INNOVATIVE MATHEMATICS PROGRAMS THAT PROMOTE CURIOSITY & JOY

Out-of-school learning opportunities can improve student academic achievement and support social–emotional learning.[1] Such programming is valued by the public and in high demand.[2] Teachers can also benefit from seeing students engage in learning in contexts that promote creativity, safe risk-taking, and a tolerance for ambiguity and failure.[3]

The need and demand for out-of-school programs is widespread. Surveys say the following:

- In 2017, 83 percent of respondents opposed cutting public funds for out-of-school programs.[4]
- In 2022, 24.6 million children were not able to access out-of-school programs. Demand was highest among Latine and Black families living in poverty.[5]

The COVID-19 pandemic caused a massive disruption in students' schooling experience. Mathematics scores on the National Assessment of Educational Progress (NAEP) in the 4th and 8th grades dropped sharply from 2019 to 2022—the biggest drop since 1990. Nearly two thirds of 4th and 8th grade students scored below the proficient level.[6]

There has also been an impact on teachers, who are leaving the profession at an unprecedented rate.[7] Those who remain are recovering from the trauma of the pandemic and shouldering the burden of understaffed schools.[8]

Students and teachers need ideas that extend beyond business-as-usual approaches. They need interventions that help participants discover joy in learning mathematics in ways that support development of mathematical and social–emotional skills. A recent survey demonstrates that that the latter is of particular concern to parents. A 2021 survey found that 80 percent of parents believe that social–emotional learning is more important in the wake of the pandemic and that it is not emphasized enough in school.

Parents want more social–emotional learning support.[9] A 2021 survey of parents found the following:

- Eighty-seven percent believe that social–emotional learning is important
- Eighty-two percent believe the importance has increased since the pandemic
- Eighty-one percent believe it is not emphasized enough

Out-of-school settings provide flexibility that classrooms cannot. This has the potential to create an environment that is highly responsive to the needs and interests of the participants. Without the pressure of having to adhere to covering material in a predetermined schedule, out-of-school programs can allow time for activities driven by curiosity, discovery, and innovation. Some programs also create an opportunity to experience learning as a social activity within a group that spans ages and expertise. The inclusion of communities, parents, and caregivers can improve relationships with teachers and schools. It also helps students see that everyone is a mathematical learner and expands the network of people supporting student learning and growth.

WestEd has produced profiles of five programs that all, in very different ways, create opportunities for students and/or teachers to build confidence in their mathematics abilities and increase their enjoyment in doing mathematics. These programs were utilized primarily in out-of-school or summer school settings, but they could also be implemented within the traditional classroom. Key features of the programs are summarized below; the full profiles include data on student and teacher experiences.

Findings

WestEd conducted high-level studies of the program by reviewing previous data, conducting student and teacher surveys, observations, and teacher interviews. The findings support the premise that nontraditional mathematics activities are effective strategies to create positive learning and teaching mathematics environments.

All five programs **increased students' positive attitudes about mathematics** and **increased teachers' enjoyment of teaching mathematics.** Teachers reported that a subset of the programs—Math for Love, Math Teacher Circles, and NBA Math Hoops—**increased student understanding and skills**. Math for Love and Math Teacher Circles were shown to have **impacted teachers' instructional practices.**

Table 1. Student Findings

	Increased students' positive attitudes about mathematics	Increased student understanding and skills
Almost Fun	•	
Julia Robinson Mathematics Festival	•	
Math for Love	•	•
Math Teacher Circles	•	•
NBA Math Hoops	•	•

Table 2. Teacher Findings

	Increased teachers' enjoyment of teaching mathematics	Impacted teachers' instructional practices
Almost Fun	•	
Julia Robinson Mathematics Festival	•	
Math for Love	•	•
Math Teacher Circles	•	•
NBA Math Hoops	•	

A common theme across the programs was that participants had fun and found the mathematics interesting. The following characteristics emerged as factors that contributed to that outcome:

- Four of the five programs used **games** to motivate students' initial interest. Games can support students in developing mathematical skills and reasoning[10] and generally help students remain focused and promote positive attitudes toward learning.[11]
- When the programs in this study were implemented well, the participants were not rushed. They had **time** to play, become puzzled, and then ask questions to try to understand why something was working the way it was.
- Participants in the programs experienced mathematics within different **contexts**—sometimes

literally in a different space (e.g., occurring in the gymnasium rather than in a classroom, in a group of other teachers, online, in a summer school program, etc.). These different contexts created the room for participants to try out something new with mathematics without the limitations of their previous experiences in mathematics classrooms.

