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# Critical Inquiry in Developmental Mathematics

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CRITICAL INQUIRY IN DEVELOPMENTAL MATHEMATICS

BY

ROXANNE TISCH

A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE

REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

IN

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UNIVERSITY OF RHODE ISLAND

AND

RHODE ISLAND COLLEGE

2014

DOCTOR OF PHILOSOPHY DISSERTATION

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RHODE ISLAND COLLEGE

2014

## **ABSTRACT**

Critical mathematics literacy is a necessary but often overlooked portion of developmental mathematics. This exploratory study focuses on the experiences of students in a developmental algebra course at a community college in New England. The theoretical framework combined critical pedagogy, teacher research, and critical discourse analysis resulting in a qualitative analysis. The analysis found that students who completed a social-justice oriented developmental algebra course increased their perception of their ability to understand math. The analysis also indicated that developing a sense of solidarity within the classroom was beneficial to students. Other issues for future study that surfaced during the analysis are the problems of deeply engrained learner dependence on the instructor and students' reliance on short term memorization rather than understanding.

## **ACKNOWLEDGEMENTS**

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## CHAPTER 1

### INTRODUCTION

#### **Critical Math Illiteracy: A National Problem**

In the past few years, I have noticed a disturbing trend even among my mathematically-skilled scientist and engineering friends. These people have a great deal of mathematical knowledge, yet they lack the ability to interpret and understand the world in which they live, even mathematically. One of the most important things that students should learn in math class is the mathematical process, similar to “matheracy” as described by D’Ambrosio (1999), which includes asking questions, identifying assumptions, gathering information, processing information, drawing conclusions, evaluating the feasibility of a solution, determining the generalizability of the solution or process, and/or asking further questions. Even for the mathematically literate, application of this process is generally absent in daily life. Here is an example. On Facebook, a friend posted a link to a graph (Figure 1) from the Washington Post (January 5, 2010). The graph showed that the number of jobs in our country was no longer increasing.

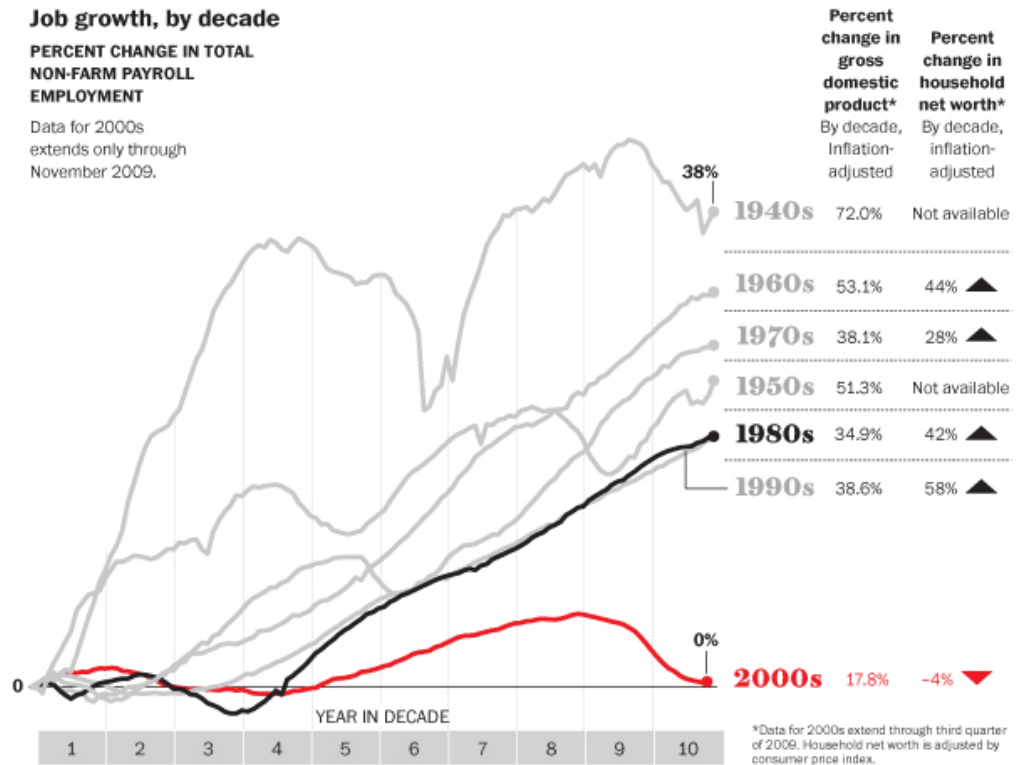


Figure 1. Graph from the Washington Post

Friends believed the media hype and proclaimed that this graph was a sign that the leaders in the country were not performing as they should. Not one person put the politics aside and thought about what it means if a quantity grows by 15% (a low estimate based on graph) per decade. This is an example of exponential growth and, in almost all situations, exponential growth is not sustainable. Does the graph show failing leadership or an inevitable outcome? I don't know. I do know that highly educated people with substantial math backgrounds bought into the media representation without asking more questions or demanding more information.

In today's data-driven society, are we preparing individuals to critically analyze numerical information? Or are we preparing individuals to blindly accept the numbers put before them? Unfortunately, I think we are preparing most people to blindly accept data presented by the media. This is mirrored in our educational

system, especially in developmental math classes in community colleges, where I have taught for the past several years. Students are the receivers of knowledge; teachers are the givers. Students answer questions; teachers ask questions. Skills are emphasized; applications are nearly non-existent. Placement tests are made up of skills-based, multiple-choice questions. In my own Connecticut community college math course I often hear in class, “Don’t ask why, just do what she says!”

### **Community College Students: A Vulnerable Population**

For many students, community college is a necessity, not a choice. Based on economic situations, academic preparation, and outside commitments, students may not have the luxury of choosing to attend a four-year college (Rendon & Garza, 1996). In 2012, 46% of Hispanic students and 43% of black students enrolled in higher education were at two-year institutions. In comparison, 35% of white students and 32% of Asian students enrolled in higher education were at two-year institutions (U. S. Census Bureau, 2012).

**Enrollment Growth.** According to the report *Community Colleges: Special Supplement to the Condition of Education* (Provasnik & Planty, 2008), the number of public community colleges increased 15% between 1976-77 and 2006-07, while the enrollment grew about 66% in that same time period to 6,225,120 students. In that same time frame, the number of private, not-for-profit two-year colleges decreased 43%, while the number of private, for-profit two-year colleges increased by 1,233%. Interestingly, the figures for change in the number of private two-year colleges did not appear in the written report. The numbers only appeared in the tables of the report. The enrollment for private, two-year colleges increased by 123% to 293,420 students

in 2006-07. In 2006, there were 6,518,540 students enrolled in 1685 two-year colleges: 1045 public; 107 private, not-for-profit; and 533 private, for-profit. In 2006-07, the average tuition at a public two-year college was \$2,017 while the average tuition at a private two-year college was \$12,620 (Provasnik & Planty, 2008). Despite higher tuition at for-profit institutions, academic attainment and future earnings are both lower for students at for-profit institutions than at public colleges or non-profit colleges (Liu & Belfield, 2014).

**Completion Rates.** As previously stated, enrollment in public two-year institutions has grown from approximately 2.2 million students in 1970 to 6.6 million students in 2008. Enrollment is projected to reach almost 8 million students by 2019 (HEGIS, 2010). According to the Complete College America report (Bosworth, 2010), 61% of students entering a two-year public college in Connecticut need to take at least one remedial course (Figure 2a). Of the 61% of students taking remedial courses, only 48% complete them (Figure 2b) and only 7.8% graduate within 3 years

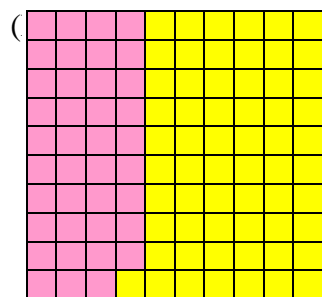


Figure 2a. Students taking developmental courses. Yellow represents 61 students who must take at least 1 developmental course.

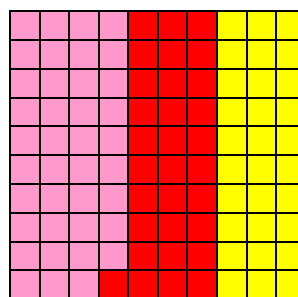


Figure 2b. Students completing developmental courses. Red represents students who do not complete courses. Yellow represents 47% completing courses.

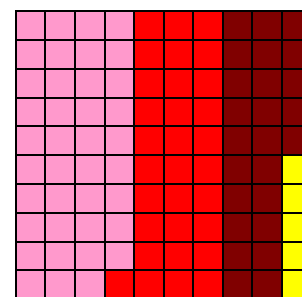


Figure 2c. Students graduating. Maroon represents students completing developmental courses but not graduating. Yellow represents 7.8% who graduate.

**Figure 2. Developmental Completion**



More disconcerting is that only 30% of students enrolled in developmental math successfully complete the course, and often students must take more than one developmental math course (Bailey, 2009; Attewell, Lavin, Domina, Levey, 2006). Less than 40% of students who enrolled in a public two-year institution in 1995 completed a degree within 8 years. The completion rate is drastically lower for students of color. Only 28.4% of black students and 34.3% of Hispanic students who enrolled in a public two-year institution in 1995 completed a degree within 8 years (NCES).

In 2000, the national three-year completion rate for an Associate's degree was 30%, while the rate in Connecticut was 23.7%. The former rate has remained relatively steady for the country. In 2009, the national three-year completion rate for an Associate's degree was 29.2%. The rate for Connecticut dropped significantly; in 2009, the completion rate was 11.7% (National Center for Higher Education Management Systems, 2012).

**Consequences.** Community colleges and developmental education courses affect a large portion of the population but, until recently, did not command widespread attention. Why not? One likely answer is that community colleges do not appeal to or directly concern the middle or capitalist classes. The middle class is interested in four-year colleges or universities, while the capitalist class focuses on either university or elite, ivy-league education. Historically, community colleges have not appealed to the capitalist class that controls the national and global finances and the media.

What happened to suddenly create interest in developmental education?

Hunter Boylan, a leader in the field of developmental education, spoke on this topic at the Iowa Developmental Education Association conference in fall 2011. His stance is that the sudden interest is motivated by fiscal reasons and the desire to maintain global competitiveness. The retirement of the aging baby boomer generation, the infeasibility of the Social Security system, and the upcoming shortage of college graduates all work together to undermine the economic well-being of the United States. According to Boylan, a child born into the lowest 20<sup>th</sup> percentile of income will have a 64% chance of graduating from high school, a 7% chance of obtaining a B.A. by the age of 26, and an average net worth of - \$1,000. Boylan argues that the best chance of securing the economic well-being of the United States is to graduate “more of our poorest and most disenfranchised citizens” (Boylan, 2011).

Developmental level courses at community colleges are the focus of controversies, professional meetings, and government legislation (State of Connecticut, 2012; State of Florida, 2013). Innovative curriculum and teaching at the community college level are not priorities. Too often, especially at the developmental level, faculty fall back on out-dated methods of instruction, such as lecture, to present basic skills and encourage rote learning and memorization. Not surprisingly, as already mentioned, completion rates for developmental courses are very low. Due to poor success rates, the transformation of developmental courses is being thrust onto more faculty (State of CT, 2012; NCAT, n.d.). In Connecticut, the current transformation, based on PA12-40 (State of CT, 2012), is problematic because it further reinforces the notion that basic skills are the most important while ignoring the

importance of the mathematical process. In other words, the new curriculum continues to focus on low-level quantitative literacy (NCES, 1993, 2005) or functional mathematical literacy (Gutstein, 2006) while neglecting critical mathematical literacy. Critical mathematical literacy (Gutstein, 2006) is similar to the mathematical process described at the beginning of this chapter, built on the idea that people need to question and understand the assumptions and processes that produce data, formulate a situation mathematically, perform mathematical operations correctly, and then evaluate not only the correctness of the answer but also the implications.

### **The Need for Critical Literacy in Developmental Mathematics: My Experience**

**Observations.** For five years I have worked with community college students. Each semester, my time has been split between working with students in developmental courses and students in college credit-bearing courses. I was an adjunct my first semester and did not have any experience working with students at a community college. Before I began teaching I was given the book, a list of chapters to cover, and a couple of email addresses just in case I had any questions. The problem was that I did not know what questions to ask. I had prior teaching experience at a high school, so I did have an understanding of the learning process but I did not have any understanding of the culture at the community college. Not until the end of the semester did I find out that I had a school email address. I was also told by the students at the end of the semester that I was supposed to give a departmental final common across all sections of the courses. By the end of the semester, I had gained a better understanding of the school culture, but I still needed a better understanding of the students.

After that first semester, I became a full-time lecturer and decided that in order to get to know the students better I would have them submit a written math autobiography at the beginning of the semester. I asked students about their past experiences with math and their expectations of themselves and me for that semester. I was amazed at the level of detail and the honesty expressed in their writing. Two common themes were the number of times that students repeated the course and a desire to take as little math as possible in their college journey. I figured that the students did not have adequate preparation in math before coming to the college, but I was curious as to why so many students were still not experiencing success. My interactions with students led me to some conclusions about the low success rates. Through conversations with students, I found that some instructors would give test reviews that were exact replicas of the test but with different numbers; they would give homework exercises that exactly mimicked the examples from class; they would discourage students from asking questions in ways that the students said made them feel inferior; and they would provide step-by-step processes for students to follow instead of helping to develop problem solving strategies. It appeared as though these instructors viewed the students as empty vessels that require filling. The students' prior knowledge and intelligence were disregarded. Students who were able to keep track of the rules and how to apply them were "successful" in passing the course. Students who were not able to keep track of seemingly random rules were not able to move on.

Students in both categories were done a disservice. Not passing the developmental course confirmed their beliefs that they were not good at math and that

math is some sort of mysterious system that can only be understood by a few. The need to repeat courses requires money and time, two resources that are very scarce for many community college students. When students did pass one of the developmental courses described above, they brought this functional, mechanical view of mathematics with them to future courses. I observed this on many occasions in developmental courses, when students would complain that I did not give steps for every type of word problem, and they resisted homework problems that were different from classroom examples. Even more problematic, I observed issues in higher level courses. These students can be classified into two groups: those who started at the college in developmental courses and those who started at the college in credit-bearing courses. In my experience teaching higher level courses, the number of students who started at developmental level was much lower than that of those who started in credit-bearing courses. When I taught higher level courses, I observed that the gap between the critical thinking ability of students in these two groups was expansive. Students who started in developmental courses had more difficulty generalizing principles, thinking abstractly, learning independently, and demonstrating persistence in problem solving.

**Developmental Algebra: The Need.** Students enrolled in developmental math do not fit a mold regarding past experiences, current situation, or future plans. Some students are seeking a certificate or a two year degree to secure a better job, some students want to transfer to a social science program with minimal math requirements, and some students plan to enter engineering or technology programs requiring a significant level of math. What these students have in common are their need to think

more critically about the numerical information encountered within their lives. The specific situations will vary but they will all need to have the confidence and knowledge to ask questions, identify assumptions, determine if additional information is necessary, gather more data, process the information (including determining if the mathematical results are correct), draw a conclusion, and evaluate the feasibility and consequences of the solution. Part of this process involves the need for a strong mathematical foundation based in conceptual understanding.

**Developmental Algebra: The Evolution of a Plan.** I began to develop a plan based on two developmental math concepts that students often struggle with: percents and linear functions. I designed projects to be used within the existing courses that would make these topics more relevant and comprehensible. I chose topics based on NPR stories that I would hear on my drive to school. For example, one semester we studied unemployment rates broken down by gender and race, one semester we studied educational attainment broken down by gender and race, one semester we studied the electoral college. Whatever the theme, it carried through the semester. Early on, I would provide a small data table, for example unemployment rate based on gender, and we would work towards developing an understanding of percents and graphs. Then I would provide a larger data table, for example unemployment rate based on gender and race. Students were asked to come up with a theme or categories that they wished to compare and to present their results both numerically and graphically. Interestingly, students were drawn to using circle graphs because of the percents, but very few executed the graph correctly, indicating there was a disconnect between the concept of a percent and the circle graph representing the total 100%. In

the traditional curriculum, a teacher might not realize the students' misconception because circle graphs are always provided and students just answer questions based on the given numbers. Later in the semester, I would bring in another table with the same information from a different year. We would use this to introduce the idea of ordered pairs and functions. We started with assuming the function would be linear and making predictions about unemployment rates in other years. This type of problem not only required higher levels of thinking from the students but also provided me with a better sense of their understanding of the material.

Students had mixed reactions. Some students appreciated the chance to take math outside of the classroom and to understand real data to which they could relate. Some students did not feel that math class was the place to consider issues other than numerical data. For example, students were asked to provide reasons why the unemployment rate between groups was so disparate. While most students' answers ranged from regional clusters of groups and different unemployment rates between regions, to racism, to laziness, some students refused to answer, saying that they were in a math class not a sociology class. Other students did not like this style of problem because of the level of thinking and the work required outside of class. These students had been socialized to believe that math class involved listening to the teacher, possibly doing some similar problems for homework, doing a test review, and regurgitating answers to similar questions on a test. From my earlier experience and observations, I became determined not only to offer a course that was more critically-oriented but to study what happens when doing so.

## **Initial Research Problem and Questions**

When I first conceived this project, I was interested in better understanding how students in a developmental mathematics course begin to identify and question assumptions in a course oriented toward critical thinking and problem solving within an institution that appears to value only functional mathematical literacy. In particular, I was interested in how the combination of critical pedagogy with functional and critical mathematical literacy affects students'

- ◆ beliefs about mathematics,
- ◆ attitude towards mathematics,
- ◆ perception of their ability to do mathematics, and
- ◆ perception of their ability to use mathematics to bring about change in their lives or the world.

Stated in question format, the initial research problem would look like this:

1. How does the combination of critical pedagogy with functional and critical mathematical literacy affect students' beliefs about mathematics?
2. How does the combination of critical pedagogy with functional and critical mathematical literacy affect students' attitudes towards mathematics?
3. How does the combination of critical pedagogy with functional and critical mathematical literacy affect students' perceptions of their ability to do mathematics?
4. How does the combination of critical pedagogy with functional and critical mathematical literacy affect students' perception of their ability to use mathematics to bring about change in their lives or the world?



In Chapter Three I will discuss both the course itself and its rationale in more detail. For reasons that I will discuss in subsequent chapters, the scope and goals of this study evolved as I began to see the import of social class on students' background, self-concept, and feelings of self-efficacy.

### **Data Collection: Emergent Issues**

Once I secured IRB approval, I began collecting formal data: written reflective pieces by the students, videotapes of class meetings and field notes, and mathematical work, all of which I discuss in Chapter Three. As the semester progressed, I began to see changes in my students' perceptions of their ability to do mathematics. More importantly, as mentioned above, with the help of my dissertation committee, I also saw something I had not fully anticipated: issues directly related to social class and power dynamics, to be discussed chiefly in Chapter Six, which deals with findings that exceeded the scope of my original four research questions.

### **Limitations**

As a teacher-researcher, I had two sets of obligations to my students. My first and foremost responsibility was to be their teacher and ensure that I designed and delivered learning experiences that would best prepare them for college-level work. My secondary responsibility was that of a researcher. I say secondary because, as the semester progressed, I saw that I needed to modify my original design to better fit the needs of the students enrolled that semester. In other words, I could not compromise my role as teacher to satisfy my role as researcher.

Nonetheless, I also could not compromise my role as researcher. I saw it as my duty to accurately represent the people involved and the events that transpired during

the semester. I needed to observe and try to understand the students, and myself, with as much objectivity as possible. Though my interpretation is informed by my background and my culture, I was careful to use multiple data sources to verify my analysis.

I make no claims about the generalizability of this research. I believe that classroom learning is a cultural experience and is dependent on the people involved. With a different teacher or a different mix of students or a different institution, the results of this research might be different. So what can be taken from this research? I believe that knowing the participants and studying the discourse within a developmental mathematics classroom can help uncover hidden issues related to both mathematical misconceptions and student empowerment. In the following chapters, I attempt to show the successes and limitations of this approach.

### **Overview of Subsequent Chapters**

In Chapter Two, I begin by describing different visions of quantitative or mathematical literacy with an emphasis on critical mathematics literacy and social justice. Next, I focus on developmental mathematics at the community college. Then I link critical mathematics literacy and the community college using working class studies. In Chapter Three, I provide a description of and justification for the qualitative methods employed in this research. In Chapter Four, I detail the research setting, the participants, and the classroom setting. In Chapter Five, I offer an analysis related to my initial research questions and a description of the evolution of the course, data collection, and data analysis. In Chapter Six, I provide an extended analysis of issues related to social class and power that surfaced during the semester but were not related

to the original research questions. In Chapter Seven, I suggest implications for practice at the classroom and institutional level as well as for policy makers involved in the research process.

## CHAPTER 2

### LITERATURE REVIEW

#### **Mathematical Literacy**

Innumeracy is a persistent problem in the United States. This problem affects people of every race and social class. Lack of mathematical understanding can influence a person's choice of career, financial well-being, and daily life decisions (Paulos, 1988). Parents and communities perpetuate innumeracy by telling children that it is acceptable not to be good at math. Even Jerome Bruner (1996) states that "not everybody is supposed to be numerate" (p. 26).

Mathematical literacy has two branches, functional and critical. *Functional mathematical literacy* is using mathematics in order to understand basic functions of everyday life (Gutstein, 2006). Paulos (1988), Gal (1997), Steen (2001), and the National Center for Education Statistics (1993, 2005) have functional definitions of mathematical literacy. Paulos (1988) defines *numeracy* as the ability "to deal comfortably with the fundamental notions of number and chance" (p. 3). The National Center for Education Statistics (NCES) (1993, 2005) defines *quantitative literacy* as "the knowledge and skills required to apply arithmetic operations, either alone or sequentially, using numbers embedded in printed material (e.g., balancing a checkbook, completing an order form)" (p. 293). Gal (1997) describes *numeracy* as the "aggregation of skills, knowledge, beliefs, dispositions, habits of mind, communication capabilities, and problem-solving skills that people need to autonomously engage in and effectively manage situations in life and at work that involve numbers, quantitative or quantifiable information, or textual information that

is based on or has embedded in it some mathematical elements” (p. 37) but clearly indicates that numeracy and mathematics are not the same. Steen (2001) also differentiates between mathematics and numeracy. According to Steen, being *mathematically literate* implies having the skill to perform computations, while *numeracy* refers to the ability to understand data.

By contrast, *critical mathematical literacy* requires people to “approach knowledge critically and skeptically, seeing relationships between ideas, looking for underlying explanations for phenomena, and questioning whose interests are served and who benefits” (Gutstein, 2006, p.5). D’Ambrosio (1999) and Best (2008) focus more on critical mathematical literacy. D’Ambrosio (1999) proposes that schools leave the antiquated idea of teaching reading, writing, and arithmetic and embrace what he calls a new trivium – literacy, matheracy, and technocracy. His concept of literacy includes functional mathematical literacy – the ability to understand tables and graphs as well as manipulating numbers and performing operations. D’Ambrosio’s concept of matheracy involves making inferences, proposing hypotheses, and drawing conclusions from data.

Best (2008) contends that *quantitative literacy* goes beyond understanding and applying mathematical processes to also questioning and understanding the social and political processes that produce data. Best describes three levels of quantitative literacy when interpreting data: calculations, assumptions, and questioning assumptions. The first level, based strongly in traditional mathematics, focuses on computation and calculation techniques. The second level, assumptions, begins to combine mathematics with critical thinking skills. In order to understand a situation,

one must understand the assumptions behind the data. The third level of quantitative literacy falls outside the traditional realm of school mathematics. In order to fully understand a situation, one must question who defined the assumptions and why. For example, when investigating the unemployment rate in the United States, one must understand more than just the mathematical concept of ratio or “part over whole.”

<p><b>Level 1</b></p>	<p>Understand the mathematical operations involved</p> $\text{Unemployment Rate} = \frac{\text{part}}{\text{whole}} \cdot 100\%$ $\text{Unemployment Rate} = \frac{\text{number of unemployed people}}{\text{total number of people}} \cdot 100\%$
<p><b>Level 2</b></p>	<p>The number of unemployed people only refers to people who do not have a job but are actively seeking employment. The total number of people includes the number of people who are classified as unemployed and the number of people who are employed either full or part time in civilian positions.</p>
<p><b>Level 3</b></p>	<p>Some questions that could be asked about the assumptions:</p> <p>Who decided that people serving active duty in the military should not be included in the total number of people?</p> <p>Why are “discouraged workers” (people with no job who have given up looking) not included as unemployed?</p>

Table 1. Best's (2008) Levels of Quantitative Literacy

The combination of functional and critical math literacy begins to characterize mathematics for social justice.

### **Education for Democracy and Social Justice**

Education is an agent of socialization. People learn how to interpret and negotiate society through both stated and unstated values in school. Part of the problem is what Barth (2002) calls the “nondiscussables,” topics that are important and should be discussed frequently but that are also associated with fear and anxiety. Before her change of heart regarding the present federal and corporate intrusion into public education, Ravitch (2005) wrote that bringing the “nondiscussables” such as race, gender, and class, into classroom discussion is inappropriate because politics should not be brought into the classroom. (While she has arguably become the most outspoken critic of the push towards privatization in public education, in her most recent books (2011, 2013) Ravitch has not taken a clear stance on the practice of bringing politics into the classroom.) But according to Shor (1992) and those with a more critical perspective, expelling politics from the classroom is neither logical nor possible because education cannot be divorced from society, which is highly political (Dewey, 1916/1944; Counts, 1932). By attempting to neutralize the classroom, teachers are actually transmitting values without identifying the existence of those values, which means there will be no discussion or debate relating to the dominant value system (Profreidt, 1980). Discussion of the “nondiscussables” needs to be present in the classroom. Dewey (1916/1944) believes that we need to “extract the desirable traits of forms of community life which actually exist, and employ them to

criticize undesirable features and suggest improvement” (p. 83), which is in line with Gutstein’s view of critical literacy.

Freire (1970) states that knowledge is neither static nor neutral. The act of knowing requires a subject and also an object; the subject is the person and the knowledge of the object is based on the subject interpreting the object. Knowledge is produced by people trying to make sense of the world. For Freire the purpose of knowledge is to become liberated from domination by people humanizing themselves. People must overcome participation in their own domination by developing critical consciousness rather than massified consciousness. Broadly speaking, developing such consciousness is best accomplished by changing the educational system from a “banking” system, where the teacher is the expert filling empty vessels (students) with knowledge, to a dialogical system, where students and teachers work together to co-create knowledge.

“Social justice” is an educational buzzword in today’s society. The term was first used in 1840 by Luigi Taparelli, a Jesuit priest. Taparelli believed that Descartes’s philosophy of radical doubt – the refusal of an individual to accept anything as true unless it strikes the individual as clearly and distinctly true – would promote a dangerous elevation of self-interest over the common interest. Taparelli believed that society is made up of smaller societies. The smaller societies should work for the common good of the larger society. In this philosophy, change and power are developed from the bottom up (Boyles, Carusi, & Attick, 2008).

