IMPROVING MATHEMATICS TEACHING AND LEARNING IN AN ADULT BASIC EDUCATION PROGRAM USING COGENERATIVE DIALOGUES

by

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A dissertation submitted to the Graduate Faculty in Urban Education in partial fulfillment of the requirements for the degree of Doctor of Philosophy, The City University of New York

2010

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This manuscript has been read and accepted for the Graduate Faculty in Urban Education in satisfaction of the dissertation requirements for the degree of Doctor of Philosophy.

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Abstract

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This study explores the use of cogenerative dialogue (cogen) in an Adult Basic Education (ABE) program located in New York City, and the ways in which students and teachers collaborated to cogenerate resources that afforded a positive and equitable learning environment built on solidarity and new perspectives on teaching and learning of mathematics. Cogen was introduced to understand how certain structural characteristics within the classroom environment enable or constrain students' agency and understandings of mathematics. The research presented in this study focuses on improving the teaching and learning of mathematics in a General Education Development (GED) mathematics class from the perspectives of the students—the immediate stakeholders.

The theoretical frameworks employed in this critical ethnography are cultural sociology, sociology of emotions and hermeneutic phenomenology, which are used to describe and interpret students' experiences within GED mathematics classrooms and their associated computer-assisted instructed class. Cogen and conversion analysis were used to gather data and process multiple data sources such as observations, interviews, video and audio recordings. Findings from this research depicts that cogen created

learning environments that fit the needs of adult learners in which they were afforded the opportunity to co/plan, critique and implement curriculum and instructional practice that value how they learn mathematics as adult learners. Thus, students engaged in the process of evaluating, analyzing and interpreting their mathematical knowledge in the form of sharing, coteaching, and helping each other understand ideas regarding problem solving in a collaborative setting.

This research has salient implications for the teaching and learning of mathematics in urban ABE programs, the use of computer-assisted instructed programs and provides insight on how collaborative approaches among math teachers and their students improve and enhance mathematics teaching and learning.

Dedication

To my mother, family, friends, research participants and colleagues.

ACKNOWLEDGEMENTS

I would like to thank the cogen student participants referred to in this dissertation as Jasmine, Lorna, Joseph, Cathy, Janice, Jacinth and Saul, for working with me to restructure classroom and instruction practices to improve the quality of teaching and learning in a GED program. These students' perspectives on mathematics teaching and learning enhanced and improved teaching and classroom practices for themselves and future GED students. I am truly grateful and have learned a lot about adult learners and the capital they bring to the learning environment.

I am also grateful to Dr. Kenneth Tobin, my advisor for his continuous guidance and support throughout this journey. Dr. Tobin provided me with the essential elements for becoming a researcher and teacher educator in the field of mathematics education. Additionally, I am grateful to my committee members Dr. Konstantinos Alexakos for his insights and encouragement during this process as well as Dr. Wesley Pitts, a great friend and mentor who provided guidance and support throughout this journey.

I would like to thank the members of Tobin's Thursday research squad who welcomed me into their squad. I wish to thank Christine Saieh for her friendship and encouragement during my academic career in the Urban Education Program.

Finally, I wish to thank my mother Cynthia Wharton, for her unconditional love, support and encouragement. Your many words of wisdom helped me through this journey. Thank you for instilling in me the virtues of being Bajan and a Wharton, which was handed down from your parents Ethelind and Bertram. Without you and my immediate family this would not have been possible. I would like to thank three of my best friends Arleen Walker, Wendy Johnson and Andrea Kelly who entered my life at

different stages and supported me in this journey. And thanks to Muffin (my cat) a great companion.

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CHAPTER 1

Rebelling Against the Curriculum

Arriving to work on October 10, 2007 I had a feeling that the day was going to be a good one. Not only did my train arrive early, I was able to make my connection, decreasing my commute by fifteen minutes. However, the good feeling that began the day soon dissipated as I heard the echo of raised voices as I approached my classroom. As I walked the short distance from the elevator to room 305, the yellow walls did not illuminate warmth or happiness, but a warning of caution. The air was layered with negative emotional energy and high collective solidarity as students agreed and disagreed collectively about the extra mathematics class added to their program. It seems the students liked the idea of an additional mathematics class; however, they did not like the structure. The class was a computer-assisted instructed mathematics class.

Entering the class a hail of questions descended upon me as the students angrily inquired about the significance of the computer-assisted mathematics class, examples included, was attendance mandatory? And can an instructor replace the computer-assisted program? Although I was unprepared for the attack, I quickly assumed my teacher stance and regained control of my class. I firmly emphasized the importance of the computer-assisted class, as three hours of mathematics instruction per week was not enough to ensure a passing grade on the General Educational Development (GED) mathematics test. In addition, I indicated to students the consequences for not attending class and the beneficial properties of computer-assisted instruction. But, looking out at the faces before me, I knew the students did not believe me. To them, I was an instructor whom they saw

four Saturdays consecutively, who was not familiar with many of their personal, social, cultural, or academic struggles. Thirty minutes later I formally began class.

My students' questions and actions bothered me that Saturday, and the following week. I was angry, hurt and disappointed because I was part of the administrative team that created and implemented the curriculum, which the students obviously disliked. Re-living the conflict from multiple angles I realized that I could not ignore or suppress the tension that occurred in my classroom. Ultimately, I realized I let my students down. I did not put the students' mathematical well being at the forefront. That is, instead of planning ways with the students to create resources needed to learn mathematics I appropriated the institution's rules and procedures to assert my identity and power over the students as the assigned instructor.

The incident, which took place in my classroom on October 10, 2007, was a turning point within my praxis of teaching mathematics. Randall Collins (2004) states emotions, "hold a society together—the 'glue' of solidarity—and what mobilizes conflict—the energy of mobilized groups" (p.103). In my case, anger and distress were the emotions that disrupted the learning environment that Saturday and motivated me to change how I taught mathematics and create curriculum for adult learners. Gone was the old regime of teaching mathematics and I welcomed a collaborative approach to teaching mathematics with adult learners. That is, the students and I worked together to refine, develop, and implement curriculum and instructional practices that were responsive to how they learned mathematics as adult learners. This dissertation tells about the ways in which my students and I collaborated to enhance and transform the teaching and learning of mathematics in a GED program through the use of cogenerative dialogues (cogen).

Adult Basic Education (ABE) Programs in the United States

In 1998, Adult Basic Education (ABE) became Title II of the Workforce Investment Act and was renamed the Adult Education and Family Literacy Act (AEFLA). As a result, ABE and vocational rehabilitation programs became workforce programs, that is, one stop educational systems providing free educational programs for adults and youth aged 16 years and older. These programs assist non-immigrants and immigrants who lack sufficient mastery of basic educational skills to function effectively in society; did not possess a high school diploma; achieved an inadequate level of education; or were unable to speak, read, or write the English Language and were below a postsecondary level of education (Amstutz & Sheared, 2000). ABE programs help adults develop the necessary literacy and numeracy skills to find jobs or pursue higher education.

The General Educational Development (GED) Testing Program

The GED testing program is an essential component of ABE as it provides adults with a second chance to obtain their high school equivalency credential. Adults are provided instruction in the subject areas of language arts reading, language arts writing, mathematics, science, and social studies in order to be prepared to take a battery of five tests. The GED testing program has a rich history that dates back to the early 1940s.

In 1942, the United States Armed Forces Institute (USAFI) launched the GED testing program as a means to help military personnel and World War II veterans take advantage of the post secondary education benefits offered in the GI Bill. The USAFI commissioned the American Council on Education (ACE) with the support of the

National Association of Secondary School Principals, and regional accrediting associations to design a battery of tests to measure high school instructional outcomes. These tests would allow military personnel to complete their high school program and advance directly to college or enter the civilian workforce. In 1943, the first GED test was administered to military personnel and World War II veterans discharged from the military. In the late 1940s, ACE noticed that the GED testing program could be beneficial to civilians who did not complete their high school program. Accordingly, they made a major marketing appeal to allow non-veterans to take the test. In 1947, New York became the first state to be approved for the sponsored diploma program making the GED test available to civilians, revolutionizing the GED testing program. By 1974, the GED testing program was enacted in all 50 U.S. states, Canadian provinces and territories as a means to award an alternative high school credential (GED Testing Service, 1993). Each year, the GED test affords millions of adults, 16 years and older lacking a high school diploma, a second chance to earn their high school credential. The GED credential accredits that test-takers have attained the knowledge and skills relative to a graduating high school senior closing the gap between adults and their many aspirations for post secondary education and access to job opportunities. Thus, more than 98% of colleges and universities in addition to 96% of employers in the United States accept the GED credential (GED Testing Service, 2009).

