

# Journal of Math Circles

---

Volume 2  
Issue 2 *Special Issue: Math Circles in Times of  
Physical Distancing*

Manuscript 1036

---

February 2022

## Incorporating Social Justice and Equity as Themes in Math Circles Online

Matthew Jones  
*California State University, Dominguez Hills*, [mjones@csudh.edu](mailto:mjones@csudh.edu)

Sharon Lanaghan  
*California State University, Dominguez Hills*, [slanaghan@csudh.edu](mailto:slanaghan@csudh.edu)

Carolyn Yarnall  
*California State University, Dominguez Hills*, [cyarnall@csudh.edu](mailto:cyarnall@csudh.edu)

Follow this and additional works at: <https://digitalcommons.cwu.edu/mathcirclesjournal>



Part of the [Science and Mathematics Education Commons](#), and the [Secondary Education and Teaching Commons](#)

---

### Recommended Citation

Jones, Matthew; Lanaghan, Sharon; and Yarnall, Carolyn (2022) "Incorporating Social Justice and Equity as Themes in Math Circles Online," *Journal of Math Circles*: Vol. 2 : Iss. 2 , Article 2.  
Available at: <https://digitalcommons.cwu.edu/mathcirclesjournal/vol2/iss2/2>

This Article for current special issue is brought to you for free and open access by ScholarWorks@CWU. It has been accepted for inclusion in Journal of Math Circles by an authorized editor of ScholarWorks@CWU. For more information, please contact [scholarworks@cwu.edu](mailto:scholarworks@cwu.edu).

# Incorporating Social Justice and Equity as Themes in Math Circles Online

Matthew G. Jones \*, Sharon Lanaghan, and Carolyn Yarnall

California State University Dominguez Hills

The CSUDH Math Teachers' Circle chose a focus on equity and social justice in 2020. The national focus on social justice caused us to reflect on what we can do to affect change regarding issues of equity and social justice in our society. In addition, the global pandemic caused us to shift our circle online, which presented both obstacles and opportunities. In this paper, we expand upon how we addressed various challenges faced in facilitating an online Math Teachers' Circle, focusing on our experience facilitating sessions focused on equity and social justice and participants' reactions to this experience.

**Keywords:** Equity, professional development, social justice

## 1 Introduction

The COVID-19 pandemic forced educational institutions to reconsider all aspects of their operations, including the practice of teaching. In addition, the death of George Floyd on May 25, 2020, and the ensuing social unrest and the national focus on social justice, caused many of us to reflect on what we can do to affect change regarding issues of equity and social justice in our society. Our institution's Math Teachers' Circle (MTC) was no exception. In this article, we provide an overview of sessions and steps we took to address equity and social justice through our sessions, and how these connect with our core values as a Math Circle. We then examine reflections from participants and conclude with our own discussion of what we learned from this experience, including our advice for other circles that may be interested in taking up a similar focus on equity and social justice.

---

\*Please address all correspondence to Matthew G. Jones, [mjones@csudh.edu](mailto:mjones@csudh.edu).

## 2 Who We and Our Participants Are

The CSUDH MTC meets regularly throughout the academic year, and hosts a week-long themed summer institute each year. Facilitators have included university and community college faculty, and middle and high school teachers. Participants are a diverse group of teachers from local schools in the southern Los Angeles area. For the 2020 Summer Institute, we had 29 teacher participants, with 55% of participants identifying as Hispanic or Latinx, 15% identifying as Asian or Pacific Islander, 10% identifying as Black or African American and 10% identifying as White or Caucasian. Participants also vary in the number of years they have been teaching, ranging from pre-service teachers to those with over 20 years' experience; grade level and subjects taught, from upper elementary to advanced high school math; and mathematical preparation, with approximately 45% having an undergraduate degree in math or math education. Many of the participants have been attending CSUDH institutes for many years.

