

UNIVERSITY OF WISCONSIN-LA CROSSE

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

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PRE-SERVICE TEACHERS' BELIEFS, DISPOSITIONS, AND ABILITIES  
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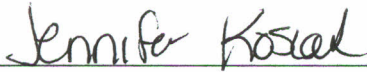
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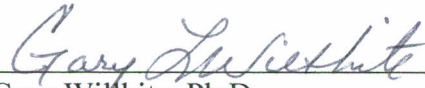
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## ABSTRACT

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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 their 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 a means to change. In mathematics, specifically social justice mathematics, numbers, facts, and statistics are also used as a means to inform, persuade, and create a means to change.

Coming from the secondary perspective, I thought it was necessary to see 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 come to life. 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 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, Wisconsin recently 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 school 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 II**

### **LITERATURE REVIEW**

Across the country, many educators recognize the importance of social justice education; however, not all teachers understand how to effectively integrate social justice pedagogy into their content specific and standards driven classroom. Teachers, specifically pre-service educators, must be taught how to integrate social justice into a content specific classroom. Though pre-service teachers take courses on multicultural education and diversity awareness, the ideas and information from these social justice courses do not always directly translate into teacher practice.

Furthermore, some traditional content driven classrooms lend themselves more easily to social justice education, such as language arts and social studies where books highlighting diversity in its many forms (race, gender, religion, etc...) can be read or lessons on the diverse cultures of America easily weave into the traditional history lessons. However, teachers of mathematics may find the diversity of social justice a bit more difficult to integrate into their curriculum and pedagogy. Integrating social justice pedagogy becomes easier, however, when modeled by critical educators. It is imperative for pre-service teachers to learn not only the importance of integrating a social justice pedagogy but also how to do so in the field of mathematics. Therefore, this literature review seeks to analyze the emerging trend of social justice mathematics and how the

beliefs and attitudes of pre-service educators effect the integration of social justice pedagogy into their mathematics classroom.

### **Social Justice Education**

Before integrating social justice education into the mathematics classroom, one must gain a clear understanding of what exactly is a social justice pedagogy and what place it already holds in the educational system. Social justice may not be clearly defined in the minds of educators, administrators, and students. Even teachers within the same school may have varying perspectives. A social justice pedagogy stemmed from the work of Paulo Freire (1970) and his theory of critical education and liberation of the oppressed. Freire first begins by illustrating how schools follow the “banking model” of education, which is that educators deposit knowledge into the minds of the students. This model does not meet the needs of students nor does it advance the idea that education should create citizens of the world who are ready to tackle complex issues.

Therefore, Freire (1970) defines the idea of liberation through education as “a praxis: the action and reflection of men and women upon their world in order to transform it” (p. 60). At the foundation of Freire’s theory is the understanding that knowledge is neither static nor neutral. According to Frankenstein (1983), Freire’s concept of knowledge contends that “knowledge is continually created and re-created as people reflect and act on the world” (p. 316). Through the continual, dialectical interaction of reflection and action, people can move from a position of oppression to an empowered stance that can promote change in the community. In essence, this is the definition of a social justice pedagogy, one where students learn about and reflect upon social inequities and act to promote change.

Most schools today do not work to promote the critical consciousness needed in a social justice curriculum. McLaren (2003) believes that schools are failing to meet the needs of students to become critical thinkers, writing, “School knowledge should have a more emancipatory goal than churning out workers” (p. 86). Giroux (2009) believes that “students seem to be valued more as consumers and test takers than they do as potential critical citizens” (p. 9). These critical theorists believe that schools ought to be teaching students how to examine and analyze social injustices rather than maintaining the current state of affairs. To counter the status-quo-keeping component of schooling, teachers need to become critical educators.

### **Learning to be Critical Educators in Teacher Education Programs**

One opportunity for teachers to learn about being critical educators would be in their teacher education programs. However, some critical educators and theorists argue that this opportunity is often not provided for pre-service teachers (Cochran-Smith, 2004; Giroux & McLaren 1986; Ladson-Billings, 1995). For example, Cochran-Smith (2004) writes, “In most of their pre-service programs, the role of the teacher as an agent for change is not emphasized, and students are deliberately socialized into assuming responsibility for school reform and renewal” (p. 29). Providing opportunities in teacher education programs for pre-service teachers to learn critical pedagogy is important because it can help them address concerns about diversity, equity, and multiculturalism in their future classes (Aguirre 2009; Ladson-Billings, 1995).

Social justice education and the preparation of teachers to address diversity in the classroom is a standard set out by the National Council for Accreditation of Teacher Education (NCATE). Standard number four on diversity states that it wants all teacher

education candidates “to demonstrate and apply proficiencies related to diversity” (NCATE, 2008, p.34). Although some schools of higher education preparing pre-service teachers have moved toward an inclusive, integrative approach toward educating students on the importance of addressing stereotypes to enact change, many teacher education programs still address this education as add-on approaches (Mills, 2008; Vavrus, 1994) through “courses in multicultural education, required clinical experiences with students from diverse backgrounds, and otherwise created opportunities for prospective teachers” (McDonald, 2005, p. 419). This type of approach has led to a fragmented or non-cohesive view of how social justice initiatives should be integrated. Though pre-service students become aware of diversity, addressing diversity through a socially just curriculum is still a foreign idea.

Depending on the teacher education courses required at some universities, the added on courses previously described are not always mandatory. This may leave some pre-service teachers with little to no training on social justice education. Additionally, “unless the ideas introduced in the added courses are reinforced and expanded on in other courses, prospective teachers are not apt to embrace them as their own particularly if those ideas clash with the views they bring into teacher education” (Villegas & Lucas, 2002, p. 20). Furthering that idea, Villegas and Lucas (2002) write that if the rest of the regular curriculum does not support or contradicts these new understandings, any effect towards a positive change will be lost. Additionally, after examining courses in teacher education programs, “when markers of identity such as gender, ethnicity, ‘race’, or social class are examined, the focus is on developing student teachers’ understandings of how these discourses shape learner identities and rarely on how these *also* shape *teachers’*

identities” (original emphasis) (Allard & Santoro, 2006). Thus, it is imperative to re-envision the idea of social justice education and preparation in not only pre-service teacher programs but the entire collegiate curriculum.

One issue various researchers have examined is the prevailing whiteness of pre-service education students and how that whiteness, or more accurately lack of cultural experiences and underlying life of privilege, plays a role in fostering a truly diverse educational experience. While America’s classrooms are becoming increasingly more diverse, America’s teachers remain, largely, white and middle class (Cross, 2005; Hill-Jackson, 2007). Furthermore, as Sogunro (2001) argues, “today’s monocultural and monolingual teacher is becoming increasingly less competent in a culturally, racially, and linguistically diverse classroom setting” (pp. 19-20).

As Berlant (2008) expresses, the primary and overarching goal of preparing and fostering a socially just pre-service teacher is “to challenge the reproduction of white power and privilege that is ubiquitous in US schools” (p. 47). Researchers recognize that teacher education programs are actively pursuing a reformation of their program in order to respond to the ever-changing racial, ethnic, and cultural diversity (Cross, 2005; McDonald, 2005; Sogunro, 2001). However, Cross (2005) argues that reforming teacher education programs using what Cross terms as “soft, safe code words (contrasted to racism, white privilege, and power)” has led only to small advances in preparing future teachers for the diversity they will face in the classroom (p. 265). Thus, a more critical approach must be taken in order to more than adequately prepare pre-service teachers.

## **Re-conceptualizing Teacher Education Programs**

A variety of research has been conducted on re-conceptualizing teacher education preparation programs in terms of infusing a more socially just curriculum, one where teachers fully embrace a diverse education in mind and practice. According to Sleeter (2001), pre-service education programs have taken two distinct courses of action in order to address the cultural gap between pre-service teachers and the students they will soon teach. One course of action is to recruit more culturally diverse educators; the other track is to develop the critical multicultural lens of predominately white pre-service teachers (Sleeter, 2001). The recruitment of more diverse educators can be seen at predominantly white college campuses nationwide; for example, the University of Wisconsin-La Crosse has hired a diversity recruiter specifically for the School of Education.

However, researchers have also argued toward recruiting teachers with dispositions that would foster a more receptive attitude toward diverse students. For example, Haberman (1991) and Garmon (2004) advocate for selecting those teacher candidates who possess specific experiences, dispositions, and knowledge that would best suit a diverse classroom. Mills (2008) supports the use of the three dispositions that Garmon (2004) identified as factors that would aid in the recruitment of pre-service educators, namely

- ❖ “openness (receptiveness to others’ ideas or arguments, as well as receptiveness to diversity);
- ❖ self-awareness/self-reflectiveness (having an awareness of one’s own beliefs and attitudes, as well as being willing and/or able to think critically about them); and

❖ commitment to social justice” (Mills, 2008, pp. 269-270).

By being more selective in the choice of candidates, teacher education programs will achieve greater success in developing socially just teachers.

The second option of developing the critical multicultural lens of teacher education students is perhaps the track many current college programs have undertaken. In order to develop this critical lens, pre-service teachers must first examine their own diverse identities. As Brown (2004) states, “Teacher beliefs about themselves can be strong predictors of their behaviors toward students and their ability to nurture academic achievement” (p. 124). This extends to a teacher’s belief about infusing a socially just curriculum. Both Ambe (2006) and Sogunro (2001) cite a study conducted by Wade (1998) who interviewed white pre-service education students. One student’s comments support the necessary development of a critically diverse lens: “Well, I guess I have some prejudices—but I certainly wouldn’t let them influence how I teach. I’m going to get a teaching job in my hometown—I don’t need to know about multicultural education” (Wade, 1998, p. 84 as cited in Ambe, 2006, p. 694 and Sogunro, 2001, p. 23). This unwillingness to change and belief that multicultural education, and thus social justice education, will not matter back in this student’s hometown is exactly why researchers have advocated to select teacher education candidates based off the previously mentioned dispositions and to take these selected candidates even further in their development of a critical lens. Diversity, whether racial diversity or otherwise, will affect all teachers of the 21<sup>st</sup> century, even in those small rural hometowns.

As previously addressed, concern about the overall whiteness of pre-service teachers, as compared to the children they will teach, has forced a re-conceptualization of

teacher preparation programs. What must first be addressed is the fact that pre-service teachers have the potential to learn and perpetuate racism if their teacher education program and courses do not explicitly question “racism, power, and whiteness” (Cross, 2005; Furumoto, 2008). This does not mean using the soft words of multiculturalism or diversity, but the harsher yet more real words. By addressing these ideas of power and whiteness, white pre-service teachers will begin to examine their own privilege, a necessary step in order to effectively embrace a social justice pedagogy. In order to do this, pre-service education students must have an educator or professor willing to guide this process; both professor and student “must be willing to lower their defensiveness, adopt reflexive thinking, and be willing to accept alternative perspectives” (Ambe, 2006, p. 694). Yet, G. R. Howard’s (1999) book *We Can’t Teach What We Don’t Know: White Teachers, Multiracial Schools*, appropriately cautions, “It is important to remember as we embark on this complex and sometimes uncomfortable journey into greater understanding that the ‘enemy’ is dominance itself, not white people” (p. 27). With this thought in mind, perhaps more teacher educators and pre-service teachers will let their guard down in order to critically examine their identity and privilege.

Once privilege is critically examined, teacher educators can focus on the traditional way diversity education has been taught and re-conceptualize how a socially just curriculum of the 21<sup>st</sup> century ought to look. Mills (2008) suggests that pre-service education programs need to move away from “the fragmented and superficial treatment of diversity” (p. 268) towards a more substantive approach where social justice and multiculturalism become infused into every course taken to prepare pre-service teachers, regardless of their cultural background. Preparation programs need to be re-designed

with the foremost thought of social justice education in order to best prepare pre-service teachers to become successful educators in this increasingly diverse global society. No longer limiting social justice education to single, add on courses will allow for what has been termed *transformative multicultural pedagogies*, a curricular movement that will progress beyond learning about diversity to assisting pre-service teachers to appreciate and focus on diversity as a strength (Ambe, 2006; Morey & Kitano, 1997).

### **Pre-Service Teacher Attitudes and Beliefs about Diverse Students**

As Kyles & Olafson (2008) so appropriately state, “Beliefs drive action” (p. 503). Therefore, along with addressing the actual teacher education program, an equally if not more vital step is to address the views and beliefs of pre-service teachers about social justice in the classroom and larger school community. The views and beliefs of teachers have extensive implications not only for the students in their classrooms but for the entire school and even school district; thus, the attitudes of pre-service teachers “must be transformed so that they can in turn transform the school environments in which they work” (Ambe, 2006, p. 694). However, the initial attitudes toward teaching of pre-service education students come from their upbringing and are shaped mainly by parents and teachers, as these pre-service education students have observed countless hours of their own elementary through high school teachers and have formed a fairly strong viewpoint on the concept of teaching (Feiman-Nemser & Remillard, 1996).

Having such deep-seated beliefs often presents a problem for teacher educators who want to challenge a student’s view of education, specifically if the view is completely opposite what the pre-service teacher experienced (Kyles & Olafson, 2008). Furthermore, teacher education candidates often “use the information provided in course

work to confirm rather than to confront and correct their pre-existing beliefs” (Kagan, 1992, p. 154 as cited in Mills, 2008, p. 269). Therefore, it is of vital importance for teacher educators to challenge pre-service teachers’ existing beliefs in a safe, inviting manner that will provoke change of heart and mind, not a hardening of heart and steadfast beliefs.

If teacher educators successfully guide pre-service teachers toward understanding that their views of education may not match their need to teach an ever-changing diverse student population, then the next step is to address two prevailing beliefs that white pre-service teachers often possess about their diverse students: the deficit view and the missionary or “savior” belief. Both of these beliefs contain great fallacies that must be not only addressed but completely abolished from a pre-service educator’s thoughts and actions in order for this future teacher to successfully implement a socially just curriculum.

### **Deficit Belief**

The first view of many pre-service education teachers is that of the deficit view. The deficit belief views diverse students as one who “lacks” skills that other students possess or has “deficits” of some kind (Jay, 2005). These students, whose culture and background provide rich resources that could be utilized in the classroom, are often stereotyped in a pre-service teacher’s mind, thereby limiting the student’s potential in the classroom and the potential of the teacher to utilize the diversity as a strength in the classroom. If pre-service teachers cannot overcome their deficit thinking, these teachers may reaffirm stereotypes in their future classroom, thus perpetuating the cycle of inequality (Mills, 2008). Ambe (2006) argues that setting aside long held deficit views of

diverse students may feel “unfamiliar and uncomfortable” to pre-service teachers, but challenging that view “will eventually lead to the dismantling of deficit thinking, and true appreciation for diversity” will thus ensue (p. 694).

Extending this idea, García & Guerrav (2004) assert that changes in pre-service deficit thinking can only come when a systematic change occurs. Deficit thinking occurs not only in pre-service education students but largely is transmitted by society as a whole, including teacher education programs and teacher educators. Supporting this claim, Ambe (2006) asserts that white teacher education professors “still carry with them deeply embedded notion of deficit thinking that pervade both pedagogy and curriculum” (p. 693). Whether consciously or unconsciously, all who come in contact with students—from pre-service to in-service teachers, novice to veteran, teacher educator to administrator—must examine their beliefs about diversity in the classroom to ensure that deficit thinking does not continue to pervade our school and society by transmitting these ideas to our students and future leaders and educators.

### **Missionary Belief**

A second belief of pre-service teachers is that of the savior of “missionary” belief. Plainly, pre-service teachers who hold the missionary belief see themselves as saving diverse students from the lesser or inferior lives they lead; pre-service teachers assume the role of a superhero when no victim is in sight. The missionary belief perpetuates the idea that diverse students are inferior, that in order for these students to become equals they must become “part of a system that oppresses them.” (Furumoto, 2008, p. 84; Giroux, 1997, p. 302). Furumoto (2008) further argues that pre-service teachers exemplify their whiteness as they become “the embodied agent of the colonial, white,

racist society and schooling system attempting to teach the uncivilized persons of color how to become better by becoming like middle-class white people” (p. 84).

Allard & Santoro (2006) studied pre-service educators and found an example of this missionary belief in one of their female students who seemed “to construct culture as something of a problem that must be overcome if she (was) able to ‘help’ these students” (p. 126). If pre-service teachers learn to truly create a socially just classroom that sees diversity as a strength, then views such as the missionary and/or the deficit belief must be challenged and changed. After examining the research of pre-service education programs and pre-service educators, their beliefs, attitudes, and identities, it is imperative to understand how social justice is integrated into the curriculum. Few elementary, middle, or even high schools have a class solely dedicated to bringing about awareness of societies inequalities and injustices, yet teachers recognize the importance of teaching about diversity in all its shapes and sizes. Therefore, teachers must find ways to integrate a socially just curriculum into their content areas. Most pre-service teachers are well prepared to teach their content area; however, Sogunro (2001) points out that pre-service teachers lack the appropriate knowledge, skills, and dispositions that are crucial to implementing a successful approach to a social justice pedagogy in their specific content area.

### **Beliefs about Teaching for Social Justice**

Beyond simply understanding the views on diversity and minority students, it is important to understand how pre-service educators’ beliefs about social justice may affect their ability to integrate social justice pedagogy into the math classroom. Price and Ball (1998) studied pre-service education students in the context of a classroom that promoted

social justice and found these prospective teachers struggled with the idea of teaching mathematics for social justice due to their pre-existing beliefs about teaching and schools. Specifically, pre-service educators “were struggling with learning to see classrooms from new perspectives, to reconsider the roles of teachers and students, issues of power and opportunity, and knowledge itself” (Price and Ball, 1998, p. 262). Price and Ball believe that these pre-service teachers’ understanding of social justice in the mathematics classroom was “intimately tied to their understandings of themselves, one another, the students in the classroom, and mathematics as a field of inquiry” (p. 262).

Cochran-Smith (1991, 2004, 2009) has been studying pre-service teachers’ beliefs about social justice for many years. In a recent study by Cochran-Smith, et.al (2009) of a teacher education program whose focus is social justice, more specifically teacher candidates from this program who were student teaching, researchers found that pre-service educators held four main beliefs about teaching for social justice:

1. pupil learning—ideas about making pupils learn, accommodating and differentiating instruction, promoting critical thinking, and holding pupils to high expectations;
2. relationship and respect—ideas about building relationships with pupils and their families, developing a culture of respect, and caring for pupils;
3. teacher as activist—ideas about advocating for pupils, engaging in community work, and participating in activism; and
4. recognizing inequities—ideas about racial and economic inequities, connecting curriculum to issues of oppression, breaking down racial or class barriers, and seeing the job of the teacher as a change agent (p. 356).

What is important to note is that these pre-service educators participated in a teacher education program where every course specifically addressed teaching for social justice. Therefore, the study by Cochran-Smith et. al (2009) shows how pre-service teacher beliefs can be challenged, supported, and refined to more accurately reflect a critical understanding of social justice.

### **Mathematics Education**

The National Council of Teachers of Mathematics (NCTM) has put forth a set of Principles and Standards for the mathematics classroom; though no standard explicitly states the desire for a multicultural experience, the Equity Principle focuses solely on equity in the classroom, encouraging teachers to provide challenging, high-level tasks to *all* children. Furthermore, numerous articles and dialogues on the NCTM website focus on a multicultural, socially just classroom. NCTM does provide this vision of the mathematics classroom, *“Students of varied backgrounds and abilities are working with their teachers to learn important mathematical ideas. Expectations are high for all students, including those who need extra support to learn mathematics well. The classroom environment is equitable...”* (NCTM, 2000). Though NCTM implies its advocacy for social justice in the classroom, without exact standards, it is hard to envision exactly what that would look like.

