

Final Report  
**National Association of Math Circles**  
**H98230-15-1-0208**

## **End-of-Year Report**

### **NSA-MEPP Grant H98230-15-1-0208**

NSA-MEPP Grant H98230-15-1-0208 funded the Math Circle Grant Program administered by Mathematical Sciences Research Institute (MSRI) in conjunction with the National Association of Math Circles (NAMC), an organization operated by MSRI. The principal aim of the Math Circle Grants' Program was to start, sustain, and assess new Math Circles around the country. The Math Circles that benefited offered extracurricular mathematics education to hundreds of K-12 students and teachers annually with the ultimate goal of fostering their interest in mathematics and mathematically intensive STEM disciplines. The program has funded 91 Math Circles through 151 separate grants since 2010.

Math Circles are a form of education outreach and enrichment through which mathematicians and mathematical scientists share their passion with K-12 teachers and students. The Math Circle landscape includes two types of programs that can operate standing alone or in coordination: Math Students' Circles and Math Teachers' Circles. Math Circles bring K-12 students or K-12 mathematics teachers together with mathematically sophisticated leaders in an informal setting, after school or on weekends, to work on interesting problems or topics in mathematics. Math Circles combine significant content with a setting that encourages a sense of discovery and excitement about mathematics through problem solving and interactive exploration. Ideal problems are low-threshold, high-ceiling; they offer a variety of entry points and can be approached with minimal mathematical background, but lead to deep mathematical concepts and can be connected to advanced mathematics.

Math Circles spread to the United States from Eastern Europe in the 1990s. Today, more than 180 Math Circles are operating across the country. Since 1994 more than 210 Circles have registered with the NAMC at their website, [www.mathcircles.org](http://www.mathcircles.org). Math Circles adopt a range of practice in terms of venue, the grade level and backgrounds of participants served, and the types of mathematical professionals who are engaged. In some, but not all settings, Math Students' Circles and Math Teachers' Circles affiliate their activities. Math Circles are designed to provide an easy entry point for mathematicians with limited experience working in K12 mathematics outreach.

The Math Circle Grant recipients are required to complete a final report. These reports provide the initial survey of the Math Circle community, showing the distribution of funds and resources used for different Math Circles. We are currently working to expand these smaller scale surveys to a larger national survey that will provide insight into the general trends and values shared by the ongoing Math Circles.

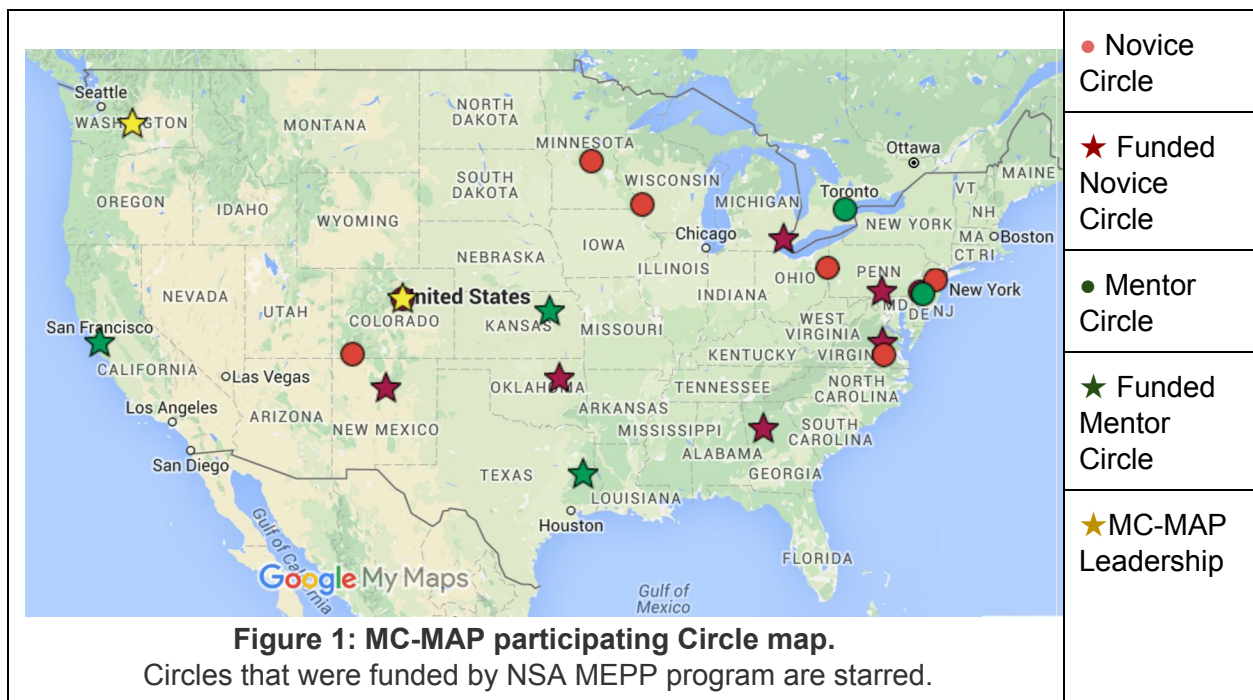
## Summary of 2015-16 Math Circle Mentorship and Partnership (MC-MAP) program

