

# MATH TEACHER CIRCLE PROGRAM PROFILE



A Math Teachers Circle (MTC) is a locally organized collaborative community comprising teachers (elementary and secondary) and career mathematicians (e.g., mathematics professors). The American Institute of Mathematics hosts the Math Circle Network, which supports a national network of MTCs as well as similar groups for students. MTCs are designed for teachers who are interested in solving nonroutine and challenging problems to develop new understandings of mathematics and new teaching methods that engage students in doing joyful mathematics. The purpose of these communities is to foster the enjoyment of mathematics and problem-solving.

MTCs meet at regular intervals to do fun and interesting mathematics problems together. Each MTC meeting is collaboratively planned and facilitated by a teacher and a mathematician. While engaging in mathematics, MTC participants informally discuss problems of practice and pedagogy.

The topics are driven by teacher interest, which results in variation across different MTCs. Several MTCs have a focused interest on a topic, such as mathematics for social justice or specific mathematical domains. Others might focus on certain grades or might not have any particular focus beyond interesting nonroutine problem-solving.

Below, we share how teachers' participation in MTCs influenced teachers' and students' math learning and enjoyment based on interviews with nine teachers and five leaders from three MTCs, 39 survey respondents representing 20 MTCs, and participant-observation field notes from one MTC's summer immersive program.

This is a product of the Overdeck Family Foundation funded Math ReEngagement Project that profiled innovative math programs that can be used outside the school day. WestEd conducted high-level studies of each program by administering student and teacher surveys and organizing observations and/or teacher interviews. Learn more about this work and view other profiles at: [WestEd.org/MathReEngage](https://www.wested.org/MathReEngage).

## In what ways does participating in Math Teacher Circles influence student and teacher math learning and enjoyment?

### Math Teacher Circles Promote Teachers' Learning of Mathematics

MTC meetings are typically designed so that each session is centered around a rich and interesting mathematics problem. For instance, the [MTC for Social Justice \(Connecticut\)](#) hosts a monthly meeting where a group of teacher-leaders facilitates a rich problem that illuminates and/or investigates a social justice issue. Other MTCs investigate mathematics problems that are interesting in their own right, such as the Jumping Kangaroos Task (pictured at right).

As teachers engage in the interesting and nonroutine problems, they learn to see and understand mathematics in new ways. During one MTC meeting, the facilitator opened the session by stating the following: "You may learn something that you can take into your classroom, but you don't have to think about your classroom. You can do it just for your own learning." Across our interviews and in survey responses, MTC participants emphasized an appreciation for doing mathematics that is new to them because this supported them to empathize with how their own students may feel while learning new mathematics ideas. For instance, teachers made the following remarks:

It helps me to keep the feeling of what it is like to be learning something for the first time, for things not to make sense immediately.

#### HIGH SCHOOL TEACHER

It is just fun to go! And it's a break from the regular type of PD where I'm just listening. . . . I'm really acting like the student.

#### HIGH SCHOOL TEACHER

MTC participants consistently shared that, through the exploration of novel problems and how the facilitators engaged participants, they developed new understandings of what it means to do mathematics. One teacher emphasized that by participating in the MTCs, they came to understand mathematics to be a social activity about sense-making rather than carrying out routine procedures. Similarly, teachers in the MTC for Social Justice emphasized that their participation provided consistent reminders that mathematics is more than a collection of rules; it is a collection of tools to think about, make sense of, and understand real-world phenomena and, particularly, to illuminate and respond to issues of social justice. In our interviews, teachers said that MTCs supported their understanding of particular mathematics content and, more importantly, expanded their understanding of mathematics as a field.

### JUMPING KANGAROOS TASK

#### Directions

Set the markers/tokens up as in the picture and try to make the kangaroos swap positions. Count the number of moves.



- Kangaroos can move to open spaces.
- Kangaroos can jump over an oncoming kangaroo.

#### Investigate

- How many moves would it take to move the kangaroos when there are 1, 2, 3, 4, 5, 6, and 7 kangaroos on each side? 10? 100?
- Could the puzzle still work if you had 3 kangaroos on one side and only 2 on the other?
- How many kangaroos were on each side originally if you needed 999,999 moves to exchange sides?

The Jumping Kangaroos Task, from [maths300.com](https://maths300.com), is an example of one type of novel and interesting problem that teachers investigated in one MTC that participated in our study. Tasks such as these promote problem-solving and systematic thinking. Patterns found through this task can lead to the exploration of quadratic functions.

Find more tasks used in MTCs at [mathcircles.org](https://mathcircles.org).

### **Math Teacher Circles Promote Teachers' Joy in Teaching Mathematics**

Across the interviews and survey responses, MTC participants shared that their participation in the MTC promoted joy in their teaching and felt that it helped their teaching become more fulfilling and personally rewarding. Teachers' statements included the following:

It activates that spark to teach math. It is fun to do the problems, students can see the spark and my enthusiasm.

#### **HIGH SCHOOL TEACHER**

It is rewarding and personally fulfilling to work on the social justice project.

#### **MIDDLE SCHOOL TEACHER**

Teacher circles help [me] to understand the world around us, and I feel more connected to my students, to my job. [I feel] more fulfilled when students see the connection with the math lesson and social studies.

#### **PRECALCULUS TEACHER**

Overall, as these quotes exemplify, teachers' participation in the MTCs supported teachers to feel reenergized to teach mathematics and provided a source of enthusiasm.