One way of defining equity in mathematics education is by the access that students have to high quality, advanced level mathematics courses. Frankenstein (1983), too, sees the need for access to mathematics courses so that students can both participate fully in and transform society. Frankenstein explains that growing in mathematical knowledge is “an important part of gaining real popular, democratic control over the

economic, political and social structures of our society” (p. 315). Frankenstein furthers this position by saying that the mathematical literacy needed to understand the complexities of society and to argue one’s opinion goes beyond that of simply being able to calculate mathematics. Gutstein (2006) similarly contends that mathematical literacy goes beyond memorizing formulas and regurgitating facts to using mathematics as a means to analyze and investigate inequalities in society. Gutiérrez (2007) supports this position of access through her definition of numeracy, indicating that this includes, “the ability to understand graphs, tables, the condensed language of codes and other ways of informing the individual” as well as the ability to “read data and communicate it” (p. 42). Thus, open access to high-level mathematics is a necessary component of an equitable society, a society that Gutiérrez defines as one where “no group oppresses another” (2007, p. 41).

### **Movements in Mathematics Education**

Before arriving at a social justice pedagogy, mathematics reform movements have undergone a variety of names and definitions, all of which combined together make up what I and other researchers term a social justice mathematics pedagogy. The first movement proposed and utilized by researchers is called *culturally relevant mathematics*. In general, Ladson-Billings (1994) asserts that culturally relevant teaching must “empower students intellectually, socially, emotionally, and politically by using cultural referents to impart knowledge, skills, and attitudes” (pp. 17-18). Expanding on that idea, Leonard & Guha (2002) assert, “Mathematics problems that tap the culture of the students have the potential to engage them” at the previously described levels (p. 114). By including various aspects of a students’ culture into the mathematics curriculum,

teachers move away from the cultural deficit view of their students towards a more inclusive classroom (Herron & Barta, 2009; Leonard & Guha, 2002).

One key aspect of successfully creating a socially just mathematics classroom is making mathematical problems relevant. Accordingly, Herron & Barta (2009) define *culturally relevant problem solving* as the “inclusion of the students’ culture in mathematical problems by making the context of the problems relevant to the culture of the students” (p. 27). Campbell & Langrall (1993) propose that teachers must recognize that all students, regardless of their cultural background, gender, or socio-economic status, have some knowledge—whether formal or informal—of mathematics. They further argue for the relevance of culturally relevant problem solving by asserting that problems that are not meaningful or irrelevant to the students “may limit some students’ potential to connect or use their informal knowledge with the mathematics or problem under discussion” (p. 106). This initial definition of culturally relevant mathematics must be extended in order to fully embrace a socially just mathematics pedagogy.

To extend this definition, teachers need to make the problems not only relevant to a student’s culture but also relevant to the community and global society. By making problems relevant, teachers can integrate information about social injustices in order for students to begin breaking down stereotypes found in society and promoting change of inequalities. This new idea is sometimes referred to as *critical math*. The term *critical math* is defined by Gutiérrez (2007) as, “mathematics that squarely acknowledges the positioning of students as members of a society rife with issues of power and domination and which furthermore, takes students’ cultural identities and builds mathematics around them in ways that address social and political issues in society” (p. 40).

Some researchers believe that teaching mathematics for social justice involves taking traditional content and linking it to social issues that affect the students' communities in meaningful ways (Gutiérrez, 2007; Gutstein, 2006). The *Radical Math* organization explains that educators can “teach math from a social justice perspective and at the same time cover state and national standards” (retrieved January 6, 2011 from <http://www.radicalmath.org/main.php?id=about>). Gutstein (2006) explains that math is often taught in a manner that segregates itself from the real world and proposes relating math curriculum to issues that are personally meaningful for students. This is, in essence, an argument for the centering of the curriculum about students' experiences as advocated by Tate (2005) who argues that mathematics pedagogy should center upon on the lives and experiences of the students who are being taught. Gutstein (2006) explains that in his own classroom, social justice issues were discussed and understood in light of the mathematics. He sees value in teaching mathematics as “an analytical tool to understand and begin to work against unjust social conditions” (pp. 13-14). Therefore, math for social justice goes beyond academic outcomes and becomes a means for transforming society by empowering students through math to recognize, understand, investigate and analyze their work in meaningful ways.

The most comprehensive definitions of social justice mathematics comes from Gutstein's (2006) work who advocates for six different components of a social justice mathematics pedagogy. The first three components (#1-3) specifically address social justice pedagogical goals; the next three components (#4-6) address mathematics pedagogical goals. These goals include:

1. reading the world with mathematics—utilizing mathematics to understand power relations, resource inequities, and unequal opportunities between social groups in one’s community, society, and world (pp. 24-26);
2. writing the world with mathematics—developing a sense of social agency where one can change the world by using mathematics (p. 27);
3. developing positive cultural and social identities—remaining rooted in one’s home language, culture, and community while surviving and thriving in dominant culture (p. 28);
4. reading the mathematical world—developing mathematical skills, understanding, and power (p. 29)
5. succeeding academically in the traditional sense—passing standardized tests, graduating from high school, engaging in higher education, accessing advanced mathematics courses, and pursuing a mathematics-related field (if desired) (p. 30); and
6. changing one’s orientation to mathematics—viewing mathematics not as a discipline of memorization and regurgitation but rather as a powerful tool for understanding complicated social phenomena (p. 30).

These goals are important to the study of social mathematics because it shows that teachers are not simply adding in culture to their word problems, that students are not simply investigating real-world problems. Social justice is a reformative approach to teaching mathematics. Gutstein (2006) furthers this position specific to mathematics education by maintaining that a critical component of social justice mathematics is what students *do* with the mathematics. Students develop into citizens who, through math, are

able to scrutinize their social world and enact positive changes. Education, specifically in mathematics, is seen as a way of engaging students in the “struggles for their own emancipation” (Gutstein, 2006, p. 14).

When math for social justice is understood as a tool to further social change and the emancipation of oppressed communities, it is being viewed as an extension of Paulo Freire’s (1970) work and his pedagogy of liberation. Frankenstein (1983) writes, “Freire’s theory compels mathematics teachers to probe the nonpositivist meaning of mathematical knowledge, the importance of quantitative reasoning in the development of critical consciousness...and the connections between our specific curriculum and the development of critical consciousness” (p. 318). Understanding this makes clear that the end product is a complete rethinking and restructuring of the current society. A social revolution fueled by education and taken up by students is the inevitable and desired outcome (Freire, 1970; Gutstein, 2006; McLaren, 2003).

### **Pre-Service Educators and Social Justice Mathematics**

Although there is a growing body of literature that addresses the topic of teaching for social justice, much less work has been done on teaching *mathematics* for social justice and on preparing *pre-service* teachers to teach mathematics for social justice (Aguirre, 2009; Muller, 2008). Aguirre (2009) worked with pre-service elementary and secondary mathematics education students, helping these students understand their privilege and equity. In her study, Aguirre made “an explicit effort to understand, push, and challenge beliefs and knowledge that may perpetuate deficit views of students that connect with race, class, culture, ethnicity, language, and gender in relation to teaching

and learning mathematics” (pp. 296-297). There were four areas of resistance to social justice mathematics that Aguirre’s pre-service educators expressed:

1. cultural stereotype—parents of Latino/a children did not value mathematics education as highly as parents of white children;
2. standards—mathematics for social justice could have no place in classrooms because of standards, test preparation, skills-based curriculum, and accountability policies;
3. time—there is no time to fully address both the mathematics curriculum while addressing social justice inequities at the same time; and
4. appropriateness—social justice mathematics is not appropriate or even doable for early elementary students.

In reaction to these resistant beliefs, Aguirre developed strategies to counter-act their beliefs. For example, Aguirre (2009) included articles and videos that emphasized “how Latino/a children and English learners can participate in high level mathematical discourse, perform well on standardized tests, and how their parents can be sources for their students’ success” (p. 304). This challenged the cultural stereotype that pre-service teachers held.

Muller (2008) examined pre-service teachers’ beliefs and experiences during a one-semester mathematics methods course in order to document what pre-service teachers identified as positive and negative influences on their learning of teaching a social justice mathematics pedagogy. Muller addressed four key findings:

1. white educators—pre-service teachers of color question the ability of white, female teachers to effectively teach minority students (p. 145);
2. change—pre-service teachers' attitudes and beliefs constantly change and may not be sustained (p. 145);
3. materials—pre-service teachers need more materials and resources for teaching mathematics for social justice to primary grades (p. 153);
4. support—pre-service teachers fear a lack of support from administrators, parents, and fellow educators when they formally teach in a school setting (p. 155).

Muller then surmised what could be done to combat these findings when working with pre-service educators, including revamping current teacher education courses where more conversations between whites and non-whites can occur and developing social justice mathematics lessons for early elementary students.

Thus, previous studies indicate that pre-service educators have feelings of anxiety and resistance when working towards implementing a social justice curriculum. They may be resistant due to their own beliefs about what teaching mathematics entails, or they may be anxious because of the newness of the idea of teaching mathematics for social justice. Many pre-service educators do not initially know how to define teaching math for social justice nor are they able to create meaningful activities that link math to social justice. Therefore, more work needs to be conducted with pre-service educators so that this resistance can slowly be broken down.

## Teacher Educators

In order for pre-service educators to move towards a social justice mathematics pedagogy, experienced teacher educators must be ready and willing to guide them on their journey toward critical consciousness. The Association for Teacher Educators (ATE, 2003) set forth standards stating that charge teacher educators to assist their pre-service and in-service educators to “apply cultural competence and promote social justice in teacher education” (p. 2). Likewise, Cochran-Smith (1991) recommended that pre-service teachers work with experienced teachers in their training to teach for social justice:

The only way for beginners to learn to be both educators and activists is to struggle over time in the company of experienced teachers who are themselves committed to collaboration and reform in their own classrooms, schools, and communities. (p. 307)

By connecting reform-minded teachers and pre-service teachers, Cochran-Smith believes that teacher education programs have a better opportunity to impact pre-service teachers’ beliefs.

Furthering this idea, researchers link this need for teacher educators to teach for social justice in the mathematics courses. Gutstein (2006) expressed this by saying that teacher educators need to “teach preservice students how to read and write the world with (and without) mathematics, deconstruct media images and representations, and ask the type of questions that their own future students should ask” (p. 208). Gay (2009) explains that “teachers need to be taught how to humanize mathematics, and to place these reconstructions into the lived realities of different racial, cultural, social, and ethnic groups” (p. 195).

However, in order for these critical mathematics teacher educators to take on a social justice pedagogy, they must first examine their own identity and privilege. This is supported by ATE which asks teacher educators to examine their own culture and how it affects their teaching (2003). As previously stated in this literature review, Freire (1970) contends that knowledge is created and re-created through continual action and reflection upon the world. This is exactly what critical educators must do: reflect upon their identity and how that identity affects their actions of teaching. This reflection may be new to critical mathematics educators yet is key to the successful development of any classroom.

Gutstein (2006) often writes about his own personal reflections as a critical mathematics educator. One reflection came after he was absent from school and another teacher took over his mathematics class. The substitute teacher created a competitive classroom where divided teams raced one another to correct mathematics answers. Gutstein first reflects on his furious response that he shared with his students, “I told the class I wanted to them to refuse to participate and show solidarity with each other, rather than be divided into ‘winners’ and ‘losers’” (p. 140). Gutstein noticed in the ensuing discussion that some students agreed, other argued, and some were quiet. After class a student remarked to Gutstein that he silenced some people in class, not allowing for every voice to be heard since he provided his insight in such an outraged manner. Gutstein actively reflects on this, saying “it was evident to me that although I tried to reconcile the dilemma and be conscious, clearly I was not always successful” (p. 140). This reflective incident is important for all critical educators to keep in mind, that actions must be reflected upon in order to create a classroom based on social justice and understanding.

Even experienced critical mathematics educators like Gutstein continually reflect and change.

### **Purposeful Modeling**

One effective teaching practice is to purposefully model for students an intended concept. This is true for teacher educators who must model best practices to their pre-service education students. The Association of Teacher Educators (2003) set forth standards, the first of which includes the importance of modeling. “In order for teacher educators to impact the profession, they must successfully model appropriate behaviors in order for those behaviors to be observed, adjusted, replicated, internalized, and applied appropriately to learners of all levels and styles” (ATE, 2003, p. 1). While purposeful modeling has been documented in many disciplines as an effective instructional practice, research on purposeful modeling in social justice is limited. For example, Muller (2008) documented a key finding that “teaching mathematics for social justice needs be made realistic for preservice teachers through modeling of lessons” (p. 145); however, Muller never specifically addressed the role of the teacher educator as a model. Therefore, more specific research into the effects of modeling for social justice needs to occur.

### **Summary**

The literature reviewed above points to the growing interest in teaching math for social justice. In this chapter I reviewed pertinent literature concerning social justice mathematics, pre-service teachers’ beliefs, and critical teacher educators. Preparing teachers to teach for social justice is also an emerging field and one that is lacking in terms of support specifically for the teaching of *mathematics* for social justice. Since this concept of teaching mathematics through a social justice lens is novel to pre-service

educators, resistance may occur, which is why critical teacher educators must provide supportive experiences in their learning. Though there is much research on pre-service educators and their beliefs and experiences related to mathematics, there is very little research on pre-service teachers' attitudes, beliefs and abilities in learning about teaching mathematics for social justice. Therefore, the study grew out of the work of researchers cited throughout this literature review and builds upon their understandings and frameworks in an effort to address issues of teaching mathematics for social justice to pre-service educators.

## **CHAPTER III**

### **METHODOLOGY**

#### **Qualitative**

As this research study attempts to uncover the attitudes, beliefs, and abilities of pre-service elementary students to integrate social justice into the mathematics classroom, the research is best suited to follow a qualitative methodology. At its core, qualitative research attempts to investigate and answer questions about the culture, society, the world, and our place in it through multiple perspectives. Denzin and Lincoln (2005) discuss the difficulty of creating any one definition of qualitative research as its meaning is often directly tied to the research at hand. Thus, for the purposes of this research, qualitative data methods will follow closely to what Creswell (2005) outlined, that the researcher “relies on the views of participants, asks broad, general questions, collects data consisting largely of words (or text) from the participants, and analyzes these words for themes” (p. 39).

I chose qualitative research because it helps unpack the complexities of the human condition. Qualitative studies allow the researcher to examine culture in an authentic, natural setting, where conclusions are drawn based on observations and analysis of spoken and written word. By utilizing qualitative research, I can pursue new angles in the field of teaching for social justice that will likely bring useful knowledge and

understanding to the interactions between pre-service educators and a content area focus. Additionally, I can provide a description of the multifaceted nature of the research at hand. This approach is consistent with the notion of knowledge as a social construction, one where participants' views, when analyzed, can present an account of the truth where truth is defined not as a fixed, objective reality but one that is constantly evolving. This evolution of thought, knowledge, and ability is why I chose qualitative research to describe the beliefs of pre-service elementary school educators about social justice, an ever-evolving subject in and of itself.

### **Bricolage**

Multiple forms of data collection will be used so as to create the best, overarching understanding of the research questions. As Steinberg (2006) asserts, the varying nature of researching critical and pedagogy “can make no guarantee about what questions will be important in different contexts; thus no one method should be promoted over others—at the same time, none can be eliminated without examination” (p. 119). As no one theoretical approach best explains this inquiry into social justice, Kincheloe’s (<http://freireproject.org/content/critical-pedagogy-and-research-> Forthcoming “Beyond Reductionism”) conceptual framework of bricolage theory will be employed.

Kincheloe illustrates bricolage theory by drawing on Bateson’s analogy of binoculars, that is by taking two things- in this case the right and left side brain images- and bringing them together, the result is greater than the parts taken separately. Thus, this theory allows me to use multiple “methodological strategies as they are needed in the unfolding context of the research situation” (p. 2). As a bricoleur, I can draw upon diverse research methods to effectively view my research in a “new vantage point,”

allowing me to gain the keenest perspective on this emerging field of research (Kincheloe, Forthcoming, p. 5). What is perhaps the greatest aspect of utilizing bricolage theory is the transformative power that Kincheloe discusses. Specifically, Kincheloe discusses personal metamorphosis when encountering “new connections between previously unconnected phenomena” (p. 6). Through my research, I have reflected on my personal identity and growth. This transformation was not a goal of the research; however, it seems inevitable that when employing bricolage and other critical theories, personal transformation will occur.

### **Grounded Theory**

Some of the theoretical frameworks used in this research study include grounded theory and critical theory. Grounded theory was relied upon as this research utilized an “inductive method, ending with a theory rather than beginning with a hypothesis” (Walls, Parahoo, Fleming, 2010, p. 8). In other words, I generated a theory derived from the data, rather than creating a hypothesis and testing it before the research began. Since grounded theory relies on discovery of concepts through critically analyzing data for trends, the data itself discloses the basis for the conceptual framework. Through grounded theory principles, I systematically coded and categorized data throughout the collection process, allowing me to form conjectures which I continued to refine and test during the research field work. This allowed me to better understand the nature of my emerging findings.

### **Critical Theory**

Critical theorists believe in the transformation of all human beings in hopes of increasing the freedom for all people. Kincheloe and McLaren (2005) discuss critical

theory, citing its specific concern “with issues of power and justice and the ways that the economy; matters of race, class, and gender; ideologies; discourses; education; religion and other social institutions; and cultural dynamics interact to construct a social system” (p. 306).

I employed critical theory by assisting in the transformation of pre-service educators toward a social justice pedagogy free of power and privilege. Critical theory, unlike other social theories, does not seek to merely understand human nature, but rather is oriented toward critiquing and changing society. In my research, I sought to develop an awareness of social justice in the participants as well as a desire to practice social justice ideologies in their future classroom. This desire to seek change is an underlying principle of critical theory.

### **Objective**

This research study promotes a variety of objectives, with the overarching goal being to address the critical need for teacher education programs to prepare future teachers of mathematics to integrate social justice into their curriculum. Therefore, this research is being used as “a means for bringing needed change” to the teacher preparation program and specifically the mathematics preparation of elementary educators (Creswell, 2005, p. 43). My hope through this intentional modeling and focus on social justice in the elementary mathematics methods course is for pre-service teachers to see the value of this curricular focus and implement this in their future classrooms. The offshoot of this goal is for these future educators to understand a new approach to the teaching of mathematics, raising awareness about the power of social justice education in this increasingly global society.

## **Research Questions**

This research study addresses two main questions that focus on pre-service elementary teachers. The two-fold questions address the initial beliefs, understandings, and ability of pre-service educators to integrate social justice into the mathematics curriculum *before* purposeful modeling and discussion of social justice in the mathematics classroom. These attitudes were then reflected upon throughout the course of one semester during the elementary mathematics methods course.

3. What are elementary teacher candidates' initial beliefs, dispositions, and ability to integrate social justice into mathematics?
4. Does purposeful modeling of the integration of social justice into their elementary mathematics methods course change their beliefs, dispositions, and ability to integrate social justice into mathematics?

## **Participants**

The participants (N =66) were predominantly white, middle class students attending a small, liberal arts university in the Midwest. In terms of diversity, the University hosts 6.1% of non-white students (Pope, 2009) with the community hosting 8.4% of non-white residents (US Census Bureau, 2000). This lack of racial diversity may affect the overall attitudes of the pre-service education students when it comes to looking at the variety of populations affected by a social justice curriculum. It'd be easy to develop an attitude of social justice among students pre-disposed to welcoming diversity and seeking to create positive change. However, it is even more critical to address the issues that would prevent pre-service educators from fully infusing social justice education into their curriculum.

The participants were all students enrolled in Teaching Mathematics Methods, Early Childhood—Middle Childhood; this one semester course is designed to assist students in the teaching of mathematics at the elementary to middle school level. The participants were enrolled in one of three sections which met on Monday, Tuesday, or Wednesday morning for two hours. The content of each class was delivered in the same manner unless revisions to the approach or content were made to enhance the classroom experience.