## 3 General Information

Prior to 2020, institutes were centered on a general mathematical theme: proof and conjecture or number sense, for example. In Fall 2019, when choosing a topic for our June 2020 summer institute, we decided on a conceptual theme rather than a mathematical one. We chose social justice as a topic that could incorporate a variety of interesting mathematics in a way that would be meaningful to our teacher participants and that they could share with their students.

In March, it was announced that our institution would not allow face-to-face gatherings, forcing us to change our plans and hold our institute in an alternate format. We decided to attempt to keep as many aspects of our institute as possible, including group problem solving, reading and discussing articles on teaching and learning, and having teachers create and share lesson plans for their grade level based on our theme.

The murder of George Floyd on May 25, 2020 catalyzed attention on the Black Lives Matter movement and the tragic loss of life at the hands of police across the country. The media attention and protests made us question how we would be able to address social justice and equity with an appropriate level of sensitivity in a context in which everyone's awareness of these issues was in a heightened state. We wanted to make sure that our institute provided a safe place for people to explore difficult, yet extremely important, relevant, and timely themes related to social justice and equity. Planning to hold our

institute online allowed us to again pivot our plans to include faculty from other campuses with expertise in social justice topics.

## 4 Overview of Sessions

The institute and subsequent academic year meetings included sessions led by the internal project team as well as external guests. We will briefly describe these sessions. Then, in the following section, our analysis will focus on the sessions led by the internal project team, where we are equipped to provide insights into the processes we used to develop and facilitate the sessions.

- “Flipping the Script” was the first summer session, led by Cristina Runnalls, from Cal Poly Pomona. Runnalls asked teachers to first reflect on ways that mathematics has been used as a tool of oppression as well as their own experience in school and as members of the mathematical community. Participants were next asked to consider ways in which they could challenge the existing narrative around mathematics and reclaim mathematics for all students. Lastly, teachers were able to experience a mathematical activity that used mathematics to highlight social justice issues in fair housing.
- In “Teaching is Political”, Brian Katz, CSU Long Beach, encouraged teachers to consider policies and pedagogies in place in their classrooms and schools that could be a barrier to the equitable teaching and learning of mathematics. Teachers were then encouraged to consider how they could be advocates for students by starting to deconstruct narratives that might otherwise seem neutral.
- Jones led “Districts and Gerrymandering,” in which he introduced teachers to a hypothetical state map and challenged teachers to draw districts in different ways, to think about what might be considered fair representation in this situation, and to apply a measure of fairness to understand the limitations of the measure.
- Yarnall led “Exploring Fairness in Voting,” and asked teachers to examine a set of ballots from a group of voters who ranked a number of alternatives, to investigate ways to determine how to rank the preferences of the group as a whole, and to explore the consequences of different voting methods.

Based on the success of our summer institute, we decided to continue the theme of equity and social justice into our virtual MTC sessions for the 2020-2021 academic year. As we moved into our regular academic year meetings,

we again leveraged the virtual format to invite speakers who had expertise in specific areas related to equity and social justice. As a result, we offered three more sessions on this theme.

- Dan Reinholz, San Diego State University, encouraged teachers to think about how bias can show up in the mathematics classroom and what tools are available to identify and combat this bias in his session, “Tools for Promoting Racial and Gender Equity in Mathematics Classrooms.”
- In “Exploring Stop and Frisk,” Jones provided background and data on the stop and frisk policy as used in New York, and participants analyzed data showing that different demographic groups experienced the policy differently.
- The cross-disciplinary team of Anne Ho, a mathematician from University of Tennessee, and Jaime J McCauley, a sociologist from Coastal Carolina University, presented “Prejudiced Polygons,” in which a hands-on simulation is used to show how small individual biases can add up to a large collective bias [1].

