

In conclusion, besides the more readily apparent mathematical aspects of organizing a conference, there can be a big benefit in terms of mathematical community building. Indeed, future mathematicians may travel less for mathematics, moving some or much of that travel to online sessions. We hope that the travel they do make and the burgeoning online meetings have the benefit of combining mathematics and pleasurable activities done with a good community and support budding mathematical friendships.



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Credits

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How to Transition a Summer Math Camp to a Virtual Experience

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When Nebraska mathematics professors Wendy Hines and Judy Walker launched All Girls / All Math in 1997, they sought to develop a program that provided girls with the opportunities in mathematics that they had lacked in their educations. They understood that without visible representations of women in the mathematics field or a strong network of female support, many girls will be dissuaded

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from pursuing their interest in the STEM fields (science, technology, engineering, and mathematics). After researching this phenomenon, Hines and Walker uncovered an abundance of literature that corroborated what they personally knew to be true: girls thrive in mathematics when given a supportive, female-driven environment to learn.

In its 23 years of operation, the All Girls / All Math Summer Camp for high school students has become an increasingly selective program that annually accepts between 25 to 30 participants per weekly camp, based on funding availability. Traditionally held on the University of Nebraska-Lincoln campus, the camp attracts students from across the United States and around the world. Due to the restrictions placed on group gatherings because of COVID-19, All Girls / All Math switched to an online format for the summer of 2020.

Structure of an In-Person Summer Camp

Before COVID-19 entered the scene, All Girls / All Math was structured as a seven-day residential camp at the University of Nebraska-Lincoln (UNL), where 25 to 30 girls were divided into two groups and taught by women who have received their doctorates in mathematics from UNL. The participants worked closely with their groups throughout the week, going to class and activities together while being chaperoned by female graduate teaching assistants and an undergraduate coordinator.

The campers attended a course on cryptography and number theory, working their way up to RSA as the week progressed; the course met three hours a day for five days, and the girls were given homework each night to solidify their understanding of the new material.

During the second half of their day, the campers participated in an additional mini-course. These self-contained three-hour classes, offered daily in varying topics, allowed the students to explore a wider range of mathematics. The program employed women guest speakers and a career panel that allowed the girls to ask questions and learn more about what they can do with a degree in mathematics.

During the late afternoons and evenings, the participants also took part in team-building activities and tours of different parts of the campus to build lasting friendships and a solid foundation for a network of budding female mathematicians.

The Switch to Online

Though the recent switch to remote learning due to COVID-19 affected various elements of the All Girls / All Math programming, the camp was conducted this summer online on Zoom, from July 12–18. The 25 campers were given the choice to defer to 2021 or participate for free online in 2020. Fifteen campers elected to attend the camp virtually, including one participant from Brazil.

While we were able to offer the camp free to participants, the cost of putting on the workshop was certainly not free.

For years, the AMS has been a generous sponsor, providing funds for scholarships to enable low-income students to participate. This year, AMS Epsilon generously agreed to provide \$4,500 for infrastructure costs to support a free camp for students. In addition, the NSF/EPSCoR grant to Nebraska provided approximately \$4,200 to support the camp, and the UNL Center for Science, Mathematics and Computer Education provided \$5,500 in no-cost staff time.

To retain the integrity of the program and ensure it had the same lasting positive impact on its participants as it had in previous years, events coordinator Stephanie Vendetti, led by UNL associate professor Yu Jin, kept all 15 campers as one group and made several necessary adjustments to the online curriculum to mitigate extenuating factors that might otherwise prevent participation.

Marla Williams, a PhD student who graduated from UNL in August 2020, was originally hired as one of the two in-person camp instructors and thus became the lead instructor for the cryptography and number theory course. While the cryptography and number theory course remained a central part of the online program, the mini-courses were removed from the schedule, reducing the number of personnel needed to operate the camp. Thus, the virtual program did not include graduate teaching assistants.

Williams divided the lessons into smaller units for Zoom instruction to help the students maintain focus without being overwhelmed. While Williams still used worksheets and slides for most of the material, she utilized either a document camera or the Zoom whiteboard feature in place of a physical board. Since it was a Zoom meeting room, the participants could ask questions aloud or in the chat function, and the undergraduate coordinator, Samantha Wolff, was online as a moderator to make sure the chat questions were seen and addressed.

Though the class's homework assignments were beneficial to the campers, the switch to remote learning necessitated a more collaboration-focused learning environment. Instead of assigning homework, the instructor mixed more work and small-group time into the lessons and the Q&A sessions, with additional time for questions on previous material at the start of each class.

As the undergraduate coordinator is responsible for the bulk of the program's communication and organizational efforts, the program director hired an additional undergraduate assistant, Taylor Bartek, to accommodate the increased workload and assist the coordinator with planning and outreach.

