UNIVERSITY OF WISCONSIN-LA CROSSE

Graduate Studies

PRE-SERVICE TEACHERS' BELIEFS, DISPOSITIONS, AND ABILITIES REGARDING SOCIAL JUSTICE AND MATHEMATICS

A Chapter Style Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Masters in Education-Professional Development

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ABSTRACT

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The purpose of this study was to examine pre-service teachers' beliefs, dispositions, and abilities to integrate *social justice* into the mathematics classroom during a one-semester mathematics methods course at a small, liberal arts university in the Midwest. The study examined participants' initial beliefs, attitudes, and abilities before engaging in a semester-long study of mathematics taught through a critical, social justice lens. Through purposeful modeling of social justice in the mathematics classroom, the study then gauged participants' beliefs, dispositions, and abilities to integrate social justice concepts into the elementary mathematics curriculum.

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CHAPTER I

INTRODUCTION

"Why do we need to learn this?"

"Am I ever going to use this?"

"What's the point?"

Teachers across America have probably heard or will hear one of these questions at some point in their educational career. Teachers of mathematics are no exception. Often, the connections of mathematics to the real world may not be so apparent to students. In fact, the broader connections of mathematics may not be apparent to all *teachers*. I was one such teacher. Throughout my life, I have enjoyed mathematics for the logical reasoning, for the problem solving, for the knowledge that there is one correct answer. Yet now, as a mathematics educator, I realize that simply a passion for the content is not enough. My students desire answers—not just the correct answer, but answers to the above questions. This desire has led me to seek answers—for my students, but more importantly for myself as an educator and for other educators interested in creating a socially just society.

I come from a secondary education background, having certifications in both English and Mathematics. These dual certifications often confuse traditional educators who believe these disciplines are disjoint. Though for a while I, too, believed that this combination was unrelated, my increasing interest in social justice has led me to believe otherwise. In English, writing is often used to inform, persuade, and create change. In mathematics, specifically social justice

mathematics, numbers, facts, and statistics are also used as a means to inform, persuade, and create change.

Coming from the secondary perspective, I thought it was necessary to learn where students began as mathematicians before I could have a complete understanding of where they need to go. Therefore, I began studying mathematics for the elementary classroom. I felt compelled to investigate social justice mathematics while engaging in a study to find children's literature that could be used in the elementary mathematics classroom. My purpose for using children's literature in the elementary classroom was to make math more accessible for math-phobic elementary instructors and more relatable to students. Upon further investigation, I realized that what was missing in my quest to make mathematics exciting and attainable for students was the application to real-world situations and the use of mathematics to create change. This is what led me to social justice mathematics.

What is the purpose of teaching mathematics? This overarching question can be explained using the critical lens of social justice. Adams, Bell and Griffin (2003) define social justice as the "full and equal participation of all groups in a society that is mutually shaped to meet their needs" (p. 1). In education, social justice themes are enacted to enhance students' learning and their life chances by challenging the inequities of school and society (Michelli and Keiser, 2005). Yet, social justice education cannot be implemented without the dedication of critically aware teachers, teachers who have examined their own identity and privilege so that they are able to guide identity development in pre-service teachers. Quin (2009) explicitly states the goal of social justice educators is "*to empower* [both] *educators and learners* to *act* in anti-oppressive ways *for* social justice" [original emphasis] (p. 110). In order for this empowerment to occur, social justice educators must create what Freire (1970) calls horizontal relationships,

relationships where educator and learner work together toward a common goal. Through collaborative immersion, educators and learners can improve upon the inequalities of society. Importantly, Quin (2009) points out that social justice is not a measurable objective, one that is arrived at, completed, and checked off. Rather, it is an ongoing, persistent effort of critical educators to bring about change through a social justice pedagogy.