Since the implementation of the first GED test in 1942, the test has evolved and undergone considerable changes. So far, there have been four generations of GED test: 1942, 1978,1988, 2002 and a fifth test was to be implemented in 2012 reflecting the curriculum and standards of today's high school program. The GED Testing Service

announced the cancellation of the 2012 test series in October of 2009. They noted that the current national conversion regarding the characteristics of a high school graduate and the knowledge and skills needed for students to successfully complete postsecondary education in addition to career readiness had a direct impact on the 2012 test. Therefore, they are currently revising and remodeling the 2012 test to be aligned with the movement towards rigorous national standards for high school education. The remodeled test will have a new format and will be built upon better preparing students for college and career readiness. In addition, the GED testing program will also be remodeled to be a more comprehensive assessment program called GED 20/20. The GED 20/20 testing program will be in accordance with President Obama's assertion for the need to support students' transition to college and career training programs (GED Testing Service, 2009b). As such, the current 2002 test series will continue assessing test-takers' ability to apply concepts, principles, analyze relationships, synthesize information, and evaluate the validity of information in the five-subject areas of language arts reading, language arts writing, mathematics, science and social studies.

More than 17 million test-takers have obtained their GED credential since the test was implemented in 1942. In 2008, more than 493,000 test-takers obtain their GED credential. However, more than 189,000 test-takers did not pass the battery of five GED tests failing one or more parts of the tests. It has been documented that test-takers struggled to pass the mathematics and language arts writing tests. These two tests are considered the most difficult in the battery of five GED tests having the lowest average standard scores of 496 for mathematics and 505 for language arts writing (GED Testing Service, 2009).

GED Mathematics Curriculum

The GED mathematics test is designed to measure students' knowledge and higher order thinking skills associated with four years of regular high school mathematics study. The mathematics test evaluates students' knowledge in problem solving, analytical and reasoning skills in word problems and graphical representations such as charts, tables, line, bar and circle graphs. The four major content areas tested are: (1) number operations and number sense; (2) measurement and geometry; (3) data analysis, statistics and probability; (4) algebra, functions and patterns in which each content area accounts for 20%-30% of the questions on the test. In addition, test-takers are assessed on different methods of applying their mathematical cognitive skills through the use of questions that assess procedural and conceptual knowledge, and application, modeling, and problem solving within each content area tested.

Thus, 20% of the questions on the GED mathematics test are procedural requiring students to select and apply correct mathematical procedures; use numerical algorithms; read and interpret graphs, charts, and tables; use formulas; and round and estimate answers to solve problems. Conceptual questions account for approximately 30% of the questions requiring test-takers to demonstrate knowledge of how basic mathematics concepts and principles work. They must be able to compare, contrast and integrate related concepts and principles; know and apply facts and definitions; interpret and apply signs, symbols and mathematical terms such as performing calculations with square roots and exponents; in addition to interpreting assumptions and relationships. Application, modeling and problem solving type questions represent the majority of questions on the GED mathematics test accounting for 50% of the questions. These questions require test-

takers to identify the types of question presented; decide whether there is sufficient information provided to solve the problem; select pertinent information; apply appropriate problem solving strategies; modify strategies or procedures necessary to solve the intended problem; and most importantly determine if their answer choice is reasonable. In all, the questions featured on the official GED mathematics test focuses on students' ability to solve problems that represent consumer situations, technology, career and family experiences (GED Testing Service, 2009a).

Structure of the Official GED Mathematics Test

The official GED mathematics test consists of 50 questions divided into two equally weighted parts, each containing 25 questions. Test-takers are allotted 45 minutes to complete each part of the test in which 80% of the questions are multiple-choice and 20% of the questions require exact answers, which are entered in standard grids or a coordinate plane grid. The majority of the questions on the official GED mathematics test are multi-step problems that require test-takers to carry out a series of steps to obtain the correct answer while some questions simply require choosing the correct method and expression necessary to solve the problem.

On Part I of the test, test-takers can use a scientific calculator (Casio fx-260) provided at the testing site. On Part II of the test calculator use is prohibited and test-takers use mental mathematics and estimation to obtain their answers. A formula page is provided as reference in each booklet, which lists the formulae for area, perimeter, volume, coordinate geometry, Pythagorean theorem, measures of central tendency, simple interest, distance and total cost. Scores are determined by the total number of correct answers on both Parts (I and II) of the test, which is converted into a three digit

standard score ranging from 200 to 800. The minimum score needed to pass the GED mathematics test is 410 in the state of New York. Kansas is the only state with a minimum passing score of 420 (GED Testing Service, 2009a).

Researching Adults Learning Mathematics

Currently there is limited research in the field of ABE regarding teaching and learning of mathematics in GED programs. The literature in this field focuses more on literacy, English Language learners and practitioner guides such as prepared curriculums, lesson plans, student activities and the social, political and economic contexts of adult education. There have been only two large-scale studies that address specific curricular, instructional or administrative issues in ABE programs. The first study, Last Gamble on Education (Mezirow, Darkenwald, & Knox, 1975) was a two-year research project on urban ABE programs throughout the country. This study focused on program operations (enrollment, funding and salaries), classroom interactions (curriculum, student-teacher relations and behavior), from the perspectives of students, teachers, counselors, and administrative personnel in ABE programs. The second study, Classroom Dynamics in Adult Literacy Education (Beder & Medina, 2001), investigated classroom behavior in adult literacy education. The study found that instruction in ABE programs were delivered by discrete skills instruction, that is, the teacher prepared and delivered lessons that conveyed factual information. Lessons taught within these programs focused on reading, writing and mathematics including GED preparation. It was observed that teachers rarely asked students their opinions, feelings or beliefs regarding teaching and learning and information was obtained from students by means of literal recall. A few classes did adopt a collective approach to learning where students and teachers worked

collaboratively using materials that were related to students' lives with the teacher as a facilitator rather than a conveyor of information. However, both of these studies failed to examine a particular academic area such as mathematics, but examined classrooms activities, student teacher interactions and student-student interactions.

In an attempt to find additional research regarding ABE I analyzed the dissertation abstracts using the search term adult basic education. This search revealed 46 dissertations on ABE. These dissertations addressed topics such as correctional facilities, English as a Second Language, rural education, literacy, accountability, leadership, retention, technology, computer-assisted instruction, students' perceptions, math anxiety, teachers' perceptions and knowledge. When the search term GED was added to ABE only 10 dissertations fit within both categories. However, on the inclusion of mathematics instruction with the two previous terms there was only 1 dissertation by Judith Ward (2000), which examined ABE, GED and mathematics instruction. In her dissertation Ward (2000) examined how mathematics instruction was delivered in GED programs in Arkansas and focused more on the GED instructors rather than the students. Currently, there is a lack of research pertaining to adult mathematics education indicating a dire need for research within this field. Mathematics is a subject many adult learners fear and is the most difficult test to pass in the battery of the five GED tests since 1988.

Teaching and Learning of Mathematics: A Form of Cultural Enactment

In this study I theorize the teaching and learning of mathematics as a form of cultural enactment composed of schema, practices, materials and social networks that are responsive to the unfolding events occurring in the classroom (Tobin, 2005). Teacher and students have the ability to produce, reproduce, and transform the mathematics being

taught and learn to construct knowledge and improve their fluency in mathematics. From this perspective, as culture is enacted in the classroom it is structured by resources that are material and schematic. These resources can be accessed and appropriated by students and teachers as they exercise their agency, the power to act within a field. Hence, there is a dialectic relationship between agency and structure in which each presupposes the other and is constantly changing to meet the varying needs of teaching and learning. A key implication in this research is to identify and understand the structures that afford or constrain the teaching and learning of mathematics and students' agency in GED classrooms.

Cogenerative Dialogues (Cogen): A Method for Change

Kenneth Tobin and Wolff-Michael Roth (2006) describe cogen as discussions among teachers and students regarding shared experiences in the classroom to identify and review practices that afford or constrain the teaching and learning of mathematics. Cogen affords teachers and students an opportunity to listen, reflect, evaluate, and understand the perspective of others who are different. As a result, students are afforded the opportunity to have ownership in their education in which they co/create, refine or transform teaching and learning practices. Teachers on the other hand are afforded an opportunity to listen attentively to students' perspectives of the learning environment and also provide students with their perspectives of what is occurring within the classroom from their point of view (Bayne, 2009). Cogen provides participants with a social bond built upon shared power, responsibility, trust and respect in order to make positive changes within the learning environment.

In this study cogen is used as a pedagogical tool to improve the quality of teaching and learning of mathematics. Teachers and students learn from each other and develop teaching and learning strategies that are responsive to the learning environment, an important aspect for evaluating and modifying pedagogy and curriculum. The changes made to the learning environment are agreed upon by the participants (teachers and students), those who have the most to lose, rather than waiting for recommendations from other educators, researchers or policy makers. Thus, teachers and students are active participants in changing their academic conditions.

Cogen has been used in a variety of educational settings locally and internationally to improve the teaching and learning of science and mathematics in K-12, private schools, colleges and graduate schools (Martin & Scantlebury, 2009). This study is a continuation of the research with cogen; however, it is situated in an Adult Basic Education (ABE) program to help adult learners achieve their goal of passing the GED mathematics test. Accordingly, this body of work with cogen builds upon existing research done by Kenneth Tobin's team of education researchers in Philadelphia (e.g., Martin, 2004) and New York City (e.g., Pitts, 2007) in which cogen was used as a methodology and/or a method to improve the quality of teaching and learning in urban schools.

