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My Math Academy® | RESEARCH REPORT JUNE 2022

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# Prekindergarten Students Using My Math Academy Significantly Improved Their School Readiness in Math During a School Year Disrupted by the Pandemic

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## Key Findings

- In a school year disrupted by the pandemic, 98 percent of pre-K students in a Title I school district who used *My Math Academy* regularly ended the school year "On Track" in math on the state-administered assessment.
- Students who used *My Math Academy* were significantly more likely to end the school year "On Track" in math on the state-administered assessment than their peers who did not use the program.
- Mastering skills in *My Math Academy* was significantly correlated with higher performance on the end of year state-administered assessment.
- The study results confirm those of earlier studies in which close to 100 percent of the teachers reported that *My Math Academy* had a positive impact on students' interest, confidence, and enjoyment in learning math.

## Overview

Over the course of the 2020–2021 school year, many of the millions of children who were learning remotely due to the COVID-19 pandemic gradually returned to in-person schooling. By the end of the school year, students were, on average, four to five months behind in math and reading.[1] While many students had substantial amounts of unfinished learning for their grade level, the greatest amount was concentrated among BIPOC,[2] students with disabilities, English Language Learners, and those attending Title I schools.[3]

Teachers returning to the classroom in the 2020–2021 school year also faced numerous challenges. Many teachers adopted some combination of in-person and remote instruction, which demanded more time and resources, and student attendance was low and inconsistent. In a survey of more than 1,000 K–12 teachers conducted in early 2021 by RAND, about 75 percent of the respondents indicated "teaching in-person and remotely at the same time" as one of their top three stressors, along with other factors such as engaging students, supporting their social and emotional needs, and concerns about teachers' own health and that of their families.[4]

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1 Dorn, E., Hancock, B., Sarakatsannis, J., & Viruleg, E. (2020). COVID-19 and student learning in the United States: The hurt could last a lifetime. *McKinsey & Company, 1.*

2 Kuhfeld, M., Soland, J., Tarasawa, B., Johnson, A., Ruzek, E., & Liu, J. Renaissance Learning, Inc. (2020). Projecting the potential impact of COVID-19 school closures on academic achievement. Educational Researcher, 49(8), 549–565; Renaissance Learning, Inc. (2020). *5.3 million star assessments show the true impact of the COVID slide.* Retrieved from https://www.renaissance.com/2020/11/23/news-5-3-million-star-assessments-show-true-impact-covid-slide/

3 Office for Civil Rights. (2021). *Education in a pandemic: The disparate impacts of COVID-19 on America's students.* Retrieved from https://www2.ed.gov/about/offices/list/ocr/docs/20210608-impacts-of-covid19.pdf; Renaissance Learning, Inc. (2021). How kids are performing: Tracking the midyear impact of COVID-19 on reading and mathematics achievement (Winter 2020–2021 Edition). Retrieved from https://www.renaissance.com/2020/11/23/news-5-3-million-star-assessments-show-true-impact-covid-slide/

4 Steiner, E. D., & Woo, A. (2021). Job-related stress threatens the teacher supply: Key findings from the 2021 state of the US teacher survey. Technical Appendixes. Research Report. RR-A1108-1. RAND Corporation. The Inverness Institute. (2021). *Teachers reflect on a year of learning under Covid: A survey of California teachers by the Inverness Institute.* Retrieved from https://edsource.org/2021/teachers-reflect-on-a-year-of-learning-under-covid-california-teacher-consultant-response-network/648206;

In anticipation of the extraordinary challenges that characterized the 2020–2021 school year, many educators and administrators across thousands of districts in the country searched for effective educational resources to support learning and teaching. One such district was the Harlingen Consolidated Independent School District in Texas. Harlingen is a city (population of approximately 86,000) located in Cameron County, the southernmost county in the state of Texas, where 82 percent of the population are identified as Hispanic or Latino, and about 33 percent of the families have income below the poverty level.[5]

