

## NAVIGATING CO-TEACHING: PERSPECTIVES FROM MATHEMATICIANS, MATHEMATICS EDUCATORS, AND STUDENTS

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*In this paper, we share reflections from two teams of Mathematics Teacher Educators (MTEs) and mathematicians who co-taught a mathematics content and a mathematics pedagogy course as part of their participation in a project that examined the nature of collaborations between mathematicians and MTEs engaged in the preparation of secondary mathematics teachers. We are particularly interested in comments from prospective teachers who were students within these co-taught courses that revealed potentially problematic issues from their perspective, or that contrasted with our perspectives as instructors. In presenting both faculty and prospective teacher perspectives, we bring awareness to potential issues that can arise in such co-teaching situations.*

### INTRODUCTION

A natural opportunity for collaboration between mathematicians and mathematics teacher educators is in courses for prospective secondary mathematics teachers. Indeed, such collaboration is in line with recommendations from the Conference Board of the Mathematical Sciences, which notes in the *Mathematical Education of Teachers* (CBMS, 2001) that “The mathematical education of teachers should be seen as a partnership between mathematics faculty and mathematics education faculty” (p. 9). Several groups of mathematicians and mathematics educators have described their co-teaching partnerships (Heaton & Lewis, 2011; Sultan & Artzt, 2005; Grassl & Mingus, 2007; Thompson, Bénéteau, Kersaint, & Bleiler, 2012). These articles have been influential in framing the contextual issues important to consider when co-teaching from the instructors’ perspective. However, not much attention has been focused on what students notice during such co-teaching endeavours, or how faculty can facilitate student learning in such an environment.

### Collaboration Context and Goals

The secondary mathematics education degree program at the University of South Florida (USF) is a joint program comprised of mathematics content courses offered by the mathematics department and mathematics-specific and general education courses offered by the College of Education. Each of the mathematician/MTE teams discussed in this paper, Bénéteau/Thompson and Kersaint/Krajčevski, first co-taught a geometry course for teachers housed in the mathematics department. This course is a content course designed to address the specific content knowledge teachers need for teaching. Indeed, CBMS (2012) recommends that “coursework for prospective teachers should examine the mathematics they will teach in depth, from a teacher’s perspective” (p. 17) and should

[provide teachers] opportunities for the full range of mathematics experience themselves: struggling with hard problems, discovering their own solutions, reasoning mathematically, modeling with mathematics, and developing mathematical habits of mind. (p. 54)

In the semester following the Geometry course, each team co-taught a high school mathematics methods course housed in the department of secondary education within the College of Education. This course provides prospective secondary school mathematics teachers opportunity to develop skills for effective teaching of mathematics at the high school level by exploring a range of

mathematics content and the efficacy of different instructional strategies. The two co-teaching teams conceptualized both courses as student-centered, inquiry-oriented courses rather than typical lecture courses. To ensure both instructors had equal roles of authority in the classroom, teaching was planned and implemented as a joint endeavour in which both parties had equal responsibility for planning, teaching, and assessing student learning.

### **Co-Teaching: Perspectives from Prospective Teachers**

Given our intent that both collaborators be actively engaged in all aspects of teaching, we wondered how the prospective teachers, as students in these courses, viewed our roles. At the end of each semester, Bleiler-Baxter, a PhD student in mathematics education at the time, who observed planning and classroom sessions, asked the prospective teachers to complete an anonymous open-ended questionnaire to gain insight into how they perceived the roles of their instructors and the benefits/disadvantages of their co-taught courses. Although we did not ask the prospective teachers to reflect specifically on planning, teaching, and assessing, their responses suggested they noticed important issues with respect to these components of teaching. In what follows, we present the goals the instructors had relative to these components, and the corresponding perspectives of the prospective teachers involved in these courses. We aim to draw attention to issues that may arise for instructors and students in such co-teaching situations.

#### **Planning**

During the semester in which a course was taught, each instructional team met weekly to reflect on the activities of the prior week and to prepare for the coming week. These meetings provided opportunities for the teams to consider how content would be addressed and the nature of the inquiry-based activities to be used; develop assessment instruments; discuss assignments and grading; and think about the structure of the class session. Students frequently commented on their perceptions of how the collaborative teams planned. For instance, students in the Kersaint/Krajčevski geometry course had strong perceptions about the roles each instructor took in planning. One student commented:

I feel like Dr. Kersaint planned all the lessons and technology, yet Dr. Krajčevski actually taught so it was kind of not so good. Dr. Krajčevski then had to teach using technology or whatever else Dr. Kersaint planned when it is obvious he's much more comfortable on the whiteboard and we all learned better that way.

Interestingly, this perception was not completely accurate. Because Kersaint had taught a technology course for prospective teachers, the students seemed to assume she created the Power Point Presentations. However, these were most often developed by Krajčevski, despite his reservations, as noted below:

At that time, I felt that the subject of technology in the teaching of geometry was overemphasized by my collaborator. In a course where the most challenging objects to sketch on the whiteboard were triangles, parallelograms and circles, which can easily be sketched by freehand drawing, the use of technology disrupted the “natural flow” of the discussion about important mathematical concepts and posed additional time constraints.