Downtown Center: The Best Kept Secret in New York

The Downtown Center[1], is an ABE program located in Brooklyn, New York and is part of a network of 10 Centers in New York State providing educational and

[1] Pseudonyms will be used throughout replacing the names of the ABE program and research participants

vocational opportunities to adult learners aged 18 to past retirement age residing in urban communities. The Center is a model for community workforce development, which is a one-stop educational system helping adults reach their goals economically and educationally for 44 years. Its mission is to ensure access to higher education and promote economic self-sufficiency to New York State residents striving to attain knowledge, acquire work skills and achieve career goals through instruction and continuous learning. It is known as the best kept secret in New York with all services and tuition free for eligible NYC residents. Students enrolled at the Downtown Center heard about the program from social networks such as friends, their church or listening to local radio stations, while others are walk-ins who happened to see our sign posted at the entrance of our institution listing the programs offered.

The Downtown Center offers a variety of academic programs to NYC residents in three categories. The academic program consist of English as a Second Language for students whose native language is not English; GED Preparation for adults who did not complete their formal high school program; and Pre-Freshman Academy designed to help students transition into local colleges and acquire the skills necessary to navigate college courses and successfully pass their college assessment test in English and mathematics. Accelerated career programs are one-semester courses consisting of Medical Billing and Coding, Computerized Bookkeeping and Web Page Design and Maintenance. Comprehensive career programs take three-semesters and consist of Computers and Networking Technology, Office Support and Medical Office Administration. Career programs provide students with the training necessary to achieve mid-level skill jobs. Recently, a hospitality management course in collaboration with a local community

college was added to the career program. The Downtown Center provides its students with a variety of support services such as academic, personal and career counseling and there is a library onsite that provides tutoring services. The Center enrolls approximately 1600-2000 students annually. More than 250,000 adults have used the services offered at the Downtown Center and our graduates have contributed $1.7 billion to New York City and the State economy (Blades-Rosado, 2008).

The Study

This study is situated in the GED program of the Downtown Center. The GED program prepares students to take a five-part battery test to achieve their alternative high school credential. Passing this high stakes test is a positive outcome for both students and the Downtown Center. The GED program consists of four courses; GED writing, which helps students develop their writing skills; GED reading, which helps students develop proficiency in reading and critical thinking skills for the social studies, science, and language arts reading sections of the GED test; GED mathematics, which helps students develop the necessary skills in problem solving, basic mathematics, geometry, data analysis and pre-algebra; and the GED test class, which provides students with test taking strategies in the five subjects areas such as time management techniques and ways to reduce test anxiety. Each GED class has a teacher who is a specialist in his or her field, hence, there is a teacher for reading, which consist of social studies, science and language arts reading, a teacher for writing and a mathematics teacher. In addition, each subject area has a computer-assisted instructed program to enhance the teaching and learning of all academic subjects that comprise the GED test. GED classes meet three hours per week

except for mathematics, which meets for six hours per week within a ten-week semester. In all, students receive 15 hours of instruction per week in the GED program.

The Downtown Center is a GED testing site for the New York State Education Department. As a result, students enrolled in the GED program must pass official GED practice test at midterm or final to qualify to take the GED test. Students must achieve a combined score of 2250 and have a minimum score of 410 in each subject area. Official GED practice test are half-length versions of the official GED test and determine students' readiness and would be success on the official GED test. But similar to the official GED test students usually fail the mathematics test in which case they do not meet the Center's requirements to be nominated to take the official GED test.

Student Population

The Downtown Center has a diverse student population with respect to age, gender, ethnicity, nationality and academic levels. Students range in age from 18 years to post retirement, but the majority of the student population is in their mid-20s to mid-40s in which there are more female students than male students. The majority of the students at Downtown Center, approximately 60% are native born American of African American or Caribbean/West Indian American descent. The other ethnic groups comprise 21% Latino/Hispanic, 9% Caucasian, 5% Asian Pacific American, 2 % Native American, and 3% other. The vast majority of the students enrolled at the Downtown Center reside in the borough of Brooklyn, which accounts for 77% of the student population, Staten Island residents account for 8%, Queens 7%, Manhattan 5%, and 3% from the Bronx. As a result, students are afforded enriched learning experiences due to the diversity of the student population.

Cogen Participants

Participants in this study are students enrolled within my GED mathematics classes, the GED lab instructor and me. In a typical semester four to eight students have self-selected to participate in cogen sessions based on conflict in the learning environment, curiosity, or a fear of mathematics. Participants attended weekly cogen meetings in which we worked in a collaborative setting, to structure the mathematics class and labs while identifying what supports were needed for effective mathematics teaching and learning for adult learners. In many cases the lab instructor could not attend cogen sessions due to a conflict of schedules in which case I held one-on-one cogen with these individuals. Students who did not participate in cogen were interviewed to understand how changes made to the learning environment affected their learning of mathematics.

Focus of the Study

The research presented in this dissertation uses critical ethnography, cogenerative dialogues, conversation and prosodic analyses as a means to understand the mathematical experiences of adult learners enrolled in a GED program and make structural changes to improve teaching and learning. A priority of this research is to describe adult learners (teacher and students) experiences as collaborators and co/learners in the planning of the curriculum, assessment and the teaching and learning of mathematics. In addition, I examine the ways in which students' agency was expanded by the resources available and the structures that enable and constrain the teaching and learning of mathematics. The theoretical lenses of cultural sociology, sociology of emotions, phenomenology, hermeneutics and the use of conversation and prosodic analyses are used to describe and

interpret students' mathematical experiences in the classroom. The questions that guide this research are:

1. What support structures were implemented for successful mathematics teaching and learning in a GED classroom?
2. How do students reconstruct their identities as mathematics learners in a collaborative learning environment?
3. Did cogenerative dialogues transform the learning environment and the curriculum in a GED mathematics class?

Authenticity Criteria

The research within this study adheres to the guidelines of the Belmont Report (1979), which indicates that the study should be non-exploitative and procedures are administered fairly such that participants are respected, potential harms should be minimal while participants' beneficence is maximized. In addition, Egon Guba and Yvonna Lincoln's (1989) authenticity criteria were also utilized within this research to ensure that the study is ethical and of high quality.

Guba and Lincoln's (1989) authenticity criteria maintain that the research has ontological, educative, catalytic and tactical authenticities to answer the question of goodness and quality. As such, ontological authenticity refers to the extent to which stakeholders' constructions regarding social life have changed throughout the research process. Educative authenticity refers to the extent stakeholders understand and appreciate the constructions of their peers. As a result, educative authenticity is part of ontological authenticity and both criteria are achieved by testimonials from cogen

participants in which stakeholders can attest to a new appreciation of the mathematics they are currently learning, in addition to the constructions of their peers, and how they learn mathematics as adults. Catalytic authenticity refers to the extent the study stimulates action and produces positive changes, which is achieved by shared responsibility and negotiation. Finally, tactical authenticity refers to the extent that stakeholders are afforded agency by the research process (Tobin, 2006a). The use of cogen in this study affords students' agency to have ownership in their education and a shared responsibility in which they are able to critique, co/plan, and implement a new curriculum and instructional practices that are beneficial to their needs as adult learners.

Overview of Chapters in Dissertation

This dissertation comprises of six chapters, which present different aspects of how cogen improved the teaching and learning of mathematics in a GED program. Each chapter is written to stand-alone with its own methodological frameworks woven in through out the chapters, which cohere with the themes of the dissertation and illuminate the teaching and learning of mathematics in different ways.

Chapter 2: Learning about and from Cogenerative Dialogues-The Initial stages

This chapter provides a detailed account of how I began using cogen in the fall 2007 semester. It chronicles how cogen was introduced because of students' dislike of an additional mathematics class, that is, a computer-assisted instructed mathematics class. The computer-assisted class was implemented to help students improve their fluency in mathematics, as three hours of mathematics instruction was not enough to ensure a passing grade on the GED mathematics test. The chapter documents the challenges my

students, the lab instructor and I encountered with computer-assisted learning, which afforded an opportunity to examine how technology such as computer-assisted instructed programs could be effectively used in ABE programs to support the teaching and learning of mathematics. The interpretive frameworks of cultural sociology, sociology of emotions, phenomenology, personal narratives and the transcript of a cogen session were used to interpret the challenges and beneficence of computer-assisted learning. Utilizing cogen provided important insights regarding how educators could improve the teaching and learning of mathematics in a technology-enhanced classroom when students were afforded the opportunity to critique, co/plan and implement a new curriculum that was beneficial to how they learn mathematics as adults. The cogenerated solutions implemented changed how mathematics was taught, learned and experienced within this class providing students with equitable and productive learning environments.

Chapter 3: Cogenerative Dialogues: Improving Mathematics Instruction in an Adult Basic Education Program

This chapter is co-authored with Wesley Pitts, Assistant Professor and Coordinator of the graduate program in science education at Lehman College, City University of New York. This chapter explores a vignette from a cogen session in the spring 2008 semester among four adult learners and me regarding how they understand, negotiate and develop the necessary process skills for enacting mathematics. Process skills are theorize as the knowledge students bring to the learning environment (social, cultural, and mathematical) and their preferred ways of enacting mathematics that is, the methods and procedures students use to solve mathematics problems. This vignette was purposefully selected because it exemplified important challenges adult learners face

solving multi-step word problems. According to the GED Testing Service, problem solving and mathematical reasoning are areas in the GED mathematics test that cause students the most difficulty. The theoretical framework of cultural sociology, sociology of emotions, cogenerative dialogues and conversation and prosodic analyses were used to describe students' experiences with mathematics in addition to the developmental shifts, which occurred among the participants, as cogen became a central site for coteaching and co/learning in mathematics. Cogen afforded the student participants an opportunity to gain fluency while enacting mathematics in timely, anticipatory and appropriate ways. Cogen was recorded and iMovie (Apple's video editing program) was used to process and view the videos at varying speeds to access and review dispositions including the production of fluency, solidarity, speech and physical movements that would not normally be available for analyses.