Social justice education has become a cornerstone of many teacher preparation programs; however, research has shown that many of these programs have a fragmented structure of implementing social justice (McDonald 2005; Mills 2008; Villegas & Lucas, 2002). Stand alone courses in social justice may help students investigate and establish their own identity in terms of critical pedagogy, but often this learning is not translated nor embedded into the content area classrooms (Ambe, 2006; Mills, 2008).

Though research on social justice in education has been growing for decades, research on teaching mathematics for social justice is just emerging (Gutstein, 2006; Leonard, et al. 2010). This research stems from Freire's (1970) work which links education to social transformation, teachers to agents of change, and marginalized students to empowered individuals. Indeed, this emerging research suggests that teaching culturally relevant mathematics that explores identity, power, class, and equity, among other things, will help students develop a positive attitude towards mathematics (Hodge 2006; Leonard, et al. 2010).

In their publication, *Principles and Standards for School Mathematics*, the National Council for Teachers of Mathematics (NCTM, 2000) addressed the need for other learning outcomes such as an equitable mathematics classroom when NCTM implemented a new Equity Principle (2000); however, upon close examination, that Principle looks at equity in the mathematics classroom as equal access and expectations from teachers. As the Equity Principle

on the NCTM website states, “Too many students--especially students who are poor, non-native speakers of English, disabled, female, or members of minority groups--are victims of low expectations in mathematics.” Furthermore, many states have adopted the Common Core State Standards which defines the mathematical knowledge and skills that students need to be fluent in at each grade level. These Common Core State Standards (CCSS, 2010) address equity in similar terms as NCTM, stating “all students must have the opportunity to learn and meet the same high standards if they are to access the knowledge and skills necessary in their post-school lives.” Though these necessary standards point to creating equality in the classroom for marginalized groups, it does not address the ability of mathematics to transform the lives and experiences of all students, including those marginalized students, which is the premise of a social justice pedagogy.

Traditionalists, or positivists as Freire (1970) and Frankenstein (1983) call them, believe that mathematics, and truly all knowledge, is “neutral, value-free, and objective” and can only be gained through a skill and drill attitude (Frankenstein, 1983, p. 316). However, many critical theorists argue that mathematics can be effectively used to analyze and critique injustices in society (Gutiérrez, 2007; Gutstein, 2006). Therefore, students can move from seeing math as a regurgitated set of facts to a dynamic base of knowledge that can be used to “to create meaning and make sense of human and social experiences” (Gutstein, 2007, p. 4). Social justice mathematics thus becomes a means to create a sustainable, more just community, society, and world.

In order to actualize the impact of a social justice pedagogy in mathematics, educators of mathematics must learn how to implement this critical curriculum. With this growing movement of social justice mathematics, various studies have been conducted with educators assisting in

their understanding and development of a social justice curriculum (Gutiérrez, 2007; Gutstein, 2006; Tate, 2005); however, fewer studies have been conducted with pre-service educators, marking their beliefs and abilities to integrate social justice (Aguirre, 2009; Muller, 2008).

Therefore, this study aims to address the lack of research on preparing pre-service elementary educators to teach math for social justice. By examining pre-service elementary mathematics teachers' developing beliefs, attitudes, and abilities to integrate social justice into the mathematics classroom, this study aims to add to the emerging literature on teaching a social justice pedagogy. One focus of this study is to investigate the effects of directly addressing social justice in the mathematics content area classroom. Furthermore, this study hopes to establish a new wave of elementary mathematics teachers who value and implement a social justice curriculum into their teaching.

Research Questions

Before defining the research questions, I must define my own personal definition of social justice in the mathematics classroom. Though literature provides multiple, albeit similar, definitions of social justice mathematics, my personal definition of teaching mathematics for social justice hinges on a teaching and learning environment where:

1. Students are introduced to the various issues of equity, diversity, and social injustices;
2. Students increase and strengthen their mathematical content knowledge; and
3. Students learn to use mathematics to identify and examine social issues with the intent to enact change.