Distributive justice is a concept that can be traced back as far as ancient Greece. In Aristotelian philosophy, distributive justice basically means that each



person receives their fair share. Injustice occurs when one person receives more or less than his or her fair share (Boyles, Carusi, & Attick, 2008). (The whole idea of fair share is not as simple as it sounds. Ask thousands of Math for Liberal Arts students across the country about all the different algorithms for fairly distributing discrete or continuous objects.)

In education, the concept of social justice has often been confused with distributive justice. This confusion is evident as early as the 19<sup>th</sup> century in Horace Mann's rationale for common schools. Mann hoped to alleviate class tension by providing all students with the same education. *Brown vs. Board of Education* is one of the most well-known cases of distributive justice being mistaken for social justice. Theoretically, *Brown* ended legally sanctioned segregation in public schools. This is considered distributive justice because the power from above decreed that everyone should have "equal" access to education. However, *Brown* is not a true example of social justice, because nothing was done to change the power structures that created and supported segregation in the first place.

Dewey (1916/1944) had a different view of social justice in education. His beliefs reflect Taparelli's philosophy. The school is a small community within the larger society. Members of the school community should investigate and deliberate over issues within the larger society. Schools should not be thought of as a holding place for children but as a place where democratic activity could influence social practice in the larger community.

W.E.B. Du Bois (1903/1990) was also a proponent of social justice in education. Unlike Booker T. Washington, he did not believe that the purpose of

education was to provide skills to enter the workforce at a higher level. He did not believe that equality and justice would simply come through participation in the workforce. Du Bois believed that schools also needed to teach children the skills to acquire social and political power.

Counts (1932) and Rugg (1928), through very different approaches, both believed that students need to study and critique social practices in order to develop a more equitable and just society. Rugg believed that the way to improve social justice was through the social studies curriculum. Rather than learning “facts” in school, students should be actively involved in critically examining social issues. Counts believed in a more radical approach that went beyond the curriculum. He believed that teachers should become the leaders that help shape society rather than being followers. He encouraged schools to join with other social groups to bring about social improvements.

### **Math Education for Democracy and Social Justice**

So how does math education tie in to education for democracy and social justice? Three key ideas related to math education come to mind: mathematics as a barrier to individual success, the view of mathematics as exact and devoid of human bias, and the pedagogy and content of math classes.

For many people, math is a “gatekeeper” holding them back from pursuing further education and limiting their career potential. Freire (1997) suggests that math is viewed by many as a content area for gods and geniuses. He believes that we need students to see that math is part of our natural world. Thinking of math as a part of our everyday world helps to work “against a certain elitism that the studies of

mathematics have” (Freire 1997, p. 8). Many people falsely view mathematics as a pure subject that supersedes human condition and culture. However, social constructivists would argue that mathematics is a social construct. The mathematics that has been discovered and invented was driven by the needs or wants of a particular society. Culture and mathematics are closely linked. Mathematics for many people is defined by an ideology of certainty as described by Borba and Skovsmose (1997). Math is viewed as a purely logical system untainted by human foibles and therefore infallible. This view gives unquestionable power to those who use graphs, data, and numbers to represent their point of view. The ideology of certainty that surrounds math is reinforced by the content of school mathematics. Quite often, math exercises in school settings lead to a single correct answer which gives the illusion that math is free from human influence.

In order to change the ideology of certainty, the structure of the curriculum needs to change. In order to show that human judgment is essential in the math classroom, some possible changes to the curriculum would include using open-ended questions, having students choose problems to investigate, and assigning projects. Skovsmose (2000) believes that intimidation is a factor in seeing math as a barrier. Students are discouraged from taking mathematics because they are intimidated by the formal, dehumanized rules and procedures that they associate with math class. Having discussions and viewing other students’ work helps students develop not only a better understanding of math, but also a better understanding of humans (Stocker & Wagner, 2007). Skovsmose agrees that one of the major objectives of math education is to prepare students for better employment, but he questions how that can be done without

changing curriculum and pedagogy. As Borba and Skovsmose (1997) warn, “gaining access to mathematics education without being critical of the ideology ... may reinforce the status quo” (p. 17).

If one believes that “education is concerned with each individual reaching his or her maximum capabilities and, at the same time, learning about their assimilation into societal life” (D’Ambrosio, 1999, p. 135), then the suggestions listed by Borba and Skovsmose for changing the structure of the mathematics curriculum are necessary and closely related to the concept of social justice education and educating for democracy. As Pollak (1997) states, “success in mathematics cannot be measured through assessment in mathematics courses alone, or in terms of preparation for the next level of course. We must also consider the ability to examine in a mathematical way situations in everyday life, on the job, and as citizens” (p. 105). Having students ask questions and then collect and analyze data to draw a conclusion prepares them for an involved life, also called a democratic life (Olbrys, 2005), rather than an apathetic life. An apathetic life is supported by the ideology of certainty; it is an easy life for people who are “socialized to embrace a consumerism predicated on buying easy solutions” (Olbrys, 2005, 1). Students are told what to do and complete routine tasks. As Stocker and Wagner (2007, p. 18) state, “we train students to do what they are told and not ask questions.” The democratic life requires “time, involvement, and a willingness to participate in something larger than oneself” (Olbrys, 2005, 1). Preparing students for a democratic life requires students to ask questions, look for challenges, and persevere to meet those challenges.

Frankenstein (1983) points out that presenting emancipatory content in a non-liberatory way will not help students change their perspective and that using liberatory methods without critical content will make students feel good but not become empowered. Critical pedagogy must be reflected in both content and method. As part of the pedagogy, students should be asked to evaluate their understanding of mathematics and analyze those topics with which they are having difficulty. Frankenstein also recommends the use of a journal for students to reflect about the learning process and to provide another method of receiving feedback from the teacher or other students.

**National Calls for Mathematics Education Reform.** Throughout the past three decades, there have been calls to reform mathematics education because government leaders saw innumeracy as a roadblock to maintaining United States economic and technological supremacy (*An Agenda for Action*, 1980; *A Nation at Risk*, 1983; *Everybody Counts*, 1989; *Curriculum and Evaluation Standards for School Mathematics*, 1989; *Moving Beyond Myths: Revitalizing Undergraduate Mathematics*, 1991; *Answering the Challenge*, 2006; *A Test of Leadership*, 2006; *National Mathematics Panel Advisory Report*, 2008; *The Common Core State Standards Initiative*, 2010). The majority of the reform efforts target primary and secondary levels. Starting in 1980 with *An Agenda for Action*, the National Council of Teachers of Mathematics (NCTM) began to call for a set of standards for both the content and pedagogy for teaching mathematics. The call for reform became more of a national priority with the release of *A Nation at Risk* (1983), which questioned the future well-being of the United States due to the allegedly poor quality of teaching and

learning in the United States from primary to post-secondary levels. The authors of this report called for rigorous and measurable standards for learning. In *Everybody Counts* published in 1989, the Mathematical Sciences Board provided transitional steps that they claimed should occur over the next decade to ensure that mathematics education continue to meet the needs of students and the country. The Board recommended a set of national standards so that all students would receive a common core of mathematics based on their level of schooling. The Board also pointed out that it is naïve to believe that states and districts have control over their own curriculum. Too often, curriculum is dominated by textbook publishers and makers of standardized tests rather than developed by educators. In 1989, the NCTM also released *Curriculum and Evaluation Standards for School Mathematics*. The NCTM used the Standards to specify content and to guide pedagogy for primary and secondary levels. The authors emphasized problem-solving and conceptual understanding and de-emphasized direct instruction of facts and algorithms. Implementation of the NCTM Standards, however, was hindered because of differing interpretations. Some people construed the Standards to mean that basic skills and precise answers would no longer be required and made a push to maintain a traditional model of mathematics education. The NCTM continued the Standards movements by publishing *Professional Standards for Teaching Mathematics* (1991) and an updated version of *Standards for School Mathematics* in 2000. In 2001, the No Child Left Behind (NCLB) Act was passed. This was another push towards standards-based reform in which measureable goals would be established and monitored. Schools that fail to make adequate yearly progress towards the goals would be punished. With the intense focus on measurable

goals and outcomes, NCLB began the testing craze and also redefined the acceptable type of educational research. “Data-driven” decisions using “scientifically-based,” measurable outcomes would become the norm. In other words, quantitative research would dominate and qualitative research would no longer be valued as part of the decision making process.

In 2006, the trend towards standardization and accountability continued with the publication of *Answering the Challenge of a Changing World* (U.S. Department of Education), which outlined three initiatives: the American Competitiveness Initiative, the High School Reform Initiative, and the National Security Language Initiative. The American Competitiveness Initiative committed more than \$136 billion dollars over a ten year period to “bring together leaders from the public sector, private sector, and education community to better prepare our students for the 21st century” (US Department of Education, 2006a, p. 5). This initiative also created the National Mathematics Panel, which released its final advisory report in 2008. The report was not a policy but rather recommendations based on views from a few select “experts.” The report did not have any startling new conclusions but rather re-emphasized the needs for testing, standards, and standardization. According to Spillane (2008, p. 641), some of the key recommendations regarding instruction were

- a "streamlined" mathematics curriculum focused on "a well-defined set of the most critical topics" (p. 11);
- improved and better-aligned student assessment instruments (pp. 21, 60);

- improved teacher quality through preparation, recruitment, and retention (p. 41);
- and more valid and reliable research findings and test data to inform educational decision making (pp. 60-65).

The composition of the panel was controversial because it was made up of educational and political conservatives rather than mathematics education researchers (Boaler, 2008). Missing from this report were issues relating to equity and access. In 2010, the National Governor's Association released the Common Core State Standards Initiative, which directly addressed the first topic described by Spillane (2008), a well-defined set of topics to be part of a national curriculum. The Obama Administration's Race to the Top program (2009) provided funding for states willing to tie the Common Core State Standards together with the other three highlighted recommendations from the National Mathematics Panel Report: aligned student assessment instruments, improved teacher quality, and valid and reliable research data.

Some calls for reform did directly target higher education. *Everybody Counts* (1989) is one of the few reports addressing primary through graduate levels of mathematics education. The authors of this document, the Mathematical Sciences Education Board, called for a revitalization in mathematics education so that students would become well-informed citizens and have better career opportunities. Though undergraduate mathematics was seen as key to the revitalization, the authors believed that college math courses should begin with Calculus and that anything lower should be left to the high school. The need for developmental courses for traditional or non-traditional students was not addressed. Designating Calculus as the gateway course to



college gives reason to question the mission of the need for reform. Is Calculus truly necessary for a citizen to make informed decisions or is revitalizing math education more about expanding career opportunities? In 1991, the National Research Council released *Moving Beyond Myths: Revitalizing Undergraduate Mathematics* (Committee on the Mathematical Sciences in the Year 2000). The council outlined ways for faculty to make math education at the undergraduate level more successful. Recommendations include incorporating active learning and not relying solely on lecture, using technology appropriately, connecting content to student background, and being educated on the processes of teaching and learning. More recently, in 2006, the Commission on the Future of Higher Education released *A Test of Leadership: Charting the Future of U.S. Higher Education* (U.S. Department of Education, 2006b). Within the report, the Commission addressed five major concerns: access, affordability, quality, accountability, and innovation. Recommendations from the commission included:

- improving access by aligning expectations for enrollment in higher education with K-12 outcomes and creating clear transfer pathways,
- improving affordability by updating the financial aid process and streamlining expenses at institutions to reduce the burden on students and taxpayers,
- improving quality and accountability by creating and monitoring measurable outcomes across all institutions, and
- designing innovative curriculum and new technologies.

Several private organizations, including the National Center for Academic Transformation and the Council for Aid to Education, were specifically named as exemplars within the report. Neumont University in Salt Lake City, Utah, was named as an exemplary innovative college using a project-based design. Students at this college can complete a Bachelor's degree in two and a half years, but the students must be full-time day students. On-line classes are not offered. Part of the report focuses on the need to improve education in disciplines relating to science, technology, and medicine. In addition to improving graduation rates within these disciplines, the commission proposes changing immigration laws for student visas to encourage graduates in technical fields to remain in the United States. The commission called on the business sector to become involved with redefining the appearance and implementation of higher education.

These calls for reform, many of which target functional mathematical literacy are rooted in maintaining the structure of society rather than questioning it. As described in a *Test of Leadership* (U.S. Department of Education, 2006b), higher education is of value to the individual because it allows for social mobility and is of value to the country because it promotes future economic growth. The calls for reform are predominantly based on individuals attaining better careers and the country maintaining or regaining a strong economy and global superiority.

**Research.** The recommendations since 1980 have been to create well-defined, measurable outcomes across school mathematics. Critical mathematical literacy has not been focus in mainstream calls for reform.

*Middle and high school.* The “Algebra Project” program (Moses & Cobb, 2001) was created in an attempt to battle innumeracy, but the rationale for the program was different from the previously mentioned reforms. Moses believes that innumeracy, like lack of voting rights in the 1960s, is the biggest factor contributing to the disempowerment of poor people and minorities. Without mathematical skills, people do not have the opportunity to gain economic access to “privileges” such as health care, child care, and education, and they do not have the ability to fully participate in our society.

Mathematics educators of a more critical bent believe that, although developing functional mathematics literacy is a necessary condition, it is not a sufficient condition for a truly democratic mathematics education. Kitchen and Lear (2000) and Mukhopadhyay (2005) describe the use of Barbie dolls and male action figures to highlight the disproportionality of the dolls and begin discussions of individual body-type, multiculturalism of the dolls, and sweatshop labor. Peterson (1995) and Gutstein (2003a) describe classroom activities used to demonstrate the distribution of wealth.

Martin (2000) conducted an ethnographic study of African-American middle school students and their mathematical achievement and attitudes. He danced around the topic of race but never put the “nondiscussable” on the table when he was interviewing students. When he met with parents, Martin did bring up the issue of race and the effect of race on the parents’ mathematical background. Gutstein (2003b) describes how students begin to differentiate between individual racism and institutional racism while investigating mortgage loan approvals. Gutstein (2006)

described his efforts at teaching mathematics for social justice in an urban gifted middle school class. His students, who were mathematically and academically successful, appreciated the opportunity to investigate the real world as it applied to them, and they were quick to let him know if he was superimposing his own opinion on a topic.

*Adults.* Frankenstein (1989) details how she uses questions based on interest of and relevance to students to analyze how mathematics is socially, politically, historically, and culturally constructed. Her main focus has been to develop class consciousness with working class adults. Patrick (1999) worked with a small group of adults in a course designed to help students gain confidence in using mathematics in their daily lives. The class was designed to develop critical consciousness and critical reflection through a dialogical structure. The use of critical mathematics education did lead to a self-reported increase in confidence in students' ability to use and understand mathematics. Stinson (2008) worked with four mathematically successful high school graduates to address the issue of race and how it played a role in the students' educational and mathematical background. He worked with the four participants to investigate their perceptions of how race influenced their academic and mathematical experience.

*Why so little research?* Why has it taken so long for the connection between mathematics and critical pedagogy to surface? D'Ambrosio (1999) and Freire (1997) both insinuate that perhaps the major players in the area of critical theory were not part of the elite class who understood math. Perhaps they were duped by the ideology of certainty. Likewise, many people in the area of math education do not fully understand

critical pedagogy. Though the decades-old work of Skovsmose and Frankenstein is inspirational, they are often misunderstood. I have been disappointed by many conference presentations, in the category “Math for Social Justice,” that dealt solely with earning potential for students.

A major problem affecting the widespread acceptance of Math for Social Justice is the view that teachers are imposing their political agenda on students. Frankenstein writes inspiring pieces, but the way that she presents herself and the issue of critical mathematics can be overbearing. Frankenstein (2009) writes of the dismay she felt in 1981 when teachers at a National Council of Teachers of Mathematics conference rejected her idea that all word problems are biased. I wonder if the rejection was based on the political climate at the time with Reagan’s election and the soon to be published Nation at Risk, or if the rejection was based on her over-zealous presentation. As described by Boaler (2009), Frankenstein goes beyond teaching mathematics and promoting equity to pushing her own political agenda. Critical Mathematical Literacy should allow students to identify and question the hidden assumptions and agendas and provide tools to form their own opinions.

Perhaps the biggest obstacle for implementing critical mathematical literacy programs is illustrated in the differences between the national education reform movements of the past thirty years and the critical education movement. The critical education movement is empowering for students, and also empowers teachers as they become researchers (Kincheloe, 2012). The national education reform movements are disempowering for students, teachers, and researchers. The movements dictate the outcomes, the assessments, and the style of acceptable research. The technological

innovations within mathematics described in *Test of Leadership* (U.S. Department of Education, 2006b) serve to de-professionalize faculty and provide students with mathematical skills but no critical thinking or problem solving.

### **Post-Secondary Developmental Mathematics**

*Post-secondary developmental education* is a broad term that covers both remedial and compensatory education. *Remedial education* applies to students whose high school experiences did not adequately prepare them for college. *Compensatory education* applies to students in a variety of situations, including those who have taken years off between high school and college and those who never completed high school (Dotzler, 2003). Students who are deemed unready for a college-level mathematics course are placed in developmental courses to prepare them for college-level work.

Developmental education has had a long history in the United States. Starting in 1636, Harvard University began teaching remedial reading to adults. In the mid 1800s, a number of private colleges were founded. Admission was open to any male who could pay tuition. Rather than institute a remedial program, the colleges hired tutors to address deficiencies in student knowledge. By 1889, at least 80% of post-secondary institutions had remedial or developmental programs (Dotzler, 2003).

The early 1900s saw an increase in the demand for post-secondary education by women and blacks. Both populations were historically denied college preparatory education, which prompted an increase in the need for compensatory education programs at the post-secondary level. The G.I. Bill of 1944 also introduced an unlikely population into the post-secondary setting. By 1947, 49% of all college students were veterans who were interested in “close to home” schools. This new demand eventually

led to the creation of the community college system and an increase in the need for developmental education at the college level (Dotzler, 2003).

Students in post-secondary developmental mathematics courses experience math class differently from students in college-level mathematics courses. Traditional methods of teaching and learning mathematics have failed these students. Students in developmental mathematics courses often have a negative attitude towards mathematics and may feel resentment at being placed in a developmental course (Stigler, Givvin, Thompson, 2009), though students are more likely to experience fear based on their previous experiences. Students are expected to learn years of material in a single semester. The issues experienced by students in developmental mathematics need to be understood by the instructors teaching the courses. An important goal for the instructor is to change the students' attitudes and beliefs regarding their own abilities and towards mathematics in general (Hammerman and Goldberg, 2003).

The number of students enrolled in public two-year post-secondary institutions has more than tripled since 1970. In the fall semester of 1970, approximately 2,195,000 students enrolled in public two-year institutions. That number increased to 6,640,000 in the fall of 2008 and is projected to reach 7,807,000 in 2019 (NCES, 2010). In the 2006-2007 school year, 1045 community colleges in the United States enrolled approximately 35% of all post-secondary students (NCES, 2010). Roughly 60% of all students in community college take at least one developmental course (Bailey, 2009; Attewell, Lavin, Domina, Levey, 2006).

In recent years, interest in developmental mathematics has been growing. Since the late 1990s, the National Center for Academic Transformation (NCAT) has supported programs to redesign courses to become more cost effective for institutions. Through the Program in Course Redesign (PCR) from 1999 – 2003, two community colleges redesigned large-enrollment, lecture-style, developmental math classes to use interactive software to deliver content. The Roadmap to Redesign program from 2003 – 2006 and the Colleagues Committed to Redesign program from 2006 – 2010 were used to expand the PCR program to other institutions. Neither of these programs included developmental education, whereas the next NCAT program, Changing the Equation, focuses exclusively on developmental courses.

The Changing the Equation program developed focuses on redesigning developmental math classes in community colleges. NCAT claims “the program will improve student learning outcomes while reducing costs for both students and institutions using NCAT's proven redesign methodology” (National Center for Academic Transformation, n.d.). Redesigned courses rely heavily on technology to deliver most if not all of the material. Material is skill-centered and the classroom is set up to be “teacher proof.”

*The Carnegie Foundation also sponsored programs to change developmental education. “The Statway™ pathway is structured especially to serve students planning to transfer and continue further studies in humanities or social sciences. The year-long experience is designed to concentrate on “statistical content with requisite arithmetic and algebraic concepts taught and applied in the context of statistics”*



(Carnegie Foundation, n.d.b). The StatWay program pilot began in August 2011 with a small select group of community colleges. In a related program, Quantway, students will focus on understanding and applying the mathematical concepts needed to facilitate their quantitative literacy rather than memorizing seemingly disconnected processes and procedures, as is often the case now. In this non-STEM (science, technology, engineering, mathematics) pathway, students who place into elementary algebra will go to and through a college-level quantitative reasoning course in one year. Students will use numerical reasoning for decision making, argumentation and sense making about real-world questions, problems and contexts of personal, social and global importance. (Carnegie Foundation, n.d.a)

The QuantWay program pilot began in January 2012 with a small select group of community colleges. What was the motivation for creating these programs?

According to the developers, “Recognizing the grave consequences for individual opportunity and more generally for our economy and society” (Carnegie Foundation, n.d.a, n.d.b).

Complete College America, a non-profit organization formed in 2009, focuses on providing structured programs of study to students (eliminating student choice) and supports using embedded remediation or co-requisite classes instead of the traditional developmental course structure.

In the spring of 2012, Connecticut passed SB-40 (State of Connecticut, 2012), “an act concerning college readiness and completion.” This act mandates that the only developmental education offered should either be embedded within a college level

course or an intensive college readiness program completed within one semester of enrollment in a degree program. Under this legislation, colleges will not be able to offer developmental level classes other than the embedded and intensive classes. The Board of Regents of Higher Education, with input from a faculty advisory committee and the P-20 Council, is working on developing options for the intensive college readiness program. In 2013, Florida passed SB-1720 (State of Florida, 2013), “an act relating to education.” This act mandates that students who have entered secondary school in Florida after 2003 and graduated from high school with a standard diploma do not need to take placement test upon enrollment at a Florida Community College. These students will not be required to take developmental classes; rather, they can select to enroll in a college level course. The law also applies to active duty military personnel. Community colleges are allowed to offer developmental classes, but many students will not be required to take them.

### **Working Class Studies**

Research on students in developmental courses at community college would be incomplete without considering social class. The majority of students that attend community college are from working class families and bring with them working class values and culture. To better understand the experience of the students attempting to succeed in an educational system designed by and for middle class culture, an understanding of social class in the United States is necessary.

Social class should not be confused with an index of socioeconomic status (SES). As described by Torlina (2011), the SES index is based on three quantitative measures: an occupational prestige score, level of formal education, and income. The

occupational prestige score and level of formal education are both biased against blue collar workers. White collar occupations score higher than blue collar occupations on the prestige scale, and white collar occupations also usually require a higher level of formal education which contributes positively to the SES index. Apprenticeship programs or trade schools, usually associated with blue collar workers, are not a factor in determining the SES index. Using the SES index as a way of attempting to quantify social class is easy because researchers are able to quantify the measure, but the index is biased and does not accurately reflect the complexity of the issue of social class. Gilbert (2002) describes social stratification as inherently unequal, with some people regarded as higher or lower than others. He developed a social class model based on occupation that is composed of six strata: capitalist class, upper middle class, lower middle class, working class, working poor, and underclass. According to Metzgar (2005), American class vernacular has adopted a three tier model: upper class, middle class, and lower class. When asked about social class and given a choice between upper, middle, and lower, the majority of Americans will identify as middle class.

Here, a person's social class will be defined by the power that the person has in relation to the production process (Anyon, 1980; Zweig, 2011). According to Zweig (2011) and Metzgar (2005), the United States is represented by three classes: working, middle, and capitalist. The working class is characterized by a lack of power; they are the people who produce and reproduce goods and services. The working class is composed of both blue and white collar workers. The middle class has some power. The middle class is made up of managers, professionals, and small business owners. The capitalist class holds the majority of the decision making power in this country.

This numerically smaller class contains the individuals who own and control giant for-profit enterprises (Metzgar, 2005).

**Working Class Culture.** Jensen (2012) characterizes people in the middle class as focused on doing and becoming. Middle class culture tends to be achievement- and future-oriented. The individual is emphasized and status is valued. Within middle class culture, rules are based on the individual and negotiation of rules is encouraged (Metzgar & Jensen, 2005; Bernstein, 1971). Torlina (2011) describes people from the middle class doing work that is financially rewarding but not intrinsically satisfying.

By contrast, Jensen (2012) characterizes people in the working class as more focused on being and belonging. Though working class culture varies significantly throughout U.S. culture, researchers have identified underlying trends that seem to be present in most working class communities. Working class culture tends to be character- and present-oriented. Community is emphasized over the individual (Jensen, 2012; Torlina, 2011). Due to the strong sense of commitment to community and family, members of the working class will sacrifice individual needs for the family (Smith, 2009). Members of the working class tend to see life as a tangled web of relationships (Metzgar, 2005). Members of this web see themselves as a part of a larger structure and have a sense of the importance of their position within a company or the larger society (Torlina, 2011). Working class culture tends to be more position-oriented than middle class culture. Rules and lines of authority are clearly defined. Rules are meant to be followed, not negotiated, but the rules may change based on the position of the individual (Bernstein, 1971). Expectations for children's interactions

with adults constitute one example of the position-based rule structure. Within the family, the parents or adults hold the power and make the rules. Children are expected to obediently follow the rules. At gatherings of adults and children, there is little interaction between adults and children, and it typically follows the “don’t speak unless you’re spoken to” belief (Bernstein, 1971).

At the heart of working class culture is a belief in cooperation and a respect for hard work (Smith, 2009; Shor, 1987). People take pride not just in their accomplishment or final product but also in the sense of “working hard.” The sense of accomplishment from doing good work is intrinsically satisfying so the value of work does not just lie in the financial reward (Torlina, 2011). Although members of the working class have a desire for and a belief in respect, they also simultaneously tend to demonstrate a resistance to authority (Shor, 1987). Members of the working class tend to see members of the middle class as self-absorbed and lacking common sense and question their ethics and sense of fairness (Torlina, 2011). People in the working class may resist opportunities to become part of the middle class because they do not want to be part of “the game” (Torlina, 2011). The working class has withdrawn from politics because they don’t want to waste their time with a system they believe they cannot affect (Zweig, 2011). Many people in the working class are conditioned to act with respect towards figures of authority, though underlying this “respect” is the question of whether or not the authority is earned through justice and fairness (Greenwald & Grant, 1999). As Greenwald and Grant describe it, “some working people harbor cynicism toward social institutions, for those institutions do things to, rather than for, them” (p. 29).

**Education and the Working Class.** Zweig (2011) uses the power of inertia to help explain the social institution of education. The power of inertia is evident in how easy it is for one to perpetuate existing ways and relations and also the belief that the existing institutions and hierarchies are “natural.” The educational system, still in effect today in the United States, is meant to generate a workforce with skills and work habits meant to keep production going (Zweig, 2011). Educational institutions are exclusionary and meant to reproduce the existing social structure through the structure of the system (Alberti, 2001; Peckham, 1995; Jensen 2012). Elite universities are meant to prepare children of the capitalist class and the upper middle class for positions of power. Other four-year colleges are meant to replenish the supply of managers and professionals within our society. This leaves the two-year colleges to train the workers.