Due to the sequence of courses, all of these students would have completed at least one Field Experience in a local classroom prior to taking this course. Almost all of the students were also in their second Field Experience during this course with the intent to student teach the following semester. Therefore, these students would have completed the majority of their education courses and had some first-hand knowledge of an elementary classroom. I felt it was important to work with pre-service teachers who had at least a strong base of educational foundation courses and some experience in the classroom as this would allow for these participants to truly assess their identity and move toward a deeper understanding of classroom practice through social justice.

### **Data Collection**

The use of multiple theoretical frameworks supports and encourages multiple data collection methodologies. Given the qualitative nature of this study, the multiple methods of data collection are interactive and humanistic as they involve the participants in every aspect (Creswell, 2003). As such, these multiple data collections and sources will allow for triangulation of data. Using multiple methods of data collection and multiple data sources remains a crucial component of trustworthy research (Glesne,

1999). When employing triangulation, a researcher utilizes different methodologies such as interviews, surveys, and participant data to validate findings (Richardson & St. Pierre, 2005). As Atkinson and Delamont (2005) assert, the beauty of triangulation “lies partly in the multiplicity of inspirations that researchers can draw from it” (p. 832).

Data collection included a pre- and post- dispositional survey as well as a pre- and post- beliefs survey, focus group interviews, written reflections of purposeful modeling, and a social justice concept plan. These data collections provided important insight into the expansion of participants’ initial and developing beliefs, attitudes, and abilities of how social justice can be integrated in the elementary mathematics classroom.

### **Data Analysis**

Data analysis has been an open-ended process involving constant, continual reflection that has occurred throughout the data collection not entirely at the conclusion of the study (Creswell, 2003; Glesne, 1999). This allowed for the refining of methods for future data collection. One example of refining data collection included an addition of written reflections on social justice. During the Monday class, an intended class discussion pertaining to the definition of social justice did not foster adequate responses; therefore, the subsequent classes were refined such that participants were first put into small groups to discuss and write a definition before combining into a large class discussion.

An example of refining the collection methodology includes the process of conducting the focus group interviews. After conducting the first focus group interview, I realized that the arrangement of participants around the computer did not capture all the voices. Only the voice of the participant sitting closest to the computer was captured.

Therefore, before conducting subsequent interviews, I moved the interview location to a table that would allow all participant voices to be captured. This research process cycling between data collection and analysis in such a way that each is informed by the other is a central part of the emerging design used in this study (Creswell, 2005).

Table 1. Methodology Summary

<b>Research Question</b>	<b>Data Collection</b>	<b>Methods of Analysis</b>
1. What are elementary teacher candidates' initial beliefs, understandings, and ability to integrate social justice into mathematics?	<ul style="list-style-type: none"> <li>❖ Pre- Dispositional Survey</li> <li>❖ Pre- Beliefs Survey</li> <li>❖ Written Reflections</li> <li>❖ Classroom Discussions after Purposeful Modeling</li> <li>❖ Instructor Reflections</li> </ul>	<ul style="list-style-type: none"> <li>❖ Critical analyses of surveys and reflections through text-based coding schemes</li> <li>❖ Critical analyses of conversational content using text-based coding schemes</li> </ul>
2. Does purposeful modeling of the integration of social justice into their elementary mathematics methods course change their beliefs, understandings, and ability to integrate social justice into mathematics?	<ul style="list-style-type: none"> <li>❖ Post-Dispositional Survey</li> <li>❖ Post-Beliefs Survey</li> <li>❖ Written Reflections</li> <li>❖ Instructor Reflections</li> <li>❖ Interviews</li> <li>❖ Social Justice Concept Plan</li> </ul>	<ul style="list-style-type: none"> <li>❖ Critical analyses of surveys, concept plans, and reflections through text-based coding schemes</li> <li>❖ Critical analyses of conversational content as recorded on interviews using text-based coding schemes</li> </ul>

Table 2. Curriculum and Data Collection Weekly Timeline

<b>Week</b>	<b>Curricular Methodology</b>	<b>Data Collection</b>
Pre-planning	Design Social Justice Curriculum	Instructor Reflections
1	Teaching Philosophy of Mathematics	
2	NCTM Equity Principle (2000)	Pre-Dispositional Survey; Pre-Beliefs Survey; Classroom Discussion on Equity Principle
3	“A Social Justice Data Fair: Questioning the World through Mathematics” by B. Alexander and M. Munk (2010)	Written Article Reflection

4	Purposeful Modeling of Honoring Linguistic Diversity and Critical Addition, Subtraction, Multiplication, and Division through <i>Ka's Garden/Kab Lub Vaj</i> by M. McHugh and B. Lo (2010)	Classroom Discussion
5	Working Definitions of Social Justice and Social Justice Mathematics	Quick Write Reflections; Instructor Reflection
6	Purposeful Modeling of Textual Analysis of Bias and Stereotypes in Children's Literature through <i>If the Doorbell Rang</i> by P. Hutchinson	Quick Write Reflection; Classroom Discussion
7	Purposeful Modeling of Critical Percents, Fractions, Decimals, and Statistics through <i>If the World Were a Village</i> by D. Smith	Classroom Discussion; Instructor Reflection
8	Purposeful Modeling of Critical Geometry and Budgeting (Accessible Playground Lesson Assigned)	Classroom Discussion
9	Individual Presentations on Accessible Equipment for Playgrounds; Examined UNICEF's Rights of Children	Quick Write Reflections
10	Purposeful Modeling of Social Justice Concept Plan on Poverty and Nutrition	Classroom Discussion
11	Differentiated Instruction Article of Choice: Article Focused on Diverse Student Populations (ELL, learning disability, socio-economic status)	Written Article Reflection; Poster Presentation; Instructor Reflection
12	Barriers to Social Justice Implementation	Classroom Discussion
13	"Teaching Math Across the Curriculum" by B. Peterson (pp. 9-15) from <i>Rethinking Mathematics</i>	Written Article Reflection
14	Presentation of Accessible Playgrounds	Classroom Discussion; Focus Group Interviews
15	Presentation of Concept Plans	Post-Dispositional Survey; Post-Beliefs Survey; Concept Plan Collection

### Dispositional Survey

I designed the Dispositional Survey of Teaching and Learning of Mathematics with the intent to assess the participants' attitudes toward social justice. This survey was adapted from multiple sources including New Mexico State University Teacher Education Program's dispositional survey, UW-La Crosse's School of Education

Conceptual Framework, and the Wisconsin Teacher Education Knowledge, Skills, and Dispositions document. The sources provided me the specific statements, terminology, and operational definitions. Content validity for this instrument was established in order to measure the degree to which the Dispositional Survey items reflected the intended domains of social justice. (See Appendix A for the complete survey.) In addition to adapting items from multiple sources, content validity was established by two content experts; one an expert in critical theory pedagogies and the other an expert in mathematics education. The statements on the Dispositional Survey not only assessed participants' attitudes in general toward social justice but also their specific attitude toward a social justice pedagogy in mathematics. Participants self-ranked their dispositions using the operation definitions of "awareness, developing, and praxis" (NMSU Dispositional Survey, 2007). Participants took the survey in the second week of classes and again in the fifteenth or last week of class. Quantitative analysis using SPSS was conducted on both the pre-survey and post-survey results.

### **Beliefs Survey**

I created the Beliefs Survey with the intent to discover the initial understandings of participants in regards to a social justice pedagogy and specifically what that would look like in a mathematics classroom. (See Appendix B for the complete survey.) In keeping consistent with qualitative studies, the survey consisted of five open-ended questions or prompts:

- ❖ What is the purpose of teaching mathematics?
- ❖ How would you define social justice in education?
- ❖ What is the role of social justice in the mathematics classroom?

- ❖ Is the integration of social justice into the mathematics classroom a valuable component of the curriculum? Explain your viewpoint.
- ❖ Describe a mathematics activity or lesson you could implement into the elementary/middle mathematics classroom that addresses a social justice issue.

These prompts provided a look into the initial understandings and misconceptions that participants held about social justice. These initial understandings help guide the social justice component of the course as the participants' understanding and misconceptions needed to be addressed in order to foster their development and identity in regards to a social justice pedagogy. As with the dispositional survey, content validity of the beliefs items was also established by experts in critical theory and mathematics education.

In order to find themes within the participants' responses, I used text-based coding. This type of coding is defined as "a progressive process of sorting and defining those scraps of collected data that are applicable to your research purpose" (Glesne, 1999, p. 135). In this research study, those "scraps" are surveys, interview transcriptions, and field notes. Furthermore, Creswell (2005) defines the process as moving from the detailed notes to more expansive themes and eventually to a theory written from these themes explaining the phenomenon of the studied group. The coding of data was done in such a way as to be open to codes and themes that emerged from the data, while at the same time working within a framework of codes that are consistent with the research questions. The openness to emerging themes and new codes comes from the grounded theory approach. Despite this, the critical nature of the study, my belief in the power of teaching a social justice math curriculum, and the goal of the research to prepare pre-service educators to teach in this manner keep the research from relying on grounded

theory in the truest sense. That is, while aspects of the grounded theory approach are used, the research itself is more critical in nature thus utilizing the bricolage approach.

The codes in Tables 3-5 below, and all subsequent coded-tables, were added to as I went through the data and came to sections that could not be categorized by the existing codes. With subsequent passes at the survey responses, the codes were refined, collapsed, changed and amended. For example, in coding Question 1 of the Beliefs Survey, I had two separate codes that are now listed under the general code “skills.” One code being problem-solving and the other code being critical thinking. After careful consideration, I combined those codes as their intent of providing life skills was similar. Additionally, operational definitions of the codes were constructed and also refined as the coding scheme was applied to the survey results. In the next few paragraphs, I will summarize the important codes for each question. See Appendix C for a complete summary of the text-based codes I utilized for the Pre-Beliefs and Post-Beliefs Survey corresponding to each of the five questions.

Table 3. Beliefs Survey Coding Question 1

Question 1: <i>What is the purpose of teaching mathematics?</i>			
<b>Code</b>	<b>Operational Definition</b>	<b>Pre-Beliefs Example</b>	<b>Post-Beliefs Example</b>
Skills	Responses indicated the skills that mathematics teach	Math allows students to learn to problem solve, reason, and think critically.	As teachers, we should help students develop critical thinking, problem solving, and reasoning skills so students can improve communication.
School Use	Responses indicated the use of mathematics in future classes or the need to teach due to state standards	The purpose of teaching mathematics is to give students the content knowledge and mathematical skills they need to succeed in math class, other classes, and life.	Math is a progressive subject where mastery of skills is needed to be successful in future school math.

Real World	Responses indicated an understanding that mathematics will be used for future endeavors in the real world.	Mathematics teaches a lot of independent skills such as balancing a checkbook, measuring amounts in order to prepare food, count change and so forth.	It is part of everyday life and no matter what career path you choose- math is incorporated into our daily lives.
Social Justice	Responses indicated an understanding of reading and writing the world with mathematics		To assist students in gaining access to the language of numbers to better understand their world.

This table provides a shortened sample of how I coded each question. Important to note about the first question was the pre-service teachers' initial beliefs about teaching mathematics. These beliefs fall into a Traditionalist (Frankenstein, 1983; Freire, 1970) view of mathematics, that of teaching to accomplish one of two objectives: succeed in future classes (school use) or succeed in basic life skills (future use and real world examples). This confirms that many of the pre-service educators in this study held a Traditional viewpoint of Mathematics Education, one that does not recognize teaching for critical agency.

Table 4. Beliefs Survey Coding Question 2

<i>Question 2: How would you define social justice in education?</i>			
<b>Code</b>	<b>Operational Definition</b>	<b>Pre-Beliefs Example</b>	<b>Post-Beliefs Example</b>
Equality	Responses indicated that the participant felt social justice focused on equality, fairness, or accommodating all students	[Social justice] is being fair to all students and giving them an equal chance. By fair, I mean giving each student the help and attention that the specific individual requires (not the same help for all).	Social justice in education is treating all students equally while expecting the most out of everyone in your classroom.

Real World	Responses indicated that the participant felt social justice focused on providing a greater understanding of the real world or real world skills	Social justice talks about creating a well rounded citizen who can function in society.	Social justice in education is the teaching of real world issues and situations that allow students to think critically.
Cultural Integration	Responses indicated that participants felt social justice included integrating culture and real world problems into the curriculum	Social justice is the awareness of others. It is teaching awareness, unbiased [sic] opinions, and integrating many views and worldly things into the classroom.	Social justice in education helps students become more culturally aware of issues surrounding them in everyday life.
Social Justice as Change Agency	Responses indicated an understanding of social justice or aspect of social justice		Social justice in the classroom should introduce students to social inequalities in our society, and it should encourage students to view their skills in math and other subjects and use those skills to promote change in those social issues.

The second question on the pre-beliefs survey displayed three main definitions of social justice, that of justice meaning equity, real world intent, or integrating a cultural awareness. These definitions showed that most pre-service educators could not accurately define social justice, which led to limited coding for the remainder of the questions in the pre-beliefs survey. The responses for Question 3 regarding the role of social justice in the math classroom produced similar results to Question 2, where participants primarily believed in the understanding of social justice as equity or multiculturalism. That cultural integration was best exemplified by the following participant's response, "While teaching math, teachers should include examples of

students with different ethnic backgrounds and family make up and avoid generalizations.” This response does not indicate a critical understanding of social justice nor how mathematics can help investigate inequalities in the world. Due to the fact that most pre-service educators could not define social justice nor its role in the math classroom, most did not understand if the integration of social justice would be a valuable component of the mathematics curriculum (Question 4). Therefore, pre-beliefs coding did not produce results which furthered the study.

Post-beliefs coding further solidified the tiers of social justice as a real world connection, cultural integration, or change agency. The misconception that social justice means equality remained from the initial pre-beliefs survey. However, most participants moved in their understanding of social justice. Furthermore, their understanding of social justice led to a more complete understanding of the role social justice plays in the math classroom. Most participants were able to describe utilizing mathematics to analyze a “real world” problem or a “social inequality.” Pre-service educators wrote about the various concepts within math to help analyze these issues such as “statistics, ratios, percents, fractions, multiplication, and other basic math facts.” As one pre-service educator wrote, “being able to incorporate numbers to explain inequalities leads to a deeper understanding of the mathematics material at hand and how it is connected to society and the world.” Therefore, once a clear understanding of social justice as an education tool was reached, pre-service educators were able to correctly define the role of social justice in the math classroom.

Table 5. Beliefs Survey Coding Question 5

<i>Question 5: Describe a mathematics activity or lesson you could implement into the elementary/middle mathematics classroom that addresses a social justice issue.</i>			
<b>Code</b>	<b>Operational Definition</b>	<b>Pre-Beliefs Example</b>	<b>Post-Beliefs Example</b>
Differentiated Instruction	Responses indicated a lesson that was differentiated to accommodate the needs of all students	Divide students into groups to work on measurement. Give lower students task of weighing, middle level students task of recording and adding measurements, and upper level students task of converting.	
Real World	Responses indicated a lesson that addressed a real-life situation	You could relate a lesson to school funding and student population. Determining how much money is invested for each student.	Analyze what students eat in terms of processed food and different nutritional levels—create graphs and statistical examples out of this.
Cultural Integration	Responses indicated a lesson that addressed the culture and identity of students or a cultural awareness	I believe having a lesson based on different forms of money, for example the U.S. dollar, peso, euro and bartering. Discuss the different forms of payment then have the children set up a market and use the forms of payment to buy “cookies, pencils, drawings” and other objects for sale.	A teacher could have students create their own survey questions and ask peers about their culture, family life, and favorite ethnic food. Data can be collected and a bar graph or pie chart can be created to show similarities and differences within their own classroom community.
Social Justice as Change Agency	Responses indicated a lesson that addressed a social inequality and/or a way to enact change	Students could find out how much it costs to purchase one net (malaria nets) for children in Africa. They could be given a budget and work out how many nets they could buy and how many children’s lives would be saved.	Students could compare wages of child labor to that of adult wages. Students can find the injustice in this and graph data on a bar graph. Students can then discuss plans on how to pass laws against child labor.

Question 5 asked pre-service educators to describe a mathematics activity or lesson which could be implemented into the classroom that addresses a social justice issue. Interestingly, pre-service educators were able to produce a variety of responses initially found in their pre-beliefs survey. The idea of differentiated instruction follows from their understanding of social justice as equality for all students; though differentiation remains an important part of a classroom, the participants did not continue with their differentiation understanding in the post-beliefs survey when asked specifically for a social justice lesson plan which shows their movement in understanding. Additionally, the three other abilities (Real World, Cultural Integration, and Social Justice as Change Agency) are all codes used in the pre-service educators' initial and final abilities, which may show that these beliefs may have been pervasive in other educational coursework taken prior to the prior to the Elementary Mathematics Methods course and were enhanced throughout the semester long course.

Often, participant responses were coded under more than one category. For example, a Pre-Beliefs survey response to question three regarding social justice in the math classroom indicated, "To give every child and equal opportunity to achieve [sic] their maximum potential. It is being aware of multiculturalism and making accommodations to prove stereotypes wrong." This response was coded under multiple categories:

- ❖ Equality – due to the response of “equal opportunity”
- ❖ Differentiated Instruction- due to the response of “making accommodations”
- ❖ Cultural Integration- due to the response of “being aware of multiculturalism”;
- and
- ❖ Social Justice- due to the response of “prove stereotypes wrong”

Furthermore, codes also have blurred lines and overlaps. One such example is the participant response found under question five and coded for social justice. The response about purchasing malaria nets could be coded under “Real World” as purchasing items and following a budget is a real life skill. Additionally, it could be coded as a “Culture and Identity” response given that looking at malaria rates in children in Africa brings in a cultural awareness of third world countries and diseases. However, I decided to code this response as “Social Justice” because of the final line of the response where the participant would have students figure out “how many children’s lives would be saved.” Taking the idea of budgeting for a supply that can ward off a disease one step further to how many lives can be saved shows a deeper awareness of social inequalities.

### **Interviews**

I conducted four focus group interviews in groups of three participants during the 14<sup>th</sup> week of classes. Interviews provide a different type of qualitative research data. As Glesne (1999) remarks “the opportunity to learn about what you cannot see and to explore alternative explanations of what you do see is the special strength of interviewing in qualitative inquiry” (p. 69). Berg (2001) continues with the specific nature of focus group interviews saying, “It is the very give-and-take interactions characteristic of focus group interviews that lead to spontaneous responses from session participants” (p. 115).

Interview questions were developed using the standards put forth by Glesne (1999). These include avoiding yes/no questions that may lead to short, vague answers by participants as well as avoiding leading questions that may result in the participants’ answer being centered on what they believe the interviewer would like them to say. This is important because open-ended questions lead to “interactions among and between

group members [which will] stimulate discussions in which one group member reacts to comments made by another” (Berg, 2001, p. 112). The interview questions also avoid relying on multiple part questions as these might result in the participant answering only one question or one portion of what was asked. In general, the interviews consisted mostly of open-ended questions that allowed for participants to respond with their own understanding and experiences.

The interviews were audio-recorded with a computer program called Camtasia. However, due to the placement of individuals around the computer during the first interview, the voices were not picked up to the extent where I could transcribe the interview. Therefore, I repositioned the students during the subsequent interviews in order to fully hear each voice. This resulted in three transcribed interviews with a total of nine students, identified as student A, B, C, etc... The interviews themselves would be classified as semi-structured. Prior to the interviews, I created a set of questions which would allow me to investigate the attitudes and beliefs of students; however, I purposefully allowed for room for the interview, conducted more like a conversation, to bring about more questions. Semi-structured interviews gave participants the ability to discuss what they wanted to disclose in a more in-depth and informal way. A list of the pre-designated questions that were vetted by content experts in order to address content validity can be found in Appendix D. After conducting the interviews, I transcribed the conversations to allow for text-based coding. Similar to the surveys, these interviews were then coded for themes.