About 80 percent of the students in the district are eligible to participate in the free and reduced-price meal program,[6] and in fall of 2020, 61 percent of children in pre-K were classified as "at-risk," meaning that they did not perform satisfactorily on a readiness test or an assessment administered during the school year. Given the crucial role of early mathematics skills and knowledge in later academic success,[7] the early childhood education administrators in Harlingen specifically sought resources that could equitably strengthen these young children's foundational math knowledge while inspiring a love of math in their youngest learners (ages 3–4), and equip educators with insights about each learner's strengths and weaknesses as well as tools to provide personalized instruction for each student.[8] They identified Age of Learning's *My Math Academy* as the resource that could address their needs, based on previous studies of its effectiveness in helping young learners from Title I districts,[9] and piloted the program in 57 pre-K classrooms during the 2020–2021 school year. Like many school districts across the country, Harlingen began the school year with all students learning remotely, and teachers worked with individual students' families to ensure that each child could log in to the program from home. By the end of the school year, about 67 percent of the students had returned to in-person instruction while 30 percent continued in remote schooling.

## My Math Academy Program

*My Math Academy* is built on a patented Personalized Mastery Learning System™ (PMLS) designed to individualize instruction for learners.[10] Efficacy research conducted on *My Math Academy* has been reviewed by LearnPlatform as meeting ESSA Level I standards for "Strong Evidence," and the program uses the PMLS to help young children build a solid foundation of number sense and operations. The PMLS used in *My Math Academy* enables a Personalized Mastery Learning Ecosystem (PMLE), which consists of three components that work together to increase children's math skills and knowledge, as well as their motivation, confidence, and persistence in math learning. The three components are the child-facing Learning Games, the parent-facing At-Home Resources, and the educator-facing Teacher Dashboard.[8] The parent and educator resources provide real-time insights based on student performance data collected from the Learning Games.

The child-facing program features 98 games consisting of over 300 activities, covering concepts and skills for prekindergarten through 2nd grade. The patented PMLS™ underlying *My Math Academy* uses initial diagnostic assessments to measure each child's prior knowledge and determine where they are placed within the program, based on what they know and are ready to learn next.[11]

Evidence of learning on each granular Learning Objective is collected as the student plays, and as they progress in *My Math Academy*, the adaptive system uses their performance to recommend Learning Games at specific level of difficulty, based on a knowledge

5 U.S. Census Bureau. (2019). 2019 *American community survey single year estimates*. Retrieved from https://www.census.gov/newsroom/press-kits/2020/acs-1year.html

6 McFarland, J., Hussar, B., Zhang, J., Wang, X., Wang, K., Hein, S., Diliberti, M., Forrest Cataldi, E., Bullock Mann, F., & Barmer, A. (2019). The Condition of Education 2019 (NCES 2019-144). U.S. Department of Education. Washington, DC: National Center for Education Statistics. Retrieved from https://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2019144

7 Watts, T. W., Duncan, G. J., Clements, D. H., & Sarama, J. (2018). What is the long-run impact of learning mathematics during preschool?. *Child Development, 89*(2), 539–555. DOI:10.1111/cdev.12713

8 Thai, K.P. & Bang, H.J. (2022). *My Math Academy empowers pre-K and kindergarten teachers to provide personalized, equitable instruction to accelerate learning.* Research Report. Age of Learning, Inc. https://www.ageoflearning.com/case_studies/HARLINGEN_MM_ResrchBrf_RGB_FINAL4.pdf

9 Bang, H.J. & Li, L. (2020). *My Math Academy significantly accelerates early elementary children's math skills and fosters greater engagement in math: A replication of a randomized-control trial.* Age of Learning, Inc. Retrieved from: https://www.ageoflearning.com/My_Math_Academy_Research_Brief_2020.pdf; Thai, K.P., Bang. H.J., & Li, L. (2021). Accelerating early math learning with research-based personalized learning games: A cluster randomized controlled trial. *Journal of Research on Educational Effectiveness*. DOI: 10.1080/19345747.2021.1969710; ™ Dohring, D., Hendry, D., Gunderia, S., Hughes, D., Owen, V. E., Jacobs, D.E., Betts, A., & Salak, W. (2019). U.S. Patent No. 20190236967 A1.Washington, DC: U.S. Patent and Trademark Office.