It is important to note that many researchers support the importance of engaging students in social justice activities (Gutiérrez, 2007; Gutstein 2006; Tate, 2005). It is essential to teach students how to take action outside of the classroom in a positive, empowering manner. Gutstein

(2006) refers to this as "developing a sense of agency" (p. 27). At the same time, developing this sense of empowerment to enact change must enhance the teaching of mathematical content knowledge, not overpower the essential tenets of teaching mathematics.

With this definition of social justice in mind, this thesis project will address the following research questions:

1. What are elementary pre-service teachers' initial beliefs, understandings, and ability to integrate social justice into mathematics?
2. Does purposeful modeling of the integration of social justice into pre-service teachers' elementary mathematics methods course change their beliefs, understandings, and ability to integrate social justice into mathematics?

This study investigated pre-service teachers' beliefs and dispositions because, as research has shown, these understandings and attitudes strongly influence their future teaching (Ambe, 2006; Garmon, 2005; Kyles & Olafson, 2008).

Overview of the Study

To address these research questions, this study was placed into the context of three elementary mathematics methods sections which meet for two hours weekly over the course of 15 weeks. Each week, the instructor purposefully modeled social justice connections within the context of elementary mathematics. Pre-service education students were asked to take a pre-test and post-test survey regarding their dispositions toward and beliefs about social justice. Furthermore, students developed concept plans which incorporated an aspect of social justice. Finally, select students participated in focus group interviews. These multiple qualitative data collections assisted in investigating the preceding research questions.

CHAPTER V

CONCLUSION

The purpose of this study was to examine pre-service teachers' beliefs and experiences related to the teaching of mathematics for social justice as they progressed through a one semester mathematics methods course. This study also analyzed the pre-service teachers' experiences as they learned about and then tried to develop for themselves lessons and projects that could be used for teaching mathematics for social justice. The purpose of analyzing their experiences was to document both the positive and negative events of and/or influences on pre-service teachers' learning to teach mathematics for social justice. Specifically, the study examined the following two research questions:

1. What are elementary pre-service teachers' initial beliefs, understandings, and ability to integrate social justice into mathematics?
2. Does purposeful modeling of the integration of social justice into pre-service teachers' elementary mathematics methods course change their beliefs, understandings, and ability to integrate social justice into mathematics?

In this chapter, I will summarize my findings to these two questions and identify limitations of the research study. I will also reflect upon the conduct of my research and how to strengthen the study as well as present ideas for further research.

Question Summaries

In regards to the initial beliefs and abilities, overall the pre-service educators were at an "awareness" stage. The majority of pre-service educators could not define social justice, let

alone social justice mathematics. This led to an inability to create a social justice lesson to be incorporated into the mathematics classroom. The promising factor was that pre-service educators held an attitude towards social justice categorized just under "developing". This meant that the educators were ready dispositionally to engage in the study. Additionally, because their disposition toward social justice mathematics was only at "awareness", their outlook toward teaching mathematics in a new focus could greatly be impacted.

The study then looked at how purposeful modeling affected the pre-service educators' beliefs, dispositions, and abilities. The most measurable impact of purposeful modeling was found in their abilities as at least six participants clearly mimicked lessons presented by the instructor or myself. Though participants clearly utilized similar lessons as those purposefully modeled, often the pre-service educators did not extend the lesson toward engaging in change agency. Therefore, although this confirms that pre-service educators learn by example and can use that learning as a springboard for future lessons, not all purposefully modeled lessons transitioned into a clear-cut understanding of social justice mathematics. Overall, this pre-service educator summed up purposeful modeling and its impact on relating social justice to the mathematics classroom, "At first, it was very hard for me to see the connection between social justice and mathematics. But then, when we related it to class materials, through examples and models, it made it easier for me to understand" (Focus Group Interview, December 6, 2010).