### **Instructor Reflections**

Due to the emphasis on purposeful modeling, literature and previous research indicated that the instructor leading a social justice course must be critically aware. Therefore, I felt it was important for the instructor of the Elementary Mathematics Methods course, Dr. Francine Flahive (\*name changed for anonymity), to periodically reflect upon her identity, her teaching practice, and the reactions of her pre-service educators to the lesson plans. Her answers were used to triangulate findings and were analyzed accordingly.

### **Written Reflections**

Throughout the semester, participants read professional articles, two of which specifically related to social justice in the mathematics classroom. The first article, “A Social Justice Data Fair: Questioning the World through Mathematics” by B. Alexander and M. Munk (2010) from *Rethinking Schools* (<http://rethinkingschools.org>), provided students with a first look at how social justice could be utilized in the elementary classroom. Read in the third week of class, participants were asked to create a definition of social justice in small groups prior to engaging in classroom discussion. This article helped lay the foundation for what social justice projects could look like in the math classroom.

The second article read by students was “Teaching Math Across the Curriculum” by B. Peterson (pp. 9-15) from *Rethinking Mathematics*. This article provided an understanding of how social justice concepts could be integrated into other disciplines, such as Social Studies Social Studies. These article reflections were completed in the

thirteenth week of class. Students were asked to individually reflect on five guiding questions:

- ❖ Rephrase or interpret the contents of the article in terms of how meaningful it was to you. Did it stimulate or motivate you, confuse you, cause you to think about the topic in a different way? Cite specific phrases in the article that made you feel this way.
- ❖ What did you learn from reading the article?
- ❖ How did this article relate to teaching for social justice in the math classroom?
- ❖ What feelings (positive, negative, or neutral) did you have regarding the main theme of the article?
- ❖ How could you use the ideas presented in this article in your future classroom?

From these questions, participants wrote reflection papers on their developing understanding of social justice; since these questions were simply a guide, not every participant answered every question. Therefore, responses were used to assess the pre-service teachers' developing phase of social justice understanding. Major themes that were coded using text-based coding are listed in Table 6 below:

Table 6. Article Reflection Coding

<b>Code</b>	<b>Operational Definition</b>	<b>Participant Example</b>
Modeling	Response indicated a desire to use the social justice methods described in the article in a future classroom	I would like to mimic the teaching practices of the author by connecting math to history, stereotypes, equality, and the lives of my students.
Reflection on Math Learning	Response indicated a reflection on the participant's own learning of mathematics	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.
Reflection on Teaching Practice	Response indicated a reflection on the practice of teaching through a social justice lens	It definitely seems that it takes a lot research and preparation to teach a lesson on social justice but the effects from doing so definitely out weighs long prep work.

## Social Justice Concept Plan

As part of a final assessment, participants developed a concept plan, a set of lessons focused on one particular topic. As part of this concept plan, participants were asked to incorporate an aspect of social justice. The directions left this task open-ended stating:

The concept plan will allow you time to develop a framework for teaching and learning of a particular concept or procedure in mathematics. The goal of the concept plan is for you to critically examine how students learn your selected concept and can apply it to a real-world situation. Your concept plan should include at least three lesson plans that focus on the development of the concept or procedure. One lesson should include the use of technology. One lesson should include a tiered approach to learning. The third lesson should incorporate diversity or a social justice perspective.

Participants completed the concept plan individually or in small groups of two or three.

The concepts plans were coded in two steps. The first step was to identify the main theme of the lesson. The coding for the themes can be found in Table 7 below. A complete description of each social justice concept plan can be found in Appendix E.

Table 7. Concept Plan Social Justice Coding

Code	Operational Definition	Participant Example (Concept Plan Objective)
Real World	Concept plan addressed a real-world problem; the issue addressed did not have a social inequality aspect to it	Students will identify healthy eating practices and use a decision-making model (food pyramid) to find a healthy recipe.
Cultural Integration	Concept plan addressed a multicultural issue; the issue addressed did not have a social inequality aspect to it	Students will learn about the importance of triangles in Native American culture.
Social Justice as Change Agency	Concept plan addressed a social inequality and often included an extension involving a change agency	The student will be able to research and answer questions about child labor in fraction form. The student will be able to create a chart or graph. The student will be able to formulate a plan of action to eliminate child labor.

After sorting the concept plans into their respective codes above, the lesson plans in the codes “Real World Example”, “Cultural Integration”, and “Social Justice as Change Agency” were then coded for the participants’ utilization of mathematics. The mathematics usage fell into one of two categories: Connected Mathematics versus Critical Mathematics. If participants simply linked a concept plan to a mathematics lesson, then that concept plan was coded as “Connected Mathematics.” An example of connected mathematics includes a concept plan where participants are studying the Ronald McDonald House and collecting pop tabs. The mathematics in this lesson asks students to sort pop tabs into groups to find a remainder, a beginning to understanding division. This division concept plan does not utilize mathematics to critically examine a social inequality. This contrasts with a concept plan which critically utilizes mathematics to examine a social inequality, such as the concept plan regarding child labor which utilizes facts and statistics about child labor to create fractions. Students then utilize these fractions to “justify their reasoning with evidence and sources” in order to “present a well thought-out plan of action for eliminating child labor” (Pre-Service Educator Concept Plan). Thus, this critical use of mathematics to create change agency produces a truly social justice mathematics concept plan.

## **CHAPTER IV**

### **DATA ANALYSIS**

#### **Introduction**

The primary purpose of this study was to examine pre-service teachers' initial beliefs, attitudes, and abilities regarding the teaching of mathematics for social justice and how those initial understandings changed throughout a semester of purposeful modeling of social justice concepts. 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 how the beliefs, attitudes, and abilities of pre-service teachers changed during their learning to teach mathematics for social justice.

In this chapter, I present the findings of my research. I begin by describing the initial beliefs, attitudes, and abilities of participants regarding the integration of social justice. Next I discuss the importance of the instructor and purposeful modeling results. Then I present the overarching themes that emerged from my analysis, including the understanding of social justice as real world problems, cultural integration, and change agency.

## **Initial Beliefs**

In order to assess the initial beliefs and understandings of pre-service educators, participants filled out a pre-beliefs survey during the second week of classes. This survey allowed me to gauge what participants knew about social justice before the purposeful modeling and class discussions began. The first question on the pre-belief's survey addressed the purpose of teaching mathematics. I felt it was essential to gauge what participant's felt the purpose of teaching mathematics was before addressing the theme of social justice. The initial beliefs centered on two main ideas: skills needed to succeed in school versus skills needed in the real-world or future. Thirty-one times, participants remarked about mathematics as a school skill, such as this participant who wrote that the purpose of teaching mathematics is "to give students a basic understanding of math concept [sic] and help them prepare for their future math classes....to develop skills such as problem solving, reasoning, communication, connecting, and representing." On the other hand, fifty-four times, participants related the teaching of mathematics to a future purpose, either citing specific real-world tasks such as "balancing a checking account, going to a grocery store and cooking" or simply acknowledging the future use of mathematics such as "to give students the tools needed to apply mathematics to solve problems in everyday life." What is important to note about this finding is that most students recognize a greater purpose for teaching mathematics than simply to pass a subject in school. This initial finding paved the way for discussing mathematics as a means to investigating social justice concepts, a truly real-world application.

The second question of the pre-belief's survey specifically asked for the participants' definition of social justice. The overarching belief that pre-service

educators held about social justice was the notion of equity. Fifty-six times, the notion of equity, fairness, or meeting the needs of all students was addressed, such as this participant who wrote, “Social justice in education is providing a fair and equal (quality) education to all students.” Five participants wrote that they were unsure of the definition of social justice, and only six participants had a developing understanding of social justice, such as the idea to “integrate diversity efforts to maximize the success of our students” or “using education to break down stereotypes.” One of those six participants was a graduate student whose thesis also centered on social justice; that participant was the only one to completely understand and define social justice. At first, I believed my data might be skewed toward the idea of fairness and equity because participants had recently read the National Council of Teachers of Mathematics Equity Principle (NCTM, 2000) which states, “Excellence in mathematics education requires equity—high expectations and strong support for all students” (p. 12). However, Muller (2008) also found that participants in his study defined social justice and equity in similar terms. Similarly Cochran-Smith, et.al (2009) found that pre-service educators believed that social justice was about making pupils learn, accommodating and differentiating instruction, promoting critical thinking, and holding pupils to high expectations. Indeed, when conducting focus group interviews at the end of the semester, one student remarked that other professors have discussed the concept of social justice, yet the student still believed that social justice “was about treating students equally and giving all students the opportunity to succeed by differentiating instruction” (December 7, 2010).

The Pre-Beliefs Survey continued with questions regarding participants’ understanding of the role social justice in the mathematics classroom; however, since

most participants did not understand social justice as a concept in and of itself, their answers regarding social justice in the math classroom did not further the research but rather confirmed their lack of knowledge. Of those participants who understood an aspect of social justice, the main response to social justice in mathematics was inclusion of diversity, “While teaching math, teachers should include examples of students with different ethnic backgrounds and family make up and avoid generalizations.” This notion trends toward the definition of multiculturalism. In focus group interviews, one student even stated that she thought social justice was multiculturalism. Again, the only student who understood social justice in the math classroom was the graduate student.

### **Initial Dispositions**

Pre- and post- surveys were given to all participants. The eighteen questions for the surveys were designed to elicit pre-service teachers’ dispositions toward teaching for social justice and teaching mathematics for social justice. Overall, the first eleven questions were aimed at the dispositions about teaching for social justice, and the last seven questions were targeted as questions regarding the teaching of mathematics for social justice including the role of mathematics in society and designing equitable activities. Administering surveys both at the beginning and the end of the course facilitated the analysis of shifts in the pre-service teachers’ dispositions. As described on the survey (See Appendix A), dispositions were defined as the values, commitments, and professional ethics that influence behaviors towards students, families, colleagues, and communities that affect student learning, motivation and development as well as the educator’s own professional growth. Participants self-ranked their dispositions using the operation definitions of “awareness, developing, and praxis” (NMSU Dispositional

Survey, 2007). These operational definitions were then given an ordinal value of one for “awareness,” two for “developing,” and three for “praxis” in order to quantify the results.

To ascertain teacher candidates’ initial dispositions toward social justice pedagogy, a quantitative analysis was conducted to determine initial means and standard deviations for each of the 18 questions as well as an overall pre-dispositional score. This dispositions score was calculated by summing the values of each participant’s response.

The data was entered into an SPSS program to provide the data as shown in Table 8.

Table 8. Pre-Dispositional Survey Results

	<b>Pre-Test Mean</b>	<b>Standard Deviation</b>
1. I appreciated and value human diversity, showing respect for my students’ varied talents and perspectives.	2.30	.706
2. I respect students as individuals with differing personal and family backgrounds.	2.41	.684
3. I am sensitive to community and cultural practices.	1.97	.642
4. I refine my teaching practices in order to address the individual needs of students.	2.08	.513
5. I seek professional development experiences which strengthen my commitment to an inclusive education.	1.83	.656
6. I am knowledgeable about the ways in which people and society are culturally, economically, historically, politically, and socially shaped.	1.83	.703
7. I promote and encourage alternative views.	2.09	.684
8. I honor linguistic diversity.	1.92	.719
9. I practice non-discriminatory and inclusive pedagogy.	2.17	.631
10. I work with students and school communities to foster equity and interrupt social injustices.	1.69	.614
11. I support a socially just curriculum.	2.08	.674
12. I am confident in connecting mathematics content to real world situations.	1.84	.648
13. I appreciate the role of mathematics in a diverse society.	1.77	.684
14. I value mathematics as a tool and as a language.	1.86	.639
15. I assist my students in moving beyond memorization of mathematical facts and procedures into constructing knowledge.	1.91	.684
16. I design activities and lessons that provide high expectations and strong support for all students.	2.00	.591

17. I promote and encourage alternative procedures/strategies in mathematics.	1.89	.645
18. I support a socially just curriculum in mathematics.	1.98	.630
<b>Total Overall Dispositional Score (maximum of 54 points)</b>	35.60	6.522

Data from the table indicates that the individual mean scores for the Pre-Dispositional Survey ranged from 1.69 to 2.41 on a 3-point scale. As a 2.0 is considered “developing” it is noteworthy to investigate which questions on average scored above and below this level. Overall, 11 out of 18 questions scored below the “developing” level in the Pre-Dispositional Survey. Upon further analysis, five out of the eleven questions related to general social justice themes such as “I am sensitive to community and cultural practices” produced a mean score of below 2.0. This is in contrast to the second set of questions regarding the teaching of social justice for mathematics where six out of seven questions had a mean less than 2.0. This indicates that although students had a more developed disposition toward teaching for social justice, the results demonstrated the difficulties of translating that general teaching practice into the specific discipline of mathematics. Lastly, the overall pre-dispositional mean was found to be 35.6 (standard deviation 6.522) which indicated an overall mean score on the 3-point scale for the eighteen questions was 1.978, or slightly below the “developing” level.

When analyzing the initial beliefs and dispositions of pre-service educators, the question to be asked is how are pre-service educators “developing” in their disposition of supporting a social justice curriculum (mean = 2.08) when they cannot define social justice in the Beliefs Survey? In order to triangulate this finding, I asked pre-service educators in the focus group interviews whether or not they had heard of social justice before the semester began. To this, most responded they had not heard of it, but some

such as this pre-service educator reflected, “I didn’t know exactly what it was or how to write a social justice lesson plan, but I had heard the term” (Focus Group Interview, Dec. 6, 2010). Another pre-service educator commented that what she had learned about was “not necessarily named social justice, but a lot of professors have incorporated that message without using that terminology” (Focus Group Interview, Dec. 7, 2010).

### **Initial Abilities**

The fifth question on the Pre-Beliefs Survey asked participants to describe an activity or lesson that could be implemented into the math classroom that addresses social justice. After the discovery that most participants in this study did not have an understanding of social justice and had only an “awareness” disposition on how to integrate social justice into the mathematics classroom, I personally did not expect them to have much of an ability to integrate social justice into the math classroom. Indeed, 23 times, participants commented that they were unsure of how to complete this integration. Sixteen others included the aspect of tiering or differentiating a lesson to accommodate all learners, such as this student who wrote, “When talking about graphing and lines, lower level students could graph points while upper students can graph line equations and advanced students could create line equations from their line.”

However, the remaining participants included diversity, culture, or even a social justice theme into their initial activity or lesson. Some of these lessons were focused on bringing in diversity into the math problems of students, such as this participant who wrote “Including Hmong cultural traditions in math problems, for example, would illustrate a diverse approach.” This participant reflects what Herron & Barta (2009) define as *culturally relevant problem solving*. It is unclear, though, how fully infused

these diverse cultural traditions would be into the problems. As reflected in the literature review, Mills (2008) contends we must move away from superficial treatments of diversity; this should also be done in the math classroom where diversity is not an add-on to questions but rather an integral part of a problem.

This integral role of diversity or culture can be examined in the following participant's initial ability to integrate social justice. "You could have students find how many languages there are in total. Then how many are in the U.S. Are there other languages in your classroom alone? Make a pie chart for the languages in the U.S. How big is the English portion?" This participant incorporated linguistic diversity as a central component of a lesson plan, in essence linking the lives of students to the mathematics concept at hand, a meaningful approach supported by multiple critical researchers (Gutstein, 2006; Gutiérrez, 2007; Tate, 2005).

Some participants actually created a social justice lesson plan, despite the fact that they could not define social justice nor its role in the math classroom. Two participants described lessons regarding poverty or wealth in the United States, such as this participant who wrote, "Looking at percentages of wealthy people vs homeless or low-income people and discuss why that might be happening. Look at highs, lows, medians, means, etc. and also talk about the effects wealth gaps have on society." This lesson plan recognizes the role, power, and influence that wealth has on this nation. This participant includes a critical discussion on the effects of wealth, a form of communication similar to what Gutstein (2006) advocates for in his classroom. Likewise, another participant took the wealth versus poverty concept even farther by writing, "Looking at statistics of people in poverty and figuring out ways in which to help." This participant included the

critical advocacy or change agency central the definition of social justice (Freire, 1970; Gutstein, 2006; McLaren, 2003). Therefore, even though these pre-service educators could not accurately define social justice nor how to integrate social justice in the math classroom, they understood the power of mathematics to investigate social inequalities and transform society.

### **Instructor Reflections**

In order for participants to understand the intricacies of a social justice pedagogy in the math classroom, it is imperative that the instructor of the course examine her own privilege and identity, then continuously reflect on her teaching practice; this action-reflection is defined as praxis by Freire (1970). Therefore, following the advice of Cochran-Smith (1991) who advocated for connecting reform-minded teachers and pre-service teachers, I approached Dr. Francine Flahive about assisting in my research. Flahive was instructing the Elementary Math Methods in the Fall of 2010 when I planned on conducting my research and had taught the course two times previously. In order to collaborate on this research, Flahive revamped her curriculum in order to present a social justice pedagogy. Throughout the semester, Flahive kept written reflections of her understandings and movements in creating and delivering a social justice pedagogy. This section will investigate the importance of the instructor who needs to accurately model a social justice curriculum.

Similar to the participants of this study, Flahive did not have a full understanding of social justice before being approached to participate in this study. Flahive reflects, “I was at first apprehensive because my belief was that social justice meant making my classroom equitable to diverse student populations” (Summer 2010). This understanding

of social justice as equity in the classroom actually reflects the participants' initial beliefs as well, since the Equity Principle from NCTM is often highlighted in math courses. After I explained more about social justice and critical theory to Dr. Flahive, she realized she was able "to reformulate [her] understanding of social justice as a mechanism to investigate inequalities of the world and create change" (Summer 2010) and immediately thought of various lesson plans. Therefore, simply defining and discussing social justice provided the initial spark of interest and understanding.

Another important step in delivering a social justice pedagogy was for Flahive to reflect upon her identity and privilege, as advocated by Freire (1970). Flahive reflected upon her first time being asked if she was privileged, and her initial gut response of "no" citing that her peers had the same opportunities as she did. However, Flahive continues to write,

As I looked around the room of mainly white faculty members and ahead of me was an ethnically diverse student cast that were performing skits regarding this issue, I realized that my privilege as a white, upper middle class, fully-abled female did set me apart from both my peers and these students. (Summer 2010)

This initial awareness of privilege and identity continued to resurface over the next two years until I approached her about partnering on social justice mathematics research.

Flahive reflected on being approached in terms of her identity, versus her ability, citing "I knew that I would have to continually reflect upon how my identity and privilege shaped my views of education and the education of others" (Summer 2010).

Throughout the semester, Dr. Flahive presented social justice lessons and then reflected upon the pre-service educators' reactions, in essence practicing the action-reflection model highlighted by Freire (1970). After initially presenting the social justice theme to her Math Methods class, Flahive expressed her relief at the fact that no

participant wondered why social justice and mathematics were being linked. Indeed Flahive found that, “many of the students came up to me and expressed interest in the practicality of including social justice in a content area since no other content methods course addressed this avenue of teaching for social justice” (Weeks 3-5). After purposefully modeling at least two social justice lesson plans and providing an article about social justice mathematics to the pre-service educators, Flahive notes “this is the first time I felt my pre-service teachers were moving from an ‘awareness’ disposition to a more ‘developed’ understanding of social justice mathematics” (Week 7). According to Flahive, this first movement did not occur until Week 7 of the 15 week course, or approximately halfway through. This shows the complexity of truly grasping both social justice and how to implement social justice into the math classroom.

In addition to purposeful modeling, Flahive and I wanted to develop a purposeful learning experience where the pre-service educators could apply their definitions of social justice to a mathematical concept. This led to the lesson we entitled “Accessible Playground” where participants were asked to develop a scale model of an accessible playground that would be both safe and inclusive while meeting the guidelines for accessibility. Flahive launched this lesson by asking the pre-service educators to reflect on the UN’s declaration of children’s rights which states, “All children have the right to relax and play.” Pre-service educators became highly invested in this activity, noting the difference between when Flahive purposefully modeled lessons versus provided opportunities to work on their own social justice lesson. One pre-service educator commented, “I think it [ purposefully modeling] definitely helped understand the concept further because we did start off with just an introduction by defining social justice, but

then we branched off that and fully got to understand [social justice] by actually creating an accessible playground” (Focus Group Interview, Dec. 6, 2010).