10 Betts, A., Thai, K-P., & Gunderia, S (2021). Personalized mastery learning ecosystems: Using Bloom's four objects of change to drive learning in adaptive instructional systems. HCII 2021: *Adaptive Instructional Systems, Design and Evaluation, 29-52.*

11 Betts, A. (2019). Mastery learning in early childhood mathematics through adaptive technologies. In IAFOR (Ed.). *The IAFOR International Conference on Education – Hawaii 2019 Official Conference Proceedings* (pp. 51-63). Japan: The International Academic Forum.

map of Learning Objectives and their prerequisite relationships.[12] Within each activity, performance data is used to provide appropriate scaffolding, adjust difficulty, and offer formative feedback. Each game includes up to six Learning Activities at varying difficulty levels, including an in-game mastery check called the "boss" level. Students master the boss levels to demonstrate their skills and understanding, indicating that they are ready to move on to the next game. Figures 1 and 2 show examples of child-facing games in *My Math Academy*. For a description of the educator-facing Teacher Dashboard, see an earlier report of this study.[8]

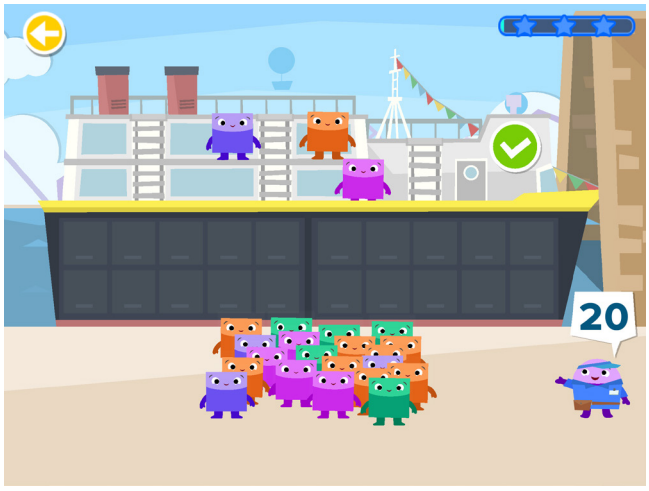


**Figure 1.** Students practice counting out quantities by helping the Shapeys do a head count for a boat ride.


**Figure 2.** Students practice backward count sequences by helping the Shapey place numbered rings on a line starting from the right side and traveling to the left by swinging on each ring.

## Participants

Across 17 high-need schools in Harlingen, a total of 976 prekindergarten students in 57 classrooms and their educators participated in a study of *My Math Academy* from September 2020 to June 2021. Most students (847) were four-year-old children in regular pre-K(4) prekindergarten programs, while 129 were three-year-old children enrolled in a pre-K(3) program partially funded by the U.S. Department of Health and Human Services' Head Start program. Although all students had access to *My Math Academy* for the entire school year, they began using the program at various times, with 8 percent starting in September and the majority (80 percent) starting between October and December of 2020.

## Procedures

Prior to the start of implementation, all pre-K(3) and pre-K(4) teachers participated in a two-hour virtual training on *My Math Academy*, which included video introductions (3 to 9 minutes each) of how *My Math Academy* works, the students' first-time user experience, and an overview of the Teacher Dashboard (student account management, exploring Dashboards, and how to get started). In between the videos, teachers participated in short virtual breakout rooms or answered reflection questions.

During the implementation period in November, teachers participated in another one-hour virtual training to gain further understanding of students' prior knowledge through the placement assessments into the *My Math Academy* system and to develop their skills in making effective use of the Teacher Dashboard, including interpreting the Student Progress Monitoring.

Teachers were asked to encourage each student to use *My Math Academy* for 45 minutes per week over multiple days (e.g., 15 minutes per day for three days a week). Each student was provided a district-issued iPad that had *My Math Academy* installed, and students used their individual accounts to log in, either at school or at home.