### **Math Teacher Circles Impact Teachers' Practice**

Teachers reported that experiences in the MTCs impacted their teaching practices. Teachers described that both the instructional practices and the tasks they used were influenced by their participation in the MTC. One common theme for why teachers joined their MTCs was to gather new types of experiences for their students. For instance, one teacher joined a specific MTC session to learn how to help their students make sense of the mathematics being discussed in the news during the COVID-19 pandemic. Other teachers shared that they sought out the MTCs because they wanted support to take "real-world math" to their students. The community of educators provided by MTCs creates a support network for teachers to try out new ideas in their teaching—particularly those that their students would find interesting and/or relevant.

MTCs support teachers to make shifts in their teaching practices. The MTC facilitators we spoke with shared that as teachers participate in the MTCs, they gradually make changes to their teaching practices, yet "the changes in classroom practice might not be detected by the teachers themselves" because the MTC can "instill a type of new way of being with mathematics—teachers might not sense the subtle changes and habits of mind that they are bringing to their students" (MTC facilitator). MTC facilitators noted that over time they notice shifts in teachers' attitudes about and relationship with mathematics as they engage with tasks during the meetings.

Most of the teachers we spoke with shared that their participation in the MTCs supported changes to their teaching practices. They were supported by experiencing new instructional strategies, learning how to use new materials (e.g., manipulatives), and understanding the research that motivates more ambitious forms of mathematics instruction. For instance, teachers reported learning about

the importance of productive struggle in learning mathematics and then being willing to implement mathematical modeling tasks and open tasks after participating in several MTCs.

Although the MTCs do not always directly discuss issues of pedagogy, by engaging in problem-solving with skilled facilitators, the MTC participants learn how to engage their own students in problem-solving through an apprenticeship of observation. For instance, during the facilitation of the Jumping Kangaroos Task (pictured on page 2), this researcher documented several pairs of teachers struggling to find a pattern. Rather than point out that their numbers were not correct or that their method was wrong, the facilitator pointed to a line on their paper and stated, “Can I challenge you to do this in three fewer jumps?” In an interview, the facilitator shared that she challenged one pair because she wanted to honor their thinking—“the number of jumps they had was possible, but it wasn’t the fewest.” In that move, the facilitator provided them the answer by stating three fewer but encouraged them to focus on the method they were using. By participating in MTCs with skillful facilitation, teachers reported picking up similar teacher moves and replicating them in their own classrooms.

### Mathematicians and Teachers Benefit From Interaction

MTCs are thoughtfully enacted to support teachers’ learning, taking up of new instructional strategies, and bolstering of their mathematics-teacher identities. Overwhelmingly, teachers shared that they felt valued in a space with career mathematicians. These collegial interactions improved their mathematics confidence and self-efficacy in teaching mathematics. Teachers shared that although they sometimes struggled during tasks, they always felt supported. For instance, teachers stated the following:

We feel like a family. Nobody is there to judge you. It is always positive and encouraging. I’ve never had a bad experience.

#### MIDDLE SCHOOL TEACHER

The Math Teacher Circle is the math class we wish we’d had when we were in school.

#### ADULT EDUCATOR

Mathematicians also shared stories of learning new approaches to mathematics problems from the teachers in the MTCs. Overall, teachers and mathematicians shared a sense of true gratitude to hear and learn from one another’s ways of thinking.

Math Teacher Circle brings a new perspective. When I first started teaching, 22 years ago, it was the way my prior teachers did. . . . It was always teacher driven. This has made me be more open to doing groupwork. They are allowed to talk. There is more academic talk and I am confident to trust the student. Trust they will do x, y, and almost z. I can see them not waiting for me to do it, but taking the initiative. Make it fun for me and then it is fun for them.

#### MIDDLE AND HIGH SCHOOL TEACHER

### Math Teacher Circles Tasks Promote Students’ Engagement and Curiosity

As stated earlier, teachers tended to join MTCs because they were looking for new ways to engage their students. The teachers in MTCs have a desire for students to see mathematics as useful and interesting. The teachers we interviewed reported that when they use the tasks from the MTC sessions,

their students are more curious than during a typical lesson—this was true for lessons that were more gamelike (e.g., Jumping Kangaroos) as well as for tasks that highlighted issues of social injustice. Teachers also reported that by having their students engage in the more open tasks promoted by MTCs, their students have more of a willingness to “play and explore” with the mathematics during a more typical mathematics lesson.

MTC is like being in “relationship therapy” for mathematics teachers, or elementary teachers. And this math camp is like a “spa day” to help teachers do new mathematics and to see mathematics in new ways.

#### TEACHER EDUCATOR

### Implications and Next Steps

MTCs create a space for teachers to learn new mathematics content while also learning what it means to do mathematics. Teachers were overwhelmingly positive about the impact of the program on their

own mathematical identities and relationships with the discipline of mathematics. MTCs help reinvigorate the joys of teaching and doing mathematics. In turn, teachers bring new and joyful experiences to their students. Supporting teachers to explore mathematics through problem solving leads to student learning and enjoyment, and it fosters positive mathematics identities for teachers and students!

Find an MTC in your area—or learn how to start one—by visiting [mathcircles.org](https://mathcircles.org).

LEARN MORE AT [mathcircles.org](https://mathcircles.org)



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This research project is supported by Overdeck Family Foundation, which focuses exclusively on enhancing education, funding efforts both inside and outside of school in the areas of early childhood, informal STEM education, and K-9 programs that include supporting educators and student-centered learning environments. For more information, visit [overdeck.org](https://overdeck.org).