Additionally, students asserted that planning was not done in a way where the instructors synchronized their perspectives in order to have complete agreement during class discussions or in responses provided to students. Students felt a tension when co-instructors had different approaches or opinions for addressing content or when instructors used differing levels of precision when answering student questions. They perceived such interactions meant the instructors did not have the same expectations for learning. For example, one student in the Kersaint/Krajčevski class reflected:

I would say they didn't seem to agree on some of the content taught. Their standpoints were not consistent or the same. I feel like when teaching a class collaboratively, they should have made sure they were on the same page.

As instructors in these situations, we were trying to be responsive to student thinking and classroom discussion, and therefore necessarily avoided following a script. However, some students interpreted this openness to different ideas as a lack of planning.

### **Teaching**

When we planned for class sessions, there was no explicit intention to have the mathematician focus on content and the mathematics educator focus on pedagogy. However, in spite of our intent to share content and pedagogical roles, regardless of the course, the prospective teachers tended to identify the mathematician as the *content* teacher and the mathematics educator as the *teaching strategies* teacher. As an example, one student wrote, “Dr. Bénéteau did most of the real math teaching while Dr. Thompson would introduce teaching strategies.” Students seemed to partition the instructors into preconceived roles and made assumptions that there are clear and distinct knowledge bases and boundaries for each instructor based on their titles/roles. This was not necessarily a negative from the prospective teachers’ point of view. As one student commented, “We learn how to be accurate mathematicians from Dr. Bénéteau and how to communicate our good ideas from Dr. Thompson. What's the point of only having half those skills?”

In both collaborations, prospective teachers noticed that the mathematicians and mathematics educators had different types of interactions with students. Although both instructors provided instruction, students, particularly in the geometry course, perceived the mathematician as being at the front of the room “teaching” the material while the MTE interacted more with students, particularly when they worked in groups. At times, they perceived the MTE as a mediator between the mathematician and the students, as indicated in the following quote:

Dr. Kersaint could occasionally help clarify if there seemed to be a misunderstanding between the class and Dr. Krajčevski. As the class moved on, the roles of Dr. Krajčevski as primary teacher and Dr. Kersaint as more of a facilitator really seemed to help establish a more regular schedule but allow for that clarification between Dr. Krajčevski and the class.

### **Assessing**

When planning how to evaluate students in the geometry and high school methods courses both teams of instructors had agreed to discuss their grading criteria, including the use of rubrics, and that students would not be told who was grading what. It was not uncommon for each of us to grade half of an assignment or to alternate the grading of assignments.

Across both collaborations, students felt there were differences in expectations related to grading from the instructors. At times, some students claimed that one of the graders was much tougher than the other, but often misidentified which of the two graders that was. For instance, when we asked students to comment on the disadvantages of the Thompson/Bénéteau collaboration, students commented “Too many conflicting ideas, not knowing what the expectations are because there are two different graders” or “They differed sometimes in opinions on what they wanted or expected and would accept.” At other times, students assumed the instructors had different roles when it came to grading. For instance, in the Kersaint/Krajčevski methods course, several students asserted that Krajčevski should not be grading their assignments because, as a mathematician and not a mathematics educator, he was not qualified to grade in a methods course: “I do not think that Dr. Krajčevski should be grading our work regarding methods besides the comments on math material.”

Given high-stakes testing occurring in many states, K-12 teachers need to prepare their students to solve problems and justify their solutions clearly and accurately so they can be read with

understanding by multiple audiences. Yet, comments from these prospective teachers seemed to suggest that they might write a solution in a particular way based on which instructor would be grading the work.

### **What are the Lessons for Future Collaborations?**

In this paper, we have highlighted some potentially problematic issues that prospective teachers noticed with respect to planning, teaching, and assessing when courses were co-taught. When we read through their comments, we were surprised by their perception of disagreement or conflict. For us, what prospective teachers perceived as conflict was actually academic discourse that served as the catalyst for improving our practice. Having had the opportunity to consider the perspectives of these prospective teachers, we now recognize the importance of making the nature and content of instructors' discussions explicit to the students. In future classes, we will draw attention to what prospective teachers might see as conflict, and help them join the conversation by considering the importance of professional growth and learning how to address multiple perspectives.

The issues we faced in sharing our classroom space with our colleagues and what we learned from our students suggests there might be much to learn from opening our classroom space to other collaborations. What similarities and differences to our experience might exist if mathematicians co-teach courses with engineering faculty for future engineers, or with biology faculty for future biologists? Although collaboration is difficult and time-consuming, it can be rewarding for the instructors and for the prospective teachers, highlighting the benefits of collaboration, which they may experience professionally in their future careers.

**Note** Denisse R. Thompson at the University of South Florida participated in drafting an earlier version of this paper, but is not included here because of limits on participation in ICME papers.

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