Utilizing Virtual Tours and Social Tools

Transitioning the academic side of camp was much more straightforward than deciding how to replace the social activities and recruitment aspect of the camp. The residential camp at UNL included campus tours of the Outdoor Adventure Center, State Museum, Mueller Planetarium,

Memorial Stadium, and the Devaney Sports Center. Participants bonded by exploring downtown Lincoln, visiting Duncan Aviation, and taking part in networking events.

Though the loss of in-person activities was a challenge to replicate, the undergraduate coordinators created an innovative virtual schedule to make sure the campers were engaged throughout the week and still learned about opportunities in mathematics at the University of Nebraska-Lincoln. In particular, during the allotted time for mini-courses, the girls had the opportunity to complete virtual campus scavenger hunts and escape rooms and participate in virtual tours of museums and businesses. Female engineers and project leaders at Lincoln's Duncan Aviation, the largest family-owned maintenance, repair, and overhaul facility for business aircraft in the world, put together an online tour and video. The campers also attended virtual workshops with the National Museum of Mathematics in New York City and the Nebraska State Museum, as well as a virtual tour of the Nebraska State Capitol. The career panel occurred online in Zoom as well.

While the program directors removed the mini-courses from the updated schedule, they still wanted to give campers the opportunity to explore another branch of mathematics in-depth. To incorporate current events into the curriculum, a mini-course taught by UNL postdoc Amanda Laubmeier on modeling infectious diseases was added. This course, held on the last day to conclude the camp, gave the girls a new understanding of not only current events but also the versatility of and necessity for women mathematicians.

Despite these changes, the All Girls / All Math online camp offered the girls a unique opportunity to focus on networking with a broader group of like-minded young women. Several weeks prior to the camp, the undergraduate coordinator created a GroupMe chat room, so that the girls could get to know one another and develop rapport beforehand. This early outreach effort was successful in not only making the participants more comfortable with each other, but also in expanding their network beyond the small group they would have been assigned to at the in-person camp.

Lesson in Creative Adaptation

This year's All Girls / All Math program was vastly different from anything done in the program's 23-year history. The online environment allowed outreach efforts to include national museums and gave more flexibility to our community partners. Transitioning elements of the camp from in-person to online was a lesson in creative adaptation, a lesson that we hoped to instill in the participants as well.

The success of All Girls / All Math exemplifies the ongoing need for fostering inclusive and female-driven environments for aspiring young women in STEM, especially during a global health crisis. In post-camp evaluations conducted annually, an overwhelming number of girls

expressed not only a deeper understanding of the types and uses of mathematics, but also a resurgent enthusiasm for pursuing a mathematics degree as a result of their experience in All Girls / All Math.

By adapting to new media for learning and continuing to extend such opportunities to young women in STEM, camps like All Girls / All Math are giving them the opportunity to be able to learn alongside the COVID-19 pandemic and find new ways to apply their knowledge. A virtual summer camp has become another platform to promote an engaged, adaptive, and forward-thinking network of young women, poised to revolutionize the field of mathematics.

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Targeted High School Math Competitions: Girls in Math at Yale

Elaine Hou and Noah Kravitz

Introduction

In 2017, the Yale Math Competition (YMC) undergraduate student organization founded a new initiative called Girls in Math at Yale. This event, which now occurs annually, serves high school girls in the local community and aims

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to promote an interest in and passion for math. Organizing and hosting Girls in Math at Yale has taught us a great deal, and we hope to share with you our insights into developing effective math outreach initiatives.

About Us

YMC was founded in 2014 as the Yale branch of the Math Majors of America Tournament for High Schools (MMATHS). The idea of college students organizing math events for like-minded high school students was not original—HMMT, PUMAC, SMT, and CHMMC, for instance, are older—but what makes MMATHS distinctive is its geographical diversity. The MMATHS annual competition is hosted simultaneously at university sites in different states, and the long-term goal is to have at least one participating university in every state of the US. So far, we have five participating schools: University of Florida, Columbia, Yale, University of Michigan, and University of Virginia. We have quite a ways to go!

Most of the organizers of YMC are veterans of various high school math competition circuits, such as the AMC/AIME/USAMO series and ARML. Many of us also took part in the Putnam Competition during our time at Yale. Participating in these events not only cultivated our interest in math but also introduced us to a bustling community of rivals, peers, and friends.

Motivation and Philosophy

Although Girls in Math at Yale began in 2017, YMC had been discussing the idea of holding such an event since its founding three years earlier. Many of our female members could directly link their decisions to pursue STEM majors and careers to formative previous experiences in women's initiatives such as Math Prize for Girls. Since there are relatively few of these influential outreach activities, we saw the need for a new girls' event and realized that YMC was in a perfect position to make this happen.

We frequently debated the merits of hosting a girls' event. Some members pointed out that hosting a competition specifically for girls inadvertently sends the



Figure 1. Participants collaborate on a team round.