At the end of the study, teachers were asked to complete a survey and were invited to participate in a one-hour Zoom interview. The survey and interview

12 Mislevy, R. J., Almond, R. G., & Lukas, J. F. (2003). A brief introduction to evidence–centered design. ETS Research Report Series, 2003(1), i-29; Owen, V. E., & Hughes, D. (2019). Bridging two worlds: Principled game-based assessment in industry for playful learning at scale. In *Game-Based Assessment Revisited* (pp. 229-256). Springer, Cham; Shute, V. J. (2011). Stealth assessment in computer-based games to support learning. In S. Tobias & J. D. Fletcher (Eds.), *Computer Games and Instruction,* 503–524. Retrieved from http://myweb.fsu.edu/vshute/pdf/shute%20pres_h.pdf;

questions collected data on teachers' experiences of using *My Math Academy* during the 2020–2021 school year; their observations of student engagement, attitudes, and learning; and their thoughts on the impact of *My Math Academy*.

Additionally, the state of Texas administers the CIRCLE (Center for Improving the Readiness of Children for Learning and Education) Progress Monitoring System assessment three times a year to pre-K students. The CIRCLE is a screening and progress monitoring tool with well-established reliability and validity when used with 3- and 4-year-olds in that it relates to other tests and predicts child outcomes.[13] Early math subskills assessed included rote counting (count to the highest number in consecutive order), set counting (count a specified number of items and verbally express the total), number naming (name pictures of numbers), number discrimination (identify a number among pictures of numbers and non-numbers), shape naming (name pictures of shapes), shape discrimination (identify pictures of specific shapes among other shapes), and operations (use addition and subtraction to respond to a question while referring to pictures on the screen). The CIRCLE Progress Monitoring System provides three benchmarks: "On Track," "Needs Support/Monitor," and "Out of Range." "On Track" indicates that a child has developed understanding and that the child will benefit from continued targeted instruction. "Needs Support/Monitor" indicates an underdeveloped understanding. "Out of Range" indicates that the child is not within the specified age range or there are no established thresholds. These data were collected from the district when they became available in fall 2021.

## Results

**Finding 1.** Ninety-eight percent of students who used *My Math Academy (MMA)* regularly ended the school year "On Track" in math overall on the state-administered assessment.

The recommended weekly usage for *My Math Academy* was a minimum of 45 minutes, and over the course of the 2020–2021 school year, pre-K students used *My Math Academy* (n = 976) on average for 35 minutes per active week (SD = 40.6) over 30 active weeks (SD = 7.2). They spent, on average, 15.2 hours (SD = 11.2) using *My Math Academy* and completed an average of 201.02 Learning Activities (SD = 142.5).

Students who mastered at least 15 skills in the program, defined as regular users of *My Math Academy* (431 students, 44 percent of those who used the program), averaged 43 minutes per active week (SD = 15.1) in the program over 26 active weeks (SD = 5.5). Of these students, 421 took the CIRCLE Progress Monitoring assessment in spring 2021, and 98 percent of those scored "On Track" on the math assessment overall.