Anyon (1980) found this class structure present even at the elementary school level. Students at elementary schools in working class neighborhoods were given rote, procedural math problems with no connection to the real world and no significance within their lives. The teachers would write notes on the board, tell students to copy the notes, then test the students. Students were graded right or wrong based on how well the steps were followed. The teacher was the sole source of authority. Students at a school in a middle class neighborhood were given some decision making power within the process but were still focused on getting a single correct answer at the end of the process. Students did not find the work rewarding but figured someday it would pay off with college or a good job. Students in a school in an upper middle class neighborhood were given work which involved creativity and were encouraged to

show individuality. Students were not given direct orders but were involved in dialogue with the teacher. Students often worked independently to create products that were valued by themselves and the teacher. Students at the elite schools did not determine if their answers were correct using the book or the teacher, but rather by logically validating the process and therefore the answer. Students were encouraged to challenge answers that they did not agree with. When working with word problems in math, for example, the teacher focused on setting up the problem and not the final answer, because the set-up is the difficult part (Anyon, 1980).

Johnson (1996) describes five conditions of education that lead to poor academic culture: (1) bureaucratic culture, (2) fragmentation of efforts, (3) lack of responsibility, (4) low-level curriculum and instructional practices, and (5) inadequate professional development. In a bureaucratic culture, chores such as record keeping, daily tasks, and compliance are the focus rather than issues of teaching and learning. When efforts are fragmented by creating too many special programs with individual administrative structures, the lack of communication and coordination is deemed to contribute to a low quality instructional program. The fragmentation of efforts also leads to an overall lack of responsibility due to confusion over the differing administrative structures. Low-level curriculum and instructional practices, as Haberman (1991) describes as the “pedagogy of poverty,” also contribute to low quality programs. Students engage in learning acts leading to low-level skills not in activities designed to result in higher level, independent thinking. Inadequate professional development contributes to the power of inertia in maintaining low-level curricula and poor instructional practices. Faculty lack knowledge of changing

practices and improvements made in the understanding of teaching and learning. The low-level curriculum becomes an unquestioned practice and seen, again, as “natural” (Johnson, 1996).

*Difficulties.* Students from the working class may experience some difficulties upon entering higher education. Shor (1987) asserts that students are not always academically prepared for higher education based on the quality of their prior education. Students may have been the victim of tracking practices based on social class and placed in low level classes, or students may have been unfortunate enough to attend a working class school similar to the ones described by Anyon (1980), where the rigid structure leads to memorization and drill rather than critical thinking activities. According to Bernstein (1971), students from the middle class are better trained for success in higher education. Students have a better opportunity to learn to become creative problem solvers, question and face ambiguity, and focus on structure and relationships. Bernstein (1971) notes that students from a working class, position-oriented culture may be less comfortable with academic discourse, questioning authority, and independent critical thinking.

Quite often, students from the working class do not see the value in college because it is disconnected from the real world (Torlina, 2011; Sennett & Cobb, 1972). The diploma, or piece of paper, is valued more than the content of the education (Linkon, 1999). Status incongruity (Sennett & Cobb, 1972), that is, discontent caused by upward mobility, may also afflict students from a working class background entering higher education. As one subject in Sennett & Cobb’s (1972) book, “Frank,” a man from the working class, describes it, “just as intellect gives a man respect in the



world, the educated do nothing worth respecting; their status means they can cheat” (Sennett & Cobb, 1972, p. 22). By gaining more education a person will gain more respect from others but, in the process, may lose self-respect. According to Rendón and Garza (1996), “a student who finds that going to college is tantamount to living between two worlds and retaining two separate sets of identities, mannerisms, and peer associations may find surviving college to be quite difficult” (p. 293). The difference between the working class culture of a student’s upbringing and the middle class culture of higher education may cause a student to have difficulties adapting to a changing identity in which they may be leaving family and old friends behind (Terenzin et al., 1994; London, 1992). Students may also feel that they are perceived as “different” from their peers, by their peers and professors alike. Lee Warren of the Bok Center for Teaching and Learning at Harvard held workshops across the country to explore the concept of race in education (Rhem, 1998). The students, even though they were accepted at post-secondary institutions, did not know how to negotiate the educational system and they felt like outsiders. They were afraid of being found out that they did not belong. Rendón and Garza (1996) summarize the student related factors that most affect student retention. In addition to cultural separation, these factors include: financial issues such as poverty and unemployment; affective issues such as self-doubt, low self-esteem, and anxiety; and educational issues such as inadequate preparation, weak study habits, and unclear goals.

Institutional factors also influence the retention of students from the working class (Rendón & Garza, 1996). Financial issues such as rising tuition and a mystifying, complicated financial aid process, and antiquated teaching styles, including the lecture

model and a passive learning environment which do not promote a sense of inclusion or community, are both problems for many working class students. Cutbacks in student services may lead to poor advising and lax drop-in and drop-out policies. García and Smith (1996) claim that the “effect of our educational system, in general, and higher education, in particular, has been to alienate the vast majority of students from education and often from themselves” (p. 275).

**Proposed Transformations.** The problem of student retention in higher education lies within the institution, not the student. Especially at the community college, innovation is the exception (Greenwald & Grant, 1999). In the traditional model of education, curriculum is developed independently of the learner, based solely on the content to be learned. However, learning is done best when there is a connection between the learner and the curriculum (García & Smith, 1996). Green (1999) believes that stories and narratives, written in the student’s home language rather than always focusing on academic language, are a way to bridge gaps between home and school and to help the student maintain a connection to where they come from. Incorporating stories of working class students “into the college, affirming the lives of working-class students, and making them part of the college experience” (Greenwald & Grant, 1999, p. 33) connects the learner to the curriculum.

Greenwald and Grant (1999) write “we need to empower our students to become part of the classroom” (p. 33). Students should be encouraged to question, to challenge, and to actively participate in their learning (García & Smith, 1996). The role of the instructor should be de-emphasized (Christopher, 2005). The instructor should identify what the students need to learn and establish clear expectations

(Rendón & Garza, 1996). Working class students need an opportunity to discuss issues and come to their own conclusions (Zweig, 2011). Even if students are not adequately prepared for college work, the focus should not be on remedial education and basic skills but rather on cognitive development, including abstract thinking, critical and independent thinking, and problem solving (Ramírez, 1996).

Rendón and Garza (1996) state that building a community and establishing connections with other students and faculty are important to retaining students. One way to do this is to create learning communities so that students view other students as active and valuable participants in the learning process (Christopher, 2005; Greenwald & Grant, 1999). In 1993, Rendón and Jalomo studied the influences on students during the first semester of college and found the importance of early validating experiences (Rendón & Garza, 1996). Students who had a person who helped them believe in their capacity to learn and in their ability to succeed academically had better retention. Faculty learned student names, met one-on-one with students outside of class, and designed learning experiences for early in the semester that allowed students to experience academic success.

Nora (1987) found that commitment to a clear, concrete, realistic goal early in the college process is more important for success than building connections. The advising process needs to help students learn more about curriculum and explore career choices. The advisor needs to advise the whole student; therefore, the advisor needs to know the student as a person (Greenwald & Grant, 1996). In addition to understanding curriculum and career opportunities, students need to acquire “political

literacy.” Students need to understand the structure of the educational institution and how to negotiate within that structure (Christopher, 2005).

The higher education experience needs to be transformed at all levels, from classroom to student services, as well as research in higher education. Social class is based on cultural characteristics and is too abstract to be described solely by statistics (Torlina, 2011). According to Torlina (2011), “Surveys are useful for gathering descriptive data, and they efficiently collect answers to questions, but they cannot explain why people selected these answers” (p. 85). Researchers also need a qualitative focus incorporating both observational and autobiographical sources.

### **Conclusion**

Clearly, the need to transform post-secondary math education, especially at the developmental level, is evident. The current round of skills-driven, technology-based reform at my institution does nothing to address critical math literacy or critical pedagogical approaches. In the next chapter I will describe the course I designed to help students develop critical math literacy while becoming empowered learners. In addition, I will describe my research methodology which is critical and exploratory, allowing practitioners to reclaim power that is presently being usurped by top-down, government-mandated policies.

## **CHAPTER 3**

### **METHODOLOGY**

As briefly discussed in the previous chapter, there is a gap in the literature with respect to understanding the interplay of social and personal factors correlated not only with success or failure in 2-year college developmental mathematics courses but, further, with what occurs when a development mathematics course takes a more empowering, critical approach. Accordingly, I conducted an exploratory, qualitative study to investigate how students in a developmental math course begin to recognize and make meaning of hidden assumptions in problem solving situations. Quantitative studies can be very successful when studying functional numeracy or when looking at well-defined measures of “success,” but my goal is to look more at the process of becoming critically numerate rather than just focusing on measurable outcomes of functional mathematical literacy. In my several years of teaching developmental courses in 2-year colleges, I have observed that many of the students had spent a lifetime being told not to question but just to do as they were told. In my more critically-oriented courses, I have asked students to break this habit and to question assumptions. Though I have been requesting a seemingly simple task, to question assumptions, students have responded with varying levels of intentional or unintentional resistance. In this study, a qualitative analysis allowed me to paint a clearer picture of what happens to students’ beliefs and perceptions as they become more critically numerate.

## **Rationale for Research Methodology**

What does it mean to be educated, what constitutes knowledge, and whose values are most worthy? According to the Standards movement of the past thirty-plus years, these questions have clearly defined answers. Yet I do not unquestioningly accept these positions as truth. Because my research questions are based on “neither theory nor practice alone but from critical reflection on the intersections of the two” (Cochran-Smith & Lytle, 2009, location 1123), practitioner research became the most appropriate research strategy. Though many forms of practitioner research exist, there are common underlying themes. Practitioner research raises questions about the goals of teaching and learning, the effect of classroom practices and school structures on the status quo, and the role of power and authority in the classroom, the institution, and society (Cochran-Smith & Lytle, 2009).

Zeni (2001) is more restrictive in her view of practitioner research. She states that practitioner research is qualitative in nature, whereas Cochran-Smith and Lytle (2009) feel that practitioner research can be quantitative, qualitative, or a mix. The underlying themes outlined by Cochran-Smith and Lytle (2009) are reflected in Zeni’s (2001) characterization of practitioner research: research conducted by insiders or stakeholders within their own work place looking at their own practice to better understand themselves and their students while solving professional problems and changing society.

Much of the research on developmental students is quantitative and revolves around retention rates and factors that influence retention rates. These studies do provide important information to institutions regarding the need for transformation.

Quantitative studies, however, are not effective at describing the journey people to take to develop their beliefs and attitudes, nor the influence of culture (Torlina, 2011). The student experience is one that cannot be ignored or assumed when attempting to transform educational programs. Gee (2011b) discusses the idea of pervasive social beliefs – things we hear so often that we are indoctrinated to believe they are true. Gee’s examples are the phrases “everyone in this country has an equal opportunity at success” and “if you work hard, you will be successful.” People with a critical view of our society know these statements are not true. There are many working class people who work very hard every day who are not classified as “successful.” Within math education, students are also indoctrinated with certain beliefs. At the outset of my courses, an overwhelming majority of my students have *stated* that anyone can be successful at math if they work hard. They have submitted this in writing as part of the first assignment. Yet, over the next few classes, I start to hear the spoken complaint, “I can’t do math!” I do not believe that quantitative research would be as effective in picking up on such discrepancies between indoctrination, wishful or defeatist thinking, and actual beliefs.

I also think that the outcomes in which I am most interested and the outcome of quantitative research are somewhat at odds. A student’s construction of knowledge and beliefs is based on his/her background, foreground, and present – and is constantly changing. Quantitative research has a tendency to present a picture that will be accepted as the one truth that describes the situation.

In my study, I used the concepts of teacher research and critical constructivism described by Kincheloe (2012). Teacher research is a way to embrace the idea of

critical education within research: beginning with the notion that knowledge is socially constructed. Teacher research is a method used to help teachers become empowered. This method encourages teachers to study situations and make their own meaning, rather than relying on research from “experts” to be replicated within classrooms across the country. This autonomous interpretation and construction are what I expect my students to do in math class. I want my students to explore concepts and make meaning rather than simply regurgitating formulas and methods presented by the teacher, the “expert.” In the field of math education, this is the concept of math literacy defined by D’Ambrosio (1999): making inferences, proposing hypotheses, and drawing conclusions from data.

### **Original Course Design**

In the introduction to a recent book about Teaching Mathematics for Social Justice (TMfSJ), Stinson and Wager (2012) point out that there is no clear definition for TMfSJ. Teachers and researchers need to make their own meaning of the concept and then blaze their own trail. According to Stinson and Wager (2012), “TMfSJ is a journey, not a destination” (p. 6). I will describe a model for TMfSJ as described by Stinson and Wager (2012) and then describe my interpretation.

What is the value in a social justice approach to mathematics education? Below is the quick list (followed later by a more detailed description). It is my and many others’ conviction that students receive the most value from a social justice approach to math education. The value to instructors should also be recognized.

For students

- Increased self-confidence
- More independence as a learner
- Increased interest and participation



- Better understanding of mathematical content
- Ability to use math to solve problems
- Feeling of community and sense of belonging
- Increased sense of responsibility
- Better understanding of life situations
- Increased ability to evaluate the consequences of a proposed solution
- More informed decision making
- Increased tolerance for other people and cultures

For instructors

- Increased student participation
- Increased sense of responsibility
- More interesting class meetings
- Feeling of satisfaction knowing that students are becoming better citizens not just better test takers

Based on my experience, by the time many students reach my class in the community college, they have given up hope of understanding, using, and enjoying mathematics. They can also pinpoint the time in their schooling that these feelings of hopelessness surfaced. If you walk down the hallway when classes are in session and you look into a traditional developmental math class, you will see a teacher standing at the board and students sitting in rows. The students may or may not be taking notes. They may occasionally be chatting with each other, but the interaction between student and instructor is typically limited to an infrequent procedural question from a student. Students see math class as a hoop to jump through on their way to a degree or certificate rather than a meaningful, useful learning experience. This is where the social justice approach comes into play.

**Teaching Mathematics with Social Justice.** Teaching mathematics with social justice (Stinson & Wager, 2012) refers to using a critical pedagogy. Having students understand that they co-create the classroom atmosphere and that they are key to creating knowledge is invaluable. The first time that I have students write a math

autobiography, they know that something is going to be different about this class, because this is the first time a math teacher ever wanted to know more about their experiences, beliefs, and aspirations. Students become intrigued – will this really be a different type of math class or is it just one assignment? When they are asked to reflect on what they understand or give input on content for word problems, they begin to realize that they are valued. When they are challenged to solve problems and then develop algorithms to use in other situations, they begin to realize that they understand more math than they realized. When students know they have something to contribute in a meaningful problem-solving situation, they are more likely to be involved in dialogue about their learning instead of relying on the teacher to tell them what is necessary to know. One of the pedagogical values to students is that they really begin to understand the math. The concepts have been constructed by the students in a way that intrinsically makes sense. Another value for students is that they will develop confidence in their ability to learn math. This will help students be more resilient when they encounter a more traditional classroom setting. The instructor also benefits from a social justice approach. Although a social justice focus does entail more work from the instructor in terms of getting to know the students and altering curriculum every semester to fit the current group of people, it provides a much more exciting class meeting. I find the dialogue and the interaction to be energizing for both students and instructor. Instructors are also opening themselves up to learn more about current events important to students and find data that could be used in other classes.

**Teaching Mathematics about Social Justice.** Teaching mathematics about social justice (Stinson & Wager, 2012) refers to the content of the course. Based on

my experience, students are not accustomed to exploring real-life, controversial situations in math class. Students are used to contrived word problems about trains, perimeters, or mixing acid solutions. Using social justice topics as the basis of problem solving helps students become more aware of current events and their community, encourages students to have an opinion, promotes dialogue within the class, and puts an end to the commonly asked question (Powell, 2012) “*When are we ever going to use this?*” (p. 189). By delving into generative themes, instructors can present issues relevant to students, allowing students to use their prior knowledge to help make meaning of the mathematics in the situation. This can help students realize that math is not a subject to be memorized and regurgitated, but knowledge to be created, developed, and applied. When students have a sense of confidence and knowledge about the content combined with a newfound understanding of the relevance of math, their enthusiasm and effort increase.

**Teaching Mathematics for Social Justice.** Teaching math for social justice (Stinson & Wager, 2012) refers to using mathematics as a tool for reading and writing the world. Math should be taught so that students are encouraged to challenge injustices of the status quo. I want to give my students the tools to analyze and critique the world.

**My Interpretation.** When planning this course, I needed to work within departmental requirements. The course outcomes (see Appendix A), the text, and the final exam (see Appendix B) were mandated by the department. The text book used was *Elementary & Intermediate Algebra Graphs & Models*, 4e, by Bittinger,

Ellenbogen, and Johnson (2011) and I chose to use the accompanying software package MyMathLab.

When designing the course, I considered how to best use class time. Students struggle the most with critical thinking and problem solving. Rather than spending the majority of time in class learning basic skills, I decided the time would be better spent on problem solving. I was not dismissing the skill work. Time in class would still be available for presenting new material, but I planned to use technology so that some of the basic skill work could be completed outside of class. I planned to create short pencasts using a smart pen. A pencast is a PDF file containing both text and audio narration. When the student opens the PDF file, the student can print out a copy of the lesson and can also play the file. When the student plays the file, they hear my voice and see me writing exercises and explaining basic concepts. They have the ability to pause playback if they want to write additional notes. What is particularly beneficial about a pencast is that students do not see the entire example or lesson on the screen. When they click play, the paper is clear and the text appears as I speak about it. This is in contrast to the output of some apps where the entire text is visible for the narration which can be distracting to students. Although many websites offer short instructional videos, I think the pencast approach is better because the students are familiar with my voice and my way of speaking. Even though we are not physically in the same room, there is the connection to our classroom community.

Once I decided that I would devote more classroom time to problem solving, I considered what type of problems to use. In the past, I chose a theme and throughout the semester created problems based on that theme. This time, I decided that I would

choose an initial social justice problem then ask the students what themes they would be interested in learning more about. Based on student responses, one theme could be used throughout the semester, or many different themes might be used. The social justice themed problems were not well-defined at the beginning of the semester because they depended on student input. My mathematics background and my educational background are strong enough that I can make data related to the chosen themes problematic, and I can help guide students to make information problematic. I also wanted students to have exposure to some of the more traditional style, textbook problems. Based on my knowledge of what type of problem is valued within my department, I planned to include geometry problems including area, perimeter, and sums of angles and total value problems including simple interest and mixture problems. Right before the semester began, I decided to have students fill out rating cards (see Appendix C) for word problems. Students would rate their interest in the problem and the perceived relevance of the problem. On the back of the rating cards, students would be encouraged to let me know if they were having trouble or to leave a comment. This was not done every day but throughout the semester for both social justice problems and textbook problems.

I wanted students to not only have better problem-solving skills critical-thinking skills but also more confidence in their ability. During class time, I wanted students to interact with each other and me. Each class I ask open-ended questions to encourage students to generate ideas, explain their ideas, and critique their own and other peoples' ideas. Throughout the semester I ask them to reflect on what they are

learning and their learning process to help them determine if they should modify their study habits.

### **Data Collection Tools**

To better substantiate my analysis, I collected data through five primary tools, which I subjected to a qualitative method of analysis.

#### ***Mathematics Autobiography Reflective Writing Assignment (Appendix D).***

At the beginning of the semester, students completed a written assignment in which they described their mathematical background, their attitudes towards mathematics, their approach to learning, and their goals. Students were reminded that they would not be graded as if this were an essay for an English class; they should focus on expressing who they are and part of this comes from their writing style.

***Informal Discussions.*** Throughout the semester, I used the time before and after class for informal discussions with the students. This allowed for individual and group interactions in an environment that was less structured and less threatening than a formal class.

***Videotaping and Field Notes.*** After obtaining signed consent forms, I videotaped class meetings. In order to best capture the context of the discourse, I also took field notes on the classroom setting, all discussions both in and outside of class, and email exchanges. I used a comprehensive note-taking strategy based on Spradley's (1980) nine-item list, including information about space, actors, activity, acts, events, time, and feelings. I also documented salient events (Wolfinger, 2002).

***Problem Solving Work.*** (Appendix E) Throughout the semester I collected examples of student work related to problem solving. I also asked students to rate the word problems based on personal interest and perceived relevance to their lives.

***Final Reflection.*** (Appendix F) At the end of the semester, students completed a reflective writing assignment in which they analyzed their progress and their interaction with the content presented throughout the semester.

## **Analysis**

**Discourse Analysis.** Discourses as described by Gee (2004) are the ways in which people talk, write, think, act, and interact to be recognized as part of a social group, in this case, students in a community college developmental mathematics course. Central to a discourse is the need to develop an academic social language which differs from the vernacular language that is used in everyday activities. Social languages are contextual structures used within a specific domain and need to be learned. Language has a situated meaning. The meaning of language cannot be separated from context, including physical setting, people present, social relations among people present, language being used, and other cultural factors. Language and context have a reflexive relationship; each has an influence on the other. Gee (2004) states that discourse analysis is used to study the association between language, context, and social practices. A social practice has four components: a set of routine activities, a set of shared goals, a set of people, and a shared knowledge of the position or role of each person. Critical discourse analysis focuses not only on social practices in terms of relationships but also in terms of status, solidarity, power, and distribution of goods.

I used critical discourse analysis (Gee, 2005; Gee, 2011b) to analyze the data that I collected. Kincheloe (2012), when describing critical constructivism, emphasizes the importance of context in research. “Human experience is shaped in particular contexts and cannot be understood if removed from those contexts” (Kincheloe, 2012, p.187). Gee’s idea of a situated/sociocultural viewpoint (Gee, 2008) – which sees knowledge construction and learning as a relationship between “a mind and a body and an environment in which the individual thinks, feels, acts, and interacts” (p.81) – ties in to Kincheloe’s (2012) concept of context as well as Skovsmose’s (2005) concepts of background, present, and foreground.

Within a critical pedagogy, the teacher is no longer the expert dispensing knowledge. Students and the teacher work together to co-create meaning. Dialogue is an essential part of the learning process. Alrø and Skovsmose (1998) describe multiple ways that dialogue can be used or misused in the classroom. Take, for example, an open-ended question. There is a possibility the question could be “too open” and discourage student participation because students are confused and unsure of the intent of the question. There is a possibility that a well-phrased open-ended question that initially engages and excites students could actually reinforce an ideology of certainty (Borba & Skovsmose, 1997), depending on how the teacher receives the students’ ideas.

When using critical discourse analysis in an educational setting, a social definition of learning must be understood. Gee (2004) describes “learning as changing patterns of participation in specific social practices” (p. 38), implying that changes in patterns of participation reflect a change in socially situated identities. By looking at



patterns of participation, I began to understand better the changes in the student's self-conceptualization with regards to learning mathematics.

**My Analysis.** So, what did I do with all of this information once I had it? I used critical discourse analysis (Gee, 2005; Gee, 2011b) to analyze both written and oral evidence. I foresaw there being two separate things I would be looking for. First, I wanted to investigate the pedagogy. Gee (2005, 2011b) describes seven building tasks related to discourse. Language can be used to build significance, activities, identities, relationships, politics, connections, and sign systems. I used three tools described by Gee (2005, 2011b) to analyze the relationships being developed by the instructor and the students. The first tool I used was the identities building tool. I wanted to determine how the students' identities or roles as learners of mathematics changed over the semester. The second tool I used was the politics building tool in order to analyze the distribution of social goods, specifically power, authority, and responsibility. The third tool that I used was the relationships building tool. I wanted to understand how the language used was by participants to interact with each other. Was the instructor truly empowering students? Or were students being unintentionally shut down by the instructor? I looked for themes related to the expectations of roles as well the types of language (non-technical, mathematical, symbolic) being used by people in the different roles. I also looked at the use of indirect versus direct language to establish solidarity.

Second, I needed to investigate what patterns were occurring during student work time, as well as their level and style of involvement throughout the semester. In accordance with Gee's (2005, 2011b) identities building tool, I looked for themes that

reflected a student's sense of self and the sense of belonging; I looked for changes and patterns throughout the semester.

At the beginning of the semester, students completed the autobiography assignment and I began videotaping classes and writing field notes. For each class, I made a copy of the room layout and a copy of the field note form for each day of class. During class, I used the room layout sheet to make notes regarding the space, objects, and actors present. I was fortunate enough to have time immediately after each class to devote to writing field notes. Initially, I tried writing complete field notes immediately after class and then typing the notes. I found this too time consuming and modified my method. Before leaving the classroom, I would jot down any immediate thoughts on the field note form. Upon arrival at my office, I would begin typing the complete field notes. I used Corsaro (1985) as a guide for coding field notes. During my initial writing of field notes, I would focus on Field Notes, that is a direct observation of what I witnessed in the classroom, and Personal Notes, notes about what might be happening in people's lives that affect what I see. Towards the end of the semester, I began to add notes related to theory and methods. As I was coding my field notes, a list of recurrent themes, including learner independence and solidarity began to emerge. I transcribed key episodes related to the recurrent themes and made a list identifying artifacts related to each theme.

### **Limitations**

**Trustworthiness.** Qualitative research, like quantitative research, should be of high quality. Because of the specificity of the qualitative research setting, reliability and validity apply to theories behind quantitative research but are not applicable to

qualitative designs (Agar, 1986). Therefore, I turned to the four components described by Guba (1981) for judging the quality of research: truth value, applicability, consistency, and neutrality.

***Truth value.*** Is my research credible or, alternately phrased, is it believable from the perspective of a participant? Was I able to accurately document the meaning and viewpoints of the participants? By documenting truth based on experiences lived by and perceived by the participants, I established credibility (Lincoln & Guba, 1985). The key to credibility was to ensure that my description was accurate from the point of view of the students.

In order to increase credibility, I needed to spend enough time with the students to identify recurring patterns (Leininger, 1985), what Lincoln and Guba (1985) call prolonged engagement. Prolonged engagement allowed me more time to identify patterns but also gave the participants time to get accustomed to the classroom setting. By building my rapport with them over time, the students divulged more meaningful information (Lincoln & Guba, 1985). Over the course of the semester, students provided more personal responses based on their lived experience, rather than perceived socially desirable responses.

I used three additional strategies to build credibility: triangulation, member checking, and peer examination. I used multiple artifacts to substantiate my analysis. I made use of the informal time before and after class to check with the participants that I understood what they meant and was portraying them accurately. When I checked with participants, I was careful that I maintained the student-instructor relationship

and didn't switch into researcher-speak. I also discussed my analysis with a colleague who has many years of experience working with students in this population.

*Applicability.* Is my research transferable or generalizable to other contexts or settings? My research was conducted in a naturalistic setting with few controlling variables and is not generalizable. As Sandelowski (1986) noted, generalization is an illusion because of the uniqueness of the participants and the researcher. Rather than being concerned with generalizability, I focused instead on transferability (Lincoln & Guba, 1985). How well do my findings fit outside situations with a similar context? As a qualitative researcher, it was my responsibility to present sufficient descriptive data to allow for comparison. If I sufficiently described the context, participants, and research process, others will be allowed to determine if the research is transferable to their situation (Krefting, 1991; Lincoln & Guba, 1985).