## **5 Equity and Social Justice as a Source of Worthwhile Mathematical Tasks That Promote Problem Solving and Understanding**

Mathematics, and the particular ways in which we seek to have participants experience mathematics in a way that is engaging and accessible, has always been the core of our MTC. In shifting our theme from an area of mathematics to the conceptual theme of social justice, particular theorems became secondary, as we sought to provide participants the opportunity to think about social justice using the tools of mathematics, as well as to think about equity and social justice in mathematics. Yet we still looked for ways to have participants engage in authentic ways with the material. In developing the sessions for our social justice theme, a central consideration was how we could engage teachers in thinking through both the mathematics and the issues in ways that would allow them to discover the mathematics for themselves and to draw their own conclusions from the data and the experience. Below, we describe some of the considerations involved in developing our particular sessions in ways that served these goals.

In “Districts and Gerrymandering,” we worked to develop ideas of measuring a good district, and introduced the efficiency gap [3] as a measure of

the quality of district maps. Participants had the opportunity to learn the difficulty of assessing the fairness of a map. Participants were put in breakout groups and given digital maps (formatted as an array of cells in a spreadsheet) and asked to use highlighting to color each district. Participants were given particular goals, such as creating districts so that one party or the other would win as many districts as possible, or to have the outcome of the set of districts approximately reflect the proportion of voters of each party. Then, participants were given the definition of the efficiency gap and asked to analyze the districts in various cases. Finally, the session closed with a discussion of the difficulty of drawing fair maps. Participants shared that they had heard of gerrymandering but had never explored it in detail, and their comments at the end of the session reflected their realizations about how the impact of one political party can be maximized by the way the districts are drawn.

“Exploring Fairness in Voting” was adapted from a chapter of *Discrete Mathematics Through Applications* [2] and involved an exploration of methods to determine a single favorite or winner from a set of voter preferences and an evaluation of these methods according to different measures of fairness. Participants began by devising a method to determine a ‘most popular’ activity based on a collection of rankings of four activities. While working on this task in breakout rooms, participants were asked to consider whether their method is fair in this and other potential situations. They were also prompted to discuss what they would do if one of the activities was no longer a viable choice. After returning for a whole group discussion, participants were introduced to several existing group ranking methods, many of which they had already discovered in the first activity. They again worked in groups to apply these methods in different scenarios and consider the fairness of each method. Some participants found this portion challenging, while others were more familiar with the ideas. We ended with a discussion of different measures of fairness, ultimately concluding that no group ranking method is completely fair.

During the year, “Exploring Stop and Frisk” challenged participants to see how a policy can be implemented in ways that have disproportionate impacts across different age and racial groups. Participants were reminded of discussion norms introduced in the summer (these norms are discussed further in section 8 below), introduced to a definition of stop and frisk, and introduced to the concept of a population sample. They were given two sets of data in a spreadsheet. In the first set of data, labeled, “General population,” participants were given two sample data sets, each with  $n=50$  individuals. Individuals in the data set were labeled with one of four colors, purple, orange, green, or blue. In the second set of data, labeled, “SAF population,” two additional data sets, each with  $n=50$ , were also given and labeled with the four colors. Participants

had to analyze the proportion of each color appearing in each of the four samples, and were asked to judge whether the underlying populations, “General population,” and “SAF population,” were likely to represent the same population, if the samples were drawn at random from each population. In fact, the samples were set so that they were drawn to reflect the population of New York at large in 2010, and the population of New Yorkers who were subjected to stop and frisk that year, with the four groups being representative of those who identified as Black non-Hispanic, White, Hispanic, and all others in the fourth category. Participants were then given the census population data and stop and frisk data and computed the percentages of the general population and of the stop and frisk population in each of these groups. Finally, participants examined some additional data and information, and had a concluding discussion of the results and the impact of the stop and frisk policy. During the body of the session, participants were absorbed with the mathematical model used for the population. At the end of the session, participants were able to step back and reflect on the way that stop and frisk was applied and how this experience was very different for different ethnic and racial groups.