Chapter 4: What must I do to Pass this Test?

This chapter investigates students' mathematical experience taking official GED mathematics practice test and the mathematical errors they incur given the structure of the test. Students were administered an official GED practice test at midterm to determine their readiness and would be success on the official GED test. I assumed that students would pass this test given what was taught so far, however, only six students passed the test indicating their were some contradictions regarding what students should have been able to accomplish. To construct meaning of students' mathematical experience, that is, the methods, procedures, and cultural knowledge used to solve the problems featured on the official practice test I enacted a dialectic process consisting of explanation and understanding. This process attempts to understand events that occurred in the past and

also as they unfold in the present. The process of explanation is achieved by the use of cogen and conversation analysis in which students provide a rich description of their mathematical experience taking the official practice test through language and their body orientations. The theoretical frameworks of cultural sociology, sociology of emotions and hermeneutic phenomenology are used to understand students' mathematical experiences with regards to the structural constraints that prevented students from doing well on the test. This chapter provides critical insight of the unconscious mistakes that students incur on official practice test such as not reading the questions carefully, misinterpreting questions and not judging the reasonableness of their answers.

Chapter 5: Adult Learners' Perspectives on Mathematics Teaching and Learning in a GED Program: A Metalogue

This chapter is a metalogue in which four cogen participants Cathy, Jacinth, Saul and me discuss mathematics teaching and learning in a GED program. The metalogue is based on chapter 3 of the dissertation and provided an opportunity for us, the central participants, to reflect on what was learned such as how cogen improved the learning environment, the implementation of coteaching, and the contradictions that emerged such as Jacinth's difficulties with word problem. Introducing a metalogue into this dissertation provided another method of inquiry that allowed the reanalysis of the data in chapter 3 with the immediate stakeholders. As such, we learned more about ourselves as students and teachers of mathematics and the roles we embraced within the classroom.

Chapter 6: The Metamorphosis of Teacher and Student

In this concluding chapter I discuss how cogen transformed the teaching and learning of mathematics for my students and me in a GED mathematics class. Cogen expanded students' agency and increased their fluency in mathematics as well as enhanced how I taught mathematics with adult learners in a GED program. In addition, I re-examine the research questions posed in chapter 1, discuss the implications for this body of work and its relevance to the field of adult basic education, GED mathematics, and adults learning mathematics.

CHAPTER 2

Learning about and from Cogenerative Dialogues-The Initial Stages

Over the years there has been an increasing demand for Adult Basic Education (ABE) programs in the United States to incorporate technology within their classrooms to improve the quality of teaching and learning. Technology, such as computers, serves as additional instructional tools to help students increase their knowledge and skills in academic subjects (Souter, 2002), while obtaining the necessary computer skills required for employment in today's workforce (Lowther, Inan, Daniel, & Ross, 2008). In ABE classrooms computers are used to deliver and improve instruction in the subject areas of writing, reading, science, social studies, mathematics and workforce readiness similar to K-12 schools. Research studies reveal that computers have the potential to improve students' proficiency in academic subjects such as mathematics, a subject in which students have exhibited poor academic performance (Ozel, Yetkiner, & Capraro, 2008).

In the Principles and Standards for School Mathematics (2000), the National Council of Teachers of Mathematics (NCTM) suggests that computers and calculators allow students to learn more mathematics. These instructional tools influence how students are taught, learn and enact mathematics in the classroom. Research indicates that technology enriches students' mathematical experiences providing them with ownership in their learning as they develop necessary higher-order thinking skills and enhance prior mathematics skills while learning at their own pace. Yet, in spite of these positive effects of the usage of technology in the improvement of academic performance in K-12 educational settings these results have not been replicated within ABE programs. Many

challenges exist in the integration and implementation of technology such as computer-assisted instruction within ABE programs.

This chapter focuses on the challenges faced by my General Educational Development (GED) mathematics class when a computer-assisted instructed class was incorporated into the GED program to improve the learning of mathematics. The voices of my entire GED mathematics class, lab instructor, cogen participants, and me are featured within this chapter in which we identify the challenges encountered with computer-assisted learning. In addition, we identified pertinent strategies cogenerated through the method of cogen to improve and enhance the learning of mathematics for all students. The difficulties my students, the lab instructor, and I encountered with computer-assisted learning afforded opportunities to examine how technology can be effectively used in ABE programs to support the teaching and learning of mathematics. This chapter outlines a possible framework of how ABE programs can integrate computer-assisted learning in their classrooms to improve curriculum, instruction and students' mathematics skills.

Computer-Assisted Instructional Programs and their Place in ABE Programs

Teachers, program directors, researchers, and policymakers in ABE programs have favored the idea of utilizing technology to improve the quality of teaching and learning since the early 1970s (Rachal, 1993). As such, many ABE programs have adopted technology to deliver instruction in order to enhance students' learning. ABE programs have embraced multiple forms of learning technologies such as smart boards, projectors, calculators, computer-assisted instruction and classroom response systems-clickers to support various educational activities that influence students' learning and

understandings of academic subjects. For instance, at the Downtown Center an ABE program located in New York City, all of the classrooms have been upgraded to "smart classrooms" in which teachers have access to computers linked to projectors that display information to students. In addition, the GED program utilizes computer-assisted instruction in the teaching and learning of science, social studies, mathematics, language arts reading and writing the subject areas featured on the GED test.

Computer-assisted instruction allows students to learn concepts and procedures from computer software at their own pace. In mathematics, these programs teach the necessary principles, computation and problem solving skills in a tutorial format to improve students' fluency in mathematics. Students are able to access these instructional programs anytime of the day, as these classrooms are open 24 hours, seven days a week. This is beneficial to teachers and most importantly to students because it increases the amount of instructional hours students receive in any given class period. Students enrolled in ABE programs in the State of New York receive a minimum of six hours to a maximum of 20 hours per week of academic instruction. Thus, computer-assisted instruction provides additional hours of academic instruction whereby students can set their own schedules to review and practice their mathematics skills.

In computer-assisted instruction students have a personalized approach to learning that is, private, visual, self-paced, provides immediate feedback and can be customized to meet students' immediate learning needs (Osei, 2001). The interactive tutorials, exercises and games allow students to construct knowledge and discover mathematical interrelationships linked by prior knowledge. Essentially, students learn by doing as they direct and control the events within the simulation. As a result, students view

mathematical concepts less abstractly and more in a concrete manner providing a framework for thinking, reflecting, reasoning, and problem solving. For teachers, computer-assisted instruction can be modified to fit the academic needs of a specific student or class. Students enrolled in ABE programs bring diverse academic abilities and educational experiences to the classrooms in which technology provides differentiated instruction for struggling learners or students who may be more advanced (Barrow, Markman, & Rouse, 2007).

Researchers who examined computer-assisted learning reported that students remember information appropriated in this manner because of the visual, auditory and kinesthetic components. Visual learners read words and view graphics in an interactive mode presented in an orderly fashion, auditory learners listen to a clear voice that articulates key points and kinesthetic learners use the keyboard and the mouse to drag, drop, match, click on target, type or choose appropriate answers (Yonder & Elias, 1998). Students use a variety of skills in computer-assisted instruction to enhance their learning of mathematics, which cannot be accomplished from a standard textbook. Thus, computer-assisted learning is hands on learning at its best in which students appropriate information in an interactive format rather than being expected to learn from narrative, that is, passively recording, memorizing and regurgitating random rules and procedures.

Difficulties with Technology

As a mathematics educator at the Downtown Center I was unprepared for the difficulties students encountered with computer-assisted instruction. My assumptions regarding students' abilities to use computer software to improve their mathematics process skills, enthusiasm of learning mathematics in a non-traditional classroom and

students' ability to produce the wherewithal to combine knowledge from the traditional and computer-assisted class to achieve fluency in mathematics created conflicts and contradictions.

