	100	$57,300.00	27.6%
Teacher—Public	Year 1 content maintenance	25	Hour	45.10	$1,127.45	0.5%
Teacher—Public	Year 2 content maintenance	12	Hour	45.10	$541.18	0.3%

7 This number represents the number of students who enrolled in the intervention schools at the beginning of the study. To avoid any potential bias, we excluded students who joined the study schools later. Students who moved out of the school after the study started were not tracked. The actual number of students served by the program might be different.

Ingredient	Description	Quantity	Unit	Adj. price	Total cost	% of total cost
Teacher—Public opportunity cost	Year 1 opportunity cost	-1,124	Hour	45.10*25%	-$12,672.54	-6.1%
Teacher—Public opportunity cost	Year 2 opportunity cost	-1,296	Hour	45.10*25%	-$14,611.75	-7.0%
WPI software engineer	Year 1 cost for platform maintenance	200	Unit	150	$30,000.00	14.4%
WPI software engineer	Year 2 cost for platform maintenance	200	Unit	150	$30,000.00	14.4%
WPI support staff—Work study student	Year 1 cost—content Maintenance	100	Hour	30	$3,000.00	1.4%
WPI support staff—Work study student	Year 2 cost—content maintenance	48	Hour	30	$1,440.00	0.7%
Training						
Professional development lodging[8] and food	Year 1 cost during professional development training	34	Person	250	$8,500.00	4.1%
Professional development lodging and food	Year 2 cost during professional development training	36	Person	250	$9,000.00	4.3%
Local coach—Being trained by implementation coordinator		120	Hour	35	$4,200.00	2.0%
Local coach—During professional development	Year 1 cost, provide training teachers	90	Hour	35	$3,150.00	1.5%
Local coach—During professional development	Year 2 cost, provide training teachers	74	Hour	35	$2,590.00	1.2%
WPI implementation coordinator—Training local coach		128	Hour	53	$6,784.00	3.3%
WPI implementation coordinator—Training local coach	Year 1 cost, provide training teachers (no Year 2 cost)	82	Hour	53	$4,346.00	2.1%

Note. Prices are expressed in 2021 dollars.

8 The professional development workshops were held at multiple locations in North Carolina. Most teachers drove to attend the workshop held at the closest location to them. Some teachers stayed at the workshop hotel for the night. The estimated cost includes the hotel room, mileage, and other miscellaneous expenses related to teachers' travel for attending the workshop.

Sensitivity Analysis

The duration of the North Carolina ASSISTments study was quite long. During the 1st school year of the intervention, teachers were given the opportunity to get comfortable using ASSISTments with students and improve their practices. Effects were measured in those students who were taught by participating treatment teachers during the 2nd school year of the intervention. One might wonder how the effects might vary in implementations that are shorter or have different amounts or quality of teacher professional development and coaching. In fact, the program developer expected that a satisfactory implementation might be achieved with only 1 year of professional development and expected that the intervention could be sustained beyond 2 years without any additional professional development. Thus, teachers may need less professional development and coaching, so schools may realize lower costs. A hypothetical subsequent year with new participants may have produced similar results with substantively reduced costs per participant.

Accordingly, the sensitivity tests examine the different variations of length of professional development, the availability of a local coach, and the necessity of a warm-up year. We performed four extra sensitivity tests for estimating implementation costs across various training or support models. The primary costs in Table 1 reflect that costs during both years of implementation were the essential ingredients for producing the observed differences during the study in math outcomes between students in the classrooms of intervention teachers and the students in the classrooms of comparison teachers. The estimated costs from the analysis (detailed in Table 2) represent what the costs would have been if a warm-up had not been implemented, as well as the marginal, per participant cost of a further year for an additional pool of students. We also estimated the per participant cost for the students in the analytic sample only (n = 2,961).