## **6 Leveraging Online Tools**

In the cases described above, participants still engaged in tasks that let them experience doing mathematics. The online instructional modality caused us to re-think how data could be shared, how participants could interact with information, and how we could continue to focus on ways that participants could engage. The tasks were worthwhile because of the mathematics they contained, but also because the context was important, and as adult learners, the mathematical tools they brought to the situation could help them gain new insights into these issues. Teacher participants were encouraged to collaborate in solving mathematical problems, but also to collaborate in sharing ways they could make a difference, whether by raising awareness of issues in their schools and with colleagues or advocating locally for policies that treat students and community members more equitably.

The virtual setting included particular obstacles and opportunities. For instance, on the topic of gerrymandering: in person, we would likely have provided maps and had participants draw district boundaries. Participants would have had the opportunity to hold up their maps or share them via a document camera for other groups to see. Online, we provided a Google spreadsheet file template, with separate tabs for each group, asked participants to highlight cells in different colors to create districts, and shared group maps by shifting between tabs on the shared Google sheet. Similarly, the session on

voting methods utilized shared online documents for group work. These kinds of adjustments were minor, and were largely successful. In some cases, such as Prejudiced Polygons 2.0, or Examining Stop and Frisk, the ability to use a simulation available online provided an enhancement to the mathematical experience of the session, as in-person meetings usually do not include having participants utilize a laptop, whereas in a virtual setting, we can freely draw upon such tools. In situations in which the mathematical experience heavily depends on the physical objects, adapting to a virtual meeting will be less appealing.

Obstacles in the online environment included difficulties with facilitating breakout groups. As with in-person meetings, one consideration is ensuring that all group members are contributing to the group's work. In person, the presenter is able to monitor the interactions around the room visually, and other leadership team members as well as participants can signal to the presenter visually when a group needs guidance. Online, the presenter can monitor the shared written work to see if groups are making progress. Other team members can embed themselves in some of the groups to ensure group members are participating. However, the presenter cannot monitor the conversation in the groups without visiting the individual groups, a process that is much slower online and, unlike the situation in a classroom, visiting one group means being unable to hear other groups. Our site used Zoom meetings to conduct sessions, which does not support a group chat among presenters. To partially compensate for this, our team set up a group chat for ourselves on Discord that enabled us to quickly update each other on progress or issues in our individual rooms. On some other online meeting platforms, such chats are embedded within the platform.

## **7 Lesson Planning Component**

In addition to the sessions discussed above, a key component of the summer institute is supporting teachers while they develop lesson plans that draw on ideas presented during the week. The 2020 summer institute was no different in this regard though the theme selected and the recent transition to virtual instruction provided a unique and stimulating backdrop to the lesson planning component. Not only did social justice provide a rich source of mathematical tasks for the participants themselves, but by way of lesson planning, participants were able to bring tasks motivated by these topics back to their students. Many participants expressed that while they did address social justice issues in their classes, it was often disconnected from mathematical content. After

engaging in some of the aforementioned sessions, participants were inspired to construct content lessons that were based more fully on such topics.

The social justice content was not the only motivation for participants to create new lesson materials. As the participants of the institute range from brand new teachers to skilled veterans, there is sometimes an imbalance with the level of engagement seen in the lesson-planning portion. While all of the newer teachers are constructing brand new lessons, there are some of the more experienced teachers who like to revisit and minimally update an existing lesson plan as they feel comfortable with what they have already created. The implementation of virtual instruction was a strong motivation for all teachers to completely rethink their existing lesson plans or to create brand new plans using ideas from other participants and the sessions facilitated by the organizers.

While the lesson plans covered a variety of content, from 6th grade to advanced high school content including modeling with functions and data visualization, every participant was able to construct a lesson motivated by social justice topics. Many lessons involved financial topics including an examination of family incomes and their relationship to SAT scores, minimum wage and fair housing, and the impact of civic fines on people with different incomes. There were lessons related to voting and fairness that had students investigate local and national elections. Additionally, some lessons focused on inequity in the healthcare system and socioeconomic impacts on health risks.

