

## CREATING ACCESS TO ENGAGED VIEWS OF MATHEMATICS AND TEACHING THROUGH INFORMAL LEARNING SPACES

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*This paper examines an informal learning setting that created a hybrid space for families, preservice teachers, and teaching interns to come together to engage with mathematics and teaching. The data analyzed included surveys, reflections, and focus interviews. Data and attendance documentation indicate that this hybrid space afforded engaged views of mathematics and mathematics teaching and holds potential for the popularization of mathematics.*

### INTRODUCTION

Today, individuals encounter many experiences and messages that contribute to their relationships with mathematics and mathematics teaching. The focus of this paper is on one type of experience that can provide access to engaged perspectives about mathematics to families, preservice teachers, and teaching interns. The construct of *Family Math Nights* (Stenmark et al., 1986) was developed more than thirty years ago, however, in a series of projects, we have renewed it to create a hybrid space with the intention of supporting the learning of multiple stakeholders. This structured experience will be referred to hereafter as *Family Math Nights* (FMNs). FMNs typically take place in a library, cafeteria, or gym with different stations set up featuring a particular mathematical focus. Preservice teachers, school faculty, university faculty, teaching interns, and parent volunteers are involved in facilitating work stations and other areas of the event. Work stations typically include a mathematical challenge, puzzle, or hands-on activity. Families are encouraged to attend. Often times, there is an event theme such as Pi Day or the Olympics that carries throughout the stations.

### ACCESS AND HYBRID SPACES

In this paper, we take the perspective that particular practices can create access to engaged relationships with mathematics (Nasir & Cobb, 2002). In this view, aspects of the social context are seen as supporting (or delimiting) individuals' opportunities to engage meaningfully with mathematics. Our design of an informal learning space draws work related to *hybrid spaces*. In their classic analysis, Gutierrez, Baquedano-Lopez, and Tejeda (1999) drew attention to a third discursive space in an elementary class. In doing so, they shed light on how a space can be created that values the voice of the participants while at the same time advances learning of the community. Gutierrez et al. analyzed literacy practices of an immersion Spanish elementary school class and illustrated the notion of a third space that can emerge in discourse. In their ethnographic study, Gutierrez et al. defined the official space of the classroom as consisting of the sanctioned, legitimate ways of participating in

classroom discourse while the unofficial space includes students' ways of participating that do not comply with the teachers' view of appropriate participation. For example, Gutierrez et al. describe how students often engage in a counter narrative within the unofficial space of the classroom through practices such as using colloquialisms and drawing on home and community knowledge in their comments. They describe how the classroom teacher included students' comments as part of discussions and in doing so sanctioned theme as legitimate aspects of the classroom. Their analysis raises the possibility of and the intentionality involved with creating a space where participants can develop ownership of the collective ideas that develop. We extend this notion of a hybrid space to informal learning environments where multiple stakeholders engage with mathematical ideas.

## **BACKGROUND**

As mathematics educators, we have worked with both urban and rural public schools implementing Family Math Nights for the past seven years as part of a series of community engagement projects funded by University seed grants and foundation funding<sup>1</sup>. These projects have taken place in a region in the Southeast United States. Initially, from 2012-2014, we worked primarily with one urban school (Hodge, Lawson, & Trent, 2013). In the U. S. academic year of 2018 – 2019, we collaborated with a total of fourteen different K-12 schools in implementing FMNs. The series of projects includes four layers of participants: 1) the teachers and school staff with whom we work to coordinate the logistics and the overall themes of the FMN; 2) the beginning mathematics teachers who are students in our University coursework related to teaching mathematics; 3) teaching interns<sup>2</sup> who are current math or science undergraduate majors with an interest in mathematics/science teaching; and 4) families who attend the FMNs, defined as a student and at least one parent/significant adult. To be clear, the role of the preservice teachers is to participate in the design and facilitation of stations as part of the FMN. In order to accomplish this many of the preservice teachers met with teachers/students from the focus school in a face-to-face or online format to understand the school setting, the local community, and the students better. The role of the teaching interns is to solely help facilitate the stations. The facilitation of the stations emphasizes questioning through open questions that allows families to construct their own language and meaning concerning the mathematics in the activities. For example, one pair of preservice teachers originally designed a station based on a NIM puzzle (Stenmark et al., 1986). In this game, two individuals play with ten items. One player begins by taking one item or two. The other player does the same. Two players alternate turns until all the pieces have been collected. The winning player is the one who picks up the final one item or two items. The questions posed to parents and students were: What is your strategy? And, do you have a strategy that helps you to win every time? Our intention was to open up a space that positions families as being the experts in explaining and justifying their reasoning.