However, through this activity of an Accessible Playground, Flahive realized that her office and the very classroom she taught in were not accessible to students in a wheelchair. “In order to be a change agent, I brought this issue up to the Inclusive Excellence committee on campus who were going to determine the proper chain of command for such an issue to be dealt with at my university” (Weeks 8-11). Flahive herself moved from her understanding and disposition of social justice to actually becoming an agent of change. (Note: To date, the issue of the accessibility of Flahive’s classroom and office still has not been resolved.) Lastly, Flahive remarked that the Accessible Playground activity was yet another marker of movement for her pre-service educators (as well as herself) reflecting that “many students displayed gains in their disposition towards social justice as they had a ‘hands-on’ application of social justice mathematics” (Weeks 8-11).

Through a culminating social justice concept plan, Flahive asked pre-service educators to focus a lesson on a social justice concept. These lessons will be examined later; however, through discussions with students, Flahive reflected that she was challenged “to further investigate how I could continue to purposefully model social justice within mathematics for not only these pedagogical courses but also the mainstream, general education math courses as well” (Weeks 8-14). Indeed, during the Spring 2011 semester, Flahive taught the Pre-Calculus course and integrated a problem-solving activity centered on the concepts of recycling, pollution of natural resources caused by toxic waste, and population growths where students needed to write-up their

findings from a political stance, examining the issue from multiple perspectives such as a citizen, business person, and governmental agency.

Flahive's final reflections centered on the growth of both her pre-service educators as well as her own growth. Flahive felt the main challenge to her as an educator was her understanding of social justice saying she often felt she learned "more about social justice as [she] processed article reflections with the students and read their concept plans" (Post Fall 2010 Semester). Reflecting upon her identity, Flahive wrote, "As a female, white educator mainly teaching white females, I think it is important for all of us to examine how our beliefs shape our teaching and the types of activities we give to our students" (Post Fall 2010 Semester). Overall, Flahive believed her experience throughout the semester was beneficial, citing ways she continues to be involved in social justice education.

### **Purposeful Modeling**

Throughout the semester, Flahive and I created social justice lessons in order to purposefully model how to integrate and deliver a mathematics lesson through social justice pedagogy. These lessons ranged from microteaching opportunities to article reflections to assigned projects. Through purposefully modeling, participants both saw and understood the power of a social justice pedagogy in the elementary mathematics classroom. These opportunities provided both reflection and the means to develop their own lessons integrating social justice.

One example of a microteaching opportunity came when participants were asked to link a children's book to a mathematics lesson plan, which occurred during the 4th week of classes. I personally demonstrated a lesson plan linking the bilingual children's

book *Ka's Garden/Kab Lub Vaj*, written by myself and a Hmong colleague Dr. Bee Lo. This children's book does not explicitly incorporate any mathematics; however, I demonstrated how any children's book can be used as a springboard to launch a mathematics lesson. In my lesson plan, I created a 4x4 grid of math problems which utilized both the English and Hmong languages. Each box in the grid contained a mathematical problem utilizing various words and symbols such as "six – tsib" or "4 divided by ob" ( $6-5$  or  $4\div 2$ ). See Appendix F for the complete *Ka's Garden/Kab Lub Vaj* activity sheet. The aspect of my microteaching linked to social justice that I conveyed to the participants was the appreciation of all students' language. In the Dispositional Survey of Teaching and Learning Mathematics, this corresponds to the disposition of "I honor linguistic diversity."

During the microteaching experience, I asked participants to complete the grid as if they were a third or fourth grade math student. I wanted the participants to put themselves in their future students' mindset. What ensued was a lively activity and discussion about a third or fourth grade student's mind. Some participants completed the math problem "six – tsib" and wrote the answer "1" while other students filled in the answer with "ib/one/1." Participants discussed whether an elementary math student would continue to honor the linguistic diversity presented before them or would simply revert to their native language of English. At this juncture of the discussion, I posed the question, "Why do you assume all students have a native language of English?" These underlying assumptions allowed the participants to begin examining their own privilege and identity, a formative step in becoming a critical educator (Freire, 1970).

In addition to discussing the background of future students as well as identity construction, participants discussed their personal ability to integrate a social justice theme into their mathematics lesson plans. At one point, a participant in one section commented, “It seems so easy to include another language. Is that all there is to social justice? Just including the culture of our students?” Again, being only the 4th week of classes, participants were beginning not only to explore their identity but also their complete understanding of social justice. The class that day discussed how lessons that bring in other languages allow students to explore a non-dominant culture. Participants decided that a lesson such as the one presented would allow for the discussion of why English is the dominant language in America, a land based off “freedom” from oppression.

From this purposeful microteaching activity, participants recognized the importance of honoring language in the mathematics classroom. In fact, two participants modeled lessons based off my *Ka’s Garden/Kab Lub Vaj* math grid. One participant created a lesson plan based off the children’s book *Grandfather Counts* by Andrea Cheng (2000). The participant mimicked the Hmong/English grid by using a Chinese/English set of mathematics such as “one plus san” or “wu minus yi” ( $1 + 3$  or  $5 - 1$ ). See Appendix G for the complete lesson and to compare this pre-service educator’s activity to the *Ka’s Garden/Kab Lub Vaj* activity. However, the participant did not include any extensions regarding social justice or conversations regarding the importance of linguistic diversity. Therefore, this participant may have simply mimicked a lesson plan without delving into the heart of a social justice mathematics lesson.

Another participant also utilized linguistic diversity similar to the *Ka's Garden/Kab Lub Vaj* grid. This participant actually wrote a short story in Hmong entitled "Me Tub" which, according to the participant, is "about the Hmong people who live in the highland of Laos and spent the majority their days working on a farm to grow their food. This book also shows students the lengthy travel Hmong people had to take in order to get to their farms." This student expanded the mathematics counting in Hmong to include Hmong colors and common Hmong phrases. The honoring linguistic diversity disposition was highly evident in the concept plan. However, similar to the previous participant, there was an obvious lack of connecting to a social inequality such as dominant language. Therefore, both participants seemed to mimic the modeled lesson but not extend that lesson toward the social justice aspect of dominant languages as discussed in class.

The idea of mimicking came across strong based off an article reflection on "Teaching Math across the Curriculum" by B. Peterson from *Rethinking Mathematics* (2005). As one participant reflected, "I would like to mimic the teaching practices of the author by connecting math to history, stereotypes, equality, and the lives of my students." This article reflection seemed to move participants closer to an understanding of teaching for social justice, such as this participant who wrote about purposeful modeling in the future classroom:

Teaching by modeling clearly and with purposeful intentions sparks interest in students and makes them want to learn more. I like that we as a teacher through many subjects including math, can show our students a great deal about social justice and have them work to fix any problems in the world/society that they are connected to.

This participant captured both the essence of purposeful modeling as well as the greater purpose of social justice, to explore inequalities in the world and work to create positive change.

The article reflections also enhanced participants' self-confidence in the teaching of mathematics for social justice. Perhaps this pre-service educator best summarizes this idea, "Very often, I feel unsure of myself when teaching math concepts. I feel uneasy, and sometimes even unqualified to teach the subject to students. Reading this article was supportive because I realized that I have already been using math as I learn about social issues." This participant captured the initial beliefs and dispositions many participants expressed, a lack of confidence in their ability to teach mathematics. However, this participant probably is moving toward a "developing" disposition, recognizing the importance of reading and writing the world with mathematics to create change (Gutstein, 2006).

An assigned lesson for all participants centered on the social justice aspect of accessibility for all. Participants were asked to create an Accessible Playground (See Appendix H). This playground needed to account for the differing needs of children. Most participants focused on physical accessibility, providing for wheelchair accessibility. Some more developing participants also accounted for other disabilities such as hearing and visual impairment. In addition, this assigned lesson asked participants to create a budget for this playground and compare the budget of their playground to the cost of a traditional playground. "Students were amazed that the cost of such playgrounds was fairly equal to the cost of traditional school playgrounds" (Flahive Reflection, Weeks 8-11).

One participant used this purposeful lesson engagement in her culminating concept plan activity. This participant utilized the topic of accessibility in her concept plan. The participant created a dice game utilizing multiplication where children would move around a game board simulated as a school. The participant writes in her concept plan, “As a follow-up project on adaptive playgrounds, students could have open discussion or research why each piece of equipment on this particular playground might not be accessible to all children.” This participant understood that accessibility is an inequality that must be addressed; however, the mathematics used in this lesson did not equate to the idea of access. The simulated game utilizing multiplication simply brought about the topic of accessibility. What was critically lacking was the “changing one’s orientation to mathematics—viewing mathematics not as a discipline of memorization and regurgitation but rather as a powerful tool for understanding complicated social phenomena” (Gustein, 2006, p. 30). This participant continued viewing mathematics as a memorization tool, not a tool used to change the inequality at hand.

### **Post Dispositions**

Consistent with the Pre-Dispositional Survey, mean scores and standard deviations were analyzed. Table 9 shows the results from my quantitative analysis. Data from the table indicates that the individual mean scores for the Post-Dispositional Survey ranged from 2.02 to 2.6441 on a 3 point scale. This increase in dispositional level showed an overall mean above the “developing” level for all eighteen categories. The overall post-dispositional mean was found to be 42.97 (standard deviation 8.595) which indicated an overall mean score on the 3 point scale for the eighteen questions was 2.387, which is above the “developing” level.

In order to compare mean scores for questions that were both on the pre-survey and the post-survey, paired t tests were run on the results from the three point dispositional scale items to see what significant changes or shifts might have occurred in their dispositions. For the overall dispositions score, the results indicated that the mean post-dispositional score (M= 42.97, SD = 8.595) was significantly greater than the mean pre-dispositional score (M = 35.60, SD= 6.522).

Effect size was calculated to determine the degree that the mean of different scores for the eighteen items as well as the overall score deviated from zero in standard deviation units. The standard effect size *d*-values of .2, .5, and .8 are by convention interpreted as small, medium, and large effect sizes, respectfully (Green and Salkind, 2003). The overall standard effect size *d* was .84, which showed a large significance in the change of mean scores from pre-survey to post-survey. Because the overall mean difference was found to be significant, further analysis included a pair-wise analysis among the means for each of the eighteen questions. Based on these results, statistically significant shifts in mean scores were found between all of the questions excluding question #8 “I honor linguistic diversity.” This indicated that by the end of the course, pre-service educators held a stronger, more developed dispositional attitude toward the teaching of social justice as well as the teaching of mathematics through a social justice pedagogy.

Table 9. Post-Dispositional Survey Results

	Mean Scores		Std. Dev.		Significance	
	Pre	Post	Pre	Post	p*	Effect Size
1. I appreciated and value human diversity, showing respect for my students' varied	2.30	2.53	.706	.642	.031	.276

talents and perspectives.						
2. I respect students as individuals with differing personal and family backgrounds.	2.41	2.64	.684	.651	.031	.276
3. I am sensitive to community and cultural practices.	1.97	2.34	.642	.623	.000	.535
4. I refine my teaching practices in order to address the individual needs of students.	2.08	2.36	.513	.651	.002	.415
5. I seek professional development experiences which strengthen my commitment to an inclusive education.	1.83	2.38	.656	.678	.000	.655
6. I am knowledgeable about the ways in which people and society are culturally, economically, historically, politically, and socially shaped.	1.83	2.23	.703	.584	.000	.489
7. I promote and encourage alternative views.	2.09	2.48	.684	.666	.002	.410
8. I honor linguistic diversity.	1.92	2.30	.719	.659	.001	.454
9. I practice non-discriminatory and inclusive pedagogy.	2.17	2.36	.631	.651	.103	.207
10. I work with students and school communities to foster equity and interrupt social injustices.	1.69	2.02	.614	.630	.001	.433
11. I support a socially just curriculum.	2.08	2.52	.674	.642	.000	.551
12. I am confident in connecting mathematics content to real world situations.	1.84	2.47	.648	.642	.000	.775
13. I appreciate the role of mathematics in a diverse society.	1.77	2.48	.684	.642	.000	.914
14. I value mathematics as a tool and as a language.	1.86	2.45	.639	.688	.000	.732
15. I assist my students in moving beyond memorization of mathematical facts and procedures into constructing knowledge.	1.91	2.34	.684	.648	.000	.513
16. I design activities and	2.00	2.31	.591	.687	.007	.352

lessons that provide high expectations and strong support for all students.						
17. I promote and encourage alternative procedures/strategies in mathematics.	1.89	2.33	.645	.644	.000	.525
18. I support a socially just curriculum in mathematics.	1.98	2.50	.630	.642	.000	.579
<b>Total Overall Dispositional Score (maximum of 54 points)</b>	35.60	42.97	6.522	8.595	.000	.840

In addition to analyzing the data, focus group interview questions also probed at the pre-service educator’s movement in disposition toward a social justice pedagogy. One participant reflected on her own identity as it relates to diversity stating, “I didn’t learn about diversity or anything like that until I came to college, and I think that’s really sad” (December 6, 2010). Therefore, this participant pointed out her hope that instituting a social justice curriculum in elementary school would assist future students in understanding the diverse world around us. Similarly, another pre-service educator expressed her fear that “gaining those perspectives will be a challenge because I haven’t been exposed to a lot of differences until college, and I still don’t feel comfortable with teaching about all the different cultures and inequalities in the world or even this community” (December 7, 2010). Therefore, though these pre-service educators moved in their disposition toward a desire to teach a social justice mathematics curriculum, doubts and challenges were still prevalent in their responses.

Another pre-service educator announced her plan to implement an anti-bias curriculum, as opposed to a social justice curriculum, because “I plan on teaching younger children and they have a hard time grasping abstract concepts, so maybe just

providing opportunities everyday and everywhere for them to become familiar with first off understanding about differences and then maybe carrying that into Social Justice” (December 7, 2010). This pre-service educator, specializing in Early Childhood, had a hard time grasping how very young children could understand the complexities of the social issues addressed in the Math Methods Course. However, the movement toward a social justice pedagogy seemed evident.

Similar to research by Aguirre (2009) and Muller (2008), pre-service educators expressed a variety of challenges and barriers to implementing a social justice mathematics curriculum. Supporting what Aguirre (2009) found, two participants expressed concern over the new Wisconsin Common Core State Standards, citing, “I’m not overly familiar with the core standards, but depending on what the standards actually say, it might be slightly more difficult to incorporate into that classroom depending on those standards.” (December 7, 2010). Pressures concerning “meeting the standards today; teaching to the test” seem to overwhelm pre-service educators (December 6, 2010).

Similar to what Muller (2008) presented, pre-service educators expressed a lack of materials. “I don’t think [social justice] is as well known, so looking on the internet and researching, it’s a little harder to find. We had trouble writing our lesson plans or concept plans because there are not as many resources for us.” (December 6, 2010). Also reflecting what Muller (2008) uncovered, pre-service educators expressed a fear of lack of support, as evidenced by this focus group interview response, “I think depending what the issue is you are teaching, maybe resistant parents and administration may not want you to go on whatever route you want to take” (December 7, 2010).

## Post Beliefs

From coding of multiple sources, I found participants held one of three beliefs regarding the integration of social justice into the mathematics classroom. The first belief I term “Social Justice as Real World Connections.” Many participants understood that social justice needed a connection to the real world or lives of students, such as this participant who defined social justice as “making connections to the real world and connecting the world to their own lives” (Focus Group Interview, Dec. 6, 2010). A definition from one participant’s Post-Belief’s Survey states social justice is “integrating the real-world into the classroom.” However, participants who fell into this belief did not make the connection that the real world example needed to center on a social inequality.

This understanding of social justice as real world connection often carried through into the participants’ definitions of social justice in the math classroom. The pre-service educators often defined the role of math as a subject taught “to provide all students with the basics of math which will help them throughout the rest of their lives and careers.” Sometimes, pre-service educators linked the idea of real-world issues with making a change, but did not explicitly link the real-world issue as a social injustice. Such understanding of the role of social justice in the math classroom was expressed by these pre-service educators who believe that by seeing “math in action and how it is used in real-life, students can tackle problems they see and use math to evaluate, analyze, and progress through data to reach a common goal.” Upon further examination, it became evident that this participant truly linked social justice as a real-world connection as this participant described a social justice math lesson involving “simulation of salaries and cost of living and creating a monthly budget including finding a place to live, groceries,

utilities, gas, and extras.” Therefore, this participant may understand the verbiage of creating change but not the connection beyond real-world issues.

Another belief of the participants was to center their social justice definitions and lessons on a cultural aspect. Culture is indeed part of social justice, but simply highlighting a diverse culture or learning about another culture is not a complete understanding of social justice pedagogy. In interviewing focus groups about this idea, many participants expressed their confusion between the terms multiculturalism and social justice. One participant expressed her movement toward a broader understanding of social justice:

Social justice is more like teaching real world issues and critically thinking about how to change that issue while multiculturalism is more including inclusive messages. They both are inclusive, but multiculturalism is more based on race and culture and not necessarily analyzing or critically thinking about those issues like social justice promotes. (Focus Group Interview, Dec. 7, 2010)

Yet, some participants remained confused about this distinction. One participant used these words and math operations to define social justice on their Post-Beliefs Survey, “diversity + cultures + equity + celebrating differences – pity.” Through this operational definition and other statements made throughout the survey regarding breaking down “stereotypes of ethnic minorities,” it is apparent that this pre-service teacher equates social justice with multiculturalism. Other participants often used phrases such as “integrating diversity into all subjects” or “learning about differences.” In the focus group interviews, one participant reflected on what diversity meant in both high school and college, “I think diversity in high school is like, be nice to people of different colors. It wasn’t about learning about different cultures. I just don’t think that became relevant until college.” (December 6, 2010). However, the question posed to this participant was

about the benefits of implementing social justice into the curriculum. Therefore, it can be assumed that the participant still did not have a clear grasp of the difference between a diverse, multicultural approach and social justice.

Pre-service educators who linked social justice and culture often made that connection during their definition of social justice in the math classroom, making such assertions as “mathematics can help us become aware of diversity. We can measure, predict, collect data, organize data, and examine it, and use this info to break down stereotypes.” Some participants discussed using cultural names in their word problems or using “multicultural literature and children’s books to explore the world’s cultures and the diversity of America, which can be represented in bar graphs or pie charts.” Again, though culture is a part of social justice, these participant’s belief did not extend to examining the inequalities created between dominant and minority cultures, which can translate into issues of poverty, illiteracy, access, career choice, education, etc...

The third category of beliefs about social justice is “Social Justice as Change Agency.” Here, participants understood the central tenets of a social justice pedagogy and most often included some form of bringing about change through analyzing these inequalities. This participant’s definition captures that idea of change agency, “Social justice is teaching children about the world they live in and giving them the tools to change or maintain that world.”

This belief often led to a complete understanding of how social justice can be utilized in the math classroom. For example, one participant’s Post-Belief’s Survey stated that “social justice can be used in math by incorporating data and statistics and allowing students to critically analyze and evaluate social issues in the world around

them.” This participant recognized that not only is social justice used to evaluate inequalities in society but also that mathematics can be a tool for the necessary critical analysis.

### **Post Abilities**

The fifth question on the Post-Beliefs Survey asked participants to describe an activity or lesson that could be implemented into the math classroom that addresses social justice. Every participant was able to describe a lesson that he or she would implement into the classroom, unlike the Pre-Belief’s Survey where 23 participants simply stated they did not know how to implement a lesson and 16 participants described a lesson about tiering and differentiating, not social justice. Most participants described either a lesson or activity completed during their Methods course or the lesson or activity they developed for their final concept plan. In order to fully analyze the participant’s abilities, I utilized information coded from their Post-Belief’s Survey as well as their concept plans. I also relied upon my definition of social justice mathematics to accurately code the beliefs. My definition relied upon three aspects for a complete social justice mathematics lesson:

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.