*“I thought that the program was useful to me as a novice Math Circle organizer. The wealth of resources and materials that were shared was for me, the most useful part of the program. I was able to use directly or modify many of these resources for my sessions or direct potential guest speakers to these resources as examples of what we could do during sessions. The webinars were also useful and informational.” 15-16 MC-MAP participant.*

NAMC piloted the Math Circle Mentorship and Partnership (MC-MAP) program as an extension of the Math Circle Grant Program to facilitate opportunities for informal training of Novice Math Circle leaders by experienced Math Circle leaders. This program supported six Novice Math Circles and three Mentor Math Circles with funding from the National Security Agency for the 2015-2016 pilot year. An additional eight teams participated in the training program without additional funding support.

### Program Participants

A group of thirty-nine mathematicians and educators from across the country participated in the MC-MAP program. These leaders represent fourteen novice Math Circle leadership teams that have come together in partner teams to develop the academic and administrative components for a local Math Circle, as is shown in the map below these selected Circles represent interest across the country in developing Math Circle programs.



The MC-MAP yearlong program provided training and structured planning time for novice Math Circle leaders in academic, pedagogical, and administrative components of Math Circles. Mentees learned effective teaching techniques, shared resources for finding quality Math Circle lessons, and gained knowledge of effective support for Math Circle leaders.

To complete the training the 2015-2016 program leveraged the resources of NAMC with further material development for Novice Circles, a three-day MC-MAP Workshop in September, a regular webinar training and regular check-ins between mentors to assist in the progress of creating a new Math Circle. Additional details of each of these program components are provided below.

### **Material Development**

An extensive sixty-page training manual was prepared for the MC-MAP training teams. The manual includes recommendation for creating initial Math Circle program structures, tips for instructing at the Math Circle sessions, and a review of other areas of support. To support the manual, a folder of related documents was collected, reviewed and shared by Dr. Wieggers electronically to provide the Novice Math Circle leaders a set of starting materials for initial Math Circle planning. After the workshop in September, more than 80% of the participants indicated that these are enough resources to start their program. Specifically, several different novice leaders mentioned that these resources were the support that they had been missing for planning their Math Circle, and they looked forward to using the resources throughout the year as they continued to prepare to begin their new outreach endeavours.

We envision that both of the training manual and electronic resources will continue to grow over the next several years as other experienced Math Circle leaders across the country contribute to and support this project. Based on feedback and input from the 2015-16 MC-MAP teams, we have developed and refined the materials to supplement the 2016-2017 MC-MAP cohort.