Program Features

Almost Fun

This web-based mathematics program provides key skill and problem-solving tools when students need support or practice with a skill or concept. It is especially designed for marginalized students and to help reduce student mathematics anxiety with the use of familiar and culturally responsive contexts and analogies.

Cost: Free

Grades: Middle and high school

Access: Students can use the program on their own. Data indicate that most use occurs at night, which is a sign that it is being used to help with homework. Students can also participate in real-time Discord groups. Teachers can access lessons with Common Core State Standards–aligned instructional guides to accompany the lessons.

Julia Robinson Mathematics Festival (JRMF)

This nonprofit organization provides materials and guidance to support schools and communities to host play-based events that capture students' curiosity and foster students' problem-solving skills.

Cost: Offers free materials with options for services and kits for a fee.

Grades: K–12

Access: Schools or organizations wishing to host a Mathematics Festival can download materials and request a free consultation or can pay a fee to have JRMF host the event for them.

Math for Love

This program offers games and activities designed to spark students' curiosity, encourage them to struggle with new mathematics concepts and skills, and build their mathematical understanding through playful explorations.

Cost: Many free games and materials are offered, with some additional games and activities available for purchase.

Grades: Primarily K–5

Access: Math for Love offers curricular materials designed for classroom use or summer mathematics programs; teacher professional development related to these materials is also available. Parents and schools can also purchase individual games or use the free materials on the website.

Math Teacher Circles

Mathematicians and mathematics educators work together in solving nonroutine and challenging problems to develop new understandings of mathematics and teaching methods.

Cost: Free unless there are local costs

Grades: Educators

Access: Mathematicians and mathematics educators self-organize circles.

NBA Math Hoops

This is a basketball-themed board game in which students play in pairs to "draft" NBA and WNBA players and solve problems by applying mathematical skills. It supports team building, social–emotional learning, and strategic thinking.

Cost: Materials for schools are available for a fee. An app for individual play is free.

Grades: 3–8

Access: Schools host and support teams locally and can participate in NBA Math Hoops events. Students can also play individually on the app.

References

[1] Durlak, J. A., Weissberg, R. P., & Pachan, M. (2010). A meta-analysis of after-school programs that seek to promote personal and social skills in children and adolescents. *American Journal of Community Psychology*, *45*(3–4), 294–309. https://doi.org/10.1007/s10464-010-9300-6

McCombs, J., Whitaker, A., & Yoo, P. (2017). *The value of out-of-school time programs.* RAND Corporation. https://www.wallacefoundation.org/knowledge-center/Documents/The-Value-of-Out-of-School-Time-Programs.pdf

[2] McCombs et al. (2017).

[3] Lenowitz, G., & Magneson, B. (2021, October 18). Analysis: Out-of-school STEM programs inspire, empower and engage children. What teachers can learn from them. *The 74.* https://www.the74million.org/article/lenowitz-magneson-out-of-school-stem-programs-inspire-empower-and-engage-children-what-teachers-can-learn-from-them/

[4] Quinnipiac University Poll. (2017, March 24). *American voters want to save Big Bird, Quinnipiac University national poll finds; most oppose spending cuts in Trump budget* [Poll release]. https://poll.qu.edu/Poll-Release-Legacy?releaseid=2444

[5] America After 3PM. (n.d.). *Special report: Promoting healthy futures.* Afterschool Alliance. http://www.afterschoolalliance.org/AA3PM/

[6] Result for the National Assessment of Educational Practice can be reviewed at https://nces.ed.gov/nationsreportcard/.

[7] Barnum, M. (2023, June 27). The teaching profession is facing a post-pandemic crisis. *Chalkbeat.* https://www.chalkbeat.org/2023/6/27/23774375/teachers-turnover-attrition-quitting-morale-burnout-pandemic-crisis-covid

[8] Walker, T. (2022, February 1). Survey: Alarming number of educators may soon leave the profession. *National Education Association.* https://www.nea.org/advocating-for-change/new-from-nea/survey-alarming-number-educators-may-soon-leave-profession

[9] McGraw Hill. (2021, September 27). *New K–12 survey: Social and emotional learning gains awareness and prioritization amid COVID-19 pandemic* [Press release]. https://www.mheducation.com/news-insights/press-releases/social-and-emotional-learning-survey-2021.html

[10] Buchheister, K., Jackson, C., & Taylor, C. (2017). Maths games: A universal design approach to mathematical reasoning. *Australian Primary Mathematics Classroom*, *22*(4), 7–12.

[11] McKenzi, J. (2020). *The impact of game-based learning in a special education classroom* [Master's thesis, Northwestern College, Iowa]. NWCommons. Available at: https://nwcommons.nwciowa.edu/cgi/viewcontent.cgi?article=1240&context=education_masters

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