Table 2. Tests of Sensitivity in Incremental Costs for the ASSISTments Program

Sensitivity test	Incremental cost	Cost per participant
Primary—Full sample (4,495 students; see Table 1)	$207,794.34	$46.23
Primary—Analytic sample only (2,961 students)	$207,794.34	$70.18
2 years, no local coach	$80,247.59	$17.85
No warm-up	$116,239.42	$25.86
No warm-up, no local coach	$39,787.78	$8.85

***Note*.** Incremental cost represents the cost above business-as-usual math instruction.

***Note*.** Prices are expressed in 2021 dollars.

Cost-Effective Analysis

With a well-articulated analysis of the cost of implementation, it is possible to estimate a CER (Hollands et al., 2015). This ratio considers how costs were distributed by participants relative to the average effect of treatment via the following formula:

$$CER = \frac{(Cost\ of\ Implementing\ Above\ Business\ as\ Usual)}{(Number\ of\ Treated\ Students) * Average\ Treatment\ Effect}$$

Given that the primary effect of intervention on the EOG eighth-grade math test corresponds to an effect size of 0.10 standard deviations (Hedges's *g*; see sections on effectiveness of ASSISTments) and that the estimated cost per participant was about $46.23 (Table 2) in 2021 dollars, this yields an approximate cost of $462.30 per student per standard deviation difference in performance on the long-term EOG math assessment above comparison peers.

In Table 3, we report different estimates of cost-effectiveness based on different assumptions regarding costs.

Table 3. Tests of Sensitivity in Cost-Effectiveness for the ASSISTments Program

Sensitivity test	Cost per participant	Cost-effectiveness
Primary—Full sample (see Table 1)	$46.23	462.3
Primary—Analytic sample	$70.18	701.8
2 years, no local coach	$17.85	178.5
No warm-up	$25.86	258.6
No warm-up, no local coach	$8.85	88.5

Note. Incremental cost represents the cost above business-as-usual math instruction.
Note. Effectiveness in units of dollars per standard deviation difference (based on a Hedges's g estimate of 0.1).
Note. Prices are expressed in 2021 dollars.

DISCUSSION AND CONCLUSIONS

Improving mathematics education is an important national educational challenge, and technology is increasingly viewed by many educators as part of the solution. However, educational leaders require additional information to make data-informed decisions in a systematic manner regarding the adoption of edtech programs and the necessary resources and costs for effective implementation.

This study addresses the need for further research on program implementation cost by projecting both the explicit and implicit costs of implementing a technology-based program in schools of diverse populations. This report provides a comprehensive cost and CEA derived from an efficacy study conducted in seventh-grade classrooms utilizing the ASSISTments platform to enhance student math learning. We employed the "ingredients method" (Belfield et al., 2018) to identify all the resources required to implement the ASSISTments program during the study. Our estimated cost amounts to about $46.23 per student for an average long-term effect size of 0.1. Such a price puts ASSISTments at the lower end of cost relative to other math interventions (Barrett & VanDerHeyden, 2020).

We hope the cost analysis of ASSISTments yields information that is helpful to administrators and educators when they are considering whether to adopt ASSISTments or a similar intervention. Schools can compare ASSISTments with other intervention options based on cost-effectiveness and may evaluate the relevance of this study to their needs, taking cost into account as a factor. Schools should also consider how their specific settings differ from the setting of this study in terms of student population, access to technology, or availability of time and resources for teacher learning.

In making sense of cost and cost-effectiveness, readers should compare the designs of the studies under consideration. The range of expected effects can vary greatly by the scale, scope of implementation, and rigor of the studies included in the analysis (Kraft, 2020). Generally, reported effects and cost-effectiveness tend to be higher in studies that involve smaller, less diverse populations; have less rigorous designs; and measure immediate impact with closely aligned assessments. Reported effects are also higher in studies using an investigator-designed assessment.

This study, with its relatively large sample size (63 schools and 9,000+ students), followed a rigorous design and used a policy-relevant, high-stakes state standardized measurement. It examined the impact on learning 1 year later. Therefore, it could be unfair to compare this study with benchmarks derived from other studies with fewer schools, quasi-experimental designs, or less rigorous designs or from those measuring immediate effects, as intervention effects tend to diminish over time. Cost analyses of studies at similar scales and those measuring delayed effects with standardized tests are rarely reported in the literature. The only comparable study that we could find was the high school multiyear study for Sago high-dosage tutoring done in Chicago Public Schools. Guryan et al. (2023) reported that the tutoring cost by Saga was $3,200 to $4,800 per year per student for a comparable delayed effect of 0.10 standard deviation on a standardized test.

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