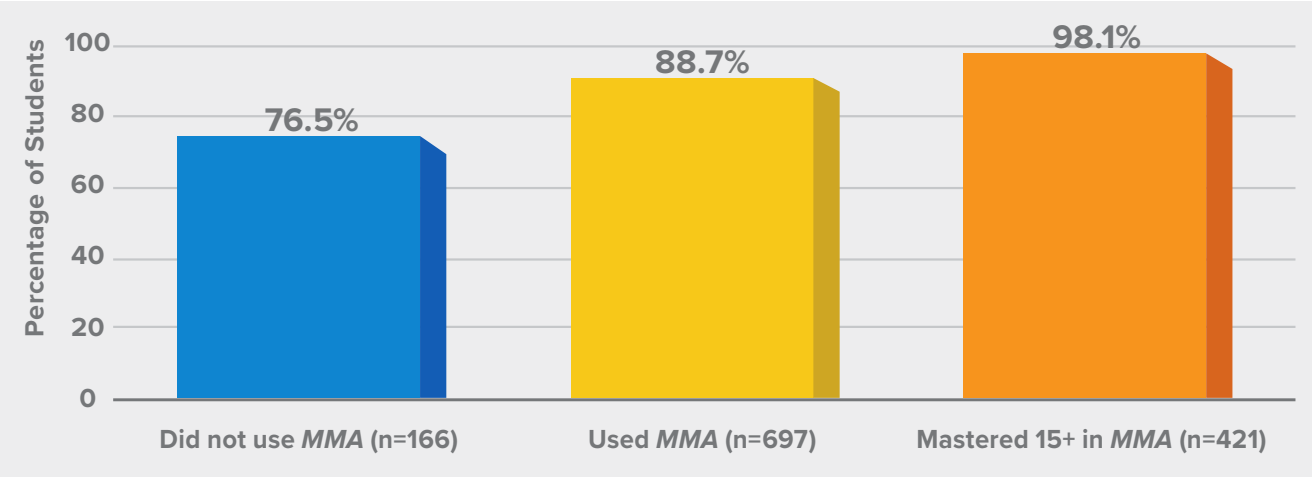


**Figure 3.** Comparison of students who used *My Math Academy* (~45 min/week vs. at all) to those who did not use the program

13 Assel, M. A., Montroy, J. J., Williams, J. M., Foster, M., Landry, S. H., Zucker, T., ... & Bhavsar, V. (2020). Initial Validation of a Math Progress Monitoring Measure for Pre-Kindergarten Students. *Journal of Psychoeducational Assessment, 38*(8), 1014-1032; Landry, S.H., Assel, M., Williams, J., Zucker, T.A., Swank, P.R., & Gunnewig, S. (2014). CIRCLE (formerly C-PALLS+STEM): The CIRCLE phonological awareness language and literacy system + science, technology, engineering and math. Children's Learning Institute: University of Texas Health Science Center;

**Finding 2.** Students who used *My Math Academy* were significantly more likely to end the school year "On Track" in math overall on the state-administered assessment than their peers who did not use the program.

Among those who used *My Math Academy*, 786 (81.5 percent) took the CIRCLE Progress Monitoring System assessment at the end of Spring 2021 after spending on average 35 minutes per week (SD = 15.6) on the program over 22 weeks (SD = 8.3). Of these students, a total of 697 (88.7 percent) ended the school year "On Track" in math overall. In contrast, 76.5 percent of students who did not use *My Math Academy* ended the school year "On Track" in math overall. Therefore, students who used *My Math Academy* at all were significantly more likely to end the school year "On Track" in math than their peers who did not use the program ($t(902) = 2.88$, $p < .01$, Cohen's $d = .25$). Those who used *My Math Academy* regularly (i.e., mastered at least 15 skills in the program) were even more significantly likely to end the school year "On Track" in math than those who did not use the program ($t(592) = 8.27$, $p < .001$, Cohen's $d = .76$). These results are illustrated in Figure 3 (p. 4). (Cohen's $d$ measures the size of the difference between two groups, and effect sizes of 0.25 or larger are "substantively important" according to the What Works Clearinghouse, a federal repository of research evidence on educational programs.)[14]

**Finding 3.** Students who used *My Math Academy* were significantly more likely to end the school year "On Track" in math subskills on the state-administered assessment than their peers who did not use the program.

Comparing students who used *My Math Academy* and those who did not on the math subskills assessed on the CIRCLE Progress Monitoring System assessment showed that those who used the program outperformed the nonusers on all seven subskills assessed. *My Math Academy* users were significantly more likely to end the school year "On Track" on four of the subskills than their peers not using the program: Rote Counting ($t(947) = 2.41$, $p < .05$, Cohen's $d = .21$), Set Counting ($t(942) = 2.90$, $p < .01$, Cohen's $d = .25$), Shape Naming ($t(948) = 2.24$, $p < .05$, Cohen's $d = .19$), and Shape Discrimination ($t(947) = 3.26$, $p < .01$, Cohen's $d = .28$).