In particular, one lesson plan had students simultaneously learning about modeling using exponential functions and how socioeconomically disadvantaged groups were affected disproportionately by the pandemic. In this lesson, students first shared what they already know about the coronavirus and then watched a short video about it. They were then asked to collect information about their local communities, such as current populations, number of hospitals and clinics, and closest COVID-19 test sites. Students then completed an activity where they created tables and graphs based on spread of disease scenarios and were asked to compare their results and discuss how these results could be impacted by the information they collected earlier about their community. The lesson ended with students writing a brief reflection on how the math they learned impacts their lives.

## **8 A Mathematical Community Online**

As described above, most of our sessions were explicitly about mathematics embedded in social justice contexts. In “Teaching is Political,” and “Tools for Promoting Racial and Gender Equity in Mathematics Classrooms,” doing

mathematics was not central to the session, but our identities as mathematics instructors and as members of a community were critical to our examination of practices, including department and school policies, that impact the students we serve. Across both of these types of sessions, we asked teachers to engage and to bring their entire selves to participate in the discussions. A critical aspect of the success of this community was building norms for participation.

In our case, Runnalls helped to set norms at the outset of our summer work, which we and Katz reinforced in later sessions. Jones relied on previous experiences in setting expectations at the first fall follow-up, and both Reinholz and Ho and McCauley set similar expectations in follow-up sessions. These norms included, “Engage/listen to be changed,” which we further explained with, “There will be many places where we ask you to share your thoughts, reactions, and observations. Engage with others’ contributions fully, and engage with the goal of learning (as opposed to evaluation).” Other norm statements included, “Share your ideas, share the space,” which asked participants who were quiet to contribute, and those who contribute easily to make space for others to share, and “Expect messiness,” a reminder that there will be ambiguity and tension in our discussions, and not everything may be resolved.

Creating an online mathematical community through the institute facilitated teachers in engaging with the lesson-planning portion. In face-to-face institutes, teachers typically do the lesson planning portion on laptops and, after presenting the lesson plans to the group, these lessons are shared via Google Drive at the end of the week. Since, in a typical summer, participants are largely engaging with hard copies of materials for most sessions throughout the week, the virtual sharing of the lessons can feel a bit disconnected from the rest of the institute. This past summer, as all sessions were online, participants were accustomed to accessing all materials in the shared Google Drive folders and as a result, the virtual sharing of lesson plans was a natural extension.

Across the institute, teachers were able to engage with each other online. It is likely that this engagement was facilitated by the fact that this is a pre-existing community of teachers, 62% of whom were past participants at in-person sessions. Also, in comparison with the struggles the authors had as instructors, fellow teachers were willing to keep their cameras on and to share their ideas vocally, in session chats, and on shared session documents.

## 9 Participant Feedback

Two weeks prior to the start of the summer institute, instructors were asked to respond to three questions using a five level Likert scale.

