Examining Teacher Candidates' Learning and Enactment of Mathematics Teaching Practices

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Introduction

P*rinciples to Actions* comes at much needed time, as mathematics educators implement the more rigorous, coherent, and focused, Common Core State Standards for Mathematics (CCSSM). The CCSSM and the embedded *Standards for Mathematics Practice*, call for a more ambitious vision of student learning than is currently the norm in US classrooms (Lampert, Franke, Kazemi, Ghousseini, Turrou, Beasley, et al., 2013). While the CCSSM do not dictate teaching methods, teacher educators must "prepare new teachers to do a kind of teaching that most experienced teachers are not yet doing" (Lampert et al., 2013, p. 226). Many teacher educators are suggesting a push toward practice-based teacher education with a focus on developing teacher candidates' (TCs') knowledge of teaching practices as well as their ability to enact these practices. My research builds on the *mathematics teaching practices* proposed in *Principles to Actions* (NCTM, 2014) by exploring teacher candidates' learning and enactment of three *mathematics teaching practices* over the course of a 13-month post-baccalaureate teacher preparation program.

There are many prominent scholars supporting the redesign of teacher education (e.g., Ball & Forzani, 2009; Core Practices Consortium, 2014; Grossman, Hammerness, & McDonald, 2009; Franke, Kazemi, & Battey, 2007; McDonald, Kazemi, & Kavanagh, 2013). This redesign suggests that teacher education be organized around a set of core practices—or routine practices of the profession. *Principles to Action* identifies eight *mathematics teaching practices* that "represent a core set of high-leverage practices and essential teaching skills necessary to promote deep learning of mathematics" (NCTM, 2014, p. 9). While these eight practices are all important and interrelated, this research explores a subset of three practices that focus on classroom interactions and more specifically classroom discourse. Classroom discourse has received a great

deal of attention in recent years (e.g., Franke et al., 2009; Herbel-Eisenmann, Steele, & Cirillo, 2013; Sleep & Boerst, 2012; Smith & Stein, 2011; Walshaw & Anthony, 2008) and has been identified as one of the most challenging, but crucial, aspects of ambitious teaching for novices to learn (Lampert, Beasley, Ghousseini, Kazemi, & Franke, 2010). The three interactional mathematics teaching practices that are explored are as follows:

Facilitate meaningful mathematical discourse

Pose purposeful questions

Elicit and use evidence of student thinking

Research Questions

This research explores the following questions:

- What are the shifts and changes in teacher candidates' discourse patterns when enacting mathematics instruction over the course of a 13-month post-baccalaureate program?
- How do TCs perceive various activities in the methods course influencing their learning and enactment of interactional mathematics teaching practices?
- What opportunities and tensions do TCs encounter as they learn and enact interactional mathematics teaching practices?

Conceptual Framework

The interactional nature of these particular *mathematics teaching practices* requires a conceptual framework that focuses on classroom interactions. This research utilizes an extended instructional triangle framework that identifies the students, content, and school context as well as the teacher educator and the experiences within the methods courses that support the TC in

their learning (Ball, 2012; Nipper & Sztajn, 2008). This expanded instruction triangle, shown below, allows for analysis of both the learning and enactment of the mathematical teaching practices that occurs within the field placement as well as the preparation courses. The expanded triangle, applied in teacher education, embeds the original instructional triangle (see Cohen & Ball, 2001; National Academy Press, 2001) allowing for candidates to learn in and from practice by making practice "studyable" (Ghousseini & Sleep, 2011). For example, the methods course includes readings, video exemplars, tasks, frameworks, and other activities and resources that allow the TCs to study the practices of teaching. Moreover, this framework can also help analyze the TCs' learning in and from their own practice via methods course assignments that require the exploration of audio and video artifacts of their teaching.

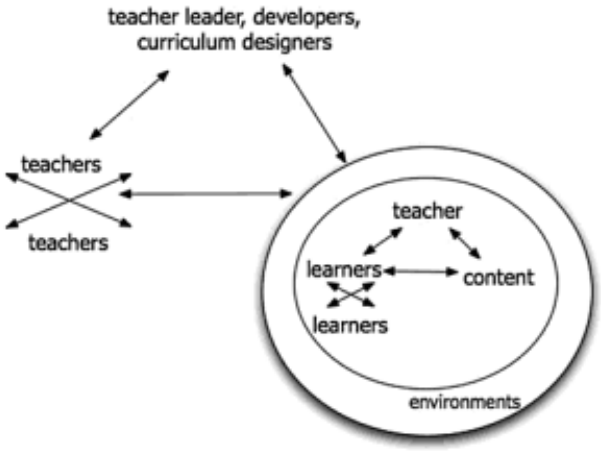

Figure 1: Expanded Instructional Triangle (Ball, 2012, p. 352)

Methodology

This research takes a situative perspective that stems from sociocultural theory. Sociocultural theory incorporates not only the engagement of the learner in an activity, but the

situation in which the activity takes place (Greeno, Collins, & Resnick, 1996). A situative perspective allows for the consideration of teacher learning in two contexts—the methods course and the field placement.