The mature adults (25+ years) experienced the most difficulties using computer-assisted instruction. Many of these students had been out of school for an extended period of time, which indicate they might not have the necessary schema and resources to use computer-assisted instruction as a means to learn mathematics. Schemas are rules, procedures, and knowledge while resources are human and nonhuman that inform the teaching and learning of mathematics. Joseph, a student in the class stated that the last time he was in a classroom was 1984 and computers were not used as instructional or learning tools; a probable reason for his apprehension for using computer-assisted instructed programs. Another student Jasmine stated that she was use "to doing stuff from the book … I [Jasmine] am from the old school." Jasmine like many of her peers were accustomed to traditional methods associated with teaching and learning in which the instructor lectures, provides course materials, students listen, take notes and complete in class and homework assignments. To Jasmine and her peers, computer-assisted learning was a foreign instructional tool, which may explain the uncertainty these students felt utilizing this tool to improve their fluency in mathematics. The mature adults' struggles with computer-assisted instruction became visible when they were confronted with a classroom environment that did not reflect their notion of teaching and learning of mathematics. These students were conditioned to value a teacher-centered approach to teaching and learning, based on their prior educational experiences. As such, they did not have a sense of belonging and affiliation to computer-assisted instruction. Computer-

assisted instruction became a structure within the learning environment that constrained and shaped students' agency that is, their power to act within a technology- enhanced mathematics classroom (Tobin, 2005). From a sociocultural lens, the structural characteristic of the computer-assisted instructed class in addition to the schema and practices of students can afford or constrain agency and in turn, agency produces structures. As a result, agency and structure cannot be separated, but constitute a whole indicating a dialectic relationship.

Not surprisingly, the younger students (18 -24 years) enrolled in the GED class encountered fewer difficulties or challenges using computers to improve their fluency in mathematics. These students possess the schemas and resources to use computer-assisted instruction to learn mathematics, which afforded positive emotional energy around learning mathematics from such mediums. Positive emotion supports synchrony and creates solidarity around computer-assisted learning. Several surveys indicated that more than one half of young adults spend nine hours a week on Internet activities (Owston, 2009). These students represent a generation who use computers and other digital tools such as graphing calculators in their prior school experiences to a greater extent than mature adult learners. Jerry, a young adult indicated that he was satisfied with the current structure of the class. Jerry felt at ease with computer-assisted instruction and favored this form of teaching and learning due to his age, mathematics ability and knowledge of using computer-assisted programs. From Jerry's coursework it was evident that he was more advanced and knowledgeable in mathematics than the older adults. Yet, Jerry did not consider himself a strong mathematics student because he failed to achieve 100% on his test and quizzes due to "certain things and silly mistakes."

The mature adults were discontented with the learning environment in addition to the behavior and acts of disrespect displayed by some of the younger students. However, the negative emotions displayed by these students were projected more towards the structural characteristics of the computer-assisted class, Sara (lab instructor), and me (primary instructor). Emotions are a critical component in the teaching and learning of mathematics and have the potential to control, maintain or disrupt the learning environment (Collins, 2004). Positive emotions tend to maintain solidarity while negative emotions disrupt the learning environment. The negative emotions displayed by the mature adult students led to unsuccessful encounters with in the learning environment originating from students unfulfilled expectations of teaching, learning and understanding mathematics in a non-traditional manner. When students enter classrooms they hold within their schema (beliefs, ideas and values) expectations regarding teaching and learning acquired from their prior experience within a classroom setting. Hence, in the computer-assisted class the mature adults did not understand their respective roles, those of the teacher or the computers within this new classroom setting. As a result, students' expectations about the classroom structures and those associated with the instructors' roles were not satisfied, which led to the display of first order negative emotions such as anger, fear and sadness.

This chapter builds on the concept of structure and resources and how these entities afford and constrain students' agency and identity within mathematics classroom and how modification of structures can resolve these conflicts and contradictions. Accordingly, cogen was implemented to bring students and teachers together to discuss the social dynamics of the computer-assisted instructed class. It afforded the

identification of schema, practices and resources that truncated and enabled how students learn mathematics from computer-assisted instructed programs. As a research group our aim was to create an equitable and productive learning environment that maximize the effectiveness of computer-assisted instruction to improve the learning of mathematics.

Cogen and their Applicability to ABE

Curriculum and instruction in most ABE programs tend to be teacher controlled and directed rather than collaboratively planned with students (Amstutz & Sheared, 2000). Paulo Freire (2000) refers to this practice as the teacher-student contradiction in which the teacher is solely responsible for depositing knowledge and skills into passive students; regarded as depositories who must comply and adapt to the knowledge bestowed upon them. Hence, to improve the quality of education in schools critical theorists like Paulo Friere (2000) and Ira Shor (1996) advocate for active dialogue and shared cogovernance in classrooms.

The use of cogen within the computer-assisted class challenged the teacher-student contradiction through active dialogue and cogovernance to examine oppressive structures and afford positive changes within classroom encounters. Active dialogue is achieved through critical discussions between teachers and students regarding shared events within the classroom to eliminate conflict and contradictions. Subsequently, cogovernance is achieved through coteaching in which students assume the role of teachers to plan, enact, and implement curricula that support their learning needs. Through cogen, teachers and students actively interrogated and reconceived classroom practices in an emancipatory manner (Tobin & Roth, 2006). Participants explore and identify features in the curriculum and structure of the class that prevent and alienate the

teaching and learning of mathematics and cogenerate necessary changes to be enacted in future classes. Cogen has the potential to change and modify classroom structures that constrain students' agency by helping them learn more about computer-assisted instructed programs so that they can use these resources strategically to inform their learning of mathematics.

Focus of the Chapter

This chapter focuses on my initial experiences with cogen as a method to improve curriculum and instruction in a computer-assisted mathematics class. As such, the vignette selected is from my first cogen session and it highlights a variety of challenges experienced by students with computer-assisted learning programs and the weakness and strengths of such instructional tools from the perspective of GED students. The students in this class displayed extreme anger, anxiety and disapproval indicating that the computer-assisted mathematics class was not a productive learning environment but a site for struggle and resistance. I learned first hand about the struggles and challenges my students endured in the computer-assisted class three weeks into the semester. Students agentically conveyed their dislike of computer-assisted instruction and indicated their preference for a teacher instructed class. Some of the students did not understand the significance or beneficence of computer-assisted learning and many were considering not attending class. It became apparent that there were numerous issues and challenges regarding how computer-assisted programs were being used for educational purposes within this GED class.

To make sense of what was occurring within this class I use the interpretive frameworks of cultural sociology, sociology of emotions, phenomenology, personal

narratives and the transcript of a cogen session to examine the challenges and beneficence of computer-assisted learning as means to enhance teaching and learning in a GED mathematics class. Studying the use of cogen in a GED mathematics classroom provides important insights regarding how educators can improve the teaching and learning of mathematics in technology-enhanced classrooms when students are afforded the opportunity to critique, co/plan, and implement a new curriculum that is beneficial to how they learn mathematics as adults. The cogenerated solutions have the ability to change the structure of the class, that is, how mathematics is taught, learned, and experience in computer-assisted instructed classrooms. This chapter addresses change and what constitutes effective teaching and learning of mathematics in computer-assisted classrooms. However, as a research group other variable outcomes were attained such as an increase in student agency, identity shifts, mathematics success, the adaptation of new roles and instructional tools for both teachers and students.

Allies in Teaching and Learning of Mathematics

The vignette presented in this chapter acknowledges an incident that took place three weeks into the fall semester regarding the implementation of a computer-assisted class. This afforded the opportunity to implement cogen to resolve the difficulties students were experiencing within this non-traditional class. Cogen was introduced to students as a discussion among teachers and students regarding their shared experiences within the classroom from the perspective of the other. The students who decided to participate in cogen were representatives for their peers given the diversity of students found in the class. As such, participants differ with respect to age, gender, ethnicity, religion and mathematical ability in order to develop successful lessons and curriculum to

improve mathematics teaching and learning for all adult learners. Essentially, the purpose of cogen was to identify the structural characteristics within the computer-assisted class that afforded and prevented the learning of mathematics. At the end of each cogen session we cogenerate strategies and resolutions needed to improve and afford an equitable learning environment. Given the current disequilibrium within the class I did not ask for immediate volunteers, but insisted students think about this venture over the weekend. If students decided they wanted to be cogen participants they would meet at my office the following Monday at 5:45 P.M. By showing up to the Monday meeting students verified their commitment to be part of cogen, eliminating any feelings of coercion.

The following Monday I wondered how many students would turn up to participate in cogen. On Saturday many of the students thought it was a good idea and were excited to change the current structure of the class. As it approached the time for the scheduled meeting I began to assume that the students had forgotten about the meeting or decided that they did not want to participate in the forums after all. However, at 5:40 P.M. a work-study student alerted me that my 'debate squad' was here. I recalled asking him who was 'the debate squad' he indicated that they were three students at the front desk who were here for the 5:45 P.M. meeting. At the front desk stood Lorna, Jasmine and Joseph my first cogen participants. Each cogen participant had different motives for becoming involved in cogen; however it was the shared mood, that is, the negative emotions towards the learning environment and the asynchrony markers associated with computer-assisted instruction that motivated these students to participate in cogen. Our main objective as a research group was to improve the structure of the computer-assisted

instructed mathematics class to produce synchrony, which addresses coherence in practice and shared schema among participants.

"The debate squad" consisted of four participants, three students and me. The metaphor of "the debate squad" reflected the students' understandings of cogen as it was explained to them that Saturday. I felt these students wanted to put forth their respective arguments to me, the designated authority for the computer-assisted class. My identity as the 'authoritarian teacher' was established the day of the incident when I used my teacher stance to regain control of the class. As I emphasized the importance of the class and the beneficence of computer-assisted learning, I also stressed the consequences for not attending class, thereby reinforcing students' perspectives of my authoritarian role and identity. According to Wesley Pitts (2007) identity is a construct of human action and social life therefore I was perceived as the individual who held the most power with regards to curriculum and instruction.