Critical mathematics education and critical constructivist research is about the journey, not the result. The research can give people ideas to plan their own personal journey, but it does not provide a roadmap. From the start, it was my intent that my work will open conversations and raise questions that are usable in other settings.

*Consistency.* Would my findings be consistent if I repeated the research with the same participants or within a similar context? If I were to answer yes to this question, I would be implying that there is a single knowable reality, which is contrary to the assumptions in my theoretical framework. I am to learn from the participants, not control for them. Dependability is the construct that Lincoln and Guba (1985) describe to show that research is consistent. Variability is to be expected but needs to be ascribed to identifiable sources. Though a person may not be representative of the

group, the experience of that person is still valuable. I am used triangulation and peer examination as described earlier to improve dependability.

**Neutrality.** Is my research free from bias in both procedures and results (Sandelowski, 1986)? This question is especially important since I was conducting teacher research. My findings needed to be a function of the participants and the context (Guba, 1981). I needed to consider the possibility of researcher bias. One way that I reduced this bias was to maintain reflexivity. I constantly reminded myself to look for all possibilities, not just what I wanted to find. I also had to be on the lookout for negative cases. In the math world, we would call these counterexamples. I needed to look for cases that disconfirmed my expectations. For example, in my study, some students did not have a preference for either social justice themed word problems or canned, textbook word problems. More important to these students was gaining the sense of understanding how to translate written words into math.

## **Conclusion**

I am using discourse analysis to better understand the ways in which students in a social justice oriented developmental math course change. Changes within the individual are evident in changes in patterns in the way students talk, write, think, act, and interact. By establishing initial questions, I am providing a framework that I think is important to interpret what the students *might* say, write, and do. Using a qualitative, empowering approach enables me construct a different framework, more relevant to the students, to interpret what the students *actually* say, write, and do.

In the next chapter, I will describe the participants and the research setting. In Chapter 5, I will describe modifications made to the course and the analysis based on

the students and the rich discourse they provided. I will also address the initial research questions in Chapter 5. In Chapter 6, I will provide analysis of issues that emerged in discourse throughout the semester.

## CHAPTER 4

### SETTING AND PARTICIPANTS

#### **Institutional Setting**

This study is based on research collected at a public community college located in a small city in New England during the Spring 2013 semester. Over 5,000 students enrolled at this college in the Fall 2011 semester. Two-thirds of the students were white, and their ages ranged from 15 to 85, with a mean of 27 years and a median of 23 years. Twenty-five percent of students enrolled in a developmental class in Fall 2011 (Internal Reports, 2011). The mathematics department at the site school focuses on developing functional literacy predominantly through skills-based lecture. The school is located in a working-class area. Most of the students did graduate from high school, but many still require developmental mathematics courses.

The college was formed in 1992 by merging an existing community college with a technical college. Approximately 5000 students enroll each semester in the technical, career, and liberal arts programs offered through the college. In the fall 2012 semester, 1569 students enrolled full-time and 3421 students were enrolled part-time. Twenty-five percent of the students were age 19 or younger, and 56% of the students were age 24 or younger. The majority of the student population is white non-Hispanic (66.4%), while 12.6% of students identify as Hispanic and 7.9% identify as black non-Hispanic. Twenty-nine percent of students (1464) enrolled in at least one developmental course during the fall 2012 semester. Seventy percent of newly admitted, degree-seeking students required at least one developmental course.

## **Recruitment**

Upon receiving IRB approval, I had another member of the math department use a prepared script (see Appendix G, page 167) to describe the research and the consent process to the students in an oral presentation and simultaneously project the text at the front of the room. The department member fielded questions and distributed the consent forms (see Appendix G, page 169). To protect the privacy of students, the department member asked students to fold their consent forms in half and place them into a designated envelope. In order to minimize the effect of their peers, students were asked to put the forms, either blank or completed, in the envelope regardless of their desire to be in the study.

## **Participants**

The study was conducted in two sections of a developmental beginning algebra course. This course is the second-level developmental course at the college. Students in this course either tested into the level (MAT 095) through Accuplacer, successfully completed the first level developmental course (MAT 075), or were placed in a college level course and chose to take this course to improve their foundation. Both sections met twice a week on Tuesday and Thursday for an hour and fifteen minutes per class.

**Early Morning Class.** The early class met from 8:00 am until 9:15 am. Of the 28 students registered, 11 students placed into MAT 095, 16 students placed into MAT 075, and one student placed into college-level math. The student who placed into college-level math took a higher level math course in a previous semester and was not satisfied with his grade. He decided to take this class in order to improve his



understanding and his GPA. Of the 16 students who placed into MAT 075, 14 students successfully completed a traditional MAT 075 course, one student took four semesters to complete a technology-driven first level developmental course, and one student never successfully completed the first-level developmental course. Eleven of the 28 students in the course had previously taken this course. Six of the 11 students had previously taken this course multiple times. Twenty of the students had also placed into developmental English courses, and four of the twenty were enrolled in both developmental English and math during that semester. Three of the 28 students were enrolled in English Language Learner classes. Two of the students did not have any English placement testing results or English courses listed on their transcripts. Only three of the 28 students placed into college-level English.

I had previous experience working with three of the students in other classes. Susan was a student in the same course during the previous semester. She did not pass the course previously. She demonstrated good understanding of solving equations and working with polynomials, but she had difficulty understanding linear functions. She demonstrated a good work ethic but was hesitant to ask questions. Cheri was a student in my MAT 075 course in a previous year. She had attempted MAT 095 twice before with other instructors. She decided to enroll in this section because even though it was at an earlier time than she wanted, she felt comfortable with me. I met Amanda two years prior to this course. She had difficulties with the instructor and in-class tutor during her first semester in a self-paced, technology-driven first-level developmental math course and did not meet the requirements for a satisfactory grade. I was asked by the Dean to let her into my summer section of the same course. She successfully

completed the requirements and enrolled for another semester with me in order to complete the course. In that semester, she was not able to complete the course. I did not have her in class again for a year, but Amanda would regularly stop by my office to chat. Amanda did have documented modifications including extra time on tests, separate location for taking tests, and calculator usage.

Of the twenty eight students enrolled in the course, two students never attended class and two students only attended the first day. Of the remaining 24 students, 14 were female and 10 were male. The demographics of the students in the class were 62% white, 17% Hispanic, 13% African-American, 4% Haitian, and 4% Iraqi. One of the students had partial hearing loss, though she did not require modifications or an interpreter. She did prefer not to speak during class or work with other students because of her hearing loss. One of the students needed to use a wheelchair.

Throughout the semester, no new students were added but 14 students either withdrew or stopped attending class. Nine of these students received grades of F (fail), W (withdraw), or N (no basis for a grade) for every class in which they were enrolled. One of the 14 students withdrew from 3 classes and received a B in his fourth class.

**Late Morning Class.** The late class met from 11:00 am to 12:15 pm. Of the 28 students registered, 9 students placed into MAT 095 and 19 students placed into MAT 075. Of the 19 students who placed into MAT 075, eighteen students successfully completed a traditional MAT 075 course, two students took a semester of MAT 075 then three semesters of a technology-driven first level developmental course. Eleven of the 28 students in the course had previously taken this course. Four of those 11 had previously taken this course multiple times. Eighteen of the students had also placed

into developmental English courses, and three of the twenty were enrolled in both developmental English and math during this semester. No students were enrolled in English Language Learner classes. Ten of the 28 students placed into college-level English.

I had experience working with four of the students in previous semesters. For one semester Pam was a student in my self-paced, technology-driven developmental math course. She made adequate progress for the semester but did not ever complete the course requirements. Pepper was enrolled in this course with me in a previous semester. Aliya was a student for three semesters in my self-paced, technology-driven developmental math course. At my suggestion, she switched to a classroom format rather than self-paced. Although these students experienced varying levels of success in my previous classes, they felt comfortable with me as a teacher and told me that they chose to enroll in this course for that reason. Ashley successfully completed MAT 075 with me then chose me as her MAT 095 instructor.

Of the 28 students enrolled in the course, 18 were female and 10 were male. The demographics of the students in the class were 37% white, 33% African-American, 22% Hispanic, 4% East Asian, and 4% Middle-Eastern. Half of the students were of non-traditional age. One of the students was deaf and did require an in-class interpreter. This student was concurrently enrolled in a developmental English course.

In the course of the semester, no new students were added, but 7 students either withdrew or stopped attending class. Two of these students received grades of F, W, or N for every class in which they were enrolled. One student withdrew from three

classes and earned a D in the fourth class. Another student withdrew from two classes and earned a D in the third class.

### **Classroom Setting**

The classroom setting was similar for each section (see Appendix H). Tables were lined up in rows. Though there was no assigned seating arrangement, most students sat in the same location each class. The tables faced the white board and instructor podium set up at the front of the room. The chairs were on wheels and could easily be moved into a small group configuration. The walls were bare, other than the white board and projector screen. One of the walls had windows from table level to ceiling. Though the rooms were sterile, the tables were in excellent condition, the chairs were height-adjustable and soft, and the instructor had instant access to technology, including an internet ready work station and a document projector. The video camera used to collect data was placed in the back of the room. The rooms were similar in many aspects, but there were some notable differences.

The room used for the early morning class was located on the first floor of the building and had room for 40 students. Although the room was spacious, the entrance to the room was crowded with desks and a trash can, which made it difficult for the student using the wheelchair to enter and exit. The building has been renovated recently, but the outlet box at the front of this room was no longer securely attached to the wall. The only other outlet in the room was located on the back wall. On the first day one of the students requested that I lock the door at the start of class.

The room used for the late morning class was located on the second floor of the building and had seating for 32 students. This room had been altered from the

original design and is smaller than the average classroom. To make more classroom space, an office was divided in two. The smaller side remained an office, and the larger side is the classroom to which I was assigned for the late morning section. This room had an L-shape rather than the rectangular style of the other rooms. The ASL interpreter sat at the front of the room directly in front of the student who was deaf.

A typical class meeting usually began with some warm-up problems to either review material from the previous class or to remind students of pre-requisite content to be expanded upon during class. The problems would be projected on the white board while the instructor greeted students and checked their progress. Sometimes students would present the solutions, and other times the instructor would present the solutions. The remainder of a typical class consisted of short amounts of teacher direction and presentation of new material followed by an opportunity for students to practice, discuss, and present their work.

## CHAPTER 5

### INITIAL FINDINGS

As mentioned in previous chapters, during the course of my study my thinking evolved in directions that were unanticipated in my original design and research questions. This evolution was the result of two chief factors: (1) the richness of students' lives as revealed in their math autobiographies, comments, and informal conversations and (2) what seemed to be a reluctance on the students' part to grow beyond their dependence on me and to think for themselves. Both factors pointed to issues of social class and power that were not part of my original thinking and study design. I will thus divide my analysis into two sections: In Chapter 5 I will describe how and why the course evolved from its original design, the parallel evolution of my thinking, and the findings based on my original research questions. In Chapter 6 I will present the less-anticipated findings that emerged as a consequence of the evolution of the course, theoretical framework, and analysis.

#### **Evolution of the Course**

In Chapter 3, I described the course as I originally designed it. At the beginning of the semester, I determined that the initial design would not be appropriate. In this section I will describe problem solving activities in more detail, explain the changes made to the course, and discuss how the changes affected data collection.

**Phase 1.** At the beginning of the semester, I had to alter the intended structure for the class in ways that I hadn't anticipated, which interfered with the type of data I wished to collect. I did not see this interference, however, as an obstacle but rather as

an opportunity. The ability to adapt to unexpected contextual factors was, in fact, one of the chief reasons I chose an exploratory, qualitative methodology. Initially, I planned to structure the course so that class time was devoted to problem solving and homework time was devoted to developing basic skills. I planned to use technology to record lessons on basic skills for students to access through the Internet. The lessons were to be recorded using a Smart Pen so students would have a printable PDF of the lesson and could also listen to my voice narrating the lesson and pointing out some nuances that might not be written. On the first day of class, I learned that one of the students in my class was deaf and required an interpreter. In addition to needing an interpreter, the student struggled to understand written text. In order not to alienate this student, I changed the format of the course to include more basic skill lessons during class time, which meant less time devoted to problem solving. Though students were receiving less problem-solving time than I had hoped for, they were still receiving more emphasis on problem solving and critical thinking in this course than in any other section of beginning algebra.

The first problem-solving activity was given during the first week of class, before students had turned in their autobiography assignments. The topic of the activity was death penalty cases for murder in the state of Florida (see Appendix E, page 150). The data used were relatively old, from 1976 to 1987. For the first part of the activity, the data were divided into two categories, based on the race of the defendant. In the second part of the activity, the data were subdivided even further to account for the race of the defendant and the race of the victim. Why did I choose this topic for investigation? Most of the students did not have any experience with crime or

the legal system, though some were actively engaged as defendants in different cases while enrolled in this course. Based on a quick show of hands I determined that more than half of the students have never been to Florida and were not even alive in 1987. I did not know that the Trayvon Martin case would be heard in Florida during this semester. I knew from past experience with students at this institution that many students do not see racism as a problem in our current society or within its institutions. For their first leap into questioning assumptions and thinking critically, I wanted to provide them with an example of how numbers can be used to influence people's beliefs.

On the first day of class I announced that we would have another word problem. I used the document projector to display the table (Table 2), and I handed out a paper with questions to think about.

**Florida Death Penalty Data 1976 - 1987**

	<b># of Murder Trials</b>	<b># Receiving Death Penalty</b>
<b>Black Defendants</b>	191	15
<b>White Defendants</b>	483	53

Source: Radelet, M. L. and Pierce, G. L. (1991). *Florida Law Review*

**Table 2. Death Penalty Assignment – Part 1**

As I handed out the paper, I talked about the table and the need to understand what was in the table. I asked, “What does the number 191 represent? How about 483?” I went through all four numbers in the table. When students described what the numbers represented, I pointed out that they were taking the labels from the columns and rows to form their description. I asked students to look at question 1, which asked



them to use “the information in the table, to make at least three statements involving math that describe this situation.” Most students started writing, but a couple students just stared at the paper. I told them, “If you aren’t sure what to do think of some good math words like ‘more,’ ‘less,’ ‘total’ and see if you can use those ideas to describe the situation.” After students had the opportunity to write down a few statements, I asked them to share their statements with the people next to them. We then brought everyone together to generate a list from the entire class. The list included:

- there were 292 more white defendants than black defendants,
- the data covered 11 years,
- on average there are about 27 more white defendants than black defendants per year,
- 10% of all murder cases resulted in the death penalty,
- the total number of murder trials was 674,
- 38 more white defendants received the death penalty than black defendants,
- about 8% of black defendants received the death penalty,
- about 11% of white defendants received the death penalty,
- 92% of black defendants didn’t receive the death penalty,
- 430 people on trial for murder did not receive the death penalty,
- the number of defendants is approximately 10 times the number of people receiving the death penalty, and
- a lower percentage of black defendants received the death penalty than white defendants.

For homework, I asked students to respond to the remaining questions, “Are you surprised by the information in this situation?” and “List any additional questions that you have based on this situation.”

On the third day of class, we started the second part of the death penalty assignment. I said we were going to look at the information in more detail, and I told the students that I had another table for them. I used the document camera to project another table (Table 3) and began handing the assignment to students.

**Florida Death Penalty Data 1976 - 1987**

		# of Murder Trials		# Receiving Death Penalty	
		Defendant		Defendant	
		Black	White	Black	White
Victim	Black	143	16	4	0
	White	48	467	11	53

Source: Radelet, M. L. and Pierce, G. L. (1991). *Florida Law Review*

**Table 3. Death Penalty Assignment – Part 2**

I asked them not to think about the questions yet but to “look at the table and try to figure it out first.” “What information is it showing?” Some people said it had information about the victim. I pointed to the 48 and asked, “What does this 48 mean?” I then did the same thing with 467. I asked them to do two things for homework: (1) convince themselves that the data from table 1 and the data from table 2 represent the same number of people then (2) complete question 1 for homework. At the beginning of the next class, we generated a list of descriptive comments from the entire class. The list included:

- in 11 years there were an average of 6.2 defendants receiving the death penalty per year,
- white kill black: 0% received death penalty,
- black kill black: 3% received death penalty,
- white kill white: 11% received death penalty,
- black kill white: 23% received death penalty,
- the total number of white (defendant) murder trials was 483,
- 96% of white defendants had a murder trial with a white victim,
- 90% of black defendants had a murder trial with a black victim, and
- 73% of black defendants receiving the death penalty had white victims.

Now that I have described the implementation, I will outline the pedagogical and content rationale for the structure of the assignment. The first question in each part of the assignment was open-ended. I wanted students to see that they could use mathematical terms to paint a more detailed picture of the situation. Even if students gave basic information about the total number of defendants or the number of defendants not receiving the death penalty, they were able to make a valuable contribution to the discussion. In each class, we generated lists with more than 20 descriptive statements about each situation. This helped students see that questions asked in a math class do not always have a single answer. Approaches to open-ended questions and interpretation of the situation depend on the individual. This activity also helped to break down the ideology of certainty surrounding mathematics when comparing the descriptive statements from both parts of the assignment. Through class

discussion, students were able to see how math could be used to describe the same situation in very different ways.

This activity was given at the beginning of the semester. The mathematical concepts I expected students to use within their statements were addition, subtraction, fractions, ratios, and percentages. These topics are all prerequisite material for beginning algebra. Based on student responses, I was able to review the required material within the context of the situation. For example, students were comfortable with the concept of totals and differences, but some did not recall how to calculate percentages.

For question two in each assignment, I asked students if they found anything about the situation surprising. My intent was to help determine a baseline critical measure for each student. Were students questioning the data, especially in part 1, based on outside knowledge and/or stereotypes or were they simply accepting the values because numbers don't lie? This is not a perfect critical measure because some students may not have had the outside knowledge to question the information.

## **Phase 2.**

After I determined that my initial course structure needed modification, I decreased the number of problem-solving small-group discussions during class time, and I increased the amount of time spent on conceptual development and skills. In order to have students become part of the decision making process, I asked students to fill out a sheet telling me what topics they would like to learn more about or investigate as part of the problem-solving experience, explaining that I would use their input to develop future problems. Some themes that multiple students requested,

which appeared throughout the semester, were gas prices and information related to level of education and race. Though some students had indicated other, in my opinion, more interesting topics, I intentionally chose not to pursue those topics in order to maintain the comfortable learning environment we had established for all students. For example, one student wanted to look at incarceration rates and race for individuals within the state, and another wanted to further investigate sexual harassment and assault rates. I chose not to pursue these particular topics because there was a student in class awaiting trial on a sexual assault case, and I did not want to alienate him.

Changing the course design also changed the data on which I was focusing. Initially, my intent was to concentrate on the classroom discussion involved with the problem-solving activities. When I decreased the amount of problem-solving discussion, I concentrated more on the written work of students and the discussions before and after class. I also focused more on my role in class discourse.

### **Evolution of the Analysis**

At the beginning of the semester, I started the early analysis of data to determine patterns based on my initial research questions. As the analysis progressed, I found other patterns emerging. In this section I will describe the trajectory of my original analysis, then the analysis of emergent issues.

**Phase 1.** In my early analysis, I began coding the student autobiographies and identifying passages related to the four areas listed in the initial research question: (1) beliefs about mathematics, (2) attitude towards mathematics, (3) perception of their ability to do mathematics, and (4) perception of their ability to use mathematics to bring about change in their lives or the world. I then began coding my field notes. I

noticed that one of the four areas, perception of their ability to use mathematics to bring about change in their lives or the world, from the initial research question, was not surfacing during the coding process. I was not surprised by this lack, however, because of the short time frame of the study. I will discuss my initial findings later in this chapter.

**Phase 2.** As I was reviewing student artifacts and field notes, I began to notice recurring incidents related to power or, more precisely, the tendency of students to be dependent on the instructor, unaware of their own autonomy and potential for power. I also noticed the sense of community that was building in one of the sections and not the other. I started the coding process again with a new focus. I will discuss my extended findings in Chapter 6.

### **Initial Research Questions**

Initially, I was interested in how the combination of critical pedagogy with functional and critical mathematical literacy affected students' beliefs about mathematics, attitude towards mathematics, perception of their ability to do mathematics, and perception of their ability to use mathematics to bring about change in their lives or the world. Throughout the course of data collection during the semester, my interest shifted to studying the issues of power and class culture that were evident in the data. Although my focus shifted, I was still able to address three parts of the initial question: (1) the change in students' beliefs about mathematics, (2) the change in students' attitudes towards mathematics, and (3) the change in their perception of their ability to do mathematics.

**Beliefs about Mathematics.** At the beginning of the semester, students described their beliefs about mathematics in their autobiographies. The majority of students described math as very procedural. Math was often associated with rote memorization for short periods of time. When describing previous math classes, Ashley, Farah, and Laura wrote of similar strategies for passing tests.

Ashley: *I usually learned only enough to pass the tests and by the next day, I would forget most of the material.*

Farah: *I learned just enough to pass tests and make it through the math class, but then after high school was over, I forgot everything.*

Laura: *In high school, I learned just enough math to get by and pass the class.*

Another student, Raina, wrote that she struggled with math because “*I get confuse and I have a hard time remembering and memorizing the formulas.*” Math was viewed as the ability to compute correctly.

Students also tended to note a difference between school math and real math. Mekelle referred to the procedural aspect of mathematics and wrote “*there is more structure with math in school, and in outside math rules can be broken and specifically fit for any particular situation.*” Claire was similarly of the opinion that school math is more abstract and procedural than real math.

Claire: *School math is teaching the student a group of equations and learning how to solve them. You’re taught some of the necessities you need in real math. Real math, in my opinion, is calculating.*

Dionne also believed in a procedural view of mathematics, as evident in her description of past struggles with math: “*I am just one of those people that just ‘gets*

*by in math to pass. I know it's bad but I forget all the rules and properties.*" Her view of the differences between school math and real math is interesting considering her past struggles with math. She wrote, *"In school, math is set up differently to help you learn. In the real math world, it's made so the math is already done for you."* Once again, the focus is on computation rather than a thinking process. Dionne saw the structure of school math as intentionally different to help learners, but the irony is that the structure of school math did not help her learn math.

Over the course of the semester, some students expressed a change in belief structure, while others clung to the procedural view of math. In her final reflection, Laura continued to relate success in math to seeing examples of problems and then redoing similar problems until she had memorized the procedure. Unfortunately, Laura did not earn a passing grade in the class. Claire did earn a passing grade for the class, but her beliefs about math did not change. She *"found every topic to be easy to understand because everything was taught step by step so it was easy to remember."* Ashley also successfully passed the class, but she had a shift in her beliefs. Initially, she thought of math as an exercise for the memory, but by the end of the semester her focus had changed to understanding rather than memorization.

Ashley: (referring to the level of education word problem) *I think the problem provided information on an important issue and, without it, I may have never considered how different the levels of education are among races. This table made me think about why there are such large differences and made me want to know more. I almost forgot we were*



*dealing with math. Using the information to predict future data was very informative and made the process understandable.*

Raina is another student whose beliefs began to shift from viewing math as content to be memorized to viewing math as content to be understood. She was taking the class for the second time and began with the belief that math was a series of steps to be memorized. She had not completely moved away from viewing math as an exercise in memorization. Her favorite part of the course was using substitution to solve a system of two linear equations because she felt the steps were “*easy to understand and memorize.*” In her autobiography, Raina included four passages describing her beliefs about math. Three of those passages focused on memorization and procedures, while only one passage included the desire to understand the concepts. In her final reflection, Raina included eight passages about her beliefs about math. This time, only one of the passages referred to memorization while the other seven passages referred to understanding. Based on informal conversations after class and the shift in the number of times she referred to understanding versus memorization in her final reflection, she was beginning to see math as more than just content to be memorized.

**Attitudes towards Mathematics.** When coding the data, I looked for evidence of student attitudes towards mathematics. The evidence I found fell into four categories: (1) overall usefulness of math, (2) enjoyment of math, (3) people who are good at math, and (4) self-perception of their ability to do math. Throughout the semester, I did not find any evidence of change in most categories. Students were divided on the importance of math in their lives. Students who were planning on being social workers, nurses, and engineers felt that math would be required for their jobs.

Students who were planning on entering law enforcement, or becoming artists or rehabilitation counselors did not feel that math would be required or beneficial to their future jobs. Farah felt that math is only useful to understand science.

In the autobiography assignment, a few students indicated that although they struggled with math, they enjoyed doing it. Throughout the semester and in the final reflection, many students indicated that they enjoyed the math class, but I was not able to separate their attitude towards math from their attitude about the class. In the autobiography, most students indicated that anybody can be good at math if they are willing to work hard and persist, though some people, as Ashley wrote, “*are born with a gift for understanding numbers.*” I am not convinced that students truly believed this about themselves. Immediately after stating the belief that anyone is able to learn math, students would write “I am not good at math.” In the next section, I will provide more detail about students’ perceived ability to do math.

**Perception of Ability to do Mathematics.** Most of this section will be devoted to students who began the class with low confidence in their math abilities. Few students showed no change in confidence level or offered conflicting evidence. Most students showed an unambiguous positive change in their math confidence. At the end of the section I will focus on a student who reportedly lost confidence in her ability to do math. The only students represented in this section are students who completed the course, whether successfully or unsuccessfully.

**No change in perceived ability.** Two students in the class either showed no evidence or conflicting evidence of an increase in perceived ability to do math. Farah began the semester lacking confidence in her math ability. She wrote, “*If I do it by*

*myself, I will struggle with it and have problems.*” She went on to state, *“It’s easier for me and when I have people helping me with math, I don’t struggle.”* In her final reflection she still believed that she could not set up word problems without someone helping her.

Laura also began the semester lacking confidence in her ability to do math. When describing herself at the beginning of the semester she wrote, *“I am not a math expert. I am not good at math at all.”* Within the same assignment, she later wrote *“Math is difficult to me.”* She also indicated that *“anybody can be good at it (referring to math), just like anything else; it’s just that some people have to work harder than others.”* Throughout the semester, she attended class regularly but did not complete all of her homework. This is where I began to see the contradiction, she knew math was difficult to her, she wanted to pass the class with at least a B, and she believed that anyone can do math with enough hard work, but she did not demonstrate that she was willing to do the work required. In her final reflection she wrote, *“I feel as though all of the topics were easy to understand.”* She also wrote, *“I feel as though this course was a great one, and that you are a very great professor,”* leading me to believe that she perhaps she was giving me what she believed were the socially desired answers rather than what she actually believed to be true. Alternatively, she may have been sincere in her positive evaluation of the class but put in less effort than she might have due to a lack confidence that more effort would be enough to make a difference.

