The Use of NCTM Articles as Reading Assignments to Motivate Prospective Elementary Teacher Engagement in Mathematics Courses

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In this study, we examine the use of assigning articles published in NCTM’s practitioner journals as readings in mathematics content courses for prospective elementary teachers (PTs). In particular, we study the articles’ roles in motivating PTs to engage in their content courses. As a conceptual foundation, we characterize NCTM articles as having potential to (1) increase PTs’ “buy-in” of pedagogical approaches used in content courses, (2) challenge PTs’ unproductive beliefs about mathematics, and (3) address mathematics content via children’s thinking. We plan to analyze an existing dataset of PTs’ online typed responses to assigned NCTM articles to identify whether and how their responses reflect increased motivation to engage in their content courses. We anticipate that our results will lead to an increased understanding of PTs’ actual experiences related to the assigned article readings.

Key words: Prospective elementary teachers, subject matter knowledge, student motivation

Elementary teachers must have deep subject matter knowledge (Hill, et al., 2008) in order to teach mathematics well (Ball, 1990; Conference Board of the Mathematical Sciences, 2001; Kilpatrick, Swafford, & Findell, 2001; Ma, 1999). Thus it is of critical importance that PTs engage fully in their preparatory mathematics content courses in order to maximize their learning. This is particularly true in light of the fact that prospective elementary teachers (PTs) in the U.S. typically enter their content courses with limited subject matter knowledge (Ball, 1990; Ma 1999; Thanheiser, 2009; Thanheiser et al., 2014). And yet, it has been shown that PTs do not enter their content courses motivated and ready to learn (Kurz & Kockic, 2011; Moyer & Husman, 2006; Philipp et al., 2007; Thanheiser, 2009; Thanheiser et al., 2013).

Accordingly, mathematics teacher educators have developed pedagogical techniques and interventions that work to motivate PTs to engage in their content courses (Philipp et al., 2007; Thanheiser, 2009; Thanheiser et al., 2013; Thanheiser & Jansen, 2016). A recent example of one such intervention is the use of one-on-one content-based interviews that instructors can implement with their PT students (Thanheiser et al., 2013). Thanheiser and her colleagues showed that interviews can motivate PTs to learn by changing their beliefs about mathematics, and by increasing their awareness of their own unpreparedness to teach mathematics.

In this study, we investigate ways in which having PTs read and reflect on articles from NCTM’s practitioner journals (e.g., Teaching Children Mathematics and Mathematics Teaching in the Middle School) might also motivate PTs to learn mathematics, according to the perspectives of the PTs themselves. As instructors of mathematics content courses for PTs, we find these reading assignments to be indispensable. Prior to this study, though, we know of no research specifically examining the use of NCTM articles in PT content courses and how such article assignments might support PTs in engaging in their content courses, promoting their development of subject matter knowledge for teaching mathematics. Our work addresses this, and moreover, our work illuminates PTs’ own experiences and reactions to NCTM articles.

Conceptual Framework: Three Types of NCTM Articles to Motivate PTs’ Learning
Below, we introduce three types of NCTM articles according to how we, as instructors of PT content courses, believe the articles boost PTs’ motivation to learn mathematics. Further, we point to previous research literature to support these notions. Note that our discussion of each type of article is not intended to imply that every NCTM article can be categorized as being only one type. In other words, we see these three article types are interconnected, and indeed, many articles are two or three types simultaneously.

Type 1: Potential to increase PTs’ “buy-in” of our pedagogical approaches

In our content courses for PTs, we strive to develop a collaborative, discussion-heavy learning environment that is built upon PTs’ own ideas (Thanheiser, Browning, Moss, Watanabe, & Garza-Kling, 2010), and that fosters an orientation towards mathematics as a sense-making and problem-solving activity (Lampert, 2001). We do so not only to model for PTs how we hope they will someday conduct their own classrooms, but also because we believe this type of environment is necessary for PTs’ own learning of mathematics. However, such an environment can differ drastically from the types of environments PTs experienced as K-12 students (Beswick, 2005; Comiti & Ball, 1996). For example, we ask PTs to share their thinking often in class, yet one study recently found that 85% of PTs had little to no experience being asked to share their thinking during any previous mathematics class prior to taking their first PT content course (Thanheiser & Jansen, 2016).