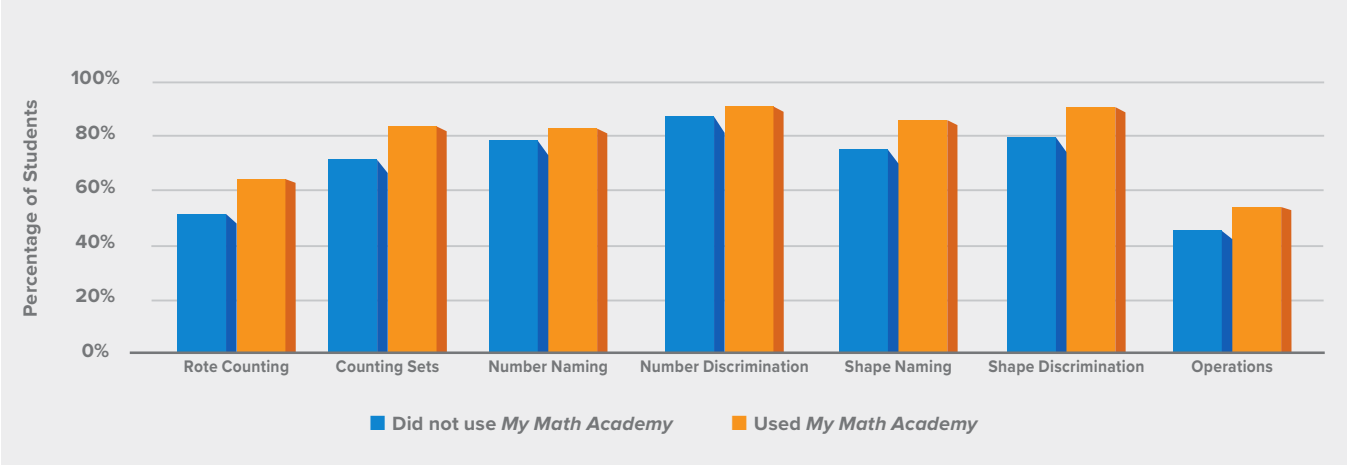


**Figure 4.** Comparison of students who used *My Math Academy* to those who did not on math subskills assessed on the CIRCLE Progress Monitoring System assessment

14 What Works Clearinghouse. (2020). What Works Clearinghouse Standards Handbook, Version 4.1. Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance. https://ies.ed.gov/ncee/wwc/Docs/referenceresources/WWC-Standards-Handbook-v4-1-508.pdf

**Finding 4.** Mastering skills in *My Math Academy* was significantly correlated with higher performance on the end-of-year state-administered assessment.

An examination of the relationship between *My Math Academy* usage and performance on the state-administered assessment showed a significant positive correlation between the total number of skills mastered in the program and the end-of-year performance ($r = .50$, $p < .001$).[15]