***Positive change in perceived ability.*** Most students began the semester with low confidence in their ability and showed signs of positive change in their perceived ability to do math. Julie had experienced some degree of success in the previous level

of developmental math, but, by the beginning of the semester, she had forgotten much of the content. She still found that math was a hard subject. By the end of the semester she had develop some confidence in her math ability and a sense of pride in her accomplishment. She appreciated the time to attempt problems in class with others present so that she could ask questions if she got stuck. As she wrote in her final reflection, *“I know that coming into this class I did not have much confidence in math but now I have a little. I think the quiz I got a 100 on was my first 100 in math ever, on a quiz at least.”*

At the beginning of the semester Ashley wrote, *“I am not good at math”* and *“I get discouraged very easily.”* Yet she also believed that, with enough time, anyone could be good at math and decided early in the semester that she was going to try changing her habits related to math. In the past, she gave up easily when she *“was flustered,”* but this semester she decided that she was going to push herself harder. She was very successful throughout the entire semester. She completed every homework assignment, attended every class, with the exception of when she had dental work performed, and earned an A on every test. In her final reflection she described her transformation.

*Ashley: During my classes, I usually stay quiet. Most times, I don't ask for help if I am struggling and I also don't answer questions even if I know the answers. This semester I tried to change that. I think becoming more involved in class gave me confidence that I was capable in understanding math. Also, when I was struggling I would email or stay after class to ask a question. I think that has made a huge difference. It*

*is easy for me to become frustrated and give up when I don't understand a math concept. So, before I get to that point, I spoke up and was able to understand and succeed. This semester, I truly applied myself. I made sure to complete all assignments and prepare for all tests. Math is typically my worst subject and I usually lack confidence that I arrive at the correct answers. I am surprised at how well I have done and I owe that to you.*

Ashley had the determination to change her relationship with math. All that I did was help establish a safe environment for her learning. Through her hard work and dedication, she developed confidence in her abilities.

One other student who exemplified a positive change in her perceived ability to do math is Raina. At the beginning of the semester she said she tended “*to just give up doing math homework*” if she didn't get it the first time. She believed math was not her strong subject and she would get confused. Her description of word problems embodies what students often seem to feel: “*Word problem confuses me and sucks the life out of me.*” She confessed in her final reflection that she considered skipping class because she hated word problems because they confuse her. Nonetheless, she came to class for all of the word problem activities. After a few problems, she began writing messages on the back of the rating papers. The first message I received from her was, “*Looking forward for more word problems because I easily get confuse but I now understand it so well... so Thank you.*” A couple of weeks later she wrote “*Weee! I'm getting good at this. Thank you.*” She also included a smiley face, a heart, and a smiling stick figure labeled “*happy me.*” On the final word problem rating card of the

semester she wrote, “*I’m getting good at word problems. Thank you.*” At the end of the semester she shared her experience with the text-book mixture problem.

Raina: *I actually get it and was proud of myself because I got it right 😊 I was soo happy that I actually put it on my facebook and twitter account 😊*

Overall, she stated that she is “*now not afraid to do word problems.*” Like Ashley, Raina displayed the determination to overcome the desire to just give up and built her self-confidence when she experienced success.

***Negative Change in Perceived Ability.*** Only one student who completed the class reported a decrease in her confidence level. Alicia began her autobiography describing her “*rocky relationship*” with math. She recalled her first problem with math in the fourth grade. In both fourth and fifth grade, her dislike of math stemmed from reported conflicts with teachers. In grades six through eight, she had “*great math teachers*” and was successful. In high school, her perceived math success correlated with how much she liked the teacher. She did not refer to any issues with the content, just the personalities. When she got to my class, Alicia had been out of high school for at least eight years. Her more recent experiences with math as described in her autobiography were also based on her relationships with people. Her first developmental math instructor was “*patient.*” From what she learned she was able to help her boyfriend with his carpentry work and wrote that she had “*done much more math than she ever did before.*” Once again, she omitted her relationship with math per se and focused instead on her relationship with the person involved. She focused on her impression of the relationship between herself and a person of authority. She

tended not to relate well with other students and wrote, *“I prefer working alone because I don’t need to defend myself and my ideas.”*

Early in the semester Alicia asked me if I was going to review homework at the beginning of class. I told her that I did not plan to regularly review homework in every class. Part of becoming an independent student is to seek help when it is needed. Since she was on campus often, I encouraged her to stop in and see me if she had problems. I also let her know that we could use email if she was not on campus. If she let me know before class started, I told her that I could work a specific problem into the warm-up questions at the beginning of class. She never stopped in, sent me an email, or asked a homework question before or after class. Having homework review time in class seemed to entail more for her than just reviewing math concepts. Though she did not want to work with other students, Alicia seemed to rely on other people to determine her relationship to math. As she stated in her final reflection, *“I like knowing that the student next to me is either as confused or gets it like I do.”*

Based on Alicia’s writing, I believe she was struggling with the ideology of certainty surrounding certain aspects of school math. Her desire to listen to the teacher and not work with students indicated that she wanted to know the one correct way to do a problem. She also indicated that she valued low level work more than problems requiring critical thinking. In her final reflection she wrote, *“The days you gave us a ditto and we went over it the next day were my favorite.”* The work she was referring to was usually a handout given after a test to review old material and set the stage to learn new material. Where word problems were concerned, she sounded as though I was trying to impose a single way of approaching the problem when she wrote *“I used*

*to think I was good at word problems but now not so much. I know I have a different way of processing information but in class the ways you demonstrated how to solve never crossed my mind and on some occasions I still got the right answer, just a different way.”*

### **Conclusion**

Though my research focus changed as I immersed myself in the analysis, I was able to address some of the initial research questions. Though the experience of being in a social justice oriented developmental math class did not appear to have a consistent influence students’ attitudes and beliefs about mathematics, it did have a positive influence on students’ perceived ability to do math. In the next chapter I will present extended findings based on learner dependence and power relations experienced within the classroom.



## CHAPTER 6

### EXTENDED FINDINGS

Approximately half way through the semester in which I was collecting data, my committee suggested that I look into the theory of working class studies. Before I finished reading the prologue of *Reading Classes: On Culture and Classism in America* (Jensen, 2012), I knew that I had found a critical part of the theory to guide my analysis.

#### **Working Class Culture**

Though there is no single definition that could possibly describe all working class cultures, common themes do exist. Often community is emphasized over individual needs (Jensen, 2012; Torlina, 2011). Working class culture tends to be more position-oriented than middle class culture, with members focused on being and belonging rather than individual achievement (Jensen, 2012). Smith (2009) and Shor (1987) describe the value of cooperation and the respect for hard work demonstrated by members of the working class. People take pride in their final accomplishments but also in the process of working hard to reach their goal. The themes related to working class culture were evident in the classroom, through both instructor and student actions.

**Instructor.** Before the course started, I knew that I wanted to build a sense of community within the classroom. My rationale was that, if students felt comfortable with each other, the learning process would improve because there would be more discussion of ideas. From the first day of class, I was intentional about trying to develop a sense of community. I encouraged students to exchange contact information

and create study groups. In the Florida Death Penalty problem, students were given time to generate their own lists of statements about the data, then, when I saw that everyone had a few items listed, I asked them to compare lists with the people next to them. Finally, we brought it to a full classroom discussion. Some students would roll their eyes or sigh when I took time to explain basic concepts to the class. After reading the autobiographies and gaining a better sense of who they were, I directly addressed the students as a class. I chose to address the class while reviewing the comments and questions generated during the first part of the death penalty problem. The questions and comments covered a wide range of issues related to the death penalty question. I used this opportunity to remind students they were all coming to this class from different perspectives and different math backgrounds. Some had taken this class before and just needed to get a better grade, some were reviewing, and some were seeing the information for the first time, so I asked them make sure to be patient with each other.

As the semester wore on and I was listening to the recordings of the class-time, I realized that I was building a sense of solidarity with my use of indirect discourse (Manke, 1997). My use of pronouns usually positioned me with the class rather than as a teacher in a position of power. For example, at the beginning of class one day, while I was collecting homework and taking attendance I asked students to solve an equation that involved fractions. This was a review exercise, but I noticed that more than half the class was struggling to solve the equation

$$\frac{1}{2}(x + 8) = \frac{3}{5}x - \frac{7}{4} + 2x.$$

ME: *Ok, there are lots of different ways you can proceed with this one. I saw some people trying to get rid of the fractions. I saw some people working with the fractions. It really depends on what you are comfortable with.*

ME: *So looking at this what is the first thing you'd like to do?*

MULTIPLE STUDENT VOICES: *Distribute.*

ME: *Distribute. Ok. So we can distribute this one half through the parentheses and get (writing equation on the board as I speak) one half  $x$  plus four equals three fifths  $x$  minus seven fourths plus two  $x$ .*

ME: *Now if you are comfortable working with fractions feel free to carry out the solving steps using fractions instead of whole numbers.*

ME: *Do you want to work with the fractions or do you want to get rid of em?*

MULTIPLE STUDENT VOICES: *Get rid of em!*

ME: *Get rid of em? Ok. How do we get rid of fractions?*

MALE STUDENT: *Find the common denominator.*

ME: *Find the common denominator. Common denominator is twenty? (I look around to see if people agree or look confused. Some people do not appear to know why 20 is the common denominator.) We're looking for a number that is divisible by two, five, and four. Twenty is divisible by all of em.*

ME: *Now there's two ways we can proceed with this. The way we've been doing it usually is multiply both sides by the common denominator.*

Rather than differentiating positions of power by using “I” and “you” to describe roles in classroom activities, I often referred to us as a group by using “we.”

In this next example, I used pronouns in multiple ways. I start by using “I” and “you” to differentiate myself from the students. I handout an article (see Appendix E, page 152) from a local newspaper on gas prices and give them a chance to read it. Then I introduce the article and provide a summary of the information.

ME: *So I was sitting at home yesterday thinking of you and your percent homework and I found this short little article. In [our state] over the course of a week, gas prices for unleaded gas rose fourteen point three cents and closed at three eighty three on Sunday. That’s sixteen point seven cents higher than last month and seven point four cents higher than a year ago.*

I use the “I” again in my teacher voice to ask the question, then I make the transition to “we” to emphasize that we are a learning community.

ME: *So there’s no question here?*

*We’re going to focus on [our state].*

ME: *I would like to know: (I write this down as I say it) In the past week what was the percent increase in the price of a gallon of regular unleaded gas?*

ME: *As you are writing the question down, think about what numbers in the article are really important for us. (pause) What are the important numbers for us?*

FEMALE STUDENT: *Increase*

ME: *The increase. What was the increase?*

FEMALE STUDENT: *Fourteen point three*

ME: *Fourteen point three. (I write 14.3¢ increase). Any other numbers that are important?*

FEMALE STUDENT: *Average price*

ME: *What average price?*

FEMALE STUDENT: *Of gas?*

ME: *What number?*

STUDENT: *Three eighty three.*

ME: *Three eighty three – that’s the price we have (I write down \$3.83)*

In the next portion of the lesson, I use the pronoun “I” again, but this time I am putting myself in the position of a problem solver.

ME: *Please notice that when I write down this information I am making sure that I put labels on there. I’ve got my dollar signs, I’ve got my cent signs, I’m not just writing the plain old numbers.*

ME: *Now this three eight three. Is that the price at the beginning of the week or the end of the week?*

MALE STUDENT: *At the end.*

ME: *This is the price at the end of the week (I write down “price at end of week” next to \$3.83). So now before we can answer the question we need one more number. And the number is not found in that article.*

MALE STUDENT: *Last week’s.*

FEMALE STUDENT: *The beginning.*

ME: *We need to figure out the beginning of the week. So if you could please take a minute and fill in the price at the beginning of the week.*

STUDENT VOICES discussing the numbers

MALE STUDENT: *Said it rose fourteen point three in one week?*

ME (to an individual student): *Beginning of the week negative ten dollars?*

FEMALE STUDENT (to me): *Yah, I thought it was wrong*

As the lesson continues, I continue to use the pronoun “I.” This time, I am modeling a problem solver trying to make sense of a situation.

ME: *How do I find the price at the beginning of the week?*

MULTIPLE STUDENTS: *Minus fourteen point three out of three eighty three.*

ME: *So you do three eighty three minus fourteen point three?*

MALE STUDENT: *No*

FEMALE STUDENT: *Ya gotta line up the decimals*

MALE STUDENT: *Well, point fourteen*

ME: *Point fourteen?*

MALE STUDENT: *Point fourteen three*

ME: *Why would I do that?*

FEMALE STUDENT: *‘Cause it’s cents*

I then slip back into teacher mode and use “we” to reestablish the sense of solidarity.

ME: *Exactly. It’s cents. One is in cents. One is in dollars. Our units aren’t matching. In order to subtract these things, we’ve got to make sure the units are the same. So don’t just go punching in numbers without*

*thinking about what they represent. We want to change fourteen point three cents to dollars.*

This example demonstrates flexibility in the use of pronouns. By changing the way I use pronouns, I am de-emphasizing the teacher as the authority figure and building solidarity within the class. Note that the teacher is still clearly the authority figure. The students requested gas prices as a topic to investigate, but the teacher found the article, asked the questions, and is still controlling the class.

My use of pronouns also set me apart from the math department at my institution as well as mathematicians and text book writers. Throughout the semester I would identify the level of importance for different concepts. Some concepts were important for understanding future math topics, but other concepts were important because “they,” meaning the math department, classified them as important. This semester, I did not comment on my dislike for this type of problem because I wanted students to fill out a rating card related to a mixture problem. I did not want them to be biased because of my feelings towards mixture problems.

*ME: Now I have to give you fair warning. The department likes mixture problems. They write the final exam. You are guaranteed to see a mixture problem on the final exam.*

I would also identify potential issues that students would encounter when using the software package, MyMathLab. This particular warning was in regard to graphing lines. In class we would graph three points before drawing a line. The third ordered pair was a check to make sure that the points lined up.

ME: *When you're in MyMathLab doing your homework, they will only allow you to put in two points. Don't try to do three because they won't let you.*

I found myself referring to the software program as “they” when I needed to warn students about how to enter their answers. I referred to it as “MyMathLab” when I wanted them to do homework or download a document.

The use of pronouns also surfaced in the discussion of the conventions used when writing the standard form of a linear equation. In this example, students started with an equation in point slope form and needed to rewrite the equation in standard form. The equation is of the form  $\frac{2}{3}x - 6y = 7$ .

ME (addressing the class): *What do you think?*

JOE: *I don't like fractions.*

ME: *We are actually in luck because the people who came up with standard form, they're not crazy about fractions either. They don't want fractions in standard form.*

ME: *So when we use standard form, we don't keep fractions. How do we get rid of fractions?*

JULIE: *Multiply both sides by the denominator.*

When addressing the convention of organizing the terms in a polynomial, I do not use refer to the rule makers but just the rule. This excerpt surrounds the polynomial  $-3k^5 - 6k^2 + 12k^3 - 8k^4$  obtained by adding two other polynomials.

ME: *Susan asked a question earlier.*



*Does it really matter how we write this? Which term comes first, which term comes last...*

*And, in the grand scheme of things, no, it doesn't matter, as long as you have the terms and the signs of the terms correct. But, according to convention, there is an important order. According to convention, you start with the highest degree term and you end with the lowest degree term. You write the terms in decreasing order by degree.*

I wanted students to know the convention established long ago, and the format expectations when using the software program and even in future classes. I also wanted to convey that multiple ways exist to represent an answer. An answer can be correct even if it does not follow conventional notation.

Throughout the semester, my use of indirect discourse also extended to nonverbal communication. This is an excerpt from Aliya's final reflection:

*We had a quiz scheduled and I'd been sick the entire previous week, missing both classes. I came to class, prepared to take either a zero or to start with a lower grade (so I could take it later) and my professor insisted that I at least try. When I attempted to submit half-finished work, I was returned to my seat with what I refer to as the "side-eye"—that look your parent gives you that requires no words. In the end, I received a strong C on that quiz and I was grateful that my teacher didn't allow me to settle... This experience reminded me that there are teachers who authentically care about each individual student.*

I knew that Aliya was capable of doing more than her initial attempt and I knew that Aliya also had insecurities in her mathematical ability. I did not want to call her out in class and directly command her to go back and try harder.

**Students.** In both sections of the course, I observed students attempting to create their own sub-communities within the class. In the early morning section, Cheri often reached out to other students. Cheri is an African-American woman who was taking this course for the third time. She has at least four children ranging in age from 8 to 20 and is currently unemployed. At the end of the semester she told me that she was pregnant. Cheri attempted to connect with Joy and Carmen. Joy is a Haitian woman who is in her first semester at the college. She is also enrolled in the beginning English Language Learner class. Joy occasionally works with the one tutor in the Tutoring and Academic Success Center (TASC) that knows a little French. She has at least one child who was undergoing surgery at the end of the semester. Carmen is a Colombian woman, also in her first semester at the college and also enrolled in the beginning English Language Learner class. Carmen has a family and is heavily involved with her church. I noticed Cheri exchanging contact information with both of these women and approached her after class one day.

Cheri had a particularly moving exchange with Joy near the end of the semester. Joy's daughter, who was twenty-three months old, was going for surgery three days before the final exam. Joy was worried about her grade and asked me after class how well she needed to do on the upcoming test and exam in order to pass. After I calculated the grades and told her that she was definitely able to pass, she informed me that she would be missing class on the exam review day because her daughter

would be in the hospital. I asked her to keep me posted and to let me know if she needed to reschedule the exam. Joy returned to her seat to collect her belongings and Cheri put her arm around her. Joy proceeded to crumple into Cheri's arms. Cheri quietly talked with Joy, telling her about the time her son went in for surgery and then gave advice.

CHERI: *It's not an easy process, trust me. Especially when you gotta watch them go under.*

*You get in there and you make sure you are the first one she sees when she wakes up.*

After Joy left, I told Cheri, *"You are so nice! I am glad you were here and comforted Joy."*

Cheri replied matter-of-factly, *"I know what she's going through. She's very nervous."* Cheri is by nature a caregiver, and this part of her personality translates into the classroom. This particular attempt at building a learning community was not successful. Both Joy and Carmen were embarrassed by their relatively inability to speak English and tended not to speak. The physical environment of the classroom could have had an effect on the community building within this section. The room was large enough that people were spread out in the room.

In the late morning section the room was much more compact, so people could not spread out. A sub-community did successfully form in this section. Maria, Shaniqua, and Farah developed a bond both in and out of the classroom. Maria was the definite leader of the community. She is Latina and at least forty years old. She is

actively involved in her church. She does not have a family, though she does have a boyfriend who lives about an hour away. She relishes her independence.

MARIA: *I was visiting family in OtherTown. My boyfriend is there as well. He wants me to move back there and I like it here. I said I'm not going to move back until I get done.*

ME: *Tell him to come here.*

MARIA: *No, his kids are in OtherTown and that's just not happening. I'm just scared that if I go down there... He likes when I'm there. I can't do my stuff when I have to make sure... I have to clean the place because the place is a mess. I feel like I'm more my own woman here. It is very important. I am coming to the conclusion that... am I going to be my own independent woman or am I going to cave into him and all that stuff? I don't have time for this. This is a chance for me to discover who I am.*

ME: *Throughout the rest of your life, have you done that or have you been catering to everyone else in the world?*

MARIA: *Oh yeah. My mother, my family, my dad. I always been taking care of everybody else and I'm last. By the time it comes to me, I can't do anything.*

Maria is determined to be successful in school and will not let anything, even her relationship with her boyfriend, distract her.

Shaniqua is a married African-American woman. She is also at least forty years old. Farah is a younger Iraqi-American woman who lives with her parents. The

three women arranged study sessions throughout the semester. Maria would scold Shaniqua if Shaniqua did not live up to Maria's expectations.

MARIA: *Ok Shaniqua, listen. We can meet up this weekend.*

SHANIQUA: *Ok, um...*

MARIA: *But if I go over to your house it has to be quiet.*

SHANIQUA: *Well listen, I got three kids and a dog so I can't tape their mouths shut. I'll get child abuse!*

MARIA: *Well, we can go to the public library*

Maria and Shaniqua are of similar age and both were knowledgeable about expectations of behavior in American culture. Farah is a young Iraqi-American woman, born and raised in the United States but still unaccustomed to mainstream American culture because she was raised in a traditional Iraqi household. Maria and Shaniqua were more gentle with Farah than with each other, but throughout the semester, they brought her into their math sub-community and helped her be more aware of how the mainstream American culture might be at odds with her Iraqi culture. The first encounter happened about a month into the semester and revolved around communication for setting up a study group.

MARIA: *We had a ... We had a... I talked to Farah and you know she apologized. I said Farah you could at least text. She said she can't text. I said well, listen, if you're gonna have a study group. I'm not angry, I'm just letting you know. It doesn't have to be me – it could be anyone else – when they're calling you consistently every day at least more than one time a day and you don't get back to them – any normal*

*human being will think that you're brushing them off. And I said I understand – I'm not angry*

SHANIQUA: *But she doesn't know how to tell us.*

MARIA: *What do you mean she doesn't know how to tell us?*

SHANIQUA: *She doesn't know how to tell us. It's her heritage and her family, their culture.*

MARIA: *I explained...No...Hold up. I already know about their heritage. I have a friend...*

SHANIQUA: *Yeah, she says her father doesn't mind but her mother does so*

MARIA: *After six, but I've called before six and I've done that so now she is making an effort. She said she's going to download an app and I'll call you. I said I'm not angry with you but I said...*

ME: *She needs to know for the future.*

MARIA: *Yeah I said Listen, it doesn't have to be mean but people will take it that way.*

About a month after the first conversation, the discussion extended to social gatherings, not just study groups.

MARIA: *I talked to Farah. I said "Farah, honey, you have a busy life. I know you have rules.*

SHANIQUA: *I just wanted to call and find out why.*

MARIA: *Well I was nice.*

SHANIQUA: *Yeah, I know you were.*

MARIA: *I was nice to her. I said "It doesn't have to be first thing." No. I just told her... I told her it would be good for her to get out. We don't have*

*to do studying. We can go to an afternoon matinee. Did you not hear me say that?*

SHANIQUA: *Yeah.*

MARIA: *What's wrong with that?*

SHANIQUA: *I think that's a great idea, but I just don't want to pressure her.*

MARIA: *I am not pressuring her.*

SHANIQUA: *But I am saying... I don't think you are, but her situation is something that we would never imagine.*

MARIA: *No. I know her situation. I used to work for an Indian lady, and I know how the whole family is. But she has leeway. She said as long as she gets home before six o'clock. There you go. I just told her I'd leave the ball in her court.*

SHANIQUA: *Yeah, I see that was nice... giving her the option.*

MARIA: *But she like, really... You can even tell how she reacts to people and she needs to get out. It's gonna help her, too. She's gonna be a nurse. She's gonna need those...*

SHANIQUA: *Those social skills*

MARIA: *Yeah. She can't be like that. She won't have a nice bedside manner.*

Both Cheri and Maria have experienced some degree of success in mathematics. Both passed the first level of developmental math, though Cheri has struggled for two semesters with MAT 095. Maria has established habits to help her be a successful student. She is always in class, takes detailed notes, asks questions both during and after class when she needs to, sees a tutor regularly, completes every

homework assignment in great detail, and participates in class. Cheri is still working to establish these habits. She often arrives late to class, asks questions during class, completes most homework assignments on time, and participates in class. Both women sit in the front row. Neither woman exhibits confidence in their mathematical abilities, but both are persistent in their desire to become more educated.

*MARIA: Having math skills is very important to me. All my bad experiences which I endured with numbers and concepts should have made me give up. I've taken care of all my immediate family and put my life on hold. I moved to MyTown to start my life. I decided it was time for me to move on and invest in myself.*

Both women have made sacrifices in their lives to care for those around them and are pursuing education for themselves. Regardless of their confidence level, they continue to be caregivers and reach out to other students in an attempt to help others adjust to the expectations of academic culture.

### **Education and the Working Class**

Community colleges are institutions that predominantly serve the working class population. Historically, the function of community colleges has been to prepare future workers (Zweig, 2011; Jensen, 2012; Peckham, 1995; Alberti, 2001). The theory was that workers need to be able to follow procedures and rules without questioning authority. Within the community college, this theory translated to low-level curriculum and practices (Johnson, 1996). Within the math class specifically, students are expected to master or memorize basic, low-level skills and are not expected to think critically or develop conceptual understanding.



**Learner Dependence: Classroom Practices.** Students at this level within my institution have already been enculturated to believe that original thought is not required in math class. As is evident in their writing and discussions in class, they have been trained to expect the teacher to provide rote steps and procedures for them to follow. In her math autobiography, Shaniqua told me, *“I feel I have learned a lot in Ms. Smith’s class and like her teaching techniques.”* Based on discussions with students and viewing their notes from Ms. Smith’s classes from previous semesters, I know that she presents math as rote procedures and formulas to be memorized. Maria also described being in Ms. Smith’s class as a positive experience and that *“the math professor should present the problem by solving it step by step on the board and assignment sheets.”* The view of the teacher as dispenser of knowledge is prevalent and is clearly visible when students describe how they best learn math.

DIONNE: *The best way I learn is by seeing it done. I seem to grasp it better seeing it done a time or two then I fully.*

RQ: *I find it much easier to learn by examples. If someone shows me the steps I grasp it much quicker.*

JOHN: *How I learn is by watching something being done over and over again along with very specific steps with nothing being skipped in the problem or else I get lost.*

Interestingly, these students also mention that they do not retain the material for long.

JOHN: *When it came down to it I just learned the material for the time being and it never really stuck in my head but I do recognize some things when I see them or relearned them again.*

The students have also been trained to rely on the teacher to evaluate their understanding of the material.

MARIA: *Every week, the sections that you cover, we should just have a quiz to see where we're at... It won't be a lot of pressure because it's every week but once a week it's ok. For me, I tell me it's well worth it because at least I know what I'm doing.*

By relying on the teacher instead of their internal sense of understanding, the students are reinforcing a status wherein the teacher is a person of authority and the student is powerless without the teacher.

I wanted to reinforce the belief, stated in *Everybody Counts* (Mathematical Sciences Education Board, 1989), that “more than most other school subjects, mathematics offers special opportunities for children to learn the power of thought as distinct from the power of authority” (p. 4). When Shaniqua approached me at the end of class one day and asked me to have weekly quizzes so that both she and I would know her strengths and weaknesses, I refused and explained my rationale. I told her that I didn't want her to rely on me to know whether or not she understood the material. I told her that my use of the warm-up questions lets me know what people understand and what they might be struggling with. I felt so strongly about this position that I restated it as part of the final reflection assignment. As part of the directions, I included a sample question. I then provided two sample answers. The first answer is an example of what not to do; the second response modeled the level of reflection and detail I expected to see in their writing.

The key to this assignment is to give lots of detail. See the example below:

*Me:* Why don't we have any quizzes?

*Not enough detail:* I don't like to give quizzes.

*Good detail:* My goal in this class (in addition to helping you learn math) is to **help you become a more independent learner**. You do not need me giving you a graded quiz to determine whether or not you know the material. When we do the warm-up questions at the beginning of class or when you are working on your homework, you have a good sense of what you know and what you need to learn. When I walk around the room while you are working, I get a good sense of what you know and what you still need to learn. Rather than give quizzes and perhaps “punish” you with a bad grade, we have the review problems at the beginning of class. These questions help get you thinking about the math needed for the new lesson, but they also help you figure out what you are having difficulty with. Once you know what you are having trouble with, you can then start to determine the best way to learn the information. You can come see me, you can see a tutor, you can search the internet, you can check out MyMathLab, etc.