### **2015 Training Workshop - September 10-12, 2015**

The MC-MAP program is organized around and powered by relationships. The September workshop provided the initial introduction between leaders of established Math Circles with leaders of novice Math Circles. The workshop was designed to nurture rapport and community among program participants as well as to demonstrate the kinds of informal, discovery-oriented learning experiences that are at the heart of Math Circles. This shared workshop allowed mentors and mentees to meet in person, and begin to establish a strong working relationship through structured planning and shared experiences. Novice Math Circle leaders were able to take advantage of the expertise of their more experienced peers through a variety of contexts during the meeting: structured planning sessions, guided observation and structured debriefing of a demonstration Math Circle session, and an opportunity to practice important skills via a one-day Julia Robinson Math Festival open to local students. These experiences supported the mentees in learning effective teaching techniques, sharing resources for finding quality Math Circle lessons, and gaining knowledge about effective support for Math Circle leaders that will be facilitating sessions at their Math Circle. In addition the workshop sessions addressed logistical issues (e.g. fundraising, recruiting and advertising, administrative essentials and emergency plans); effectively facilitating a meaningful experience for participants; and content issues (how to develop or identify a rich problem or activity). When asked about this workshop one participant said, "*What a great opportunity. We almost never get to sit 'outside' a learning environment to watch, learn, and discuss.*"

As mentioned above, to support the training experience of the workshop participants the NAMC supported CU Denver in organizing their first ever Julia Robinson Math Festival in Colorado. The festival was financially supported by the Julia Robinson Math Festival organization and directed by Dr. Diana White and Dr. Michael Ferrara with support of local teacher Lorraine

Garrison and NAMC associate director Dr. Brandy Wieggers. The morning event brought together 324 students from seven middle schools across the greater Denver metro area. The seven schools were selected to take field trips to attend the festival based on either the socioeconomic (an average of 33% of the students on free and reduced lunch) status, racial profile, or academic success of the students at the schools (one-third these schools have less than 50% of their 8th grade students scoring proficient levels on standardized tests). Workshop participants found that working with the middle school students was helpful for their development as Math Circle leaders. Students defied their expectations of middle school student behavior with their focus on the problems and enthusiasm. As stated by one participant, *"The Julia Robinson Math Festival ... gave practice on Math Circles mentality."*

At the end of the workshop, participants took a post-survey. Feedback from the survey was almost uniformly positive, with all participants stating that overall the workshop and the resources they acquired were very useful to them. They were excited about meeting other professionals working with Math Circles and building relationships with other participants. Eighty percent of participants indicated that the Julia Robinson Math Festival was useful to their Math Circle development and organization. Seventy-seven percent of participants indicated that the Rocky Mountain Math Teachers' Circle observation was useful as well. As stated by one participant, *"It is easy to say that you want to help children learn mathematics and problem solving in a different way. The workshop is practically a complete bridge between talking about it and doing it."*

### **Continued Yearlong Mentorship: MC-MAP Listserv, Webinar, and Mentor/Mentee Support**

While the MC-MAP training materials and workshop were a strong start to the MC-MAP program, the support to the novice Circle leaders continued throughout the year. Regular contact was maintained through the MC-MAP listserv and periodic training webinars:

- Math Circle Safety & Logistics (October 2015) <https://youtu.be/CPENXVRiQ0Y>
- Mentor & Novice Check-in (Winter 2016)
- Grant Writing (February 2016) <https://youtu.be/zaeN0GThviY>
- Wrapping up your Math Circle for the year, including tips on evaluation (April 2016) <https://youtu.be/U0XFb2YefmE>

Novice Math Circle leaders had requested these topics, and new webinars are under development. In particular, Training Math Circle Facilitators (August 2016) <https://youtu.be/tdw9xxIDQYw>, is a new addition for the 2016-2017 MC-MAP cohort.

### **Exchange Program**

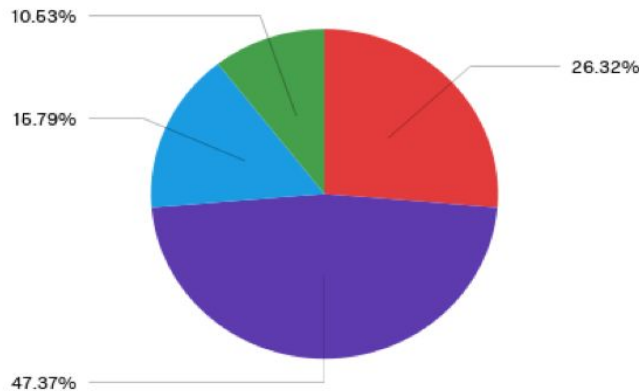
A final component of the MC-MAP 2015-16 program was five Math Circle exchange visits. These programs send a leader from one Math Circle to present or observe another Math Circle. The reports from these visits indicate that the visits meet their goal of providing a forum for an exchange of ideas that enhances the activities of both Math Circles involved. One participant shared, *"The MC-MAP program provided a great opportunity to learn from seasoned circle leaders. The Mentor- Mentee idea has been a value asset to us as we continue learning from our mentor back home."*