This multiple case study research design (Merriam, 2009) spans a 13-month post-baccalaureate teacher preparation program administered by a large mid-Atlantic public university. From a pool of thirteen consenting teacher candidates, four were chosen for this case study. This phenomenon of interest in this study is the teacher candidate's learning and enactment of three mathematics teaching practices. The context is the TC's experiences in the teacher preparation program. These experiences include both the TC's field teaching experiences as well as experiences in the mathematics methods courses. It should be noted that the primary research is also the instructor of two of the mathematics methods courses.

The design of the summer and fall courses is structured around the learning cycle presented by McDonald and colleagues (2013) and includes the following pedagogies: modeling, video exemplars, written cases, microteaching, collaborative planning, analysis of audio and video recordings, and reflective writing. The methods coursework and program requirements will provide three sources of data for this research: 3-audio recordings of the TC's practice, and 3-video recordings of the TC's practice and two interviews. See the graphic below for an overview of the time frame for data collection.

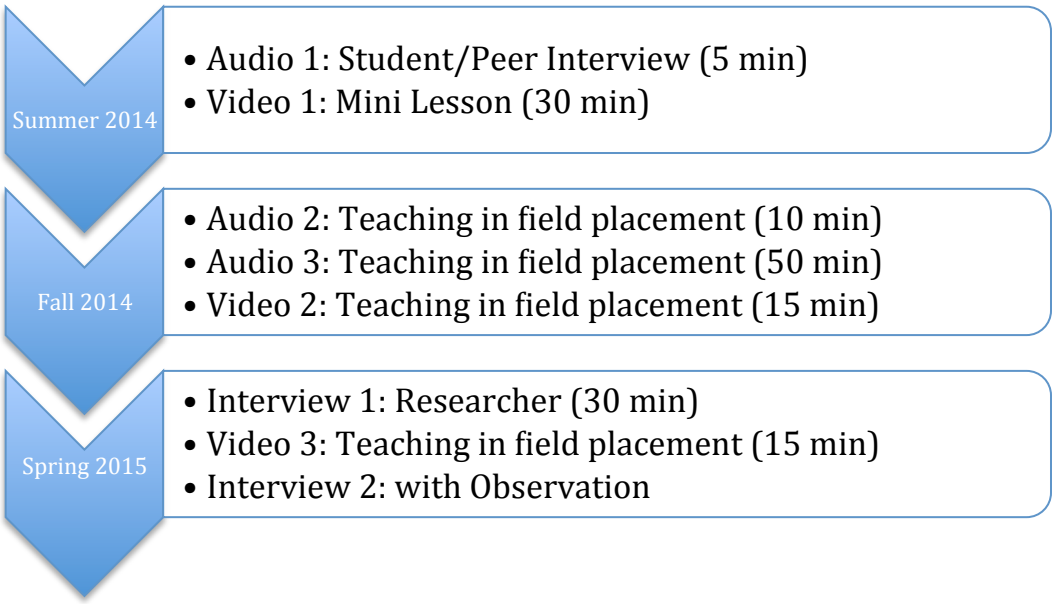

Figure 2: Time frame for data collection

Data Analysis

All audio and video recordings were transcribed. These transcriptions are currently being coded for types of questions and discourse moves. There are nine question types that will be used for coding: gathering information, inserting terminology, exploring mathematical meanings and/or relationships, probing, generating discussion, linking and applying, extending thinking, orienting and focusing, and establishing context (see Boaler & Brodie, 2004, p. 777). Various teacher discourse moves will also be identified, such as: revoicing, restating someone else's reasoning, applying someone else's reasoning, and using wait time (Smith & Stein, 2011). The general patterns of questioning will also be noted (i.e., IRE, focusing, funneling) (Herbel-Eisenmann & Breyfogle, 2005). Lastly, the two interviews transcriptions will help determine which course assignments the TC perceived as influential in their learning and enactment of the three mathematics teaching practices.

Preliminary Findings

This project is in progress and preliminary findings will be presented at NCTM. The presentation will focus on the findings regarding question types, which will be analyzed by both individual case study participants as well as course assignment. I will also discuss the methods course activities that case study participants identify as influencing their classroom discourse. Lastly, I will address potential tensions and opportunities that arise in the methods course as well as the field placement.

Significance and Contributions

Building on the learning cycle framework proposed by McDonald and colleagues (2013) and the *mathematics teaching practices* set forth by NCTM (2014), this research aims to further understand the opportunities and tensions faced by teacher candidates as they develop mathematics teaching practices over the course of a 13-month teacher preparation program. If teacher educators have a better sense of the opportunities and tensions that TCs encounter in the current CCSSM climate, then we will be able to better support them in their development of ambitious mathematics teaching practices. Similarly, understanding how particular assignments support TCs in their development of these teaching practices can help the field improve practice-based coursework.

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