The three main abilities of participants to integrate social justice follow the three beliefs, that of *Social Justice as Real World Connection*, *Social Justice as Cultural Integration*, and *Social Justice as Change Agency*. These abilities relate to the first and third aspects of my definition, introducing students to a social inequality and engaging

students in mathematics to examine that inequality. In addition to these three main social justice abilities, there are two main mathematical abilities that pre-service educators expressed: *Connected Mathematics* and *Critical Mathematics*. These two mathematical interpretations correspond with the second and third aspects of my definition. Some pre-service educators simply connected an issue (social justice or otherwise) to a mathematical topic, which I coded as *Connected Mathematics*. Others connected their issue at hand to what Gutstein (2006) termed reading the world with mathematics which is “utilizing mathematics to understand power relations, resource inequities, and unequal opportunities between social groups in one’s community, society, and world” (pp. 24-26); I coded these lessons as *Critical Mathematics*, mathematics that assists in breaking down stereotypes to promote change (Gutiérrez, 2007).

Therefore, concept plans were coded in one of six possibilities, as expressed in Table 10 below. As pre-service educators created concept plans in groups of one to three people, a total of  $N = 29$  concept plans were coded with the number of each concept plans falling in each category listed below. These findings were triangulated with information from the Post-Dispositional Survey, the Post-Beliefs Survey, and focus group interviews. The six codings were also verified by a Mathematics Education content expert. From the six possible codings came the ability to move from awareness to praxis, also illustrated in Table 10 below. This table by no means has a set movement from awareness to praxis, but rather can be used as a guide to assist in the coding of a concept plan to assess the dispositional movements of pre-service educators.

Table 10. Concept Plan Operational Definitions

*Awareness* → *Praxis*

	<b>Connected Mathematics</b>	<b>Critical Mathematics</b>
<b>Real World Connections</b>	Concept plan integrates a real world issue yet does not enhance the student understanding of the concept through mathematics. (N = 10)	Concept plan integrates a real world issue and critically engages students in understanding the concept through mathematics. (N = 3)
<b>Cultural Integration</b>	Concept plan integrates a cultural concept yet does not enhance student understanding of the concept through mathematics. (N = 5)	Concept plan integrates a cultural concept and critically engages students in understanding the concept through mathematics. (N = 1)
<b>Change Agency</b>	Concept plan integrates a social justice issue yet does not enhance student understanding of the concept through mathematics only sometimes leading students to enact change in their society or world. (N = 4)	Concept plan integrates a social justice issue and critically engages students in understanding the concept through mathematics often leading students to enact change in their society or world. (N = 6)

↓ *Praxis*

### **Social Justice as Real World Connections**

Participants who created a concept plan that I coded under *Social Justice as Real World Connections* had chosen a topic that centered on a real world example. Often, the real world example has nothing to do with a social inequality, such as a budgeting a grocery shopping trip or measuring the size of their bedroom. Sometimes, the real world example could have been tied to a social inequity in society or the world; however, the

participants did not make that explicit connection. This often caused me to reflect on my own definition of social justice as topics in this category could have some social inequality implications. Two examples of this border-line social justice theme include a lesson on cyber bullying, examined below, and a lesson centered on Habitat for Humanity. Additionally, lessons coded under this category often did not promote a change agency to their concept. If that change agency had been connected, the participant probably would have realized they needed to more explicitly connect their real world example to a social inequality. A chart detailing the concept, math connection, and explanation of lesson can be found in Appendix E.

### **Real World Connections and Connected Math**

One clear-cut example of a real world problem came from a lesson centered on donating to the International Crane Foundation. The pre-service educator who created this lesson plan had her students collect aluminum cans to raise funds for the International Crane Foundation. The mathematics involved dealt with estimation. Students were asked to estimate how many aluminum cans were in each bag. After estimation, students then counted the aluminum cans and used multiplication to find the total amount their can collection would raise for the International Crane Foundation. This lesson clearly purports a real world theme as the mathematics involved did not assist in examining the issue of why the class was donating to help preserve cranes. Additionally, restoring wildlife populations does not seem to address a social inequity in the world. Therefore, this lesson was clearly coded as a real world connection with only connected mathematics, leading me to an ability rating of “awareness.”

## **Real World Connections and Critical Math**

One example of a real world example that accurately utilizes the mathematics to examine an issue comes from three participants who centered their lesson on Cyber Bullying. They define cyber bullying as “when a child is tormented, threatened, harassed, humiliated, embarrassed or targeted by another child using the Internet, mobile phone, or other type of digital technology.” The pre-service educators provided their students statistics on the percent of children who experienced cyber bullying at various month intervals with the intent for their students to create a graph of the increasing percentage. This use of mathematics to read the world and examine an issue fits the intent of social justice. However, because cyber bullying can affect any child, not simply a child from a minority or sub-dominant group, I categorized this concept as real world, though I strongly advocate for this topic to be addressed in the classroom. Additionally, I did not see any engagement with the statistics, simply a presentation of the numbers to serve as mathematics learning, not mathematics as a tool to create change. This further led me to keep this lesson coded as a real world example with critical mathematics intent, which I would code as a “developing” state of their social justice and critical math integration ability.

## **Social Justice as Cultural Integration**

Participants who created a concept plan that I coded under *Social Justice as Cultural Integration* had chosen a topic that centered on culture or ethnicity. However, given that culture and ethnicity can lead to a social justice theme, I carefully examined the lesson plan to determine if any inequality or discussion of power or privilege was included in the lesson, moving it more toward social justice. What I found was that few

participants were able to make that leap from a multicultural perspective to a social justice perspective. A chart detailing the concept, math connection, and explanation of lesson can be found in Appendix E.

### **Cultural Integration and Connected Mathematics**

Two participants partnered to create a lesson on Native Americans and the importance of triangles in their culture. Their opening launch began with these ideas “Think about Native American culture. What are some things that come to your mind when thinking about how triangles relate to Native Americans? Most of you probably thought about teepees or arrowheads.” This lesson, targeting sixth grade students, actually begins with some very stereotypical responses about Native American culture. This lesson does not even investigate current Native American living. Though it integrates a mathematic lesson of triangles, area, and perimeter, these math models do not enhance the investigation of Native American culture. This integration of math is merely connected to the topic at hand and does not advance students’ understandings or perspectives of Native American culture. Therefore, I would categorize these pre-service educators in the “awareness” state of their social justice and critical math ability.

### **Cultural Integration and Critical Mathematics**

Another set of participants created a cultural lesson plan centering on Native Americans and Tribes. These participants asked sixth grade students to use their understanding of coordinate plans to create a map of Wisconsin identifying where 11 current tribes live, such as the Red Cliff, St. Croix, Ho-Chunk, and Oneida. Students then engaged in an investigation of the tribe to present to the class. This lesson plan, centering on Native American culture, at least presented Native Americans as current

residents of a state. Additionally, the mathematics integrated was essential to the student investigation, finding location through coordinate systems. Where this cultural integration did not become social justice is the lack of an extension to an inequality. For example, these participants could have engaged the students in looking at historical maps of the land regions tribes occupied, then current maps of their territory, essentially leading to the dominance of the White man to take over land that did not belong to them. This link to the historical and current dominance of White privilege would have provided that necessary component to look at an inequality in society.

Furthermore, the mathematics, though essential to understanding where Native American tribes are located, could have delved deeper into the understanding of Native Americans by looking at the percent of Native Americans living at each tribal site versus the total population of Native Americans in Wisconsin or even in the nation. These numbers could have been compared to more historical numbers to see the population growth or decline at each of these sites, involving research on Native American culture in terms of American society. Therefore, I would categorize these pre-service educators in the “developing” state of their social justice and critical math ability.

### **Social Justice as Change Agency**

Participants who created a concept plan that I coded under *Social Justice as Change Agency* needed to have chosen a topic that reflected an inequality of societal, national, or global implications. From this inequality, I actively searched to see if the participant extended the understanding that simply centering a topic around an inequality does not make it social justice. A lesson must actively encourage critical analysis of that inequality, with the even greater intent of creating change or finding solutions to that

problem. A chart detailing the concept, math connection, and explanation of lesson can be found in Appendix E. However, I will analyze some of the concept plans to point out the participants' understanding and ability to integrate social justice in mathematics.

### **Change Agency and Connected Mathematics**

Two pre-service educators partnered together to create a lesson centered on creating a global community dinner. These participants began their lesson by reading the book *If the World Were a Village* by D. Smith which was read to the class during Week 6. This is yet another example of how purposeful modeling effectively transitioned into the pre-service educators' abilities to integrate social justice and mathematics. After reading the book, the pre-service teachers provided probing questions to begin having their students think about inequalities expressed in the book, such as "What statistics were the most interesting? How does this book change the way you think about the world around us?" These questions then led to the activity of creating a community dinner for a village of 100 people. After students predict how much food they might need to be, "Student will be using multiplication to investigate how much food and how much it would cost to provide the village with a community dinner." These pre-service educators even created an extension opportunity to challenge students by posing the question, "How much money would it cost to feed the world based on the numbers in the book?" Where these participants faltered to capture the true essence of social justice was in the food and drink chosen to represent their community dinner. These participants listed drinks of bottled water, milk, and lemonade and food items of vegetable medley, apples, dinner rolls, potato salad, rice, coleslaw, turkey, baked chicken, and ham. When giving students these options, the pre-service teachers failed to provide cultural or ethnic

variety to their food and drink choices. This does not match the intent for students to examine feeding the global village through a community dinner.

In terms of the mathematics, these participants grasped the concept of using math to help explore the concept of hunger and feeding those most in need. They utilized mathematics appropriate for students in Grade 3, multiplication and basic statistics. However, the statistics were merely discussed, not utilized to create change. Furthermore, the multiplication was superficial; students were asked to multiply the cost of an item for the community dinner by how many items the student felt was needed. This leads to an inaccurate view of how much money it would cost to feed the village of 100 people. Additionally, no extension regarding the connection between the global village and the entire world was made, furthering the inaccuracies of the cost involved in removing hunger. Therefore, the math was simply connected to a social justice lesson plan, leading me to code these pre-service educators' abilities as "developing."

### **Change Agency and Critical Mathematics**

Another set of pre-service educators collaborated to create a social justice mathematics lesson centered on the injustice of child labor. These participants also linked the lesson to Social Studies by providing a historical context for child labor in the United States as well as current working conditions. They then linked child labor to a global scale citing "in Sub-Saharan Africa around one in three children are engaged in child labor, representing 69 million children. In South Asia, another 44 million are engaged in child labor." These pre-service educators then enhance the lesson by asking students what fraction of child workers are in the world, in Sub-Saharan Africa, and in South Asia. The students then create graphs or charts to visually represent their findings.

These pre-service educators effectively utilized both the concepts of social justice and mathematics to provide a meaningful fraction activity for their third grade students.

What makes these pre-service educators especially social justice minded is their assessment, “Have students formally present their findings to the class, and explain their thoughts and opinions on child labor laws. Students must justify their reasoning with evidence and sources and must present a well thought-out plan of action for eliminating child labor.” This extension to include change agency by eliminating child labor is exactly how social justice mathematics should be integrated, leading me to code these pre-service educators as “praxis” in their ability to effectively integrate both social justice and critical mathematics into their curriculum.

## **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 teacher candidates' initial beliefs, dispositions, and ability to integrate social justice into mathematics?
2. Does purposeful modeling of the integration of social justice into their elementary mathematics methods course change their beliefs, dispositions, and ability to integrate social justice into mathematics?

In this chapter, I will summarize my findings to these two questions and identify any 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 of 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, though 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 in to 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 made 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 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 Theorist, 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.

## REFERENCES

- Adams, M., Bell, L.A., & Griffin, P. (Ed.). (2003). *Teaching for diversity and social justice*. (Eds). Second edition. New York, NY: Routledge.
- Aguirre, J. 2009. Teacher domain specific beliefs and their impact on mathematics education reform. In J. Maaß & W. Schlöglmann (Eds.), *Beliefs and Attitudes in Mathematics Education: New Research Results*, (pp. 45–58). Rotterdam, The Netherlands: Sense.
- Alexander, B., & Munk, M. (2010). A social justice data fair: questioning the world through math. *Rethinking Schools*, 25(1).
- Allard, A., & Santoro, N. (2006). Troubling identities: teacher education students' constructions of class and ethnicity. *Cambridge Journal of Education*, 36(1), 115-129. doi:10.1080/03057640500491021.
- Ambe, E.B. (2006). Fostering multicultural appreciation in pre-service teachers through multicultural curricular transformation. *Teaching and Teacher Education*, 22, 690–699.
- Association of Teacher Educators. (2003), Standards for Teacher Educators. Retrieved January 21, 2011, from <http://www.ate1.org/pubs/uploads/tchredstds0308.pdf>.
- Atkinson, P. and Delamont, S. (2005) Analytical Perspectives. In N. Denzin and Lincoln, Y. (eds.), *The Sage handbook of qualitative research*. 3<sup>rd</sup> edition. (pp. 821-840). Thousand Oaks, CA: Sage Publications, Inc.
- Berg, B.L. (2001). *Qualitative research methods for the social sciences*. Needham Heights, MA: Pearson.
- Berlank, A. (2008). Challenging the hegemony of whiteness by addressing the adaptive unconscious . In V. Lea & E. J. Sims (Eds.), *Undoing whiteness in the classroom: Critical educultural teaching approaches for social justice activism* (pp. 47-66). New York: Peter Lang Publishing, Inc.
- Campbell, P., & Langrall, C. (1993). Making equity a reality in classrooms. *Arithmetic Teacher*, 41(2), 110. Retrieved from Academic Search Complete database.
- Cochran-Smith, M. (1991). Learning to teach against the grain. *Harvard Educational Review*, 61(3): 279-309.
- Cochran-Smith, M. (2004). *Walking the road: Race, diversity, and social justice in teacher education*. New York: Teachers College Press.

- Cochran-Smith, M., Shakman, K., Jong, C., Terrell, D. G., Barnatt, J., & McQuillan, P. (2009). Good and Just Teaching: The Case for Social Justice in Teacher Education. *American Journal of Education*, 115(3), 347-377.
- Common Core State Standards Initiative (2010). *Common core state standards for mathematics*. Retrieved from <http://www.corestandards.org>.
- Creswell, J. W. (2003). *Research design: Qualitative, quantitative, and mixed methods approaches* (2<sup>nd</sup> ed.). Thousand Oaks: Sage Publications.
- Creswell, J. W. (2005). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research* (2<sup>nd</sup> ed.). Upper Saddle River: Pearson Education, Inc.
- Cross, B. (2005). New racism, reformed teacher education, and the same ole' oppression. *Educational Studies*, 38(3), 263-274. doi:10.1207/s15326993es3803\_6.
- Darling-Hammond, L. (2000). Teacher quality and student achievement: a review of state policy evidence. *Education Policy Analysis Archives*, Retrieved March 25, 2011, from <http://epaa.asu.edu/epaa/v8n1/>.
- Denzin, N. K. & Lincoln, Y. S. (2005). *The Sage handbook of qualitative research*. 3<sup>rd</sup> edition. Thousand Oaks, CA: Sage Publications, Inc.
- Feiman-Nemser, S., & Remillard, J. (1996). Perspectives on learning to teach. San Francisco: Jossey-Bass. Retrieved from <http://ncrtl.msu.edu/http/ipapers/html/pdf/ip953.pdf>
- Frankenstein, M. (1983). Critical mathematics education: An application if Paulo Freire's epistemology. *Boston university journal of education*, 165(4), 315-359.
- Freire, P. (1970) *Pedagogy of the oppressed*. New York: Continuum.
- Furumoto, R. (2008). Future teachers and families explore humanization through chicana/o/latina/o children's literature. In V. Lea & E. J. Sims (Ed.), *Undoing whiteness in the classroom: Critical educultural teaching approaches for social justice activism* (pp. 79-95). New York: Peter Lang Publishing, Inc.
- Garcia, S., & Guerra, P. (2004). Deconstructing deficit thinking: Working with educators to create more equitable learning environments. *Education and Urban Society*, 36(2), 150-168. Retrieved from ERIC database.
- Garmon, M. (2004). Changing pre service teacher's attitudes/beliefs about diversity: what are the critical factors? *Journal of Teacher Education*, 201-213.
- Garmon, M. A. (2005). Six key factors for changing preservice teachers' attitudes/beliefs about diversity. *Educational Studies*, 38(3): 275-286.

- Gay, G. (2009). Preparing culturally responsive mathematics teachers. In B. Greer (Ed.), *Culturally Responsive Mathematics Education* (pp. 189-205). New York, NY: Routledge.
- Giroux, H. (2009). Education and the crisis of youth: schooling and the promise of democracy. *The Educational Forum*, 73, 8-18.
- Giroux, H. (1997) Racial politics and the pedagogy of whiteness. In M. Hill (Ed.), *Whiteness* 294- 315, New York and London: New York University Press.
- Giroux, H., & McLaren, P. (1986). Teacher education and the politics of engagement: The case for democratic. *Harvard Education Review*, 56(3), 213-238.
- Glesne, C. (1999). *Becoming qualitative researchers: An introduction*. New York: Addison Wesley Longman.
- Gutiérrez, R. (2007). (Re)Defining equity: The importance of a critical perspective. In N. S. Nasir & P. Cobb. (Eds.). *Improving access to mathematics: Diversity and equity in the classroom*. (pp. 37-50). New York: Teachers college press.
- Gutstein, E. (2006). *Reading and writing the world with mathematics: Toward a pedagogy for social justice*. New York: Routledge.
- Gutstein, E. (2007). And that's just how it starts: Teaching mathematics and developing student agency. [Electronic version]. *Teachers College Record*. Retrieved March 15, 2011, from <http://www.tcrecord.org/Content.asp?ContentID=12799>.
- Haberman, M. (1991). Can cultural awareness be taught in teacher education programs?. *Teaching Education*, 4(1), 25-31. Retrieved from ERIC database.
- Herron, J., & Barta, J. (2009). Culturally relevant word problems in second grade: what are the effects?. *The Journal of Mathematics and Culture*, 4(1), Retrieved from <http://nsgem.rpi.edu/files/1722>
- Hill-Jackson, V. (2007). PART III: CREATING MULTICULTURAL CLASSROOMS: Wrestling whiteness: Three stages of shifting multicultural perspectives among white pre-service teachers. *Multicultural Perspectives*, 9(2), 29-35. doi:10.1080/15210960701386285.
- Hodge, L. (2006). An orientation on the mathematics classroom that emphasizes power and identity: reflecting on equity research. *The Urban Review*, 38(5), 373-385.
- Howard, G. R. (1999) *We Can't Teach What We Don't Know: White Teachers, Multiracial Schools*. New York: Teachers College Press.
- Jay, G. (2005). Whiteness studies and the multicultural literature classroom. *MELUS*, 30(2), 99-121. Retrieved from Academic Search Complete database.