### Impact of the 2015-16 MC-MAP program

*“This program pointed out many potential pitfalls and difficulties in running a math circle; this was invaluable to someone completely new to math circles like me. More importantly, I’m now connected with a community and we’ll continue to share our passion for math circles in the future!” 15-16 MC-MAP participant.*

In Spring 2016, NAMC completed a survey of all Novice Math Circle teams to detail their MC-MAP experience.

The twenty-two 2015-16 MC-MAP participants found the supports provided through the program to be highly useful. The workshop, associated resources, and webinars being some of the most useful aspects for their work in developing Math Circles. This was complemented by the fact that over 74% of the participants now feel prepared to run an outreach program, as seen in the figure below:



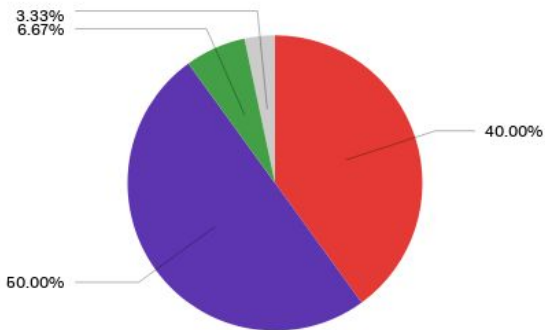
To understand the impact of the 2015-16 program we can compare the pre-surveys for the 2016-17 cohort to the post-surveys of the 2015-16 cohort. This allows us to see the average attitudes of preparedness of participants entering the MC-MAP program, compared to where they left the program.

**How prepared do you feel for the following components of your Math Circle program?**

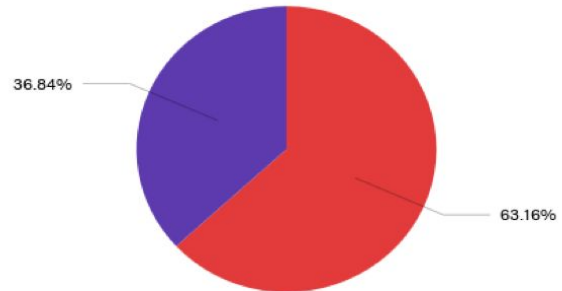
■ Extremely prepared    ■ Somewhat prepared    ■ Neither prepared nor unprepared  
■ Somewhat unprepared    ■ Extremely unprepared

**How prepared do you feel for the logistics of running a Math-Circle**

**2016-17 Pre-survey**



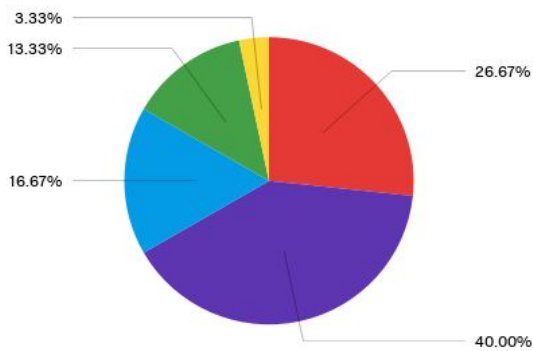
**2015-16 Post-survey**



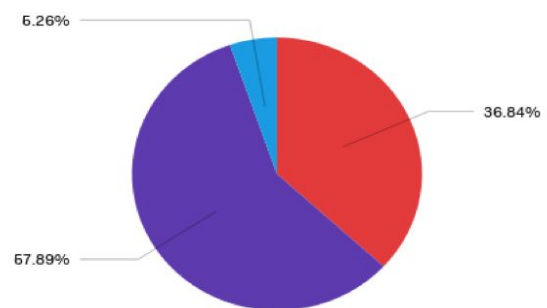
While participants overall start the program somewhat prepared for the logistics of running a Math Circle, they all end the program more prepared.