Even with this passage as part of the introduction to the assignment, when asked what they would change about the course, some people still said they wanted weekly quizzes.

SHANIQUA (part of her final reflection): *I feel more quizzes at least once every 2 week will let the instructor know as well as the student there weakest point in the section.*

I am puzzled by this resistance to becoming more independent.

**Learner Dependence: Cell Phone Assignment.** To better understand the learner dependence situation, I looked at a pair of assignments which I will refer to as the Cell Phone Assignment (Appendix E, page 153). Day 1 of the Cell Phone Assignment involved classwork on a Thursday. The goal of the activity was to help students translate between the four different representations of a function. I provided a verbal description of a cell phone plan, including a monthly fee and a charge per text, that could be modeled using a linear function. As a class, we then represented the situation numerically in a data table, algebraically using  $y = mx + b$  notation, then graphically on a Cartesian coordinate system. Students were assigned homework through MyMathLab related to the representations of linear functions. In the next class meeting on Tuesday (Day 2 of the Cell Phone Assignment), we continued to learn about linear functions. The second part of the assignment was given as a homework assignment on Tuesday. This was a low-level homework assignment intended to reinforce the idea of multiple representations of functions and to prepare students for discussing the algebraic interpretation of parallel and perpendicular lines. The homework assignment was an exact replica of the classwork from the previous meeting with different values for the monthly fee and charge per text message. Students were given the verbal descriptions and asked to write equations and graph lines. On Thursday, Day 3 of the Cell Phone Assignment, I collected the student work.

Overall, I was not pleased with the results. Though some students did demonstrate understanding of the material and time spent producing high-quality graphs, half of the students either did not hand in anything or turned in low quality work that appeared to have been scribbled at the last minute. I devised a reflective survey (see Appendix E, page 154) to have students complete when they received their corrected assignments.

The next class meeting, Day 4 of the Cell Phone Assignment, I returned the homework and asked students to complete the surveys. In the early morning class, of the twenty students handing in surveys, six people did not hand in the cell phone homework assignment. Two that did hand in the assignment rushed to complete it within ten minutes before class. Of the twelve students who handed in the assignment and reportedly worked on it over the weekend, six students knew what they needed to do for the assignment and ten claimed to look back at their notes from day 1 of the Cell Phone Assignment. But I do not have confidence in this number, if all ten looked back at their notes, because I know some of the students claiming to look back did not take notes. I believe that some of the students were answering in a socially desirable way rather than reflecting on the reality. Of the twelve students handing in the assignment, none asked the instructor for help, one asked both a classmate and a tutor about the problem, and one other asked a tutor for help. Half of the eight students who did not hand in the assignment or completed it right before class indicated that the assignment was hard, though only four claimed to look at the notes and none of them asked for help.

In the late morning class, of the twenty-one students handing in surveys, seven people did not hand in the cell phone homework assignment. Four who did hand in the

assignment rushed to complete it within ten minutes before class. Of the ten students who handed in the assignment and reportedly worked on it over the weekend, six students knew what they needed to do for the assignment and eight claimed to look back at their notes from day 1 of the Cell Phone Assignment. Of the ten students handing in the assignment, none asked the instructor for help, one asked a classmate about the problem, and three others asked a tutor for help. Five of the eleven students who did not hand in the assignment or completed it right before class indicated that the assignment was hard, though only three claimed to look at the notes and none of them asked for help.

What does this response to the Cell Phone Assignment tell me about learner dependence? Some students, including Maria, Farah, and Shaniqua, did very well on the cell phone assignment. They were provided with a model and were able to follow the guided practice from class. As Farah says: *“I was satisfied with what I handed in because I did everything correctly and I did what the instructor says.”* Ashley said, *“I followed the formula from a similar problem we did and plugged in the new information.”* None of these students viewed this as a hard homework assignment. Though the format of the questions was different from the format of questions in a traditional math class, the principle is the same: the homework is just a regurgitation of the class material. This was a perfect homework assignment for a dependent learner. The fact that approximately half of the students either did not do the assignment or did not do it well indicates that factors other than learner dependence influence student completion of word problems.

## **Exceptional Cases**

**Aliya.** Imagine a single mother. She works full time. She is returning to school after more than 20 years. She is African-American. She was born in South Carolina but grew up and currently lives in a small city in New England with a population (in 2010) of approximately 28,000. The population of the city is 28.3% Latino, and 17.4% African or African-American compared to the state percentages 13.4% Latino, and 10.1% African or African-American. The percent of people living below the poverty level from 2006-2010 is 17.3%, compared to the state-wide 9.2%. At first glance, Aliya seems to fit the stereotypical profile of a developmental student at a community college. Taking the time to get to know her, however, reveals a much more robust picture of a vibrant woman.

One factor that differentiates Aliya from her peers is her educational background. During a visit to my office one day near the end of semester, Aliya shared her secondary school experience. Instead of the going to the public high school, Aliya attended a private, independent college preparatory high school located in her city. She experienced the culture shock associated with leaving her diverse, multi-racial world to a predominantly white, upper class world. She tells of the questioning students: Are you afraid to live in your city? Do you breakdance? She described the change in expectations from the teachers, similar to what Anyon (1981) described in comparing schools serving the working class to schools serving the upper middle class. Upon submitting repeated history papers and receiving grades of C or lower, she began to question her teacher's motives, because the same papers would have received a grade of A in her previous public school.

As a freshman, she had the courage to go to him and ask why she was receiving such low grades. The teacher took her paper and opened to a page and said, “That was a good point but why do you think that?”

Aliya proceeded to explain her thoughts. The teacher flipped through the paper and said, “Hmmm...I don’t see that anywhere in the paper.” He repeated this scenario a couple of times with different parts of the paper. She walked away from that encounter with two valuable realizations. First, she realized that her teacher was not the enemy and developed a respect for him. She took his words and changed her approach to assignments and began receiving better grades. This first realization was critical, since she would have this teacher for two more years! Second, she realized that, although she was getting good grades in her previous public school experience, she had not been receiving a high quality education. Her experience in this school also allowed her to develop strategies for negotiating the academic world. Though she respected her teachers, she did not fear them and learned to work with them to be successful. As she noted, “*When I find myself stuck, after several attempts, I make a note to myself and ask the professor (no shame in my game).*”

Though Aliya had an amazing secondary school experience, she did not develop and maintain confidence in her mathematical abilities. As she describes it: “*I usually engage math with a defeatist attitude, like there’s no way for me to conquer the great math demon.*” She is very aware of her anxieties and fears towards mathematics, and she has developed several strategies to overcome these anxieties. She states, “*When it comes to math, I experience an instant heightened level of anxiety, but note-taking, isolation, and music help soothe that.*” Her response when



asked about her math habits between the Tuesday and Thursday classes reflects her anxiety and dislike of math.

*ALIYA: Typically, Tuesday night, once I get my child settled, I crack open the homework and my notes from the day. I do my homework until I have some sort of epic bock (doesn't always happen). The block means put it away & finish Wednesday – otherwise, I finish the work that night... For purposes of full disclosure, I like to get the homework done on Tuesdays so there's no more math in my life until Thursday (no offense, true story though).*

In her career, Aliya regularly uses and interprets data. *“Statistics, trends, etc. are all part of what I do – how I'm able to connect disparities, inequities, and injustices to health outcomes.”* Nevertheless, she insists that she does not use math. *“I don't use math (in my estimation) regularly though – only primarily when it comes to reporting.”*

Aliya is highlighting a problem with math education. Math is viewed as an abstract activity performed in a classroom without any real-world connection. When Aliya was able to see the connection between math and her world in the problem involving educational levels for females of different races, she said *“The best part for me was being able to fuse trends with math, combining something I usually fear with something I love.”* Aliya also questioned the figures from the first part of the death penalty assignment and admitted that the math question was interesting to her. She wrote, *“This was an interesting sequence for me professionally. I still wonder about*

*the figures though – given the #s of blacks in the criminal justice system.”* Aliya provides an example of the importance of the connection between the learner and the curriculum (García & Smith, 1996)

**Gedeon.** On the first day of class, I was walking around the room talking to people and taking attendance, when I came to a name that I had never seen before, Gedeon. I attempted to pronounce the name and the man in the back of the room said that was close enough. At the beginning of the next class, as I was walking around talking to students and trying to learn names, I asked him the correct way to pronounce his name so I could say it correctly. He did answer me but, in general, he was very quiet. He would not sign the IRB form for participating in the study. He did not hand in the autobiography.

Since he did not hand in the autobiography assignment and spoke little during class, I knew very little about him. I could tell that English was most likely not his first language and that he was probably around forty years old. He was left-handed. He was slightly overweight. He would not volunteer to speak or ask questions in class. However, as was evident in his analysis of the death penalty data, he was very thoughtful. Though he would not hand in his paper, I viewed it during class. Both on the paper and quietly to me during class, he mentioned that the date might be affected by the jury selection. He was also one of the few people to mention that the number of murder trials for each racial group should be proportional to the populations of the racial groups within the state. He wanted to know the demographics of the state in order to draw a better conclusion.

In spite of this intrinsic interest and thoughtfulness, he was still reluctant to share his ideas during class. After the first death penalty assignment, I provided a list of comments and questions (see Appendix I) generated by the students on the written hand-in portion. Towards the end of the discussion, I pointed to an observation by Shaniqua: The table did not include any data on the Hispanic population. I asked the students if they thought data on the Hispanic population should be included. The students overwhelmingly replied that, yes, more data should be included because of the location, Florida. Since the state is so close to Cuba, the Dominican Republic, and Puerto Rico, the Hispanic population is significant. I made the comment that “*the people who made the table made a gross oversight by leaving out a very important part of the population.*” Alicia, a younger white woman at the front of her room, raised her hand and said that perhaps it wasn’t an oversight but they just didn’t have the data on ethnicity yet. I said that might be true and that I didn’t know when the US started collecting information on ethnicity as well as race. As Alicia was speaking, Gedeon was sitting in the back of the room rolling his eyes and shaking his head. After class one day, he told me why he was reluctant to share his views during class. He said, “*I don’t like go into detail about what I believe. Too much focus on the individual.*”

Gedeon spent the next few weeks of class quietly sitting in the back of the room. He would listen intently and rarely write anything. He would leave immediately at the end of class. After the first test, students received a summary of their grades. Gedeon did not do very well on the first test, his homework scores were low, and he had a 0 for his autobiography. I offered him the chance to submit his autobiography late. After a few more weeks he gave me the assignment. Here is what I learned:

Gedeon is a 38 year old man raised in Santo Domingo in the Dominican Republic. Verbatim:

*Life in general was normal, but looking in retrospect something's were a bit off. when I was in the school like confusing words, lack of concentration and thing of that nature, most of that was downplay, because of my capabilities to be a good listener, and the fact that under pressure I can memorize a lot and that can carry me.*

Soon after giving me the autobiography, Gedeon stayed after class to ask me what I did with my notes from every class. I told him that I file them away at home. He asked if he could get copies of my notes because he could not write and process the material at the same time. I copied the previous class notes for him, and from then on he would stay after class to get my notes and then make copies.

Why did it take Gedeon so long to ask for my notes? One reason is based on his previous academic habits. Gedeon had completed secondary school by using his listening and memorization skills. He continued to rely on these skills, but he finally reached a point where he needed more than those skills. The second reason is based on his experiences since arriving in the United States:

*When I was 19 years, the opportunity of coming to this country was laid on front of me and I take it, always with the idea of further my education in some point but even the best plans can fail, I arrived to New York in September of 1994.*

*After a couples of month find some friend an let me tell you that I don't remember a lot from those days to much parting and drinking*

*during that time. In the 1999, I meet someone that ended being my wife that has given me another outlook on life, I work very hard to become a good partner and after sometime decide to go back to school in 2004.*

*My plan was to work nighttime and back to school in the daytime, but we find out that she was pregnant; in that time priorities change; I ended getting a job in the morning. I worked for a Psychopath for 8 years and was force to tolerated a lot of humiliation and more just to be a good provider for my kids. I ended up developing high blood pressure and diabetes type 2, I spoke to the psychopath and after I mention the word lawyer he agree to give me a layoff.*

*Now at 38 years I am trying to go back to school, with no job and just a bunch of old promises that I make to myself during my teen years, that is the reason that I don't like to talk about myself.*

Gedeon was hesitant to trust a person in a role of authority because his previous employer abused that authority. He was also embarrassed because he is only now, 20 years later, continuing his education. He views the past ten years as degrading and humiliating rather than a testament to his sense of responsibility and commitment to his family. As Withers (2010) advises working class students, "You don't have to trust people you don't know." Authority figures are not necessarily trustworthy, so a working class student needs to be convinced that the person in a position of power is genuine (Sennett & Cobb, 1972).

Once Gedeon decided that I was safe, the semester changed dramatically. He signed a consent form. He stayed after class every day to get a copy of my notes and

then chat. Before the second test, Gedeon came to my office to reassure me that he was going to do better: *“I know I can do better. I don’t want to go down in flames like Phoenix.”* During the time after class and occasional office visits, Gedeon would also initiate discussions on topics ranging from our mutual love of books to questions like, *“Do you think learning math is like learning a foreign language.”*

Gedeon came into the class with a good sense of numeracy. When taking a test, he was asked to write an equation of a line with a slope equal to  $-\frac{4}{5}$  that passes through the point  $(6, -3)$ . He came up with the equation  $y = -\frac{4}{5}x + \frac{9}{5}$  which is the correct answer, but there was no work, no indication of where this answer came from. After the next class, I asked him how he figured out the answer. He told me that every time he went back one for  $x$ , the  $y$ -value increased by  $\frac{4}{5}$ . To get to the  $y$ -axis, he had to go back 6 in the  $x$ -direction so he added  $\frac{24}{5}$  to  $-3$  which gave  $\frac{9}{5}$  as the  $y$ -intercept. He demonstrated an intuitive understanding of linear functions but realized the need to apply algebra and make the process more abstract and generalizable. He continued to improve his understanding and his grade throughout the semester, but he still never spoke during class. At the end of the semester, he did not turn in a final reflection, but he did give me two things: a book and a thank you letter:

*Not everyone has the opportunity to go back to school in their mature years, family responsibility and personal obligations are some of the reasons why going back to school is very difficult. However, if you are able of putting all the blocks in a row, and you mustered the courage to go to school that is a good reason to be proud.*

*It is out of character expressing or give an opinion about anything, I personally prefer everything basic and simple. But that will be wrong in this circumstance, YO ARE A GREAT TEACHER I really appreciated everything you brought to the class, your explanation about the chapters was clear, the approach to resolve the mathematical problems was clear and enhance but about all you care about your students.*

*Is only I at fault for my lackluster grades in my records, you give me and everyone else opportunity to excel, your door where always open to us. thank you for the opportunity and for caring and making this class a great experience, in my opinion the way you teach your class is very good, teaching all the important parts of the chapter and not letting us get lost in the jungle  
THANK YOU*

The most important message to take away from Gedeon and his experience in this course is the need for a personal connection between the student and the instructor. If Gedeon did not feel that the instructor was genuine, he would never have asked for a copy of the daily notes, which would have resulted in him failing the course. If the instructor did not take the time to know Gedeon, she may have said “No, it is my policy to not give out my notes” without ever knowing how difficult it was for him to ask.

### **Conclusion**

Through these narratives, we can see the interplay of theory relating to working class students and theory relating to social justice education. Teaching math with social justice invites students to be part of the community of education rather

than an observer. Students are able to sense that they are valued and have something positive to contribute rather than being a deficient object of remediation. Teaching math about social justice contextualizes the content and makes math meaningful. Learner independence is fostered by promoting dialogue and encouraging students to have an opinion. Students begin to see that math is a subject to be created, understood, developed, and applied rather than memorized.



## CHAPTER 7

### CONCLUSION

#### **Implications**

In this study, I sought to better understand how social justice pedagogy and content influenced developmental math students at a community college in New England. Based on my observations and analysis, in this chapter I identify implications related to institutions working with developmental students and to institutions with researchers performing naturalistic, qualitative, social justice research.

**For Practice.** Though my research was conducted within a mathematics classroom, the influence of institutional practices cannot be overlooked. I have identified four realms within the community college that I think influenced the experience of students in my developmental course. These areas are teaching, advising, services, and professional development.

**Teaching.** Within the developmental classroom, instructors need to facilitate the development of a community environment and to encourage students to become independent, confident learners while maintaining high expectations for learning content knowledge. Often, activities that facilitate community development are the same as the activities that contribute to independent learners. I am choosing to separate the categories in order to provide a clearer description, but the interrelationship between community and individuality should always be kept in mind.

**Developing a community environment.** In order to help develop a community environment in a developmental mathematics class, instructors need to provide

opportunities for students to feel that they do, in spite of any uncertainties they may feel, belong in the class as well as in college. Early validating experiences should not be “dumbed down” activities to provide a feel-good moment for the student, but rather the experiences should be mathematically rich. Students should also have the opportunity to engage in discussions with each other about mathematical topics. The Death Penalty problem early in the semester acted as both an early validating experience and an opportunity for dialogue. Due to the open-ended nature of the question, all students were able to provide a mathematical statement describing the data table then engage in group discussions of their descriptions. Rather than having me provide a closed question that had a single correct answer, the students saw the power of coming together and pooling their ideas to generate a much longer list of all the math “hidden” in the data.

Another part of community building is developing trusting relationships between the instructor and students as well as between the students. As in Gedeon’s case, trust between a student and instructor should not and cannot be assumed. Trusting relationships may take time to build, but for some students, like Gedeon, their success depends on that relationship. As discussed in Chapter 6, Gedeon chose not to hand in some assignments or ask for help until he was certain that I was genuine. When he decided that I was trustworthy, he handed in past assignments and confided in me that his writing skills did not allow him to keep up with the notes. Knowing that I was a safe person, he was able to ask if he could have a copy of my notes to keep and study. Without that feeling of safety and trust, Gedeon would not have received what he needed in order to be successful.

Trust between students should also not be an assumed. Initially, instructors can encourage trust between students through small group discussions. As with Maria, the small group discussions help give students confidence to present their ideas to the class. For other students, such as Raina, though they may feel safe within the class and small groups, they are not yet ready to stand in front of the room and discuss math. The interpretation and manifestation of a trusting relationship is different for each person. Maria, an older student who had just become an “independent woman,” was ready to present her thoughts to the class. Raina, a traditional age student who initially considered skipping class on group-work, problem-solving days, was not ready to stand in front of the class, but she made great strides just by showing up to class and working within the group. A by-product of small group work within the class may be the formation of outside study groups. As described in Chapter Six, the group formed by Maria, Shaniqua, and Farah provided support as students but also allowed for connection on a personal level. To facilitate the development of community, instructors need to know their students as multidimensional people, not just as learners within the institution.

*Encouraging independent, confident learners.* The style of activities performed within a classroom can either contribute to or hinder the development of independent, confident learners. Based on student writing and conversations, students came to my class dependent on the instructor and confident in their ability to follow a procedure. My approach was intended to help them function independently from the instructor and build confidence in their abilities to solve a problem. I found that some students were content to be dependent learners and resisted my attempts to help them become

independent. However, through the word-problem rating cards, I found that many students, such as Raina and Aliya, wanted to develop understanding, though they were not able to in past courses, and were excited and empowered when they did understand problems.

In this course, I asked students to work with both social justice problems and traditional, text-book problems. I found that neither style of problem was more preferred for all students, but both styles of problems are important. Some students were able to identify relevance and importance in text-book style problems in a way I had never considered and didn't expect. Other students were able to connect with the social justice-style problems because they represented reality. Social justice problems should be used because in addition to contextualizing the content, these problems provide an opportunity to use newspaper articles and tables from outside sources. When using outside sources, students can gain experience being the question asker, not just the question answerer. At the developmental level, the process of solving a question posed from an outside source is more complicated than solving a text-book problem. Being able to identify relevant information from a newspaper article is very different from identifying relevant information from a text-book problem because of the amount of information presented. Also, when using outside material, students naturally tend to question the source of the data.

When choosing problems, the key is to choose open-ended problems and provide an opportunity for student discussion. I found that an obstacle for most students was developing an understanding of the situation. Having students discuss the problem-solving situation in order to identify important elements of the situation

models an important part of the process that students will eventually internalize and engage in individually. I also found that role of the instructor is to help students bridge the divide from words and numbers to an algebraic formulation. This does not mean identifying which formula to use or which table to set up but rather clarifying the thought process used to pull elements together.

***Professional Development.*** Teaching students, especially in a developmental class, requires more than just content knowledge. Instructors working with developmental mathematics classes need to be aware of and able to implement appropriate pedagogy, to have enough content knowledge to prepare students for future classes and not just “get by” in the current class, and to strategize to help students improve their attitudes, beliefs, and perception of the value of math. As described in the previous section, instructors need to help students become independent learners, and they need to develop a sense of community within the classroom. In my experience, I have found that many instructors focus only on the content knowledge to be learned and fail to consider the implications of classroom culture on both the current and future student experience.

Overwhelmingly, the tenure track and adjunct faculty members at community colleges feel that instructor-led lecture is the best way to approach education (Beach, 2011; Grubb 1999). The feeling that “I am the instructor and I need to impart my knowledge to the students during lecture” is still alive and well despite research as to its effectiveness to the contrary. Even if students are able to complete a lecture-based developmental course, they are not developing the skills required to become independent, confident learners. Many developmental courses are taught by adjuncts

who are given a book and a list of sections to cover. Both the students and the instructors deserve better. The institution needs to require that instructors attend professional development related to how students learn and best practices to facilitate student learning.

*Advising.* Many students in developmental courses at the community college are first-generation college students and do not necessarily understand the structure of and policies within the educational system (Christopher, 2005). From my experience working with advisees, I know that many students do not understand how to use the Plan of Study, and many students in developmental courses are not aware that the courses do not count for college credit and do not affect their grade point average.

At least three students in this project received poor advice from an advisor or teacher. Brian placed into a college level math class but chose to take a developmental course. Based on his participation in class, he clearly knew a great deal of the material. He did not complete the course because of transportation issues and conflicts with his job. When I ran into him at the end of the summer, I asked him why he had signed up for the course. His reply was “to increase his grade point average.” We talked about the options he had upon returning to school and was surprised when I told him that the developmental course would not affect his grade point average.

Paula was another student who enrolled in the class unnecessarily. Though she never officially withdrew, she did not attend classes beyond a few days at the beginning of the semester. She had successfully completed the course in the recent past but had not attempted the next level of math. I do not know why she enrolled in the course, but, had she met with an advisor, her path would have been different.

Carmen placed into developmental math and was in an appropriate level course. But the poor advice she received influenced her study habits. Carmen, a native Spanish speaker, was enrolled in a class for English Language Learners while she was taking beginning algebra. I found some Spanish resources for her online to help her better understand the math concepts. She refused to use the Spanish resources because her English teacher, an adjunct, told her that she should only be learning in English from now on, not in Spanish. Carmen was not successful in this math course.

Students need to understand the structure of the courses and the degree plan in order to effectively work towards a goal. Institutions need to develop and implement a strong advising system so that students do not waste time and money taking unnecessary courses. Advisors should be able not only to guide students in course selection and understanding the plan of study but also to encourage students like Carmen to use all resources available in their learning.

*Services.* Some of the students at the community college receive special services because of disabilities or veteran status. The services these students receive are critical to their success in higher education. Institutions need to have enough well-trained disability specialists and veterans affairs officers to effectively perform their jobs. I will describe three students in this project who did not successfully complete the course, in part due to the services received.

Phil was a student in the late morning class who was deaf and needed an interpreter. In addition to an interpreter, he had documented accommodations including a note taker and extended time on tests. Due to scheduling issues, the interpreter did not show up until the third day of class. I went to the disability services

office and asked what resources were available to me as an instructor because I had never had a deaf student in class before. I was asked if he had an interpreter, but that was the extent of resources available to me. I then asked if we had a software program available that would transcribe video so the student could watch a video with subtitles. The specialist for students with physical disabilities could not answer this and directed me to the technology office. It turned that no such program was available. I found out that interpreters were available outside of class time for tutoring appointments. The student would need to schedule an appointment with a tutor in the tutoring center then go to a different office in a different wing of the building to schedule the interpreter for the same time as the tutor. If the interpreter were not available at that time, the student would need to start the process again. Phil is a student who struggles to be organized and he would often mix up days or times so that he, the tutor, and the interpreter would not always show up at the same time. The lack of a streamlined process for scheduling a tutor and an interpreter worked against Phil. Though he did not pass the class, he did make considerable progress.

Amanda was a student in the early morning class. I had worked with her in the past and I knew that she struggled with focus. She also had documented accommodations including extended time on tests, separate testing location, and use of a calculator. She had struggled with developmental math for years and was feeling frustrated because she could not progress towards her goal without passing math. I witnessed her work hard during class, take organized, detailed notes, and perform tasks successfully. When I saw her the next day, she could not perform any of the tasks and could not make sense of her notes. This happened repeatedly early on in the



semester. I went to her counselor in student services and discussed the possibility of a math learning disability. The counselor was in communication with the family and asked Amanda's parents if she had ever been tested for dyscalculia. She is fortunate to have a supportive family that was able to seek testing from a private practice. She was tested and diagnosed with dyscalculia. With a documented diagnosis, she will have more specialized modifications to help her be successful.

Anthony was a student in the early morning class. He did not have any documented disabilities, but he represents a larger group of students. He is one of the eleven students who failed or withdrew from every class during the research semester. Like all students, however, Anthony is unique. He struggled with math as a child. In order to help him better understand math, his mother would represent the math using word problems. He was extremely comfortable with word problems but struggled with symbolic manipulation. He was a non-traditional student and also a veteran. He was married with a step-daughter who had a hearing impairment and was learning sign language to better communicate with her. He participated in class and consistently offered unique views on how to approach problems. Anthony disappeared right after the second test. He was passing the class. I emailed him repeatedly to see if he was okay and to encourage him to come back. I never heard from him again, but I did find a social media site indicating he was having difficulties at home and would be getting divorced. Based on his wife's post, she was not supportive of this decision and indicated he was dealing with some inner issues.

All of these examples illustrate the need to have a well-staffed student services department. Services should be streamlined and not act as an additional barrier as they

did to Phil. Specialists who are aware of and can recognize signs of cognitive disabilities are necessary. Like Amanda, some students may have spent their entire school career struggling with traditional math classes when teachers could have implemented strategies to enhance the learning experience. Unlike Amanda, many of the students are not in a position to find a private practice to administer testing so that they can get the help need. Staff are needed to determine the reasons that students leave school. Anthony is just one of eleven students who did not complete any of his courses during this semester. Each of the eleven students has their own story and their own reasons for not completing the semester. I asked what happens to students like this; does anyone keep track of them or reach out to find out what happened? I found that unless students attempt to register for more classes or are in a special grant program to retain students, no one ever asks these students what happened. Almost twenty percent of my students disappeared from the institution, and no one contacted them. The sense of community established in the classroom needs to extend to the institution. With the current focus on completion rates and student success, institutions must look beyond the classroom to identify barriers to student success and implement appropriate services for students.