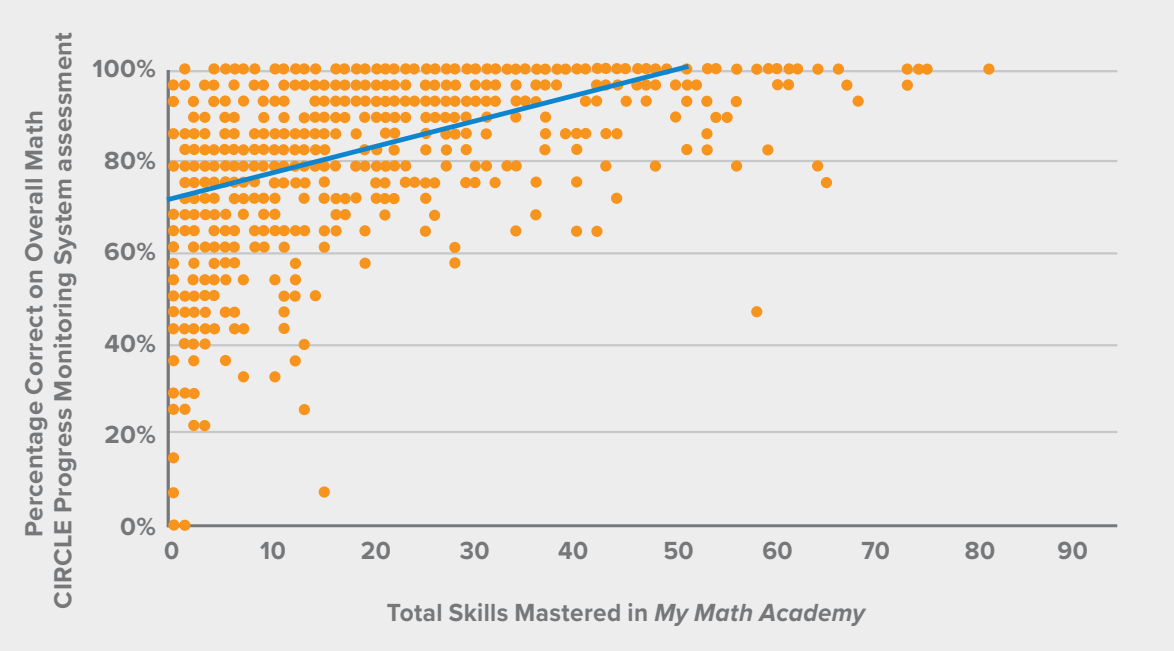


**Figure 5.** Relationship between total skills students mastered in *My Math Academy* and their overall math score on state-administered assessment at the end of the school year

## Teacher Reports

These results were corroborated by teacher surveys and interviews. For example, in a survey of 51 math teachers who used *My Math Academy* in early childhood classrooms in the same district in school year 2020–2021, 98 percent indicated that the progress that they saw for individual students in *My Math Academy* aligned with the progress they observed in the classroom. Additionally, 98 percent reported that *My Math Academy* helped increase their students' interest, self-confidence, and enjoyment in learning math, corroborating the results of earlier efficacy studies conducted on the program. Teachers also shared in interviews their thoughts about *My Math Academy*'s impact on their students.

> *"I attribute a large portion of their academic success this year especially in Mathematics to* My Math Academy. *The good thing is it doesn't just throw them into another concept. It takes a familiar concept, and then it builds on it, and that really helped. I really love its simplicity, its effectiveness; it was very user-friendly for all kinds of students, from the ones that came in with prior concepts to the ones that came in with none."*
>
> *—Kindergarten Teacher*

15 Correlation coefficients (r values) range from -1 to 1. Coefficients between .7 and .9 indicate strong relationship between variables; coefficients between .5 and .7 indicate moderate relationship; and coefficients lower than .3 indicate weak relationship.

> "My Math Academy *caught their attention, and it has maintained their interest throughout the year. That's the thing I'm really grateful for. They never got bored. They always looked forward to it because it wasn't the same thing over and over and over as I've seen with some other programs. They just really loved using that program, and it never got old.*"
>
> *—Kindergarten Teacher*

> "My Math Academy *keeps the kids practicing who are not up to where they need to be. Plus, it allows the kids that are higher up to continue. It doesn't hold them back. They can continue to practice new skills and to move forward.* My Math Academy *is not one that I ever got a complaint about. They really like it, and it has a lot of motivational things.*"
>
> *—Prekindergarten Teacher*

## Conclusion

The study results build on evidence from previous studies that using *My Math Academy* accelerates learning and increases students' engagement in math. This study provides even more robust evidence that *My Math Academy* is an effective learning tool that can be used at school and/or at home, considering the implementation of the program during a school year disrupted by the pandemic. Furthermore, the study confirms results of other studies that have demonstrated *My Math Academy*'s impact on students' interest, enjoyment, and confidence in learning math.

In sum, *My Math Academy* supports educators' instructional goals by accelerating students' math learning and helping them be on track to achieve in math. It empowers educators to provide personalized instruction that offers each child the opportunity to experience success in learning math. *My Math Academy* has also been reviewed by a third-party educational research company, LearnPlatform, as meeting ESSA Level I standards for "Strong Evidence." This study further strengthens the existing body of evidence on *My Math Academy* with the results from the state-administered assessment data.

## About Age of Learning School Solutions

At Age of Learning School Solutions, we aim to reimagine education, joining educators to deliver equitable solutions that accelerate learning for all students. Our student-first, standards-aligned digital education programs are proven to support students in achieving mastery and collectively accelerate learning gains. By providing personalized, easy-to-implement solutions, we support educators in delivering targeted instruction to address individual student needs, giving each child an engaging, customized path to learning success.

For more information on Age of Learning School Solutions, visit www.AgeofLearning.com/schools