**How prepared do you feel for creating a budget and managing finances**

**2016-17 Pre-survey**



**2015-16 Post-survey**

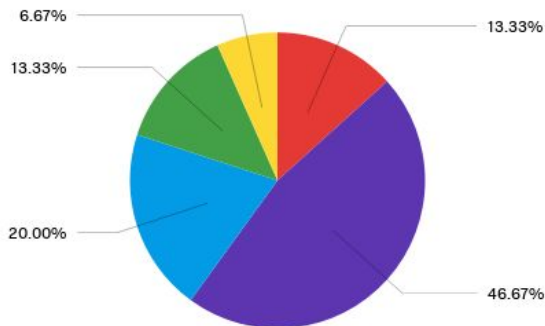


Similar patterns happened with the budget and finances, participants overall start the program somewhat prepared for creating a budget and managing the finances of a Math Circle, and they all end the program more prepared, and you'll see in the next graph they are also more prepared for grant writing and fundraising.

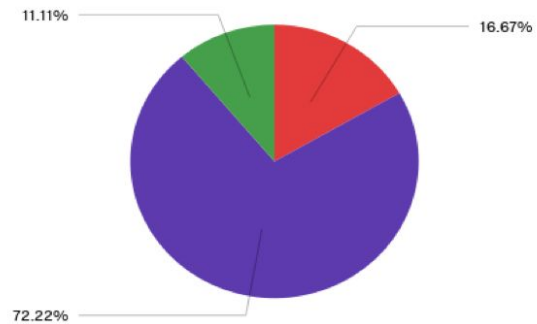


## How prepared do you feel for writing a grant/fundraising?

### 2016-17 Pre-survey



### 2015-16 Post-survey



In these graphs we can see Math Circle participants gained confidence in all areas for being more prepared for Math Circle work.

Beyond the information provided by these surveys, phone interviews were conducted with the three primary program mentors to gather feedback and recommendations for further MC-MAP work. We look forward to using this feedback to continue to improve the NSA MEPP-supported MC-MAP program in future years.

### Conclusion

In addition to the hands-on experiences of the Julia Robinson Math Festival and Rocky Mountain Math Teachers' Circle observation, participants spent time planning with their leadership teams, receiving feedback from their mentors and other participants, learning about available resources for planning sessions, and hearing about other resources available to them from NAMC and other organizations whose missions overlap with ours. Throughout the academic year we continued to provide support through a listserv and monthly webinars, as well as by having mentors and novice Math Circles visit each other to exchange ideas. The MC-MAP Workshop successfully kicked off our year-long program, and we hope to repeat each year with a new cohort of novice Math Circles.



## Summary of MC-MAP 2015-2016 Participants:

### Organizers:

- Dr. Diana White, Director of the National Association of Math Circles and Associate Professor at the University of Colorado Denver
- Dr. Brandy Wieggers, Associate Director of the National Association of Math Circles and Assistant Professor at Central Washington University

### Master Mentors:

- Dr. Amanda Serenevy, Riverbend Community Math Center
- Josh Zucker, MS, Julia Robinson Math Festival

### Math Circle mentors:

- Lorraine Garrison, York International School
- Dr. Jane Long, Stephen F. Austin State University
- Dr. Natasha Rozhkovskaya, Kansas State University
- Addie Schnirel MS, San Francisco State University Center
- Rodi Steinig MS, Talking Stick Learning Center
- Dr. Maria Wesslen, University of Toronto Mississauga

### Novice Math Circle leadership teams from the following 14 institutions:

- Colorado School of Mines
- Emory University
- Fort Lewis College
- Randolph-Macon College
- Rutgers University
- Santa Fe Preparatory School
- Shippensburg University
- St. Cloud State University
- University of Michigan - Dearborn
- University of Tulsa
- University of Wisconsin-La Crosse
- Villanova University
- Virginia State University
- Youngstown State University