To Lorna, Jasmine, and Joseph cogen was a new pedagogical tool, such as computer-assisted instruction. As a result, they assumed that it was their right to get their argument across in the form of a debate. These expectations were derived from students' prior experiences with teachers and urban schools. However, the idea of debating was quickly disposed of after the first cogen session and the students realized that I was willing to make any changes necessary to the computer-assisted class and curriculum to improve how they and the entire class experienced and enacted mathematics in this learning environment. However, 'the debate squad' title remained as our identifier.

Episode 1

01 Wharton: Today the 15th of October so were going to have a conversation now ahmmm what Joseph said Saturday was correct. We gonna have a dialogue. And really what the ahmmm actually name for it is cogenerative dialogue. So there are some rules. Everyone has to have their say. Okay, so everyone has to say something. Okay. And so it will be ahmmm everyone has equity. Now one of the problems is the lab class. So we are here to find out ways to make it work. Okay. So can anyone tell me a feature of the lab class. At least one feature that you that you would like to see change.

In episode 1 I took a moment to reiterate briefly that the dialogues, which will ensue every week, were called cogenerative dialogues. I proceeded to introduce the rules of cogen, which set the tone and expectations for the participants in this forum. The first rule established regarded that of voice in which it was articulated to participants that no one voice is privileged, an essential element of cogen. I wanted the participants to know their voices in cogen were valued. Any suggestions, perspectives and solutions to problems regarding the curriculum or class structure were encouraged and important if we were to reconstruct teaching and learning for a productive mathematics classroom. Each participant had a responsibility to contribute to the discussion whether they were responding, clarifying, agreeing or disagreeing to a peer's contribution. Cogen became a place where students identified their learning needs from self-reflection of their shared experience in the computer-assisted class and other educational settings to improve the quality of teaching and learning.

Kenneth Tobin and Wolff-Michael Roth (2006) state that the rules associated with cogen provide a foundation for productive and successful encounters. When cogen participants are provided with a structured forum it guides their actions and conduct, irrespective of their diverse backgrounds. As a collective, cogen participants bring different viewpoints with respect to their ages, gender, ethnicity, socioeconomic status, social experiences and formal education such as what Etienne Wenger (1998) refers to as

an economy of meaning. For instance, the student cogen participants were mature adults in their mid forties and early fifties while I (teacher-researcher) was in my early thirties. Lorna, Jasmine and I acquired our formal education in the Caribbean whereas Joseph was educated in the United States. Although, we differed individually, academically, socially and mathematically our perspectives regarding the computer-assisted class allowed for negotiation and co/construction of new ways of teaching and learning of mathematics in a computer environment.

As the computer-assisted class was the mutual focus for our interaction to understand the structure of this class from the perspective of the other (Lorna, Jasmine, Joseph and me) I proceeded to ask the participants for their viewpoint regarding the reasons they disliked the class. Essentially, I wanted to know of specific feature(s) of the computer-assisted class that did not afford the goals I envisioned for this class. The main purpose of the computer-assisted class was to provide students with an additional three hours of mathematics instruction in which they would review and develop their mathematics skills using a tutorial based computer program with an instructor present. The program used by the students was the McGraw Hill Computerized (MHC) Interactive GED program (2002); a tutorial-based program that prepares students for the battery of five GED tests. The MHC program covered the content areas of number operations and number sense, measurement, geometry, data analysis, statistics, probability and basic algebra. The program contained a half-length pre-test (25 questions), full-length posttest (50 questions), interactive lessons, and an on screen Casio fx 260 scientific calculator. The purpose of the MHC program was to re-organize students' understandings of mathematics through interactive lessons, games and quizzes

enabling students to be active participants in their learning as they appropriated tools from the traditional class and the MHC interactive program. Thus, amplifying students' understandings of mathematics. However, the students did not share my assumptions.

Testing the Joy out of Learning

The computer-assisted class was organized in a non-traditional learning environment where students worked in a collaborative setting with their peers and the lab instructor to improve their mathematics skills. However, I was unaware and surprised at how certain structures within the curriculum I created and the computerized program were affecting students' dispositions and attitudes towards learning mathematics. For some students, the class was neither enjoyable nor engaging and feelings of discouragement emerged within this classroom setting. In episode 2, Lorna was the first participant to identify a specific feature in the computer-assisted class that caused her and maybe others anxiety within the class.

Episode 2

02 Lorna: The quiz at the end of the lessons.

03 Wharton: uhmmm

04 Lorna: You Know. You start the lessons and everything is explained to you.

05 Wharton: Uhmmm

06 Lorna: And you go according to the directions. And you work out the problems. Well some are correct and some are incorrect. But then when you come to the end of the lesson there is this quiz. You Know.

07 Wharton: Yes, the six question.

08 Lorna: That, that, yeah.

The episode above focused on the six-question quiz at the end of each lesson, which caused Lorna anxiety as she worked in the lab to improve her understanding of the mathematics she was learning. The MHC interactive program has two formal assessment features, a six-question quiz activated at the end of each lesson and a unit test activated when students have completed all the lessons within the unit. The assessment features of the program convey data in the forms of marks or grades to teachers and students regarding mastery of concepts and skills. In the MHC program, grades for lesson quizzes are assigned as follows: if students receive a grade of 65% or better on lesson quizzes they advance to the next lesson. Students with scores of less than 65% are directed to an instructional review followed by a second six-question quiz. Once students achieve a passing grade (65% or better) they advance to the next lesson however, students who fail are advised by the program to consult with the instructor. In the unit test passing grades are 65% or better however, if students obtain a failing grade they are not advised to review the unit or take a second unit test. Grades obtained in lesson quizzes and unit tests are visible to both teachers and students in the records section of the MHC program.

Lorna's reaction to the six-question quiz in cogen indicated that the built in assessment feature at the end of each lesson undermine the purpose of the program as a resource to improve and enhance her understandings of mathematics. Lorna was not against testing but how the program was constructed to test students after each lesson aggravating the learning process. Lorna was already insecure of her mathematics ability and being frequently tested caused her to wonder if computer-assisted learning was a resource or a hindrance. Accordingly, the assignment of a numerical grade from quizzes and tests decreased Lorna's motivation to engage with the program, which in turn

affected her identity as a mathematics learner. Gillian Bayne (2007) argues that students' identities are created and recreated as social life evolves within a given field. As a result, when Lorna was assigned grades based on her performance on the quizzes and unit test her identity as a mathematics learner was in state of flux, that is, dynamically changing with each grade she was assigned. Students' identities as mathematics learners are products and by-products of the changing structure of the field. The emerging structure of the mathematics classroom mediates students' general sense of self in addition to how they think others (Sara and me) would perceive their identity as mathematics learners. In Lorna's case, she used the grades obtained on quizzes and tests to construct positive and negative identity markers of her mathematical ability, which in turn truncated her agency as she used the MHC program to improve her fluency in mathematics.

Lorna, like many of her peers, were unaware that the grades obtained in tests and quizzes were subjective and did not reflect their true mathematics ability or identity. Similarly, Jerry's failure to achieve 100% on tests and quizzes reinforced his perception that he was not a strong mathematics student. Students place great significance on grades, which structure their identity as mathematics learners without understanding that these constructs are abstract symbols, which can be misuse, abuse and misleading when they are not used to guide and scaffold students' learning to facilitate cognitive growth. Thus, I wondered where students' obsession with grades catalyzed a mindset in which they were more focused on trying to achieve passing grades on quizzes and unit tests within the program than understanding the mathematics they were currently learning from the program. On reflecting on their justified anxiety, I realize it was the rubric I created to determine the final grade for the class that may have caused chaos within the class.

The rubric for the computer-assisted class provided an academic disservice to students because it was based on one component, quizzes and unit tests. I did not take into account additional assessment techniques such as conversations and interviews with students regarding the grades they obtained within the MHC program, nor did I consider students' input when I created the rubric. If these additional assessment features were included within the curriculum I would have eliminated some of the apprehensions and frustrations experienced by Lorna and other students. As a result, students would be able to understand their mathematics ability given teacher guidance with respect to grades obtained in the program enabling students to develop their own perceptions regarding their mathematics ability and identity. Lorna's experience with the assessment feature of the MHC Interactive program allowed me to consider how assessment (grades) could be effectively used in a class that utilized computer-assisted instruction to help students reach their respective learning goals. A new rubric was developed with cogen participants that reflected their developmental shifts in attitude, motivation, effort, comprehension and confidence towards mathematics in addition to other academic activities such as worksheets and the use of another mathematics software program discussed later in this chapter. Accordingly, a daily report was created to track students' progress on lessons in the computer-assisted class, in which they listed the grades they obtained. A feedback section was included in the report that provided students with informative and critical comments based on their performance. This offered students a holistic assessment of their ability in relation to work done in the traditional mathematics class and the computer-assisted class. In addition, students could relay messages to the instructor in this section regarding their experiences in the lab, a concept they were working on or the grades they

obtained on quizzes and tests. This continuous cycle of feedback allowed students to critically consider their learning and understandings of mathematics against a range of criteria not just marks or grades obtained from the exercises in the MHC program. Students were able to make sense of their grades from associated feedback in a positive manner in which they set appropriate personal and academic goals. Currently, the progress report is still utilized within my computer-assisted mathematics classes benefiting adult learners as they reconstruct their mathematics skills. Thus, students use assessment as a means for learning rather than viewing assessment as learning.