*Conclusions for Practice.* As an instructor trying to best serve my students, I must consider my students as multi-faceted individuals. Ignoring their outside experience and just focusing on abstract math concepts is not conducive to successful learning. Similarly, when attempting to improve the student experience, institutions must look not only at the classroom but also at other institutional practices.

**For Research.** At the beginning of the semester, I noticed that the procedures required for conducting research conflicted with my theoretical models of research and contributed to the disempowerment of students. The procedures of the Institutional Review Board (IRB) are, in my experience and opinion, at odds with naturalistic, qualitative, critical, teacher research. Altrichter (1993) believes that “the research strategy must build on democratic and cooperative human relationships” (p. 44). The entire process of research, including informed consent, anonymity, and use of data should be *agreed upon* by participants and researcher rather than *dictated* by an outside board. Discourse regarding protection of participants does not take place between researcher and participants but between the researcher and the IRB. For example, in the early morning class, students asked if I could use their real names in the dissertations. Instead of opening this up to class discussion as a possibility, I had to tell the students that this was not an option. In the later morning class, students asked if they could watch the videos if they needed to be absent from class one day. Once again, I had to tell the students that this was not an option. As Van den Berg (2001) suggests, the IRB almost seemed more interested in protecting itself from litigation than it was concerned for the rights of participants.

As part of the informed consent process, the IRB changed the wording and format of my letter of consent. In presenting it to my students, I was not allowed to be in the room as the outside person read the script describing the study. As a result I was not allowed to clarify any questions students might have raised. How does this process ensure that the students’ understanding of the research project is aligned with my understanding of the research project? The process does not ensure that students and

researchers have the same understanding. How does this process help develop the trust required between students and teacher in a social justice-style course? The process in fact undermined the development of trust between students and the teacher. My soon-to-be degree-granting institution is telling the students that I am not trustworthy to explain the project and answer questions without exerting undue influence, highlighting that I am the person with all the power in the classroom.

I believe that traditional IRB procedures do not lend themselves to the type of research that I conducted. My research was naturalistic. I wanted to understand the students' experience in as natural a setting as possible. I chose not to conduct formal interviews because that would shift the focus from the experience as a student to the experience as a participant in a research study. Injecting an outsider into the classroom to present the study disrupted the naturalistic setting. My research was qualitative. I wanted to understand the student experience by analyzing discourse. If I do my job as a qualitative researcher and provide a rich, detailed narrative, participant anonymity cannot be guaranteed (Van den Berg, 2001). My research was critical teacher-research. I needed to establish a trusting environment to help the students become more empowered. The IRB procedures at the beginning of the semester undermined that trust and silenced student voices by not giving them an opportunity to participate in decision making. I would hope that research institutions recognize the value of naturalistic, qualitative, critical teacher-research and begin to explore how institutional policies affect the research process and the participants. In addition, I would recommend researchers and policy makers establish IRB procedures that empower all participants in the research process, not just the IRB.

**Suggestions for Future Research.** Initially, my intent with this study was to focus on how social justice content and pedagogy affected students beliefs about math and their self-perceptions as math students. Throughout the study, my focus changed to class and power dynamics within the math classroom. The ever-evolving nature of qualitative research opens up a variety of future research opportunities. My suggestions for future research will focus on helping students become independent learners.

As I noted earlier, differences in critical thinking ability have been observed in upper level math courses between students who began college in developmental math and students who began college with intermediate algebra or above. Students who began their coursework in developmental math were less likely to apply concepts correctly to new situations, were less likely even to attempt problem solving, and were less likely to provide coherent explanations. I would like to see if these differences in critical thinking habits still surface when students complete a developmental course such as the one described in this study. I would like to provide a longitudinal analysis of what happens to students who complete a social justice-based developmental course.

The present study was performed using teacher-research as a framework. A potential extension is to recruit other instructors and classes to participate. In order to keep the situation as naturalistic as possible, I would not want to be in the classroom as just a researcher because that introduces an artificial element into the classroom. I could analyze video tapes of class meetings and outside discussion. Another possibility based on the latest structure for developmental class is that I could work

with the instructor as an embedded tutor. This would give me an opportunity to witness the dynamics and to take detailed field notes without establishing me as the sole authority figure in the room. In the present study, as mentioned, I chose not to conduct interviews in order to keep the student-instructor relationship as natural as possible. In studies that involve other instructors, I could implement interview procedures without tainting the student-instructor dynamic.

As stated in the implication section, it would be remiss to think that the math classroom is the only influence on students as learners of mathematics. Data is collected on tutor use and final course grade, but I argue that the data collected limits the definition of student success to passing a single class and not developing skills required to be a successful student, let alone a democratic citizen. I would suggest a qualitative study of the influence of the tutoring center on students, specifically the influence on their independence and their self-perception of their ability to be successful math students.

### **Closing Thoughts**

Due to state legislation based on financial and employment concerns, developmental education is in the midst of a transformation. The speed at which new programs were developed and implemented, though remarkably efficient, left little time to discuss pedagogy, learner dependence, building solidarity within the classroom and the institution, and attitudes and beliefs about mathematics. A narrow view of student success, course completion, is seen as the desirable measure. Students were not asked to be part of the transformation. People charged with transforming the

developmental math courses focused on content without considering the role of the students. In effect, the students were completely left out of the discussion.

This study is a step in redirecting the transformation efforts for developmental math education. Transformation cannot be successful without knowledge of the participants. The qualitative nature of this study gives a glimpse of the student perspective. Using these insights, I was able to identify strategies, such as community building and open-ended problem solving, to improve the learning experience for developmental math students. The real strength in this study is starting institution-wide conversations about strategies that will be most empowering for the specific students within an institution.

*I believe that schools like my community college, which cater to the learning of an ever-increasingly diverse student body, should and can do more to consider the unique learning needs of their students.*

*-Aliya*

## APPENDIX A

### COURSE OUTCOMES

#### **MAT 095 COURSE OUTCOMES:**

1. Evaluate algebraic expressions
2. Determining if a given number is a solution to an equation or an inequality
3. Determining if an ordered pair is a solution to a linear equation in 2 variables
  
4. Add, subtract, multiply, and divide real numbers and raise a real number to an integer power
5. Add, subtract, multiply, and divide Polynomials
6. Simplify, add, subtract, multiply, and divide Radicals
7. Rules for Exponents
8. Greatest Common Factor (factoring)
9. Factor by Grouping
10. Factor trinomials of the form  $x^2 + bx + c$
11. Factor trinomials of the form  $ax^2 + bx + c$
12. Factor Perfect Square Trinomials
13. Factor the Difference of Two Squares
14. Factor Completely
15. Converting between Scientific Notation and standard notation
  
16. Order of Operations (manipulation)
17. Properties of Real Numbers (manipulation)
18. Simplifying Algebraic Expressions (manipulation)
  
19. Graphing in a Rectangular Coordinate System
20. Graphing Linear Equations by plotting points, using intercepts, and using the Slope-Intercept form
21. Graphing the solution to a Linear Inequality in one variable.
22. Graphing a System of Linear Equations in two variables
23. Rates of change (slopes)
24. Identifying Linear Equations (Linearity)
25. Solving Linear Inequalities in one variable
26. Finding the Equation of a Line (manipulation)
27. Solving Linear Equations in one variable
28. Solving formulas for a specified variable
29. Solving a System of Linear Equations in two variables (two methods)
30. Solving equations with degree 2 or greater by factoring
31. Two forms for the equation of a line (transforming back and forth)
  
32. Finding an unknown number word problem
33. Solving consecutive numbers (including odd and even) word problems
34. Solving dimension problems using geometric formulas
35. Solving Percent and Mixture problems
36. Solving table problems such as rate, time, and distance
37. Solving linear inequality problems
38. Solving linear equation in two variables problems
39. Solving System of 2 linear equations in 2 variables word problems
40. Solving factorable Quadratic Equation word problems



**APPENDIX B**

**FINAL EXAM**

**MAT 095**  
**Final Exam - Part 1**  
**Spring 2013**

NAME \_\_\_\_\_

**Simplify.**

1)  $\left(\frac{1}{2}\right)^2 - \frac{1}{3} \div 3 + 2 \cdot \frac{3}{4}$  1. \_\_\_\_\_

2)  $\frac{10 - 2(-5)^2}{(-4)^2 \div (-2)(3)}$  2. \_\_\_\_\_

3) Evaluate  $-x^2 + 4y - 2z$  for  $x = -2, y = 1, z = -1$  3. \_\_\_\_\_

**Solve.**

4)  $\frac{2(8-a)}{3} = 4 - 4a$  4. \_\_\_\_\_

5)  $-4(5x - 2) = -12x + 4 - 8x + 4$  5. \_\_\_\_\_

6)  $\frac{2}{3}x - \frac{3}{4} = \frac{1}{2}x + \frac{1}{3}$  6. \_\_\_\_\_

7) Solve and graph the inequality 7. \_\_\_\_\_

$$4 - 3(3x - 5) \leq 7(2x + 3)$$

8) Simplify the expression. 8. \_\_\_\_\_

**Write the answer using positive exponents**

$$\frac{x^{-4}(x^3y^7)^2}{(5x)^0(x^5y^{-3})^{-3}}$$

9) Simplify the expression. 9. \_\_\_\_\_

$$(2x + 3)(4x - 5) - (-5x)(-4x^2 + 7)$$

10) Find the product:  $(3x - 7)^2$  10. \_\_\_\_\_

**Factor completely.**

11)  $8x^5y^2 - 20x^3y^3 + 4x^2y$  11. \_\_\_\_\_

12)  $3x^2 - 3x + 2x - 2$  12. \_\_\_\_\_

**Solve by factoring.**

13)  $12x^3 - 27x = 0$  13. \_\_\_\_\_

14)  $6x^2 + x = 12$  14. \_\_\_\_\_

15)  $x(x - 10) = -16$  15. \_\_\_\_\_

**MAT 095**  
**Final Exam - Part 2**  
**Spring 2011**

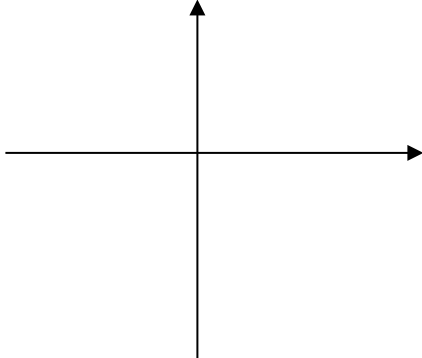
NAME \_\_\_\_\_

#16-18: Graph each equation. Indicate the x-intercept and the y-intercept.

16)  $y = -4$

x int: \_\_\_\_\_

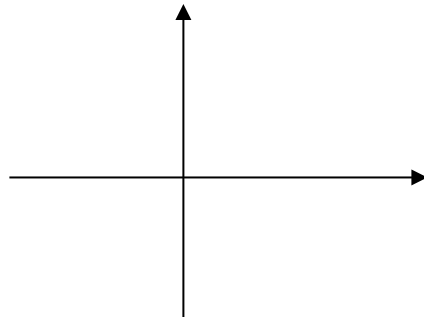
y int: \_\_\_\_\_



17)  $y = -\frac{2}{3}x + 6$

x int: \_\_\_\_\_

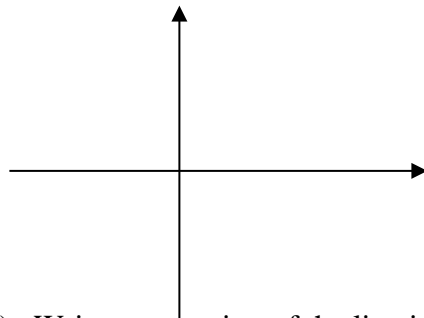
y int: \_\_\_\_\_



18)  $5x - 3y = 15$

x int: \_\_\_\_\_

y int: \_\_\_\_\_



19) Write an equation of the line in standard form with slope 4, through (2, 0)

19. \_\_\_\_\_

20) Write an equation of the line through (-1, 6) and (5, -2).

20. \_\_\_\_\_

21) Solve the system of equations

$$\begin{cases} 3x + y = -2 \\ 2x - y = -3 \end{cases}$$

21. x=\_\_\_\_\_

y=\_\_\_\_\_

22) Solve the system of equations

$$\begin{cases} 2x - 3y = 6 \\ -3x + 4y = -2 \end{cases}$$

22. x=\_\_\_\_\_

y=\_\_\_\_\_

23) Solve the system of equations.

$$\begin{cases} y = x - 7 \\ x - y = 9 \end{cases}$$

23. x=\_\_\_\_\_

y=\_\_\_\_\_

**WORD PROBLEMS:** Choose TWO. Show all work! No credit for an answer without work. You may do the other word problems for extra credit.

24) John and Nancy are celebrating their 25<sup>th</sup> wedding anniversary by having a reception at a restaurant. If the restaurant charges \$100 for cleanup and \$45 per person, find the greatest number of people they can invite and spend at most \$2500.

24. \_\_\_\_\_

25) Two trains leave L.A. simultaneously traveling on the same track in opposite directions at speeds of 50 and 64 miles per hour. How long will it take before they are 285 miles apart?

25. \_\_\_\_\_

26) How can \$54,000 be invested, part at 8% and the rest at 10%, so that the interest earned by the two accounts will be equal?

26. 8%: \_\_\_\_\_

10% \_\_\_\_\_

27) How much water should be added to 30 gallons of a solution that is 70% antifreeze in order to get a mixture that is 60% antifreeze? (Water is 0% antifreeze.)

27. \_\_\_\_\_

28) Planter's peanut Company wants to mix 20 lb of peanuts worth \$3 per pound with some cashews worth \$5 per pound in order to make a mix worth \$3.50 a pound. How many pounds of cashews should be added to the peanuts? 28. \_\_\_\_\_

29) The percentage of companies with at least one woman on the board is growing steadily. The percentage can be approximated with the linear equation  $p = 2n + 36$ , where  $n$  is the number of years since 1980.

- a) Find and interpret the  $p$ -intercept (or the  $y$  intercept) for the line.
- b) Find and interpret the  $n$ -intercept (or the  $x$ -intercept) .
- c) If this trend continues, then in what year would you expect to find all companies having at least one woman on the board?

30) The velocity  $v$  of a projectile is a linear function of the time  $t$  that it is in the air. A ball is thrown downward from the top of the building. Its velocity is 42feet per second after one second and 74 feet per second after 2 seconds.

<b>X</b>	<b>Y</b>
<b>Time t since ball is released (sec)</b>	<b>Velocity v of ball in ft/sec</b>
1	42
2	74

- a) Write an equation of the line for the two points in the table above.
- b) What is the initial velocity of the projectile?
- c) What is the velocity when  $t = 3.5$  seconds?

## APPENDIX C

### WORD PROBLEM RATING CARDS

#### Front of Rating Card

**Your Name:**

**Word Problem:**

How would you rate your level of interest and the relevance for this word problem? Circle your rating.

1 means the problem was very interesting/relevant  
4 means the problem was NOT very interesting/relevant

This problem

**Was interesting**

**Was relevant**

1 Very!!

1 Very!!

2 Kind of

2 Kind of

3 Not really

3 Not really

4 Not at all!!

4 Not at all!!

## **Back of Rating Card**

**Please tell me if you have any additional  
comments or questions.**

## APPENDIX D

### MATH AUTOBIOGRAPHY

**Purpose of the Assignment:** As your instructor, I want to get to know you as a person and as a student of mathematics. This will help me better meet your needs. It also helps our department as we work to improve our services to students.

**Content:** Your autobiography should address the four sections listed below. I've listed some questions to help guide you, but please don't just go through and answer each question separately. The questions are to help get you thinking. Remember the purpose of the paper. Write about the things that will give me a picture of you. The key to writing a good piece is to give lots of detail. See the example below:

*Not enough detail:* I hated math in fourth grade, but it got better in sixth grade.

*Good detail:* I hated math in fourth grade because I had trouble learning my multiplication tables. I was really slow at doing problems, and I was always the last one to finish the timed tests. It was really embarrassing. ...

#### **Section 1: Introduction**

Please tell me a little about yourself. How would you describe yourself? Where are you from? Why did you decide to attend Three Rivers? What is your educational background? Did you just graduate from high school? Have you been out of school for a few years? If so, what have you been doing since then? Describe your general interests, such as favorite subjects, activities or hobbies.

#### **Section 2: Experience with Math**

Tell me about your past experiences in math class. I am interested in what math classes you have taken and when. Do you have a favorite math teacher? If so, why is this person your favorite? Do you have a least favorite math teacher? If so, what did this person do to get on your least favorite list? Describe a typical day in one of your past math classes. Based on your past experiences, did you learn just enough to pass tests and make it through the class but forget everything as soon as the class was over, or do you think you developed a solid understanding of the content and retained it for at least a year after the class ended?

Now let's focus on the world outside of the math classroom. What is math? In what ways have you used math outside of school? Do you think there is a difference between "school" math (math taught in class) and "real" math (math used in normal everyday life)? If so, explain the difference. What do mathematicians do? (Please use your own words - I am interested in your thoughts not a definition copied from an outside source. Please do not say "math"!)

Are you good at math? Can anybody be good at math or is it something that you are just born with?



**Section 3: Learning Styles and Habits (specifically for math)**

Talk to me about your learning preferences. Do you learn best from reading, listening or doing? Do you prefer to work alone or in groups? Explain why you prefer the particular methods you chose.

Describe some of your study habits. For example: Do you take notes? Are they helpful? Are you organized? Do you procrastinate? Do you read the text? What do you do when you get “stuck”? Do you ask for help? If so, who do you ask for help? Think about your study habits and your past experiences in math class – are your study habits working for you or do you think the habits need to be modified?

**Section 4: The Future**

Let’s think about the short term. Describe your expectations for this course and what you expect to learn. What grade do you expect to earn? Describe your responsibilities as a student in this course. Explain what you expect from your instructor.

Now, think about the long term. How does this course fit into your educational goals? Describe what math classes you will take after this. What are your educational and life goals? Explain how math fits into your goals for the future. Describe how your goals have (or have not) been influenced by your past experiences with math.





# Norwich Bulletin

## Connecticut average gas price rose 14.3 cents last week

Not much relief in sight thanks to higher oil prices, analyst says

By **JAMES MOSHER**  
**The Bulletin**

Posted Feb 11, 2013 @ 08:21 AM

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[Income Tax Turns 100: Did You Celebrate?](#)

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[One hospitalized, five ...](#)

Norwich, Conn. — The average price of a gallon of regular unleaded gasoline in Connecticut rose 14.3 cents last week to \$3.83 as of Sunday, according to GasBuddy.com's survey of 1,540 stations.

As of Sunday, the price was 16.7 cents higher than a month ago and 7.4 cents higher than a year ago.

The national average climbed 14.4 cents to \$3.48 last week, the GasBuddy.com website reported. The national average has gone up 21.1 cents in the past month and as of Sunday stood 4.4 cents than a year prior.

Climbing oil prices means gas prices won't fall back anytime soon, said Patrick DeHaan, a Chicago-based senior analyst at GasBuddy.com.

"The national average has ticked higher in the last week have put upward pressure on gasoline prices," he wrote in his weekly note. "Unfortunately for angry motorists, there doesn't seem to be much relief in sight at least for the time being as retail prices continue to climb in virtually all areas of the country."

## Cell Phone Homework Assignment

Write a two variable equation for each situation.

Let  $y$  represent the monthly bill. Let  $x$  represent the number of text messages.

**Situation 1:** I am charged a monthly fee of \$12 and then \$0.15 per text.

**Situation 2:** I am charged a monthly fee of \$12 and then \$0.10 per text.

**Situation 3:** I am charged a monthly fee of \$15 and then \$0.10 per text.

On the paper provided, graph each equation. Make sure you label each line or use different colors so you can tell which is which.

Which situation gives the steepest line?

## Cell Phone Homework Assignment Reflection

On Thursday, February 28: We did a problem in class where we had information on a cell phone plan. We were told the monthly fee and the charge per text message. We found the total monthly bill based on the number of text messages and then graphed the line.

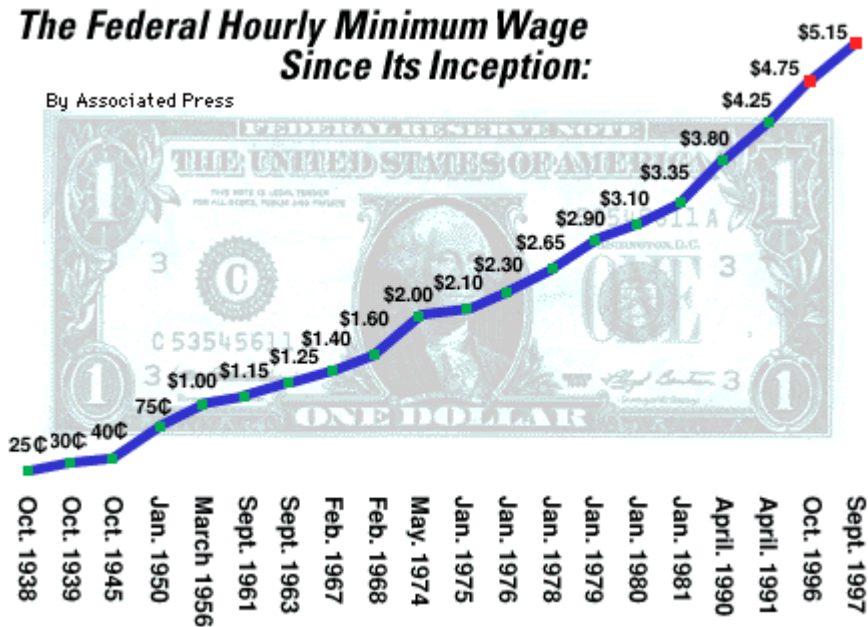
On Tuesday, March 3: You had a homework assignment where you had 3 cell phone situations with different monthly fees and charges per text message. You had to write 3 equations and graph 3 lines.

This assignment was handed back to you today. Think about this assignment as you answer the following questions. Be honest! You are not being graded on right or wrong answers!

- |  |     |    |
|--|-----|----|
| 1. I knew exactly what to do on this homework assignment.  | Yes | No |
| 2. I thought this homework assignment was hard.  | Yes | No |
| 3. I forgot about this assignment and rushed to do it at the last minute.  | Yes | No |
| 4. I forgot about this assignment and didn't do it.  | Yes | No |
| 5. I sent the instructor email asking for help on this assignment.   | Yes | No |
| 6. I asked other people in the class for help on this assignment.  | Yes | No |
| 7. I went to the tutoring center for help on this assignment.  | Yes | No |
| 8. I looked at the classwork from February 28 while doing this assignment  | Yes | No |
| 9. Were you satisfied with what you handed in? What would you do differently next time I give you a take home assignment to hand in? |     |    |

## Introduction to Reading Graphs – Page 1

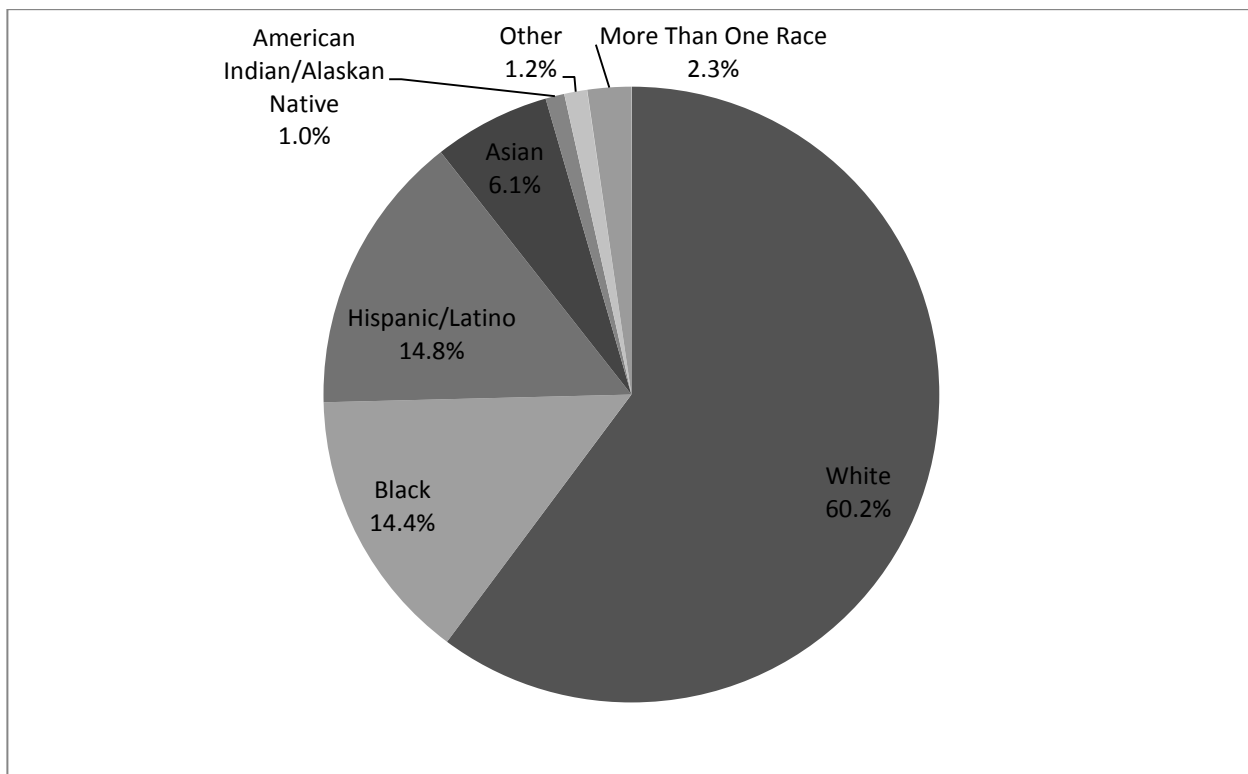
You find the following line graph, which plots the minimum wage versus time from October, 1938, to September, 1997. What kinds of things might you be able to tell from it?



1. What was the minimum wage in January, 1978?
2. When did the minimum wage reach \$3.35?
3. Between what time periods was the largest increase in minimum wage?
4. Based on your observations of the graph, make a prediction about what the wage might be in the year 2000.
5. What about the scales used on the graph might make the data appear differently than how it really is?