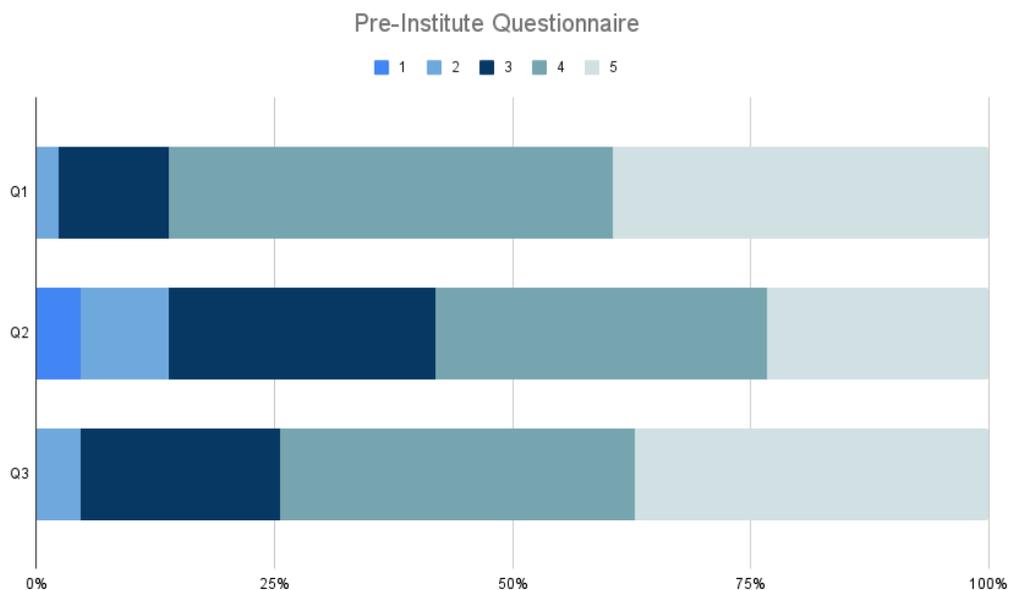


Figure 1. Pre-Institute Questionnaire

Q1: Rate your level of comfort with using Zoom as a participant in the workshop. (1: Completely new to me; no experience to 5: Use frequently; lots of experience)

Q2: Rate your level of agreement with the statement, "I address social justice issues in my classroom." (1: Never to 5: Regularly)

Q3: Rate your level of agreement with the statement, "I employ equitable teaching practices in my classroom." (1: None that I am aware of to 5: Many practices used consistently)

We received responses from 43 teachers, not all of whom ultimately attended the institute. These responses were used to help in the process of planning the summer institute. Refer to Figure 1. In Question 1, 86% of participants responded with a 4 or 5, indicating a high level of comfort using Zoom. This made us comfortable planning a wide variety of activities, using collaboration tools in Zoom and on other platforms. In Question 2, only 58% of participants responded with a 4 or 5, indicating that as a group many teachers were not addressing social justice issues in their classes. This prompted us to ensure that each session was connected to classroom activities that teachers could use in their own classes. In addition, we planned a lesson planning component so that teachers would have a specific lesson, tied to their grade level standards, that addressed social justice issues that they could use with

their students. Question 3 affirmed that most participants employ equitable teaching practices in their classroom (more than 70% responded with a 4 or 5). As a result, most sessions gave participants a chance to reflect on and share their own practice with other participants.

At the end of our summer institute, we collected teachers' (n=27) free response reflections using the following questions: Q1: What was the most interesting thing you learned about mathematics during the workshop? Q2: What was the most valuable thing you learned about equitable teaching practices during the workshop, and how will it affect your students next year? Q3: Before the workshop, you rated your agreement with the statement, "I address social justice issues in my classroom." What was the most valuable thing you learned about teaching for social justice during the workshop, and how do you plan to use what you learned?

Due to the open-ended nature of the questions, it is difficult to characterize the responses in simple categories. Responses to these questions frequently mentioned issues of equity and advocacy, mathematics, pedagogy and social justice, as well as tools and techniques to use in virtual teaching. Participants highlighted a shift in understanding of their role as a teacher within the context of the political climate in which they teach, and indicated that they would be more comfortable advocating for equity in the future. One participant wrote, "The most interesting things I learned during the workshop is in regards to the politics of teaching mathematics and the need to bring social justice issues into the classroom. (I've made a connection and they appear to go hand in hand)." Another teacher wrote, "Not only did we learn about what is happening, we were given tools to help work within this system. This is very important because it situates teachers and students as change agents as opposed to people being victimized by the system of education." Other teachers focused more on increased awareness of the issues, as in this response, "I think the workshop made me more aware of some of the issues facing our youth and how not having a forum for our kids to discuss or learn about them will perpetuate these same issues."

Regarding mathematics, pedagogy and social justice, participants reported that they enjoyed seeing and working through activities that not only brought social justice themes into their classroom, but also used grade level mathematics in an authentic way. Participants expressed willingness to try to incorporate social justice lessons within the math classroom during the academic year. One participant responded, "I teach statistics to 12th grade students. There are many scenarios in the textbook that we use that relate to teenagers, and I mention how those cases are part of the real world. However, I do not address enough that these are things that may affect my students. Instead

of generalizing, I believe it will engage my students if I make those situations connect to their daily lives.” Another wrote,

The most valuable thing I learned is that I can use MATH to tackle social issues in my classroom. I will plan to teach my math lessons addressing social issues based on the community I teach in and those that my students may or may not encounter on a daily basis so that they may be more understanding and accepting of different cultural perspectives.