Restructuring how students would be assessed in the computer-assisted class created a positive learning environment. Students did not feel pressured if they failed a quiz or test but worked collaboratively with Sara and me to analyze and review the data gathered from tests, quizzes and students' experiences in the classroom. This information was used to construct knowledge about students' performance and achievement while creating appropriate support mechanisms. Learning occurred during the enactment of mathematics with continual assessment providing a means to scaffold students' learning for productive encounters in the classroom. Information gathered from assessments within the MHC program was used to modify learning activities as students' weaknesses were identified. Assessment with its associated feedback (in the form of marks or grades) accompanied by teacher explanation and guidance provided students with the skills teachers use to define what is considered good performance.

Despite, the anxiety Lorna experienced with the six-question quiz in the computer-assisted program she did identify positive characteristics of the MHC Interactive program. In turn 04 Lorna states "You know. You start the lessons and

everything is explained to you" indicating that the concepts and skills were introduced with clarity, engaging graphics, and interactive tasks. Each lesson in the MHC program began with an introduction of the objectives to be covered followed by tutorial-based instruction with embedded exercises to reinforce the material being explained. Lorna was able to take advantage of the graphic properties to visualize and organize her understandings of mathematics. The immediate feedback feature supplied Lorna with the academic support needed to make adjustment in the understanding and learning of mathematics because at times she lacked confidence in her mathematics ability. This feature of the program allowed Lorna to control her learning of mathematics as she assessed new ways of approaching and enacting mathematics.

The Class was not What I Expected

When the administrators and faculty members decided to implement this additional mathematics class we assumed all the students knew how to use computers to enhance their mathematics skills. We envisioned students entering the computer lab, sitting at their chosen terminal, and appropriating the cultural tools from the traditional class, such as strategies, process skills and procedures to inform and reinforce their mathematics skills. However, this was not the case, the computer-assisted and the traditional mathematics classes were incongruous, each had its own goals and motives. To the students the traditional class represented the norm and correct method for teaching and learning of mathematics. This belief was ingrained into students' schema from their prior experiences in a school setting and fitted with their expectations of a typical mathematics classroom. In traditional classes students were aware of the cultural scripts for teaching and learning such as their roles, their peers' roles and those of the instructor.

In the computer-assisted class some students were unsure of their respective roles in this new classroom environment where technology was regarded as a pedagogical tool to enhance the teaching and learning of mathematics. Thus, a major disconnection occurred between the computer-based class and the traditional class in which students developed their own epistemological beliefs and these two classes developed their own trajectories causing chaos.

Episode 3

09 Joseph: Okay. Far as I figure out the ahmmm the lab.

10 Joseph: If you know at first. If the pers… If it is explained to you.

11 Wharton: Uhmmm

12 Joseph: Exactly what's going on with the programs?

13 Joseph: Exactly what is expected of that particular student?

14 Wharton: Uhmmm

15 Joseph: Exactly how you should take a step from step 1 to step 4, step 5.

16 Wharton: Uhmm

17 Joseph: It becomes to be. It becomes easy.

18 Joseph: If you can have some type of explanation. At first ever. Like when we got into the class right. Where ahmmm Ms. Wharton explained to us that you are going to here at the lab class. That when you get here. She wasn't wasn't going to be here….. Okay to us this was told right.

19 Joseph: But.

20 Jasmine: Without being tutored.

21 Joseph: But like myself I didn't expect it to be the way it is like when I got into the program.

22 Jasmine: =[like sit at the computer.]

Joseph, who identified as African American in his early fifties, appropriated the next turn at talk (turn 09) to describe his experiences in the computer-assisted class,

which he felt impeded his learning of mathematics. Joseph expressed that the computer class did not have a definite objective to guide students who were unfamiliar with using computer-assisted programs to support their learning of mathematics. Joseph stated in turn 12 and 13 that he needed to know "Exactly what's going on with the programs. Exactly what is expected of that particular student? Exactly how you should take a step from step 1 to step 4, step 5." Joseph's comments suggested that he lacked the necessary schema and resources to navigate and productively use the mathematics program. Joseph, like his peers, the mature adults of the class, were accustomed to the dominant way of schooling in which they used cultural tools such as pencils, paper, a standard textbook and the teacher. As a novice user of a computer-assisted program Joseph did not understand how he could use the GED program as a tool to enhance his learning of mathematics. Thus, Joseph became intimidated by the mathematics software, which led to feelings of inadequacy. Joseph and his peers needed to learn and develop the necessary schemes and techniques to effectively use computerized software before using the program to inform the mathematics they were currently learning. It was evident that the students in the computer class needed an extensive training session that demonstrated the program functions, contents, resources, beneficial properties and how to integrate information gathered from the traditional and computer-assisted class to inform their learning and understandings of mathematics. A training session on the use of the MHC program would provide students with the confidence and support needed to engage with the mathematics software.

Another issue brought to the discussion by Joseph was that of pedagogical support for students. Joseph suggested in turn 18 that students needed "some type of explanation"

indicating that in the computer-assisted class there were interactions amongst computers with humans rather than interactions amongst humans with computers. In other words, there was limited teacher-student interaction within the computer-assisted classroom with regards to learning mathematics from technology. Joseph's statement allowed me to reflect on how teaching and learning were enacted in both classes in which I realized that in the traditional class students were provided with the objective at the beginning of each lesson while this form of teaching and learning was not implemented in the computer-assisted class. Listening to Joseph, I understood the frustrations he endured weekly when he participated in the computer-assisted class. The limited teacher-student interaction in addition to "Without being tutored," as indicated by Jasmine in turn 20, was not what the students had envisioned, thereby creating discontent within the learning environment.

Intervention: Changing Curriculum and Instruction within the Computer-Assisted Classroom

When cogen convened each week, I began my routine of asking students what worked, what didn't work, what they liked, what they disliked, and what needed to be changed. This ritual provided cogen participants an opportunity to voice their opinions regarding the success and failure of our cogenerated strategies. From this discussion we were able to dissect the implemented strategies, which allowed critical questions to be asked regarding their experiences, as I was not a central participant in this class. My questions encouraged crosstalk between participants and me, which provided answers I sought to understand students' interpretations and experiences of the computer-assisted learning environment that accommodated their mathematical needs. Cogen became a site for mediating conflict and contradictions within the learning environment and

mathematics. Thus, a central focus was to explore the structures of the computer-assisted instructed class that constrained students learning of mathematics in order to create a learning environment that was flexible and adaptable to the needs of all the adult learners.

The first cogen session prompted immediate changes to the structure and emerging culture of the computer-assisted class as the participants articulated many difficulties (episodes 2 and 3) within this class. Students identified elements such as the six-question quiz, limited teacher-student interaction, differing pedagogies in addition to technical issues surrounding the use of computers and computerized programs, which caused difficulties in learning mathematics. Using this feedback, we collectively altered the current structure of this class and produce new culture that accommodate how students enacted mathematics in a computer-assisted instructed environment. One of the adjustments made to the class was the implementation of mini-lessons, which took place at the beginning of the class. Mini-lessons provided students with a similar pedagogical approach to the traditional class. In the lab, Sara gave a brief introduction to the lesson approximately 15 minutes in length. The introduction featured the principles, vocabulary and procedures students would encounter in the computer-assisted program. Mini-lessons provided students with the teacher-student interaction they desired in addition to a classroom structure they were familiar with. Thus, students were interacting with humans with regard to technology in order to enhance their understandings of mathematics. As Joseph stated in cogen "The teacher gives me the base… the computer cannot give me a basic understanding no way because [when] I am lost I am lost. I cannot say well computer what are you talking about. I can't do that, but I can do that once the tutor [Sara] give me that base."

The second cogenerated strategy implemented was that of huddles. Huddles were mini-tutoring sessions within the lab that supported individual or groups of students who did not fully understand previous topics covered in the lab or the traditional classes. The purpose of huddles was to enact learning through participation in which students accessed each other's knowledge resources to improve their fluency in mathematics. In huddles students had the opportunity to resolve their misunderstandings of certain mathematics principles supported by Sara and their peers. Students self-selected for this form of mathematics support, which took place at Sara's desk with approximately one to five students who needed to, master certain academic skills. Huddles were designed to be small in nature because cogen participants understood the academic diversity of their classmates and not all students needed this form of extra support. Thus, huddles made it possible to review prior mathematics concepts without imposing on the instructional time of others. Students tuned in to this resource on an as needed basis and tuned out when not needed.