By the end of the semester long study, most participants moved in their beliefs, dispositions, and abilities to integrate social justice into the mathematics classroom. Both quantitative data of the Dispositional Survey of Teaching and Learning Mathematics and qualitative data through focus group interviews showed a move favorable attitude toward both social justice and social justice mathematics, with dispositions clearly in the "developing"

category moving toward “praxis”. This aligned with their beliefs that social justice can be a powerful tool in the teaching of mathematics.

In terms of the abilities to integrate social justice into the mathematics classroom, almost all pre-service educators could define social justice; however, their abilities fell into three beliefs about what social justice looks like in the classroom (real world, culture, change agency) and how the mathematics is utilized (connected versus critical mathematics). Their concept plans highlighted these three beliefs and abilities clearly, which shows that not all pre-service educators could clearly enact the truest form of social justice in the mathematics classroom. Overall, there were positive gains in all three categories of beliefs, dispositions, and abilities toward a social justice pedagogy being integrated into the mathematics classroom.

Limitations

As with any research study, there are limitations to the work presented here. One limitation comes from the nature of the population of pre-service educators. With the majority of educators being white and female, the diversity of perspectives was limited. Therefore, an in depth understanding of how identity and privilege affects the implementation of a social justice pedagogy could not be explored. At the same time, however, some participants did explore their identity in relation to social justice as this pre-service educator explained, “I know oftentimes when you throw out the term multiculturalism, it feels like something I personally can’t relate to because I’m a white female, but when you throw out social justice, that’s something I can relate to” (Focus Group Interview, December 6, 2010). This relational understanding may lead to a greater commitment to investigating inequalities in the world, which does incorporate ethnic diversity.

Another limitation of the study is that the pre-service teachers were not followed into their field or student teaching classrooms. This was simply a matter of not having the time or resources to undertake such a broad project. As such, while the research reports on how pre-service educators discuss their disposition toward math for social justice and their possible implementation of it in their classrooms, such discussions cannot be compared with the pre-service educators' actual actions within the future classrooms. Valuable information can be gathered by discussing the implementation of math for social justice lessons with the pre-service educators after observing them in undertaking such implementation with their students.

A final limitation to this study would be the initial understanding of social justice the pre-service educators brought to the classroom. This concept has only recently begun to be discussed and taught in education courses at the university, which meant, as the pre-belief's survey exposed, that most of the participants did not have a firm grasp of the concept of social justice. If this study would be undertaken with participants who had a firmer grasp of social justice, perhaps the discussions and abilities could have delved deeper. As Darling-Hammond (2000) writes, "Higher levels of student achievement are associated with mathematics teachers' opportunities to participate in sustained professional development grounded in content-specific pedagogy linked to the new curriculum they are learning to teach" (http://epaa.asu.edu/epaa/v8n1/). Therefore, this limitation may be resolved by purposefully threading a social justice pedagogy throughout the entire education program, thus strengthening initial understandings and potentially enhancing future success in the elementary mathematics classroom.

Researcher Reflections

Fulfilling Freire's (1970) model of action-reflection leading to praxis, I felt it necessary to reflect upon the research study as whole and where this study could have improved. First, I analyzed the articulation of the concept social justice mathematics. Due to the participants' limited initial understanding, the concept of social justice may not have been clearly presented. Through purposefully modeling of social justice mathematics lesson plans and giving participants articles to read and react to, I employed a constructivist approach to learning about social justice. This may have prevented the full picture of social justice from clearly being illustrated. However, given the vastness of the study of social justice and the specific research focus of mathematics, time constraints and resources did not allow for this in depth understanding to initially develop. This may have led to confusion and frustration among participants, which is evidenced by the fact that two participants wrote in their post-belief's survey that social justice was being equitable to students in the classroom, a misconception held initially by most participants.