## **DATA ANALYSIS**

We have documented attendance of the FMN events over time. In addition, we have analyzed survey data collected from families who participated in the FMN, reflections from the beginning teachers, and

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<sup>1</sup> A grant from Battelle Memorial Institute have funded the FMN project from 2017 – present.

<sup>2</sup> Teaching interns were selected as part of a project funded by the National Science Foundation titled VolsTeach for Appalachia with an award number 1758325.

focus interviews with teaching interns who participated in the FMN. The surveys focused on open response questions and asked FMN participants about the following 1) favorite station and the reasons behind this, 2) their intent to attend another FMN, and 3) resources that would help support their student's mathematical learning. Preservice teachers were asked to write about what they learned through their participation in the FMNs. Finally, the focus interviews with teaching interns focused on similar questions related to views of mathematics, mathematics teaching, and what was learned from interacting with families. Focus group interviews were audio recorded and transcribed and were approximately thirty minutes in length. All three categories of data (open-response surveys, reflections, and focus group interviews) were analyzed using an open coding approach (Strauss & Corbin, 1991). Reflections and focus interviews were analyzed according to views related to mathematics, mathematics teaching, and families. Individual reflections were analyzed during the initial phase. In a second phase, themes were analyzed across individual cases.

### **FMN ATTENDANCE AND FAMILY RESPONSES**

The FMN attendance and the number of participating schools increased over time.

U. S. Academic School Year	Total # of Students	# of Schools
2014 - 2015	234	2
2015 - 2016	752	6
2016 - 2017	843	7
2017 - 2018	1377	9
2018 - 2019	2562	14

Table 1: Attendance over time

Over 90% of those who completed a survey indicated they would attend another FMN. With respect to what parents and students were taking away from FMN, the project team found a shift in parents' and students' views about mathematics to a subject that is useful and approachable. The majority of parents expressed how they did not realize that mathematics included much more than problems found in textbooks, and they were reminded of "...how much we use math every day!" On the other hand, most students spoke about their changing attitudes towards mathematics as they left FMN, seeing mathematics as something fun and enjoyable—as one student put it, "I enjoyed it more than I expected."

### **PRE-SERVICE TEACHERS AND TEACHING INTERNS**

A total of 143 preservice teachers have participated in the FMN projects thus far. The majority of the preservice teachers conveyed that the FMN was an effective way to bring together parents, students, and university students in a fun atmosphere to do mathematics. The following excerpt is illustrative of this point:

Family math nights are a fun experience for everyone involved, and I feel that this is a great way to eradicate the stigmatization of mathematics. By relying on several different people to help make these nights possible,

everyone involved can take pride in knowing that they helped create a safe and educational environment for students and parents. I felt that way when I participated and interacted with parents and students. (“Rachel”)

Another theme from preservice teachers was their desire to implement FMNs. The following comment illustrates this point:

I think the idea of Family Math Night is a fantastic one, and it makes sense for all kinds of schools, suburban and urban, since math is often regarded negatively by many people regardless of where they live and what they do. The idea of using preservice teachers was excellent – I hope to do this in my classroom, but a big concern of mine is getting other math teachers to participate and help with the event. (“Alex”)

Alex points to the potential of FMNs and her interest in implementing these in the future. In addition, Alex highlights a challenge in implementing, showing that he is thinking about the details of how to implement FMNs.

The comments of the teaching interns focused more on mathematics rather than teaching or family engagement. One significant theme from the teaching interns was the observation that mathematics can serve the role of community building. The following comment is illustrative:

I never thought of math as community building and interactive, and I actually described it using these words to a friend. I think it is about how you make it happen. You can show off different parts of math so at a Family night you can make it fun. You challenge what they think of math. (“Daisy”)

Another significant theme from the teaching interns was the observation that mathematics is creative.

The following comment shows this point:

The activities gave students and their parents a chance to be creative in how they solved the problems. It showed them that math is like that. You can think of something that no one else has done yet. But it was about giving them that kind of a problem. (“Brady”)

## DISCUSSION

The findings seems to indicate that the FMNs were effective in supporting positive views of mathematics, particularly with families who attended the FMNs. The FMNs were also viewed positively by the majority of the preservice teachers and teaching interns. We conjecture that the nature of the activities, which focused on problem solving and inquiry, the interactive format with questioning at the center, and the positioning of families as experts contributed to the engaged views reflected in the data.

## References

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