Because PTs hold preconceived notions about the teaching and learning of mathematics based on their own prior experiences as learners (Anderson, White, & Sullivan, 2005; Charalambous, Philippou, & Kyriakides, 2008), they are often skeptical about the unfamiliar style of teaching they are experiencing in their content courses. We believe NCTM articles that discuss the potential effectiveness of certain pedagogical approaches can help PTs make the transition to participating in class in ways that are new to them.

An example of this type of article is “Techniques for Small Group Discourse” (Kilic, et al., 2010). The authors open this article with a brief discussion of the importance of having children engage in discourse in a mathematics class. Then, the authors present two scenarios of teachers engaging elementary students in discourse, and they examine how the teachers’ facilitation of student discourse promoted students’ reasoning about the content. Although the intended audience of this article is practicing elementary teachers, we believe that having our PT students read about a classroom of children who deepened their understanding of a mathematical concept through dialogue might motivate them to similarly engage in dialogue during their content courses. We believe articles like this one can help PTs understand the rationale behind the teaching methods that we use in class, potentially decreasing their skepticism and increasing their willingness to engage with them.

Type 2: Potential to challenge PTs’ beliefs about mathematics

A second type of article serves to challenge unproductive beliefs that PTs commonly have about mathematics (Philipp et al., 2007). For example, many PTs believe that mathematics consists entirely set of procedures or rules to be memorized (e.g., Ball, 1990; Thanheiser, 2009). Such PTs might not see the value in understanding why the procedures make sense, or that there is more than one correct way to solve a problem, thus potentially shutting down their motivation to learn the content, that they believe they already know, more deeply. Articles that push against PTs’ commonly-held beliefs about mathematics might help them be more open to learning.

An example of this type of article is “Multicultural mathematics and alternative algorithms” (Philipp, 1996). This article opens with a child’s invented algorithm for long division,
introducing the idea that there is more than one way to solve a mathematics problem and that even young children can invent effective mathematical procedures. Then, the article presents and discusses examples of algorithms for multi-digit computation used around the world. None of the algorithms are the same as the standard algorithms traditionally taught in the United States. We believe that having our PT students read this article might help them recognize and re-think their beliefs centered on the idea that mathematics consists of one fixed set of procedures developed by somebody else. Additionally, this article might help challenge PTs’ belief that the procedure that they are most familiar with is the only one, is used by everyone worldwide, and is the easiest. Our intention is that articles of this type help PTs think through beliefs that might restrict their motivation to learn mathematics that is new to them.

**Type 3: Potential to address mathematics content via children’s thinking**

Prior research has pointed to the fact that PTs’ analysis of children’s mathematical thinking can be a motivator for PTs’ own learning of content. For example, the use of artifacts of children’s thinking (e.g., videos of children doing mathematics, or children’s written work) has been linked to gains in PTs’ mathematical understanding (Jacobs, Lamb, & Philipp, 2010). Our use of NCTM articles that discuss the mathematical details of children’s ideas and strategies follows directly from this work. We believe that PTs are motivated to understand the mathematics more deeply themselves when they are confronted with artifacts of real children’s mathematical thinking (e.g., via an article discussing a child’s invented algorithm for long division).

An example of this type of article is “Tuheen’s thinking about place value” (Wickett, 2009). This short article gives an account of a third-grader, Tuheen, who suggests that the regrouped “1”s in the multi-digit addition problem 59 + 67 be written as “10” and “100” instead of “1”s, to show their true value. The author then discusses how Tuheen’s insight seemed to help strengthen his peers’ understandings of place value in multi-digit addition. Because many PTs do not know the true value of the regrouped “1”s when they enter their content courses themselves (Thanheiser, 2009), we assign this article with the intention of helping them deepen their own understanding of place value and see that children can and do make sense of mathematics and come up with their own algorithms. As PTs work to follow the account of Tuheen’s mathematical reasoning in the article, we believe they strengthen their own mathematical reasoning as well.

**Research Questions**

The above potential benefits of assigning NCTM articles are derived from our perceptions as teacher educators and may or may not be actualized, according to the perspectives and experiences of our students. And so we wonder whether there is evidence within PTs’ written reactions to articles to support that they are, in fact, serving to motivate PTs’ learning of mathematics. Further, we wonder what PTs’ article responses tell us about the ways in which the ideas in the articles support their learning of mathematics. Therefore, in this study, we specifically ask the questions:

1. Do PTs experience increased motivation to engage with the course material in mathematics content courses as a result of reading NCTM articles, according to PTs’ responses to the articles?
2. If so, how do PTs experience increased motivation to engage with the course material in mathematics content courses by reading NCTM articles, according to their responses?
Methods

Participants
Participants in this study were 42 PTs enrolled in the first course in a sequence of three quarter-long mathematics content courses for undergraduate PTs at a large, urban state university in the Pacific Northwest of the United States. The content of the course focused on whole numbers and operations. Thirteen of the participants were enrolled in the course in the Summer, and the class met for 140 minutes every weekday for three weeks (equivalent to four credits in one quarter). Twenty-nine of the participants were enrolled in the course in the Fall, and the class met for 110 minutes twice per week for ten weeks, which is also equivalent to four credits in one quarter.