Therefore, in order to improve upon this, I would propose frontloading the course with more direct teaching about social justice, excluding the specific intent of implementing it into the mathematics classroom. Therefore, pre-service educators can grasp the concept of social justice more clearly before delving into the specific implementation of social justice in the mathematics classroom. However, if the entire education program follows the afore mentioned recommendation to thread social justice throughout its curriculum, then pre-service educators would be ready to engage in the specific focus of social justice mathematics.

Another area of concern for me was the lack of discussion regarding identity and privilege and its impact on classroom teaching practices. Though some participants naturally

reflected upon their identity, direct discussion of this topic was not of primary concern. It is well known that dispositions and beliefs are affected by our identity; however, due to the myriad of topics needed to be addressed in the methodology course, an understanding of privilege and its role in the classroom did not occur explicitly.

Another overarching reflection that would lead me to more fully develop the study is the concept of change agency. Though preliminary articles and lesson plans often included a component of change agency, this concept was discussed briefly near the end of the semester-long study. Recognizing the power of mathematics to read and write the world is simply the first step in promoting social justice in the classroom; empowering students to make a difference and influence inequities they find fulfills the true meaning of social justice. However, again the articulation of this idea and the practical means to create change agency was actualized through a short classroom discussion. This critical component to social justice should become second nature in discussion and implementation to truly embody a social justice mathematics pedagogy.

Lastly, one major hurdle I faced was changing the pre-service educators minds away from mathematics as a solely quantitative content to mathematics as a narrative study. As Frankenstein (1983) articulated, the traditional view of mathematics as objective and neutral where facts are learned through skill and drill still pervade the school setting. Though I did not specifically ask, I assume that most of these pre-service educators grew up learning mathematics in this traditional sense such as this pre-service educator who commented in a written article reflection, "As a student who never like [sic] the rigidity or black and white answers that math so often required, I would embrace [the author's] ideas of making math relevant and interesting for all students by molding lessons around their interests and passions." Another pre-service educator reflected, the Elementary Mathematics Methods course "always made me think beyond

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the traditional way of implementing math to a way that is more conscientious" (Focus Group Interview, December 7, 2010). This shows that pre-service educators were confronted with conflicting views of teaching mathematics: the traditional method that most pre-service educators have been schooled in and this new movement toward a critical mathematics pedagogy that investigates social justice issues through the medium of mathematics. Gutstein (2006) referred to this limitation as "changing one's orientation to mathematics" or recognizing the difficulty of moving from a Traditionalist, quantitative standpoint to a Critical Pedagogue, narrative standpoint where facts and statistics become powerful means to right the injustices of society. I now realize that this dichotomy should have been more clearly articulated early on in the semester for pre-service educators to reflect upon their own mathematics upbringing and how social justice differs.

Further Research

Though the study adds to the growing research on social justice mathematics movements in pre-service educators, it leaves unanswered questions that can serve to guide further research. One of these is to explore long-term effects of the Elementary Mathematics Methods course through a longitudinal study that would follow pre-service educators from their methods course to student teaching and eventually to their first year of teaching. This would be most effectively conducted through a case study approach. This case study approach could target specific pre-service educators, such as those lowest in their "awareness" disposition, beliefs, and abilities to track the most growth. Other case studies could follow pre-service educators of diverse backgrounds such as ethnicity, religious beliefs, ability, or sexual identity to see how their specific minority background affects social justice implementation. Another research endeavor might involve cross-curricular studies where social justice pedagogy is embedded into multiple

methods courses such as the Science, Social Studies, and Language Arts methods courses. Regardless of the nature of these studies, it remains valuable to implement a social justice pedagogy into the educational track of pre-service educators.

Conclusion

Working on this study has been both an exciting yet challenging opportunity. In doing so I began to see the complexities involved in preparing teachers to teach mathematics for social justice. While this research study's findings address some of these complexities in regards to beliefs, dispositions, and abilities to integrate social justice into the elementary mathematics classroom, it leaves many unanswered questions. There is still much work to be done in this emerging field if we are to address issues of how to best prepare pre-service educators to teach math from a social justice lens.

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