



EnCoMPASS

Emerging Communities
for Mathematical Practices
and Assessment

Bridging Communities Online: The Role of Brokers in Professional Development at the Math Forum

Jason Silverman & Anthony Matranga*
School of Education
Drexel University

Wesley Shumar
Dept. of Culture and Communication
Drexel University

Valerie Klein
The Math Forum
Drexel University

Background

Research has shown that one characteristic of effective teacher professional development is that it is ongoing and situated within the context of a professional community (Wies, Andree & Darling-Hammond, 2009; Skerrett, 2010). However, supporting and sustaining the development of professional communities of teachers is difficult. One such community is the Math Forum @ Drexel (Shumar & Sarmiento, 2008). This poster reports on two iterations of a design-based research project that sought to provide pre-service and in-service teachers opportunities to interact with The Math Forum and to begin to understand the ways in which these teachers influence and are influenced by this existing community of practice.

In this poster, we explore and discuss

- the emerging role of brokers in our professional development and community cultivation efforts.
- the results from our first iteration, which highlighted the importance of brokers.
- the results from our second iteration, which specifically focused on the development of brokers.



Theoretical Background


The Importance of Community – even Online Communities
Research at the Math Forum demonstrates that virtual communities of practice can also serve a significant role in teacher and school improvement efforts (Renninger & Shumar, 2004)

Analyzing Connections between Communities

Cobb, McClain, de Silva Lamberg and Dean (2003) noted the importance of analyzing teachers' activities against the background of the institutional contexts and communities within which they work. Given our focus on a variety of communities (online, brick-and-mortar, Math Forum), identifying communities of practices and analyzing connections among them.

Types of Connections

Each community focused on the nature of the work associated with their particular job function and in doing so inevitably created boundaries (Wenger, McDermott & Snyder, 2002). Shifting of boundaries is how communities grow and develop and evidence of these shifts comes from transference of practices, artifacts, and members across groups. Wenger (1998) describes three types of connections that can be made between communities of practice: boundary objects (a common point of reference), boundary encounters (members from different communities working together), and brokers (individuals serving as a "bridge" between communities).

 ** This material is based upon work supported by the National Science Foundation under Grant No. I222355. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author and do not necessarily reflect the views of the National Science Foundation.

Bridging at the Math Forum

While the public view of the Math Forum is as an online resource for mathematics teachers and students, it is also a distributed online community that has developed a set of well-defined practices and a unique culture (Shumar & Sarmiento, 2008). Specifically, the Math Forum community is defined by practices such as:

- valuing and grounding instruction in student thinking
- understanding and building on what learners know
- the importance of thinking, doing, and talking mathematics, and
- using whole class discussions as a context for questioning, exploring, and modeling (Renninger & Shumar, 2004).

Throughout its existence, the Math Forum has sought to grow and increase its sphere of influence through a variety of bridging efforts that bring together the Math Forum community with groups of mathematics teachers, students, pre-service teachers, mathematicians, parents, etc. Each of these bridging efforts has been crucial in fostering collaboration and initiating participants into the culture of the Math Forum.



Research Questions

In this project we explore the role of brokers in bridging communities in mathematics education. Specifically, in this poster, we explore:

- In what ways does a group of in-service and pre-service teachers engage with a set of modules that were envisioned to serve as a boundary object between the Math Forum professional community?
- In what ways can efforts to bridge the the Math Forum professional community be enhanced? Specifically, we focus on:
 - improving the boundary objects through design research to facilitate inculcation in the professional practices that define the Math Forum
 - Supporting the development of effective brokers

Research Setting

Research reported in this poster is part of a larger project focusing on community-based mathematics teacher professional development.

- Research Question 1 explored the role of participating teachers (brokers) and their mathematics methods courses at two universities: Winding River College (WRC), a small, private liberal arts college and Woodlawn University (WU), a mid-size, master's degree granting university. The participating teachers, each of which had existing relationships with the Math Forum, were responsible for integrating a series of online modules within their course content and sequence and had full authority for implementation of the VFS modules within their class.
- Research Question 2 was investigated in the context of a summer institute designed, in part, to more effectively brokering practices and the adoption of the practices that define the Math Forum and implement them in their classroom. Initial activities focused on close analysis of student work, critical analysis of student thinking and understanding, and developing formative assessment and strategies for supporting students with similar understandings and approaches. Throughout the remainder of the institute, participants explored custom software designed to scaffold the implementation of Math Forum professional practices.