## Introduction to Reading Graphs – Page 2

Student Distribution by Race at Public Two-Year Colleges, 2007-2008

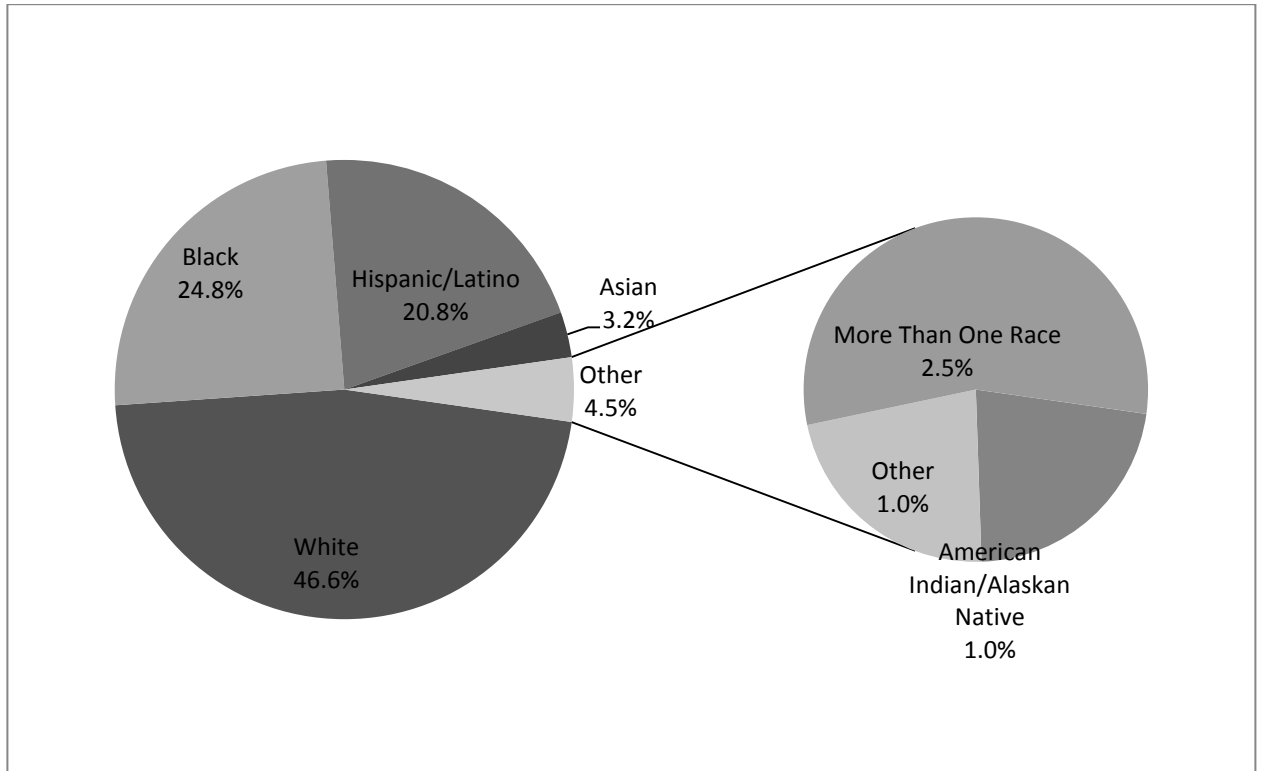


1. What do the percentages in the graph add up to?
2. If there were 10,452,789 students enrolled in public two-year colleges, how many of the students were
  - a. Asian
  - b. Hispanic/Latino
  - c. Black
  - d. White



## Introduction to Reading Graphs – Page 3

Student Distribution by Race at Private, For-Profit Colleges, 2007-2008



1. What do the percentages in the graph add up to?
2. If there were 673,785 students enrolled in private two-year colleges, how many of the students were
  - a. Asian
  - b. Hispanic/Latino
  - c. Black
  - d. White
3. What do you think of the formatting of this pie chart compared to the last? (Here are some things to think about: Is it easier or more difficult to understand? Does it give the same information? Is it misleading?)

### **Textbook Style Geometry Questions**

I am updating my rectangular living room. I plan on installing new carpet and putting crown molding around the room near the ceiling. My living room is 16 feet by 13 feet.

1. How many square feet of carpet will I need?

2. How much crown molding will I need?

### **Textbook Style Mixture and Distance Problems**

1. Wholesome Foods sells dried apricots for \$12.25 per pound and dried apples for \$7.50 per pound. How much of each fruit should be used to make a 40-lb mixture that sells for \$9.40 per pound?
2. Tropical Punch is 18% fruit juice and Caribbean Spring is 24% fruit juice. How many liters of each should be mixed to get 18 L of a mixture that is 20% juice?
3. A moving van leaves a rest stop on an interstate highway and travels north at 50 mph. An hour later, a car leaves the rest stop and travels north at 70 mph. How far from the rest stop will the car catch up to the van?

## New York City Assignment

### Article from CNN

January 28th, 2013

06:00 AM ET

## NYC hit with huge wave of homelessness

By **Steve Kastenbaum**, CNN

Follow on Twitter: @SkastenbaumCNN

*Editor's Note: Listen to the full story in our player above, and join the conversation in our comments section below.*

**(CNN)** – New York City is experiencing its largest wave of homelessness since the Great Depression.

The spike started following cuts to a government rent subsidy program. Ironically, the impact of having to provide shelter to more than 20,000 homeless children each night is costing the city more money than the cost of the subsidies.

**[3:37]** “It costs \$36,000 a year to shelter a homeless family in New York City. In comparison, a rental voucher is \$10,000 a year. So it’s more than three times more expensive to have that family in shelter than it is to give that family permanent housing,” said Patrick Markee, a policy analyst at the non-profit Coalition for the Homeless.

Ester Fuchs teaches Public Policy and Political Science at Columbia University. She says it’s a prime example of how seeking short term solutions to budget problems can result in more tax dollars being spent down the road.

**[4:03]** “They’re going after what used to be called entitlements and they are not concerned with the ripple effects down the line for state governments or for city governments.”

## New York City Assignment

### Questions to Develop Understanding

1. In New York City, the cost of sheltering a homeless family for a year is \$36,000. The cost of providing a rental voucher for a family is \$10,000 a year. Assume there were 5000 families in New York City that received rental vouchers or stayed in a homeless shelter last month. The city spent \$12,062,000 last month on rental vouchers and family homeless shelters. How much money was spent on rental vouchers and how much was spent on family homeless shelters?

Check your understanding of the situation! Focus on the first three sentences of the problem.

- If there were 1100 families receiving shelter, how many families received rental vouchers?
- If there were 1100 families receiving shelter, how much would the city pay for the shelter over the course of a year? (Assume the family is in the shelter for the whole year.)
- If there were 1100 families receiving shelter, how much would the city pay for the shelter for a month?
- If there were 1100 families receiving shelter, how much would the city pay for rental vouchers over the course of a year? (Assume the family is receiving vouchers for the whole year.)
- If there were 1100 families receiving shelter, how much would the city pay for rental vouchers for a month?
- If there were 1100 families receiving shelter, what was the total amount paid by the city for both family homeless shelters and rental vouchers for an entire year? For a month?

Now try to represent the general situation using math. Instead of assuming 1100 families received shelter, we don't know how many families received shelter.

## Education Statistics – Classwork

National Center for Education Statistics

Percentage of 25- to 29-year-old females who attained the selected levels of education by race/ethnicity: Selected years 1995 and 2005

<b>1995</b>			
	White	Black	Hispanic
<b>At least a high school diploma or equivalent</b>	93.0	85.3	58.7
At least some college	62.1	44.8	30.9
<b>Bachelor’s degree or higher</b>	29.2	13.7	10.1
<b>Master’s degree or higher</b>	5.0	1.4	1.2
<b>2005</b>			
	White	Black	Hispanic
<b>At least a high school diploma or equivalent</b>	93.8	87.3	63.4
At least some college	69.1	55.1	33.9
<b>Bachelor’s degree or higher</b>	38.2	20.5	12.4
<b>Master’s degree or higher</b>	8.8	4.0	2.6

Assume that the trends shown in the table are linear. We are going to write a set of equations representing the data for one educational category. There will be one equation for each race/ethnicity within this category.

Educational Category:

Define variables:     y is  
                              x is

Equations:

Questions:

1. Are the lines parallel? Explain.
2. In 2009, what percent of black women in the specified age group will have at least a high school diploma?
3. Will the percent of Hispanic women in the specified age group with a high school diploma ever equal the percent of Black women in the specified age group with at least a high school diploma? If so, when? If not, why not?
4. Will the percent of Hispanic women in the specified age group with a high school diploma ever equal the percent of White women in the specified age group with at least a high school diploma? If so, when? If not, why not?



## Education Statistics – Homework

National Center for Education Statistics  
 Percentage of 25- to 29-year-old males who attained the selected levels of education  
 by race/ethnicity: Selected years 1995 and 2005

<b>1995</b>			
	White	Black	Hispanic
<b>At least a high school diploma or equivalent</b>	92.0	88.4	55.7
<b>At least some college</b>	57.5	45.3	26.7
<b>Bachelor’s degree or higher</b>	28.4	17.4	7.8
<b>Master’s degree or higher</b>	5.6	2.2	2.0

<b>2005</b>			
	White	Black	Hispanic
<b>At least a high school diploma or equivalent</b>	91.8	86.6	63.2
<b>At least some college</b>	59.9	41.8	31.8
<b>Bachelor’s degree or higher</b>	30.7	14.2	10.2
<b>Master’s degree or higher</b>	6.2	1.1	1.7

1. Assuming that the data in the table is linear, for each race/ethnicity, write an equation that relates the percent of males between the ages of 26 and 29 with at least a high school diploma or equivalent ( $y$ ) to the number of years since 1995 ( $x$ ). Just like in class, you should have three equations.
2. Are the lines in question 1 parallel? Write a sentence or two comparing the slopes of the lines.
3. In what year was the percent of black men in the specified age range with at least a high school diploma or equivalent the same as the percent of black women in the specified age range with at least a high school diploma or equivalent? Find this answer by solving a system of equations and evaluating whether or not your answer makes sense in this situation.
4. Pick one of the remaining three educational categories. Choose to work with either the male table or the female table. If you want, you can use both.
  - a. For each race within your chosen educational category, write an equation representing the situation.
  - b. Graph the three equations from part a. Your graph should be done on the attached graph paper. Please make sure to label your lines.
  - c. Pick two of the equations from part a. Find out when the percents for these races/ethnicities will be equal.

## APPENDIX F

### FINAL REFLECTION

By now you may have already filled out the online evaluation form, but I am interested in hearing more from you. What went well and didn't go well? What would you change?

I am always looking for ways to make classes better and I am truly interested in your opinions. Your grade in this course in no way depends on any criticism or negative feedback. If you hand in this assignment and fully respond (see below) to the questions, you will receive full credit. It is important that I get **your feedback** so that future classes can benefit from your insights. If there are things other than what I've written above that you would like to include, please do. Your comments are valuable to me.

#### Responses

The key to this assignment is to give lots of detail. See the example below:

*Question:* Why don't we have any quizzes?

*Not enough detail:* I don't like to give quizzes.

*Good detail:* My goal in this class (in addition to helping you learn math) is to **help you become a more independent learner**. You do not need me giving you a graded quiz to determine whether or not you know the material. When we do the warm-up questions at the beginning of class or when you are working on your homework, you have a good sense of what you know and what you need to learn. When I walk around the room while you are working, I get a good sense of what you know and what you still need to learn. Rather than give quizzes and perhaps "punish" you with a bad grade, we have the review problems at the beginning of class. These questions help get you thinking about the math needed for the new lesson but they also help you figure out what you are having difficulty with. Once you know what you are having trouble with, you can then start to determine the best way to learn the information. You can come see me, you can see a tutor, you can search the internet, you can check out MyMathLab, etc.

#### Questions

- ◆ When you registered for this class, you did not have many choices. You chose MAT 095 instead of the self-paced, technology-based MAT 090. If you were offered different options, would you have still selected a generic MAT 095? For example, would you have considered signing up for a class for non-traditional students (older than 25) or a class for women? Would you have considered registering for a section of MAT 095 connected to a sociology course (Social Problems) or a criminal justice course where the math content directly relates to the other course? These are only examples so please feel free to mention a

situation that is relevant to you. Describe the major factors you would have had to consider before making your final decision?

- ◆ Discuss your general experience with word problems. Thinking back over the semester, which of the word problems helped you to best learn the material? What was it about this problems that was most helpful? When thinking about this, consider the presentation, the topic, etc.

- ◆ Think about the juice mixture problem that we had at the beginning of April. Here is the problem just in case you don't remember:

Tropical Punch is 18% fruit juice and Caribbean Spring is 24% fruit juice.  
How many liters of each should be mixed to get 18 L of a mixture that is 20% juice?

You were asked to rate the problem based on how interesting it was and how relevant. This is how you rated the problem:

Was Interesting		Was Relevant	
1	Very!	1	Very!
2	Kind of	2	Kind of
3	Not really	3	Not really
4	Not at all!	4	Not at all!

Why did you rate it this way? If you ranked it as a 1 or 2, what made this question interesting or relevant? If you ranked this a 3 or 4, what made this question NOT interesting or relevant?

- ◆ Think about the level of education completion problem that we had at the end of March. This was a three page handout that we did during class. We had a given table of data. The table is given at the end of this assignment for your reference. From the table we made equations representing the percentage of women completing high school as a function of time. Then we had some questions based on those equations. Here is part of the problem just in case you don't remember:

- 1 Are the lines parallel? Explain.
- 2 In 2009, what percent of black women in the specified age group will have at least a high school diploma?
- 3 Will the percent of Hispanic women in the specified age group with a high school diploma ever equal the percent of Black women in the specified age group with at least a high school diploma? If so, when? If not, why not?
- 4 Will the percent of Hispanic women in the specified age group with a high school diploma ever equal the percent of White women in the specified age group with at least a high school diploma? If so, when? If not, why not?

You were asked to rate the problem based on how interesting it was and how relevant. This is how you rated the problem:

Was Interesting		Was Relevant	
5	Very!	5	Very!
6	Kind of	6	Kind of
7	Not really	7	Not really
8	Not at all!	8	Not at all!

Why did you rate it this way? If you ranked it as a 1 or 2, what made this question interesting or relevant? If you ranked this a 3 or 4, what made this question NOT interesting or relevant?

- ◆ Describe 2 topics that you found easy to understand. What do you think it was about these topics that made it easy for you to understand? (i.e., you remembered from past, in-class presentation, useful homework, etc.)
  - ◆ List 2 topics that you struggled to understand. Explain what you did to try to better understand these topics. Do you feel that you completely understand these topics now? (Your grade is done and will not be changed based on your answer to this question so be honest!)
  - ◆ Describe at least two mathematical experiences from this semester that have influenced you positively or negatively.
  - ◆ What could have been differently (either by your or me) to improve your satisfaction with the class?
  - ◆ Please describe at least 3 things you feel students must do in order to be successful in this course
- 

Data Table from the Word Problem at the end of March

Percentage of 25- to 29-year-old females who attained the selected levels of education by race/ethnicity: Selected years 1995 and 2005

<b>1995</b>			
	White	Black	Hispanic
<b>At least a high school diploma or equivalent</b>	93.0	85.3	58.7
<b>At least some college</b>	62.1	44.8	30.9
<b>Bachelor's degree or higher</b>	29.2	13.7	10.1
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<b>2005</b>			
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<b>At least some college</b>	69.1	55.1	33.9
<b>Bachelor's degree or higher</b>	38.2	20.5	12.4
<b>Master's degree or higher</b>	8.8	4.0	2.6

## **APPENDIX G**

### **IRB MATERIALS**

#### **Prepared Script**

#### **Introduction Script to be read and projected**

Hello everyone,

My name is <INSERT NAME >.

The professor of this section of MAT 095 is a student enrolled in the University of Rhode Island/Rhode Island College PhD Program in Education. She is interested in studying problem solving in beginning algebra classes. She would like to study the discussion that occurs within a math class when people are involved in problem solving situations.

Taking part in the study is totally optional and will not affect your grade in this course in any way. Your participation or lack of participation in the study will not result in any extra assignments.

In the study, she will be collecting data in two ways: through video-taped class meetings and through written work. The consent form basically asks you to give me permission use

1. the videos she collects and
2. your work in the course this semester.

No other member of the faculty or staff here other than your instructor will see the videos or your work. The videos will not be made available to the public. All videos and written work will be stored at a secure, off-campus location. Your instructor needs to keep the videos for three years but then she will destroy them. In any sort of report that might be published, she will not include any information that will make it possible to identify you.

Again, you are not required to be a part of this study. Should you choose to take part in the study, she will do everything possible to protect your identity and privacy.

Do you have any questions? <Answer any student questions>

I will distribute copies of a consent form requesting your approval to be a part of a research study this semester.

- ◆ Please read the form carefully.
- ◆ If you agree to participate in the study, sign the forms (both green and white).

- ◆ Everyone should keep the white version of the form.
- ◆ Everyone should fold the green version in half and return it in the envelope provided at the front of the room.
- ◆ In order to participate in the study you need to be at least 18 years of age.

# CONSENT DOCUMENT

## Rhode Island College

### Problem Solving in a Beginning Algebra Course

You are being asked to participate in a research study about problem solving in developmental math courses. You were selected as a possible participant because of the section of MAT 095 that you registered for. Please read this form and ask any questions that you may have before deciding whether to be in the study. You must be at least 18 years of age to participate.

David Brell, a professor at Rhode Island College, and Roxanne Tisch, an instructor at \_\_\_\_\_ Community College are conducting this study.

#### **Background Information**

The purpose of this research is to better understand the process that students go through when learning strategies to deal with word problems.

#### **Procedures**

If you choose to be a participant in this research, you will be asked to do the following:

- Complete a questionnaire describing your mathematical background, attitudes towards mathematics, and how mathematics will help you attain your goals.
- Participate in individual or group informal discussions before or after class, and allow these discussions to be video tape
- Allow me to video tape you during class meetings, and use information from the video in the study. The video will be viewed by the researcher and two professors at Rhode Island College.
- Complete a reflective writing assignment at the end of the semester in which you analyze your progress and your interaction with the content presented throughout the semester.

#### **Risks of Being in the Study**

The risks of participating in this research are minimal, meaning that they are about the same as what you would experience in your normal daily activities.

#### **Benefits to You**

There are no direct benefits to you for participating in the study.

#### **Voluntary Participation**

Your participation is completely voluntary. It is not required by \_\_\_\_\_ Community College. You can choose not to participate in this research and it will have no effect on your presence in the classroom or your grade. Also, you can change your mind about participating at any time with no negative consequences.

**Confidentiality**

The records of this research will be kept private. In any sort of report that might be published, the researcher will not include any information that will make it possible to identify you. Research records will be kept in a secured file, and access will be limited to the researcher. If there are problems with the study, the research records may be viewed by Rhode Island College review board responsible for protecting human participants and other government agencies that protect human participants in research. All data will be kept for a minimum of three years, after which it will be destroyed.

**Contacts and Questions**

The researchers conducting this study are David Brell and Roxanne Tisch. You may ask any questions you have now. If you have any questions, you may contact them via email or telephone.

**David Brell**  
Rhode Island College  
[cbrell@ric.edu](mailto:cbrell@ric.edu)  
401-456-8170

**Roxanne Tisch**  
\_\_\_\_\_ Community College  
[rtisch@\\_\\_\\_\\_\\_.edu](mailto:rtisch@_____.edu)  
xxx-xxx-xxxx

If you feel you are being treated unfairly or would like to talk to someone other than the researcher about your rights or safety as a research participant please feel free to contact Dr. Christine Marco, Chair of the Rhode Island College Institutional Review Board 860 892-5774 or contact Dr. \_\_\_\_\_ the Director of Institutional of Research at \_\_\_\_\_ Community College.

**Dr. Christine Marco**  
Chair IRB c/o Department of Psychology  
Horace Mann Hall 311  
Rhode Island College  
600 Mount Pleasant Avenue  
Providence, RI 02908  
[IRB@ric.edu](mailto:IRB@ric.edu)  
401-456-8598

**Dr. \_\_\_\_\_**  
\_\_\_\_\_ Community College  
[@\\_\\_\\_\\_\\_.edu](mailto:_____.edu)  
xxx xxx-xxxx

You will be given a copy of this form for your records.

**Statement of Consent**

I have read and understand the information above, and I agree to participate in the study “Problem Solving in Developmental Mathematics”. I understand that my participation is voluntary and can be withdrawn at any time with no negative consequences. I have received answers to the questions I asked, or I will contact the researcher with any future questions that arise. I am at least 18 years of age.



Please indicate whether or not you agree to be videotaped.

\_\_\_\_\_ I agree to be videotaped for this study.

\_\_\_\_\_ I do not agree to be videotaped for this study.

Print Name of Participant: \_\_\_\_\_

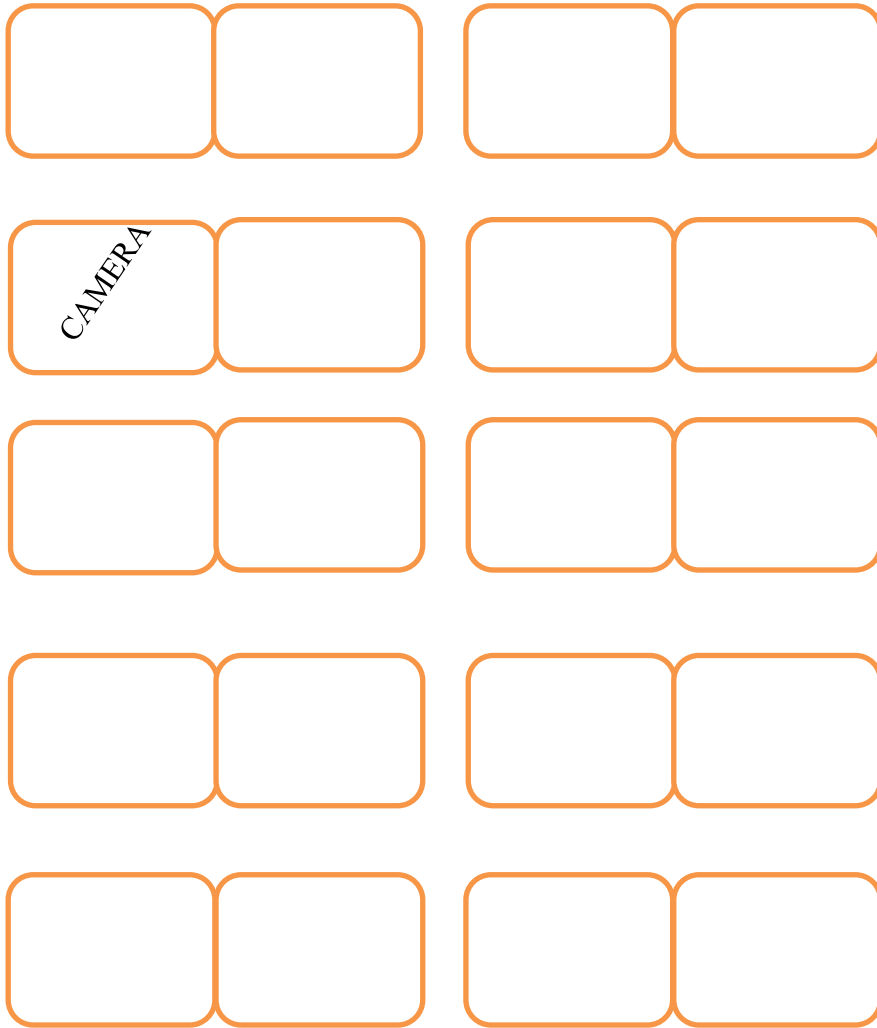
Signature of Participant: \_\_\_\_\_ Date: \_\_\_\_\_

Name of Person Obtaining Consent: \_\_\_\_\_

**APPENDIX H**

**SAMPLE SEATING ARRANGEMENTS**

**Early Morning Class**



**February 12, 2013**

**8am**

**Late Morning Class**

**February 12, 2013**

**CAMERA**








**Interpreter**

**Instructor Podium**

**APPENDIX I**  
**STUDENT COMMENTS AND QUESTIONS**  
**ON DEATH PENALTY RESULTS**

**Early Morning Class**

**Summary of Data (from last class)**

In Florida, for the years 1976 – 1987:

- There were 674 murder trials for black or white defendants
- Of these 674 trials, 68 resulted in the death penalty.
- Approximately 10% of murder trials (defendant was black or white) resulted in the death penalty.
- Approximately 11% of murder trials with a white defendant resulted in the death penalty.
- Approximately 8% of murder trials with a black defendant resulted in the death penalty.

**Are you surprised by the information?**

- No. I have researched the death penalty and the cost of it.
- No. So much going on in the world. White or black commit the same crimes.
- A little bit surprised at the total number of murder trials.
- I was surprised by how many murder trials there were on those eleven years.
- The high rate of murder trials in Florida.
- Yes I was surprised about it. There were a lot of murder trials and death penalties.
- I am only surprised there is such a small amount of people receiving the death penalty.
- It doesn't seem like a lot of people actually get the death penalty.
- I am surprised by the amount of death penalties and the amount of murder trials.
- No. The percents receiving the death penalty are very close. The number of white defendants speaks of higher population of Caucasians and conviction rates seemed similar.
- No. The percentages are close on average of case trials.
- Yes I am surprised by this information because the white defendant information for both murder trials and receiving the death penalty is a lot higher than the black defendant information.
- Yes I was surprised because there is a higher population of black people.

**Any additional questions?**

- How much did it cost the state to do all these death penalties?

## **Late Morning Class**

### **Summary of Data (from last class)**

In Florida, for the years 1976 – 1987:

- There were 674 murder trials for black or white defendants
- Of these 674 trials, 68 resulted in the death penalty.
- Approximately 10% of murder trials (defendant was black or white) resulted in the death penalty.
- Approximately 11% of murder trials with a white defendant resulted in the death penalty.
- Approximately 8% of murder trials with a black defendant resulted in the death penalty.

### **Are you surprised by the information?**

- Not really, because there are a lot of murder trials in the country, not just Florida. And death penalty costs money for the tax payers.
- I am surprised by the information because with a combined total of 674 murders at trial only 68 received the death penalty.
- I am very surprised by the information on this graph because there shouldn't be death penalties anymore.
- Yes, I did not realize the large amount of murder trials.
- The numbers in this chart are somewhat surprising to me considering how many more white defendants were on trial for murder compared to the amount of black defendants, the numbers are very far apart.
- Surprised by the gap between white defendants and black. I would have assumed the # of murder trials would have been closer.
- I am surprised that white defendants outnumber the black. You cannot count on stereotypes.
- Yes I was because I figured with all the racism going on there would be a lot more blacks on trial just because of their skin color.
- This information does not surprise me. Society has misconceptions that blacks are more vicious or violent than others, but this is untrue. Likewise, it is untrue that blacks always receive unfair treatment from authority.
- I am a little surprised. I would have thought the numbers would have been opposite.
- Slightly, I honestly would expect that the number of black defendants receiving the death penalty would be greater.
- Yes this did surprise me because in 1976 there was still segregation going on and so most white defendants were on trial because of the violence it caused.

- Yes – I assumed the majority of prisoners to be Black given the disparate numbers of Blacks in the justice system and on death row.
- Very surprised. Always assumed more blacks and Hispanics.

**Any additional questions?**

- Is it accurate?
- One question I have about these facts is that even though the number of murder trials was so far apart, why were the conviction percentages very similar?
- I am a little surprised by the information in this situation considering how the numbers are dramatically different. Makes me wonder about other information such as where this was and what the population was like, ex. How many whites vs. blacks.
- What percent of the population is white
- What percent of the population is white?
- I would like to know the death penalty data about earlier than 1976 and the data for current times.
- Why isn't there a graph depicting the number of murders by white defendant and black defendant per year?
- Why isn't there a graph showing the amount of death penalties per year?
- I want to know how many were women.
- Why didn't the table list the defendants that were tried but not convicted?

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