A different participant highlighted the mathematics and the value of the collaboration in the institute,

I learned many social justice issues can be explored through math - from minimum wage and housing to group ranking and voting. I gained experience with looking for a social justice connection for a math lesson plan and found great joy in collaborating with a teacher I had never met before. I plan to use the lesson I co-wrote and continue to seek connections between social justice and the lessons I have planned/ am planning.

Thus, participants expressed a range of impacts on their teaching and on their professional identities.

A few participants reported that they appreciated the variety of tools and techniques used by facilitators in the course of the summer institute. These included Zoom tools (mentioned by two teachers), tools for interactive collaboration such as Google tools (mentioned by one teacher), and online tools for doing mathematics such as Desmos (mentioned by three teachers). It was in part because of the positive feedback that we continued our focus on equity and social justice into the academic year, while revisiting the norms established during the summer to ground our discussions.

## **10 Takeaways/Next Steps**

The 2020-21 year brought previously unimagined challenges to the world. As educators, the challenges of the pandemic were compounded by a social context in which Black Lives Matter protests brought equity and justice for black Americans and all people of color to the nation’s attention. These circumstances meant that we faced challenges to the core values of our MTC: the challenge of finding ways to engage in mathematics; to engage with each other in an online setting; and to maintain and build our sense of community, including our responsibility as a community to respond to inequities in our society.

We chose to face these challenges by leveraging the available tools for online collaboration, selecting mathematical activities that were either amenable to or enhanced by online tools, and facing the challenges of equity and social justice through direct discussion, with help from experts who are just an online connection away. Our teachers responded by taking up difficult topics in their own lessons and making plans to rededicate themselves to be advocates for their students.

For other circles that may be considering ways to address issues of equity and social justice, we hope that our experience may provide some guidance. First, we recommend searching your professional networks for expertise. In our case, Jones had previously worked with Katz on another professional development project. Runnalls is part of a team at a sister professional development site in the network of California Math Project sites. Reinholz had previously given presentations to the California Math Project and to the MAA. Lanaghan became aware of Prejudiced Polygons through our site's Math Teacher Circle mentor, Judith Covington, and then saw a presentation by Ho and McCauley that was advertised through the Math Teacher Circle Network. Second, we recommend setting norms for participation and revisiting these norms as needed throughout subsequent sessions. Finally, we note that the use of outside experts provided our own team with the guidance and firsthand experience as participants in sessions that gave us confidence to explore other topics without outside help.

As a result of these efforts, and as restrictions on face-to-face gatherings begin to fade, the leadership team of our MTC is considering ways to leverage what we learned from this experience, including ideas such as continuing to have occasional online sessions, particularly if we want to utilize outside experts from distant universities or rely on tools that require laptops, having part of the team facilitate an online group while others meet in a classroom (sometimes called hy-flex instruction, but here enabled by the fact that there is an instructional team), and continuing to look for mathematical explorations of topics in the areas of equity and social justice. The team feels that while there are many aspects of the long lockdown that we would like to forget, the lessons we learned with our MTC are sure to be helpful in the future.

## References

1. Ho, A. M., & McCauley, J. J. (n.d.). Prejudiced polygons. Retrieved October 13, 2021, from <https://sites.google.com/site/annemho/outreach/prejudiced-polygons>.

2. Crisler, N., Fisher, P., & Froelich, G. (1999). *Discrete Mathematics Through Applications* (Ch 1). W.H. Freeman and Company.
3. Stephanopoulos, N. O., & McGhee, E. M. (2015). Partisan gerrymandering and the efficiency gap. *U. Chi. L. Rev.*, 82, 831.