Methodology

In order to better understand these boundary encounters, data was collected for each of the implementations. The data corpus for this project includes

- video and audio recordings from all project-related activities
- online interaction data from student implementation and professional development

The data was coded using a coding scheme developed specifically to identify activity and interaction that were consistent with the professional practices that define the Math Forum, such as

- identifying and investigating students' understandings
- valuing a variety of problem solving strategies
- perceiving the benefits of teaching by asking
- emphasizing private explanations

The coded data was then analyzed using constant comparative methods (Corbin & Strauss, 2008). Conjectures regarding the role and effectiveness of the bridging efforts were developed, contradictory or corroboratory evidence for the conjectures was identified, and the conjectures were continually revised and developed. This iterative process of confirming and revising resulted in stable conjectures that provide explanatory characterizations of our bridging efforts that shed light on both the significance and implications of the community development efforts.

Analysis and Results

Research Question 1

At WRC the module was not fully integrated into the course structure in terms of content or assessment. The WRC faculty member's goal was to simply provide the pre-service teachers (PSTs) with an experience in communicating mathematically with students. At WU, the PSTs were encouraged to make connections between theory and practice. Textbook readings were carefully chosen to compliment the module and the WU faculty member's goal was to help the PSTs focus on the mathematics in problem solving and not just the answer.

At Winding River College, **78% of the pre-service teachers overvalued the product and undervalued the process in finding a solution.** Even at the end of the three-week module, one participant commented, "To help move a student forward the teacher (sic) needs to be able to prepare the student on how to go about analyzing (sic) the problem and seeing which methods of solving would be the most effective," without acknowledging that this might be most effective for one student may not be most effective for another student. By the end of the three-week module at Woodlawn University, only 13% of the pre-service teachers focused on "the correct way of doing the problem". Their shift in thinking is exemplified by comments such as, "I would try to think inside their head and see where they are coming from with how they are going about solving their problems. I would take more time to reflect."

Similar discrepancies were seen in other areas of the participants' practice. **More teachers at Winding River College completed the module still believing that providing students with step-by-step examples constituted good instructional practice** and a larger number of those that did recognize the benefit of greater student-teacher interaction believed that the purpose was to give the students "hints or suggestions as to what to do differently". Comparable percentages of pre-service teachers from both schools recognized that when students only provide an answer, there is no evidence of the students' understanding of the problem and perceived the benefits that making student work public has for the teacher.

Research Question 1 (cont'd)

In the case of WRC, the use of the Math Forum's module was akin to the use of a supplementary text; students engaged with the problems in a limited fashion, and opportunities to talk about practices emblematic of the Math Forum were not capitalized on as much as we had hoped. In the case of WU, the adoption of the Math Forum modules was more integrated into the course and the faculty member was able to bridge the two communities.

As Wenger (1998) notes, effective brokers must be entrenched enough to have validity in each community, yet distant enough to be able to keep an open mind. Our data suggests that neither of our brokers were "entrenched enough" in the Math Forum community and the need to think differently about the manner in which we craft experiences to cultivate brokers emerged.

Research Question 2

Analysis of participating teachers initial engagement in the activities revealed that the goals for the activity and their perception of the role of student thinking were quite different from the envisioned goals and perspectives described above. Specifically, preliminary analysis indicates that though teachers explicit focus was on formative assessment, their engagement and discussion focused on three primary themes:

- Evaluating student work.** In different cases, the standard against which the student work was measured differed. For example, there was discussion about the mathematical correctness of the work (the answer) and the communication of that answer (show work, identify the unknown, etc.). In each of these cases, it was unclear whether teachers were referring to the correct way or A correct way to approach/solve the problem.
- Talking about their classroom.** Many of the teachers quickly moved from specific students and student thinking to conversation about their schools or their instructional practices, shifting the focus from the student to the teacher.
- Making sense of what the student was thinking.** While this was the least prevalent, it was also the most connected with the goals of the activity.

Discussion

Taken together, the results of this research indicate the importance of brokers for community-oriented professional development and the challenges supporting effective brokers and brokering. During the design process, we anticipated that the faculty members would act as brokers and support the modules functioning as boundary encounters between the students and the Math Forum community. Our data suggests that neither of our envisioned brokers were "entrenched enough" in the Math Forum community and the need to think differently about the manner in which we craft experiences to cultivate brokers. Our current work in the EnCoMPASS project, described in Research Question 2, highlights the emerging challenges supporting further enculturation with the Math Forum and broker development.



* The research team would also like to thank Cheryl Fricchione for her contributions to this project.