- Kincheloe, J. (Forthcoming). Beyond reductionism: difference, criticality, and multilocality in the bricolage and postformalism. *The Freire Project*, Retrieved from <http://freireproject.org/content/critical-pedagogy-and-research>.
- Kincheloe, J. and McLaren, P. (2010) Rethinking Theory and Research. In N. Denzin and Lincoln, Y. (eds.), *The Sage handbook of qualitative research*. 3<sup>rd</sup> edition. (pp.303-342). Thousand Oaks, CA: Sage Publications, Inc.
- Kyles, C., & Olafson, L. (2008). Uncovering preservice teachers' beliefs about diversity through reflective writing. *Urban Education*, 43(5), 500-518. Retrieved from Academic Search Complete database.
- Ladson-Billings, G. (1994). *The dreamkeepers*. San Francisco: Jossey-Bass Publishing Co.
- Ladson-Billings, G. (1995). Toward a theory of culturally relevant pedagogy. *American Educational Research Journal*, 32(3): 465-491.
- Leonard, J., & Guha, S. (2002). Creating cultural relevance in teaching and learning mathematics. *Teaching Children Mathematics*, 9(2), 114-18. Retrieved from ERIC database. [https://my.nctm.org/eresources/view\\_media.asp?article\\_id=2163](https://my.nctm.org/eresources/view_media.asp?article_id=2163)
- Leonard, J., Brooks, W., Barnes-Johnson, J., & Berry III, R. (2010). The nuances and complexities of teaching mathematics for cultural relevance and social justice. *Journal of Teacher Education*, 61(3), 261-270.
- McDonald, M. (2005). The integration of social justice in teacher education: Dimensions of prospective teachers' opportunities to learn. *Journal of Teacher Education*, 56(5), 418-435. doi:10.1177/0022487105279569.
- McLaren, P. (2003). Critical pedagogy: A look at the major concepts. In A. Darder, M. Baltodano and R. Torres (Eds.), *The critical pedagogy reader* (pp. 69-96). New York: Routledge Falmer.
- Michelli, N. M. & Keiser, D. L. (Eds.) (2005). *Teacher education for democracy and social justice*. New York: Routledge.
- Mills, C. (2008). Making a difference: moving beyond the superficial treatment of diversity. *Asia-Pacific Journal of Teacher Education*, 36(4), 261-275. doi:10.1080/13598660802375925.
- Morey, A. I., & Kitano, M. K. (1997). *Multicultural course transformation in higher education: A broader truth*. Needham Heights, MA: Allyn & Bacon.
- Muller, D. (2008) Preservice teachers' beliefs and experiences in learning how to teach mathematics for social justice. (Doctoral dissertation). Retrieved from Dissertation Abstracts Online. AAI3320006

- National Council for Accreditation of Teacher Education (NCATE). (2008). *Professional standards for the accreditation of teacher preparation institutes*. Retrieved from <http://www.ncate.org/public/standards.asp>
- National Council for Teachers of Mathematics (NCTM). (2010) *Standards and focal points*. Retrieved from <http://www.nctm.org/standards/default.aspx?id=58>
- New Mexico State University College of Education. (2007) *Office for teacher candidate preparation teacher candidate dispositions*. Retrieved from <http://education.nmsu.edu/otcp/dispositions.html>
- Peterson, B. (2005). Teaching math across the curriculum. In E. Gutstein (Ed.), *Rethinking mathematics* (pp. 9-15). Milwaukee, WI: Rethinking Schools.
- Pope, E. (2009) University of Wisconsin System Overview. Retrieved January 18, 2011 from <http://www.uwlax.edu/budgetandfinance/budget/Pdf/LFB36.pdf>.
- Price, J., & Ball, D. (1998). Challenges of liberatory pedagogy in mathematics and teacher education. *Theory into Practice*, 37(4), 256-264.
- Quin, J. (2009). Growing social justice educators: a pedagogical framework for social justice education. *Intercultural education*, 20(2), 109-125.
- Radical Math: Organization information and mission statement. Retrieved on January 6, 2011, from <http://www.radicalmath.org/main.php?id=about>.
- Richardson, L. and St. Pierre, E. A. (2005) Writing: A Method of Inquiry. In N. Denzin and Lincoln, Y. (eds.), *The Sage handbook of qualitative research*. 3<sup>rd</sup> edition. (pp. 821-840). Thousand Oaks, CA: Sage Publications, Inc.
- Sleeter, C. E. (2001). Preparing teachers for culturally diverse schools: Research and overwhelming presence of whiteness. *Journal of Teacher Education*, 52(2), 94-106. doi: 10.1177/0022487101052002002.
- Sogunro, O. (2001). Toward multiculturalism: Implications of multicultural education for schools. *Multicultural Perspectives*, 3(3), 19-33. Retrieved from Academic Search Complete database.
- Steinberg, S. (2006). Critical cultural studies research. In K. Tobin & J. Kincheloe (Ed.), *Doing educational research: a handbook* (pp. 117-137). Rotterdam, the Netherlands : Sense Publishers.
- Tate, W. F. (2005). Race, retrenchment, and the reform of school mathematics. In E. Gutstein & B Peterson (Eds.), *Rethinking mathematics: Teaching social justice by the numbers*, (pp. 31-40). Milwaukee: Rethinking Schools Ltd.
- US Census Bureau. La Crosse Quick Facts. Retrieved January 16, 2011 from <http://quickfacts.census.gov/qfd/states/55/5540775.html>.

- Vavrus, M. (1994). Acritical analysis of multicultural education infusion during student teaching. *Action in Teacher Education*, 16(3), 45-57.
- Villegas, A.M. & Lucas, T. (2002). Preparing culturally responsive teachers: Rethinking the curriculum. *Journal of Teacher Education*, 53(1), 20–32.
- Walls, P., Parahoo, K., & Fleming, P. (2010). Grounded theory. The role and place of knowledge and literature in grounded theory. *Nurse Researcher*, 17(4), 8-17. Retrieved from Academic Search Complete database.

APPENDIX A

PRE- AND POST- DISPOSITIONAL SURVEY

Pre-Dispositional Survey: Week II  
 Post-Dispositional Survey: Week XV

Name: \_\_\_\_\_  
 Day: Mon. Tues. Wed.

## Dispositional Survey of Teaching and Learning Mathematics

**What are dispositions?** Dispositions are the values, commitments, and professional ethics that influence behaviors towards students, families, colleagues, and communities that affect student learning, motivation and development as well as the educator’s own professional growth.

**Directions:** For each statement, select a dispositional rating of *Awareness*, *Developing*, or *Praxis* according to the operational definitions below.

**AWARENESS:** New consciousness, perspective, or concept

**DEVELOPING:** Processing and analyzing meaning, sense or connection

**PRACTICE:** Reflective application

	Awareness	Developing	Praxis
I appreciate and value human diversity, showing respect for my students' varied talents and perspectives.			
I respect students as individuals with differing personal and family backgrounds.			
I am sensitive to community and cultural practices.			
I refine my teaching practices in order to address the individual needs of students.			
I seek professional development experiences which strengthen my commitment to an inclusive education.			
I am knowledgeable about the ways in which people and society are culturally, economically, historically, politically, and socially shaped.			
I promote and encourage alternative views.			
I honor linguistic diversity.			
I practice non-discriminatory and inclusive pedagogy.			
I work with students and school communities to foster equity and interrupt social injustices.			

I support a socially just curriculum.			
I am confident in connecting mathematics content to real world situations.			
I appreciate the role of mathematics in a diverse society.			
I value mathematics as a tool and as a language.			
I assist my students in moving beyond memorization of mathematical facts and procedures into constructing knowledge.			
I design activities and lessons that provide high expectations and strong support for all students.			
I promote and encourage alternative procedures/ strategies in mathematics.			
I support a socially just curriculum in mathematics.			

APPENDIX B

PRE- AND POST- BELIEFS SURVEY

*Pre-Beliefs Survey: Week II*  
*Post-Beliefs Survey: Week XV*

Name: \_\_\_\_\_  
Day:      Mon.      Tues.      Wed.

## **Teaching Mathematics for Social Justice Beliefs Survey**

1. What is the purpose of teaching mathematics?
2. How would you define social justice in education?
3. What is the role of social justice in the mathematics classroom?
4. Is the integration of social justice into the mathematics classroom a valuable component of the curriculum? Explain your viewpoint.
5. Describe a mathematics activity or lesson you could implement into the elementary/middle mathematics classroom that addresses a social justice issue.

APPENDIX C

PRE- AND POST- BELIEFS SURVEY TEXT-BASED CODES

Question 1: <i>What is the purpose of teaching mathematics?</i>			
<b>Code</b>	<b>Operational Definition</b>	<b>Pre-Beliefs Example</b>	<b>Post-Beliefs Example</b>
Skills	Responses indicated the skills that mathematics teach	Math allows students to learn to problem solve, reason, and think critically.	As teachers, we should help students develop critical thinking skills, like problem solving and reasoning so students can improve communication skills.
School Use	Responses indicated the use of mathematics in future classes or the need to teach due to state standards	The purpose of teaching mathematics is to give students the content knowledge and mathematical skills they need to succeed in math class, other classes, and life.	Math is a progressive subject where mastery of skills is needed to be successful in future school math.
Real World	Responses indicated an understanding that mathematics will be used for future endeavors in the real world.	Mathematics teaches a lot of independent skills such as balancing a checkbook, measuring amounts in order to prepare food, count change and so forth.	It is part of everyday life and no matter what career path you choose- math is incorporated into our daily lives.
Social Justice	Responses indicated an understanding of reading and writing the world with mathematics		To assist students in gaining access to the language of numbers to better understand their world.

<i>Question 2: How would you define social justice in education?</i>			
<b>Code</b>	<b>Operational Definition</b>	<b>Pre-Beliefs Example</b>	<b>Post-Beliefs Example</b>
Equality	Responses indicated that the participant felt social justice focused on equality, fairness, or accommodating all students	[Social justice] is being fair to all students and giving them an equal chance. By fair, I mean giving each student the help and attention that the specific individual requires (not the same help for all).	Social justice in education is treating all students equally while expecting the most out of everyone in your classroom.
Real World	Responses indicated that the participant felt social justice focused on providing a greater understanding of the real world or real world skills	Social justice talks about creating a well rounded citizen who can function in society.	Social justice in education is the teaching of real world issues and situations that allow students to think critically.
Cultural Integration	Responses indicated that participants felt social justice included integrating culture and real world problems into the curriculum	Social justice is the awareness of others. It is teaching awareness, unbiased [sic] opinions, and integrating many views and worldly things into the classroom.	Social justice in education helps students become more culturally aware of issues surrounding them in everyday life.
Social Justice as Change Agency	Responses indicated an understanding of social justice or aspect of social justice		Social justice in the classroom should introduce students to social inequalities in our society, and it should encourage students to view their skills in math and other subjects and use those skills to promote change in those social issues.

Question 3: <i>What is the role of social justice in the mathematics classroom?</i>			
Code	Operational Definition	Pre-Beliefs Example	Post-Beliefs Example
Unsure	Responses indicated that the participant was unclear about the role of social justice in the mathematics classroom	I do not know much about how to teach social justice in the math classroom but I am very interested to learn.	
No Difference	Responses indicated that integrating social justice in the classroom is not different based on the content area	It is the same in every classroom. It is not so much the subject matter- but how its taught and how students respond. [sic]	
Equality	Responses indicated that the participant felt social justice in the math classroom focused on equality, fairness, or accommodating all students	“Equality” and “fairness” are easy concepts to incorporate in a math curriculum. Besides ensuring equality for all students, the problems and projects used in the class can help illustrate these concepts for the students.	All students have access to a high-quality curriculum.
Differentiated Instruction	Responses indicated that teachers must differentiate or tier their lessons to accommodate the needs of their students.	Social justice within the math classroom ensures that all students’ needs are being met. This includes providing a variety of instructional strategies as well as possibly altering students’ assignments.	Every child may not need the same level of guidance, but all need guidance. We as teachers need to accommodate for all our students’ needs by setting aside biases and stereotypes and integrate real-life examples in our math curriculum.
Real Life	Responses indicated that participants felt social justice in the math classroom included connections to real-life situations or problems.	Based on my understanding of social justice, the math classroom can assist students in applying mathematic concepts to real-life situations to make a difference in the world.	The role of social justice in the math classroom is to allow students to see math in action and see how it is used in real-life. Students tackle problems they see and use math to evaluate,

			analyze, and progress through data to reach a common goal.
Cultural Integration	Responses indicated that participants felt social justice in the math classroom included integrating cultural and real world problems into the curriculum	While teaching math, teachers should include examples of students with different ethnic backgrounds and family make up and avoid generalizations.	To explore math and diversity and exploring math in a different way to connect to the diverse backgrounds of students.
Social Justice	Responses indicated an understanding of social justice or aspect of social justice in the math classroom		Mathematics can help us become aware and analyze the issues our society faces. We can examine so many social justice issues through a mathematical lens. We can measure, predict, collect data, organize data, and examine it, and use this info to discuss ways to improve society.

<i>Question 4: Is the integration of social justice into the mathematics curriculum a valuable component of the curriculum? Explain your viewpoint.</i>			
<b>Code</b>	<b>Operational Definition</b>	<b>Pre-Beliefs Example</b>	<b>Post-Beliefs Example</b>
Unsure	Responses indicated that the participant was unclear about the integration of social justice into the mathematics curriculum	I would say yes, but I need to know more about what social justice is about to explain why.	As much as I enjoyed learning about social justice, I'm still unsure about how to integrate it into the early childhood classroom.
No	Responses indicated that the participant did not believe the integration of social justice into the mathematics curriculum was important	I think social justice plays more of a role in other content areas and should not be a critical part of elementary math, but there should be some sort of diversity component.	
Yes- Wrong Definition	Responses indicated that the participant did believe the integration of social justice into the mathematics curriculum was important; however, participant did not have a clear understanding of social justice	Yes! I feel like everyone needs to be given an equal opportunity. I feel that math is an area that many have a difficult time succeeding in. We need to maximize the success for every student in math class.	Yes. Students tend to believe that everything needs to be fair for everyone.
Yes- Understanding	Responses indicated that the participant did believe the integration of social justice into the mathematics curriculum was important; participant had some understanding of social justice	Yes it is. It applies and gives purpose to mathematics. Too often, students fail to see how math connects to their lives and larger social issues. This connects math with issues that students feel passionate about.	Yes. I believe social justice is valuable because it is a real-life application that highlights inequalities of society. It really allows students to analyze critically what they learn and put it to use; it answers the question, "When will I ever use this again?"

<i>Question 5: Describe a mathematics activity or lesson you could implement into the elementary/middle mathematics classroom that addresses a social justice issue.</i>			
<b>Code</b>	<b>Operational Definition</b>	<b>Pre-Beliefs Example</b>	<b>Post-Beliefs Example</b>
Differentiated Instruction	Responses indicated a lesson that was differentiated to accommodate the needs of all students	Divide students into groups to work on measurement. Give lower students task of weighing, middle level students task of recording and adding measurements, and upper level students task of converting.	
Real World	Responses indicated a lesson that addressed a real-life situation	You could relate a lesson to school funding and student population. Determining how much money is invested for each student.	Analyze what students eat in terms of processed food and different nutritional levels—create graphs and statistical examples out of this.
Cultural Integration	Responses indicated a lesson that addressed the culture and identity of students or a cultural awareness	I believe having a lesson based on different forms of money, for example the U.S. dollar, peso, euro and bartering. Discuss the different forms of payment then have the children set up a market and use the forms of payment to buy “cookies, pencils, drawings” and other objects for sale.	A teacher could have students create their own survey questions and ask peers about their culture, family life, and favorite ethnic food. Data can be collected and a bar graph or pie chart can be created to show similarities and differences within their own classroom community.
Social Justice as Change Agency	Responses indicated a lesson that addressed a social inequality and/or a way to enact change	Students could find out how much it costs to purchase one net (malaria nets) for children in Africa. They could be given a budget and work out how many nets they could buy and how many children’s lives would be saved.	Students could compare wages of child labor to that of adult wages. Students can find the injustice in this and graph data on a bar graph. Students can then discuss plans on how to pass laws against child labor.

APPENDIX D  
FOCUS GROUP INTERVIEW QUESTIONS

Focus Group 1: December 6, 2010  
Focus Group 2: December 7, 2010  
Focus Group 3: December 7, 2010

Before the interview, inform participants that their answers will be voice-recorded and transcribed. However, the participants' identities will remain anonymous and will not be linked to any information or quotations used for research or publication. If at any time the participant wishes to discontinue with the interview, he or she may express that desire and/or leave the interview without penalty.

- 1) How would you define Social Justice? How would you extend your definition for the mathematics classroom?
- 2) Before taking Math Methods this semester, had you heard of or learned about social justice?
  - a. If so, what class, professor, or event did you learn about social justice?
  - b. If not, do you recall your initial thoughts about the term social justice?
- 3) What are your views on multiculturalism in the classroom? Can you describe the difference between multiculturalism and social justice?
- 4) Can you recall any specific examples from your Mathematics Methods course where you learned about SJ in the mathematics classroom?
  - a. If students recall, ask them to delve deeper into the examples that were most effective.
  - b. If students do not recall, prompt them with ideas such as the most recent article reflection from *Rethinking Mathematics*, the example of the Accessible Classroom, *Ka's Garden/Kab Lub Vaj* lesson plan, in class discussions, group production of the social justice definition.
- 5) In your future classroom, which can include your student teaching classroom, do you plan on integrating social justice into your lessons?
  - a. If so, are there any specific concepts or ideas that you hope to incorporate? Will social justice be incorporated into the mathematics classroom or other content areas as well? Please explain.
  - b. If not, please explain why you do not believe you will implement social justice. (This may answer question #6.)
- 6) What *barriers* or *challenges* do you see to implementing social justice into the classroom (mathematics or other content)?
- 7) What *benefits* do you see to implementing social justice into the classroom (mathematics or other content)?
- 8) Are there any final comments on social justice or social justice mathematics that you would like to share?
- 9) Thank you for your time and assistance.

APPENDIX E  
SOCIAL JUSTICE CONCEPT PLAN DESCRIPTORS

Social Justice Code: Real-World

Secondary Code	Theme Math Standard* (Grade Level)	Brief Description
<b>Connected</b>	Ronald McDonald House Numbers and Operations - Base Ten (Grade 1)	In this lesson, students will apply place value concepts. They will be introduced to the “pop tab” program that benefits the Ronald McDonald House and collect pop-tabs for two weeks. They will group pop-tabs in tens and ones. Students will write a letter to the Ronald McDonald House explaining how the students collected the pop tabs and create cards for students at the Ronald McDonald House.
	Housing Measurement and Data (Grade 2)	In this lesson, students will discuss and talk to families about what the perimeter of their house is. Each student will also fill out a chart that asks for the perimeter of their home, the perimeter of their room, how many rooms in their house, and how many people live in the house. Working in groups, students will discuss the data that they recorded in the chart. <i>This will help children understand that everyone’s homes are different and can be different sizes. However, what matters most is that a home is a home to anyone that lives in it. People live in different kinds of houses all over the world.</i>
	Money and Wages Measurement and Data Operations and Algebraic Thinking – Solve addition problems (Grade 2)	In this lesson, the teacher will set up the classroom like a mini-city including a bank, doctor’s/dentist’s office, grocery store, police station, auto mechanic, and post office. Students will play roles of the workers in the city and will receive a pay check every day. They will also have to be active citizens in the city and participate by grocery shopping, cashing their check, going for a check-up at the doctor, getting their car fixed, reading their mail and paying bills, and obeying laws and rules enforced by the police.
	Socioeconomic Operations and Algebraic Thinking - Solve problems with addition and subtraction (Grade 3)	In this lesson students will create a class list of items that they would buy if they were given \$300. As a class, create an equation of which item and how many of these items can I buy (use symbols if necessary). Students will then brainstorm and make a list about things that they would buy with the \$300. Using their list, have students write a paragraph about how to spend the \$300. Students are asked determine students how a person would spend \$300 in the poor countries and asked <i>“Would you make any changes in your writing now?”</i>

	Shopping Numbers and Operations (Grade 3)	In this lesson students will use estimation in order to check their work for accuracy and to plan budgets. Students will use estimation and use newspaper fliers to plan a shopping trip.
	Safe Zoo Measurement and Data (Grades 3-4)	Students will examine the importance animal rights in zoos. . They will brainstorm what they think makes a zoo safe, both for animals and humans visiting. Students will use knowledge and understanding of area and perimeter to create a 2-D model of a safe zoo.
	Wages Operations and Algebraic Thinking – Solve problems with multiplication (Grades 3-4)	Students will complete a Social Justice Worksheet in which students will be given the average daily income of individuals in four different regions (United States, Switzerland, Hong Kong, and Brazil and asked to find the individuals yearly salary using the lattice method of multiplication
	Cranes Operations and Algebraic Thinking – Solve problems with multiplication (Grade 4)	In language arts class, students will read the multicultural book, <i>Sadako and the Thousand Cranes</i> , a story of a Japanese girl in World War II. Students will use Base Ten Blocks to represent division problems with 1000. Students then discuss how it would be possible them to actually make 1000 cranes by posing the question: “ <i>What if WE wanted to make 1000, like Sadako?</i> ” Students create word problems associated with 25, 250, and 500 students.
	Nutrition The Number System - Factors and Multiples (Grade 6)	In this two-day lesson, students will identify healthy eating practices and use a decision-making model (food pyramid) to find a healthy recipe. Students will discuss the food pyramid including: <i>Why are some of the triangles in the food pyramid larger than others? Why do you think the food groups are shown in a pyramid? How many of you think you fill up your food pyramid each day? Do we have to fill up our pyramids every day? What lead nutrient does the Fruit group provide? Why do you need each nutrient? What would happen if you never had any servings of vegetables?</i> Students will complete a Healthy Eating with Least Common Multiples to add fractions by finding the common denominators.
	Habitat for Humanity Expressions and Equations Geometry	In this lesson students are asked to help build a house for Habitat for Humanity. Given a blueprint, students find the area of individual rooms in the house by multiplying fractions.