Data Collection
As part of the homework assignments for the course, students were asked to read NCTM articles and respond online via a discussion forum in Desire2Learn (a course platform similar to Blackboard). Specifically, students were asked to: (1) type and post their initial summary and reaction to the article, and then (2) respond to at least one other person’s post. There was no specific requirement for post lengths, yet the students were asked to make their responses substantive enough to convince the instructor that they read the article.

The dataset for the analyses below consists of all students’ first summary/reaction discussion forum posts for each of three articles (one article representative of each type introduced above). Specifically the three articles are: “Techniques for Small Group Discourse” (Kilic et al., 2010, representative of a Type 1 article); Beliefs About Mathematics for “Multicultural Mathematics and Alternative Algorithms (Philipp, 1996, representative of a Type 2 article); and Content via Children’s Thinking “Tuheen’s Thinking About Place Value” (Wickett, 2009, representative of a Type 3 article).

Data Analysis Plan
This study is ongoing. At the time of this preliminary report, all data has been collected and analyses are in beginning stages, according to the plan outlined below.

In our first research question, we wonder whether the intended reasons for assigning NCTM articles appear within PTs’ reactions to the articles. For example, for a Type 1 article, we ask, “Is there evidence to suggest that PTs actually experience increased buy-in to our pedagogical approaches, in response to reading this article?” Accordingly, all PTs’ initial responses to each of three articles (one representative of each type) will be coded “yes” or “no”, according to whether they made a statement relating to the type of the article. The percentage of “yes” and “no” responses will be reported. Further, if a response is coded “yes,” the section(s) of the PTs’ response that addressed the purpose of the article will be pulled out for analysis pertaining to the second research question. Figure 1 shows sample excerpts from our dataset that would be coded “yes” for each type of article.

<table>
<thead>
<tr>
<th>Type of Article</th>
<th>Sample “Yes” Excerpt from a PTs’ Response</th>
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<tbody>
<tr>
<td>Type 1: Potential to increase PTs’ “buy-in” of our</td>
<td>“While the article primarily addresses the teacher's role in small-group facilitation, it provided me with an opportunity to reflect on my own experiences of working in small groups. The math classes that I have</td>
</tr>
</tbody>
</table>
pedagogical approaches  
Type 2: Potential to challenge PTs’ beliefs about mathematics  
Type 3: Potential to address mathematics content via children’s thinking

Figure 1. Sample PT responses that will be coded “yes” as evidence of the PT experiencing increased motivation, for each type of article.

In our second research question, we wonder how each type of article might motivate PTs to learn mathematical content, according to their own perspectives (as opposed to our own notions about how this might happen). For example, for a Type 1 article, we ask “In what ways (if any) do PTs’ responses suggest they are experiencing increased buy-in to our pedagogical approaches?” Here our goal will be to identify patterns in PTs’ open-ended responses to articles, and so we will use thematic analysis (Braun & Clarke, 2006) on the marked, relevant sections identified in our analyses for the first research question. Specifically, we will identify themes that illuminate the PTs’ perspectives on how an article’s intended purpose connects to their own motivation to learn. In this way, our use of thematic analysis will be focused on developing a deeper understanding of PTs’ perspectives pertaining to themes, using a narrow lens. This is in contrast to a more broad application of thematic analysis that would seek to capture all themes within the entirety of the PTs’ responses.

Discussion Questions for the RUME 2017 Audience

Because this is a preliminary report, we encourage feedback from the RUME 2017 audience to help shape the future directions of our work, as well as clarifying the community-wide implications of our findings. We specifically plan to pose the following questions to inspire discussion:

1) In our report, we introduce three types of NCTM articles according to the way in which they motivate PTs’ learning of mathematics content. What other “types” of NCTM articles might we consider including in future research?

2) For teachers of elementary mathematics content courses for PTs: What implications (if any) do the themes within our PTs’ responses have with respect to your own teaching?
References