	(Grade 7)	
<b>Critical</b>	Deforestation Numbers and Operations - Multiplication (Grades 4-5)	Students will discuss deforestation and watch a YouTube clip ( <a href="http://www.youtube.com/watch?v=46A_wVivbX8">http://www.youtube.com/watch?v=46A_wVivbX8</a> ) relating to how many trees are harvested. Students will work on double digit multiplication word problems related to the deforestation video including: <i>If 10 million trees are cut down every day, how many trees are cut down each month? Year? 25 years?</i> Students discuss how they came to find their answers, why math was important in this context, and why it is important to know how many trees are being cut down? (Other questions include: <i>What would happen if we did not know? What if math did not exist and we had no way of knowing?</i> )
	Nutrition Numbers and Operations - Base Ten Multiplication (Grade 5)	Students will bring in a snack and use the nutritional facts to solve mathematical problems. Students will use the newspaper adds to figure out the price of their snack and amount they can eat each day. Students will investigate using the Food Pyramid on how many daily calories they can have in the division of where their snack is. Students will discuss whether or not they can have more of a healthy snack rather than an unhealthy snack. Students will write in their journal: <i>How does the price of a snack influence whether or not you buy it? Is this good or bad?</i>
	Cyber Bullying Functions - Linear equations (Grade 8)	In this lesson, students will discuss and define cyber bullying ( <i>such as what cyber bullying, different places that cyber bullying can occur, and r what percentage of teens are effected by cyber bullying</i> ). Students will use real data to create and interpret the equation of a line that models cyber bullying rates from 2004 to 2010. Students will use their equations to predict the percentage of teenagers impacted by cyber bullying in 2015.

Social Justice Code: Culture

<b>Secondary Code</b>	<b>Theme Math Standard* (Grade Level)</b>	<b>Brief Description</b>
	French Foods Number and Operations- Fractions - Adding Fractions	Even if students are not able to leave the country they can learn about other cultures by learning about and sampling their cuisine. The students will realize that foods from other countries are very similar to the foods they eat at home. The students will use the

<b>Connected</b>	(Grade 5)	cultural connection of French cuisine to further their learning of adding fractions. Working in groups, students are given one region of France to investigate. Each group will present their regional dish and type of cuisine to the class. Students will vote on the dish that they would enjoy eating the most by placing a tally mark next to their favorite dish. The students will figure out which fraction of students would prefer each dish and add fractions related to common regions.
	Community and Human Shapes Geometry – Shapes (Grade 1)	Students will identify different shapes and understand what the defining and non-defining characteristics of shapes are. This activity involves students relating shapes to their community and to themselves. Students discuss how people come in all shapes, sizes, and colors and how all people are the same but we have characteristics that define humans, and others that make us unique.
	Shapes in Different Languages Geometry – Shapes (Grade 2)	In this lesson students start to a draw geometric figure that they have been learning about. Other students try to guess what shape they are creating and discuss its characteristics as a class (how many sides, how many vertices, whether or not it is three dimensional, etc.). Students are given shape cards and must write the name of the shape on the back of the cards. Cultural Extension: <i>A way to diversify the lesson would be to put Spanish or Hmong names of a specific shape on cards and the kids will have to recognize the name and draw it and figure out the characteristics.</i>
	Hmong Counting Operations and Algebraic Thinking - Addition and Multiplication (Grade 2)	The lesson is launched by reading the book <i>Me Tubby</i> by T. Yang, a story about the Hmong people who live in the highland of Laos and spent the majority their days working on a farm to grow their food. This book also show students the lengthy travel Hmong people had to take in order to get to their farms. Students practice counting and writing numbers from 1-20 in Hmong. Students then create a Hmong paj ntaub using addition, subtraction, and multiplication facts with Hmong Numbers.
	Native American Triangles Geometry (Grade 6)	This concept plan involves students using their knowledge of the area of rectangles to formulate ideas about area of triangles. Students will learn about the importance of triangles in Native American culture including teepees, arrowheads, and quilts.
	Native America Tribes in	Students will use the coordinate plane to map locations of the Native American Tribes in the State

<b>Critical</b>	Wisconsin Geometry - Coordinate Plane (Grade 6)	of Wisconsin. The lesson is launched by having students list all the Tribes they know. Students are divided into 11 groups and assigned one Tribe to research and present to the class. Students place the location of the Tribe on the coordinate plane.
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Social Justice Code: Social Justice as Change Agency

<b>Secondary Code</b>	<b>Theme Math Standard* (Grade Level)</b>	<b>Brief Description</b>
Connected	Community Dinner Operations and Algebraic Thinking - Multiplication (Grade 3)	The lesson will begin by having the class read the book, <i>If the World was a Village</i> by David Smith. Students discuss the statistics in the book and what categories made them change how they viewed the world. Students will work in groups and use multiplication facts to determine the cost of a “Community Dinner” for the village of 100 given prices of various food items.
	Accessibility Operations and Algebraic Thinking - Multiplication (Grade 4)	In this activity, Students will practice their multiplication facts during a fun game of “Around the School Yard” using either a game board or interactively on a smart board. As a follow-up project on adaptive playgrounds, students could have an open discussion or research why each piece of equipment on this particular playground might not be accessible to all children.
	Food Drive Number and Operations - Base Ten - Division (Grade 5)	In this lesson students will relate long division to a real life context. Students will see the importance of sorting equally and how division can be used to solve everyday problems. They will work collaboratively with one another to determine how the food donations that they collected as part of a school project can be divided equally between less fortunate families within the area.
	Sexism in Occupation Number and Operations - Base Ten - Multiplication (Grade 3)	This lesson encourages students to explore the array model of multiplication. First students make arrays with counters, and then they create a second concrete example of the array model. Using toothpicks, construct a 4 x 3 array that represents the streets and avenues of a town. Students predict and calculate how many stoplights would be needed if one were placed at each intersection. Extension: After the students have completed the appropriate tasks to their ability, as a class discuss different occupations needed to maintain community roads. Have the

		students identify occupations that maintain the roads based on people they know in their communities. For example, police officers, street cleaners, snow removal, garbage removal, construction workers, cross walk attendants, architects that design the streets and intersections, major, and other city politicians, etc. Create a list of the children’s ideas about common stereotypes associated with the above listed occupations and discuss whether the statements are true and/or fair. Students and teachers write a set of statements reflecting their growing understanding of work and gender stereotypes.
Critical	Clean Water Operations and Algebraic Thinking - Addition (Grade 1)	This lesson will be launched by asking students, “ <i>If you are sitting at home and need a drink of water, where do you go to get some water?</i> ” Students will estimate and calculate how many steps they need to walk to get to their tap or refrigerator at home. The teacher will explain to students that clean drinking water is readily available to people in the U.S. – they could get water from the tap whenever they need it. Students will work in groups to solve the following problem using repeated addition and multiplication: <i>Bititi lives in Kenya, Africa. Every day she has to miss school so she can fetch some clean water from the well for her family. Bititi walks a total of 3 miles roundtrip each day. How many miles does she walk in one week? in four weeks?</i> Students will discuss how they feel if they had to miss school every day to walk 3 miles to get water as the children in Kenya.
	Waste Number and Algebraic Thinking - Addition (Grade 2)	This multi-week project will focus on human production of garbage and recycling. The project will be launched with the essential question: “ <i>I wonder how much garbage and recycling we produce in this classroom?</i> ” Over the next three weeks students will be measuring and creating word problems related to adding up the different quantities of waste products including the garbage, recycling, and total waste from their classroom. They will discuss ways to reduce that waste.
	Child Labor Number and Operations – Fractions (Grade 3)	In this activity, students will work in groups to research and answer questions regarding global child labor laws. Students will present their findings using fractions, decimals, and percents as well as visual representations through charts and graphs. Students are also asked to formulate a plan of action to eliminate child labor.

	Poverty Number and Operations - Base Ten – Addition (Grade 3)	In this activity students will be given statistics on poverty and discuss what poverty is and how it impacts students and families. Students work individually to solve multi-digit addition problems using poverty statistics regarding the number of students at or below the poverty line in particular schools. The lesson summarizes with students discussing that the number of families considered below the poverty line is increasing in the United States.
	Minimum Wage The Number System - Solve Real-World Problems (Grade 7)	In this lesson, students will work individually to investigate how much a person earns working at the minimum wage in the United States for various family situations. They will then discuss whether these families fall above or below the poverty line. Students will work in groups to determine a budget for a family consisting of one parent and two young children. Using newspaper advertisements, internet searches, and any other resources, they will decide how much the family needs to spend in order to meet their <i>basic needs</i> while living in their community.
	Poverty Expressions and Equations - Linear Equations (Grade 8)	In this lesson, students will be investigating the U.S. poverty levels in ten main cities. The lesson is launched by asking students the following questions: <i>Where does poverty exist.... Which countries?...Does the United States have poverty?...Do children live in poverty or just adults?</i> They will be given a data table and word problems and they will be asked to set up algebraic equations to solve the problems.

\*Standards were identified using the Wisconsin Common Core State Standards for Mathematics

APPENDIX F

*KA'S GARDEN/KAB LUB VAJ* LINGUISTIC DIVERSITY ACTIVITY SHEET

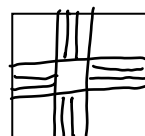
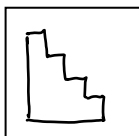
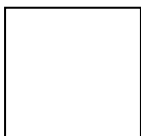
***Ka's Garden/Kab Lub Vaj Activity Sheet***  
***Creating a Mathematical Paj ntaub or "Flower Cloth"***


Solve the math problems listed below. Notice how these math problems include numbers written in English and Hmong as well as the numeral. Answer in written English, written Hmong, or numerals.

one ib	1	two ob	2	three peb	3	four plaub	4	five tsib	5
six rau	6	seven xya	7	eight yim	8	nine cuaj	9	ten kaum	10

six - tsib	4 divided by ob	ib plus one	kaum minus 9
eight ÷ 2	cuaj take away rau	one + ob + ib	xya - plaub
peb times one	2 multiplied by ob	10 - xya	yim divided by two
kaum ÷ 10	cuaj - xya	rau divided by 3	peb divided by peb

Use the table of answers as a KEY to make your own "story cloth." Fill in the grid below with the appropriate design.



one = 

Snail

ob =

Steps

3 =

Cucumber Seed

plaub =

Vegetable Blossom


Did you know? Paj ntaub is Hmong for "flower cloth", a form of artwork involving intricate needlework. The flower cloth uses several different design motifs such as those illustrated above. These designs may vary from clan to clan as clans originally were isolated in various mountain communities. Design motifs are used to help tell a story. Most designs reflect nature such as "elephant's foot" or "mountains."

The above is a plaub by plaub (4 × 4) inch square. With this information, find the following. Explain how you found your answers.

**Perimeter:**

**Area:**

APPENDIX G

*GRANDFATHER COUNTS* MIMICKED LESSON PLAN

**Book:** *Grandfather Counts*

**Author:** Andrea Cheng

**Date Published:** 2000

**Grade Level:** 2nd

**Common Core State Standards:** Grade 2 – Operations and Algebraic Thinking  
Add and subtract within 20.

2. Fluently add and subtract within 20 using mental strategies. By end of Grade 2, know from memory all sums of two one-digit numbers.

**Standard for Mathematical Practice:** Make sense of problems and persevere in solving them.

**Summary:** Helen, a Chinese Caucasian child, has to give up her room when Gong Gong, her grandfather, comes from China to live with her family in America. Gong Gong seems disappointed that his grandchildren don't speak Chinese. Gong Gong only speaks Chinese while his grandchildren (Helen, her brother and sister) only speak English. Gong Gong sits in his room all day reading the newspaper day after day until he decides to go out and sit with Helen and watch the trains pass by their house. He begins counting the train in Chinese. Before long, Helen and Gong Gong create a bond and begin teaching each other words in their fluent languages.

**Mathematical Connection:** 1. Have students complete the following worksheet which focuses on basic addition, subtraction, multiplication and division facts.

Answer the following addition, subtraction, multiplication and division facts in English and Chinese.

yi = 1 er = 2 san = 3 si = 4 wu = 5 liu = 6 qi = 7 ba = 8

one plus san	wu plus two	liu plus yi	er plus si
ba minus er	seven minus san	wu minus yi	liu minus si
one times san	si times one	er times san	Wu times yi
6 divided by er	qi divided by 1	si divided by yi	ba divided by er

2. Introduce students to inequalities (less than and greater than). Have students use < or > to solve the inequality.

Examples:

3 > 5  
7 < 1

4 < 2

6 < 8

Once the students feel comfortable completing inequalities using numbers in English, incorporate the Chinese numbers.

Examples:

san yi

wu liu

qi er

si ba

3. Ask students mathematical comprehension questions about Grandfather Counts.

Answers can be written in English.

Examples:

How many train cars were there in the first train that Gong Gong and Helen watched together?

How many cars were in the second train that they watched through Gong Gong's bedroom window?

What train had more cars?

How many train cars did they see altogether?

**Vocabulary Connection:** yi (one), er (two), san (three), si (four), wu (five), liu (six), qi (seven), ba (eight)

APPENDIX H  
ACCESSIBLE PLAYGROUND GUIDELINES

## Safe and Accessible Playground

Have you ever thought about how many children have access to safe playgrounds? Have you ever wondered if students with disabilities will have access to the school's playground equipment? To keep your students safe, the P.T.A. has decided to sponsor a "Safe and Accessible Playground Contest." To enter the contest, you must first research safe and accessible playground designs. Then, you must use your knowledge of geometry and measurement to create a 2D Blueprint or a 3D Model of an accessible playground.

First, you will form into groups of three to four. Each group member is responsible for researching two specific pieces of playground equipment such as swings, slides, seesaws, and climbing equipment. Each group member must turn in a Research Organizer. Be sure to research other areas of accessible playgrounds such as spacing of equipment, widths of pathways, and ramp slope for equipment, etc.

After you gather information about ways to make playgrounds safer and more accessible, you will share your information with your group. After you complete your research, your group will use your knowledge to create a sketch of your playground drawn to scale showing the placement of at least five pieces of playground equipment. Your group should follow accessibility guidelines for pathways and spacing needs. This sketch is due in class on Nov. 29, 30, or Dec. 1.

Finally your group must determine what your final product will be. You may choose a large 2D Blueprint Poster or a 3D Model. Materials for 3D models can be building blocks, cardboard, straws, marshmallows, or any other recycled materials. Examples of 3D models can be found on D2L. This final product must be to scale, use geometric shapes or solids, and will be presented to the class to select the winning proposal. Your final product should be accompanied with a write-up that includes the safety and accessible features of your equipment, pathways, and other surfaces. Be sure to include the maximum height and minimum area and perimeter for each piece of equipment. If applicable, include the ramp slope for your equipment. Also include an estimated cost for your playground. You will have time in class on Dec. 6, 7, or 8 to make your plans. Your group will present your models during the last class on Dec. 12, 13, or 14.

**Resources:** According to Article 30 of the United Nations Convention on the Rights of Children, "all children have a right to relax and play, and to join in a wide range of activities." There are many guidelines for creating safe and accessible playgrounds. Some links include:

<http://www.cpsc.gov/cpsc/pub/pubs/325.pdf>

<http://www.handicappedequipment.org/handicap-accessible-playground/>

<http://life.familyeducation.com/safety/toy-safety/36204.html>

<http://bostonteachnet.org/yee/button4.htm>

<http://www.playlsi.com/Explore-Products/Universally-Accessible-Playgrounds/Pages/Inclusive-Play.aspx?gclid=CJnJnqjphKUCFeTY5wodTG2KNQ>

Additionally, the “Shake N’ Shed” of Onalaska, WI, has built an accessible playground. It is not necessary for you to travel to that business to view the playground, but know that it is a resource in the Coulee Region. Check out the website for more information:  
<http://www.shakenshedfitness.com/html/boundless.html>

<b>Safe and Accessible Playground Rubric</b>				
	<b>Architect</b>	<b>Journeyman</b>	<b>Apprentice</b>	<b>Novice</b>
PLAYGROUND ORGANIZER AND 2D SKETCH Due Nov 29, 30, or Dec. 1	Each team member reports on the specifications for two pieces of equipment. The playground equipment is drawn to scale on graph paper. The spacing between equipment is also correctly scaled.	Each team member reports on the specifications for two pieces of equipment. All playground equipment is drawn to scale. Spacing a little off. Somewhat clear and easy to read.	Most of the team members report on the specifications for two pieces of equipment. One piece of equipment is not drawn to scale. Spacing off. Somewhat unclear and difficult to read.	Most of the team members report on the specifications for two pieces of equipment. Two or more pieces of equipment are not drawn to scale. Spacing non-existent. Unclear and difficult to read.
FINAL PRODUCT: 2D BLUEPRINT OR 3D MODEL Due Dec. 12, 13, 14	The 2D blueprint or 3D model is created to scale and clearly demonstrates knowledge of geometric concepts.	The 2D blueprint or 3D model is missing one of the main components or is not drawn to scale.	The 2D Blueprint or 3D model is missing several main components or is not drawn to scale.	The 2D Blueprint or 3D model is not to scale
SAFETY/ ACCESSIBILITY	The playground contains at least five features that make it safe and accessible.	The playground contains three or four features that make it safe and accessible.	The playground contains one or two features that make it safe and accessible.	The playground contains no features that makes it safe and accessible.
WRITE-UP Due Dec. 24	The write-up uses information gained from research on safe and accessible playgrounds. The write-up clearly indicates the actual perimeter and area of the playground including the width of the walkways and estimated cost. It includes a description of each piece of equipment (height, ramp slope, area, perimeter, etc.).	The write-up uses information gained from research on safe and accessible playgrounds. It includes several components of the playground design, but omits two specifications regarding the playground or the equipment.	The write-up uses limited information about safe and accessible playgrounds. It includes several components of the playground design, but omits three or four specifications regarding the playground or the equipment.	The write-up uses limited information about safe and accessible playgrounds. It includes several components of the playground design, but omits more than four specifications regarding the playground or the equipment.

PRESENTATION	All group members participated. The final product was well presented. Presentation was clear, composed and easy to understand.	All group members participated. The final product was presented. Presentation was easy to understand.	Most group members participated. One of the components was missing. Presentation was difficult to understand.	Few members participated. Two or more components were missing. Presentation was unclear and difficult to understand.
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