A third strategy proposed by the cogen participants was SkillsTutor; a web based educational software and tutoring program from Houghton Mifflin Harcourt Learning Technology. SkillsTutor, an online tutoring tool, targets instructional areas such as reading, language arts, mathematics, social studies and science to improve student achievement on high stakes tests such as the GED test. The Downtown Center acquired a license for this web-based program in the fall 2007 semester to provide academic support to the entire school population, which could be utilized from home. The program offers over 1,600 lessons that teach basic skills or thinking skills. Basic skills provide students with a brief interactive tutorial of a single academic concept such as dividing decimals

followed by multiple-choice problems that reinforce and support students' learning with hints and feedback throughout the simulation. Thinking skills modules provide students with scenarios in which they use critical thinking and computational skills to solve problems. For example, in a thinking skills problem students are given the task of choosing the most economical rental agency to hire a car for a three-day trip. Students are provided with daily rates charged, rates per mile and distance traveled in which they use their knowledge of whole numbers and decimals in addition to their comparison skills to solve the problem in a step-by-step format. Thinking skills modules allow students to use multiple mathematics skills to solve problems similar to the GED mathematics test however, there are not many of these modules within the program.

The cogen participants preferred SkillsTutor rather than the MHC Interactive due to its user-friendly format. In addition, the cogen participants were aware that some of their peers did not have access to the Internet and were not using this program, which they considered a valuable resource. One of the features students liked was the pretest at the beginning of each content area that created prescriptive assignments based on students' weaknesses. SkillsTutor allowed students to work on their identified weak areas and not all the lessons within a content area. The MHC Interactive prescriptive feature was not as advanced as SkillsTutor. MHC prescriptions directed students to lessons in the McGraw-Hill Contemporary GED textbooks, which students did not possess. However, it was emphasized to the cogen participants and the entire class that the use of these two computer-assisted programs should be equally weighted given that the MHC program was more tailored to the GED than SkillsTutor. SkillsTutor focused more on mastery and refreshing mathematics skills and was not strongly focused on word problems.

In addition to SkillsTutor the cogen participants indicated that some students did not like working on the computer for the entire three-hour class period. Many students indicated fatigue, eyestrain, head and backaches after sitting at the computer for long periods of time. The students proposed paper and pencil assignments for those who were having personal issues with the computers. To create supplemental assignments I used two mathematics textbooks that complemented the MHC Interactive program in addition to other sources in which students could complete these assignments in class. These assignments were welcomed by all the students in which some preferred to work on the assignment in the lab with Sara while others completed the assignments for homework. Cogen participants decision to introduce worksheets was a great idea as it showed that all students could enter the computer class and be supported by appropriate activities that suited their level of confidence and competence as they integrated technology effectively within their learning activities. The cogen participants and I cogenerated many successful strategies that altered the structure of the computer-assisted class. These students used their agency as mathematical learners who have transverse many educational fields to create resources, which inform how they learn mathematics as adult learners. As a research group we were able to build a mathematics curriculum and learning environment relevant to students' individual needs and collective motives to learning mathematics using computer-assisted instructed programs. Each cogen participant possessed different forms of capital constituted from their social and historically background that informed how new structures and mathematical culture was implemented.

The adjustments made to the curriculum and class structure provided students with an equitable learning environment that afforded successful encounters in learning

mathematics from computer software. Cogen participants incorporated movement within the classroom such as huddles, teacher interaction with mini lessons, additional activities such as SkillsTutor and worksheets allowing a shifting of academic gears. These activities created a micro-rhythm within the classroom that kept students motivated, engaged and focused throughout their lessons. The idea of changing activities was a recurring theme within all our strategies, as students welcomed a change of activities within the three-hour class period to make the learning of mathematics more engaging and enjoyable.

Cogen afforded the opportunity to accommodate students' perspectives and learning needs necessary to create a curriculum that supported their mathematics learning that was responsive to their educational, social, and cultural experiences within the classroom. Thus, a sense of belonging (solidarity) emerged from the students because they were afforded the opportunity to create structures that enhanced their learning of mathematics within a field that they considered foreign. Students were able to have ownership in their education with an enthusiasm of using computer-assisted programs to inform their learning and understandings of mathematics. As Joseph indicated, "Everyone is taking the challenge the way it was designed" indicating students willingness to use computers to improve their learning of mathematics after supportive measures were implemented to improve the quality of teaching and learning in a computer-assisted instructed learning environment.

Technology use within classrooms will become unavoidable in the near future as new devices are created to improve teaching and learning. As a result, teachers and students must work together to create and sustain learning environments that support and

encourage the use of technology to improve learning. Cogen provided a means for creating resources that fitted the academic needs of adult learners based on their schema and associated practices. Cogen became an interaction ritual in which there were two or more participants indicating bodily presence, participants were separated form outsiders, there was mutual focus around an object, and a shared mood, which fostered entrainment, solidarity and group membership among the participants (Collins, 2004). Thus, cogen was a social and communicative activity that established a classroom community of student-teacher and teacher-learner disabling the teacher-student contradiction as each cogen participant changed their ontologies as they learned from the differences of the other. The strategies cogenerated in cogen such as pencil-paper assignments, SkillsTutor, progress reports, and mini-lessons became resources for the computer-assisted mathematics class. Randall Collins (2004) writes that resources within an interaction depend on how individual's access, appropriates, and accept the materials open-mindedly. As such, the resources implemented were designed that students could tune in or tune out on an as needed basis in order to achieve their respective goals of improving their fluency in mathematics.

Reactions to Cogen

Cogen provided a forum for the students, Sara, and me to freely discuss students' resistance to the computer-assisted mathematics class, the social and symbolic violence they inflicted upon themselves when they refused Sara's help, and what aspects of the curriculum impeded their learning of mathematics. Cogen illustrated there is no "one size fits all" approach to teaching and learning but an ontological approach in which meaning is negotiated and co/constructed with others who are different from ourselves through

interactions and transactions. Cogen afforded Lorna, Jasmine, Joseph, Sara and me the ability to build social capital amongst ourselves, which afford positive interactions within the learning environment. Social capital refers to the social networks or connections made by others within an encounter. As a result, Sara and me were perceived as caring individuals because we willingly made changes and modified the structure of the class, which in turn led to an increase in symbolic capital.

Many changes were observed within the computer-assisted class after the implementation of cogen. The most influential change was that of students' perceptions of Sara the lab instructor. After implementing cogen students felt comfortable approaching, interacting and communicating with Sara about their problems with mathematics and the technical difficulties they had using the computer to learn mathematics. As Jasmine indicated "we can go to her and not be afraid to ask her a question and have her come over to you and help with a problem…She [Sara] changed after we had the dialogue, she changed. She got up and came around and she helped." Sara's receptivity to students' viewpoints regarding her role and the implementation of cogenerated pedagogical strategies altered students' perceptions. Sara was not considered a monitor but viewed as the instructor of the class as she applied traditional pedagogical strategies that students were familiar with and they in turn began to tune in to Sara's efforts to help them. Joseph indicated "It came up a lot that ahmm she don't seem not to want to take the time, that came up a couple of times…But she had to learn to also you know extend herself, which she does now … she'll go you okay you can do it. And I go no. I need help." Sara gained the necessary social and symbolic capital to interact with the students. Cogen afforded Sara the opportunity to gain students trust and respect,

which increased her status (symbolic capital) as the teacher of the computer-assisted class rather than a monitor. It is evident that social and symbolic capital is critical components for being an effective teacher.

Interestingly, Sara noticed the effects of cogen on students especially their attitudes towards using computers to enhance their learning of mathematics as well as to her. Sara indicated that the students seemed more relaxed and interactive within the class. I observed this when I sat in on two lab sessions to view how students were interacting with the computer-assisted program and the implemented cogenerated strategies. I noticed students calling Sara over to discuss problems, mini-tutoring sessions between Sara and students, and active peer tutoring among students even though they felt unsure about their mathematics ability. Students also took on leadership roles in which they informed latecomers of the lesson and objective of the day, which was observed when Jerry was late to class. It was evident there was a sense of solidarity (belonging and affiliation) within this class, which was supported by common goals and motives; that is, the improvement of mathematics skills in order to be nominate for the official GED test. A classroom community built on trust and collective responsibility among the students and Sara was established in which there were minimal acts of resistance towards the learning environment as it met students' learning needs.

Students also commented on my transition from an authoritarian to a collaborator and co/learner. Jasmine mentioned that I got to know students as individuals and their desires and struggles as they tried to achieve their high school credential. For Jasmine, my roles as a cogen participant, collaborator, listener, and willingness to make the necessary changes to the curriculum and classroom structures were appreciated as she

indicated “It was very helpful personally to me.” Cogen altered the way I taught and enacted mathematics as an instructor in a GED program. I was able to build social capital with students by listening to their perspectives regarding mathematics teaching and learning and affording them the opportunity to co/plan the curriculum. This exercise allowed me to learn many things about and from my students in order to improve how they interacted with computers to enhance their learning of mathematics, resistance to the curriculum I created, and reasons for returning to school to acquire their GED. Cogen provided shared governance of the curriculum and the structure of the class with my students as we interrogated the learning experience to recreate it for the productivity of collective and individual goals. Cogen was such a positive experience with the “debate squad” that I was inspired to use cogen in future mathematics classes to improve the teaching and learning of mathematics. Each semester the way cogen was implemented was different and participants joined due to different conflicts and contradictions within the learning environment. For instance, in the winter 2008 semester I held whole class cogen in the first 15 minutes of class to obtain a collective understanding of the structures that supported or constrained mathematics teaching and learning. In the winter semester students did not self-select to be participants in cogen. However, the following semester (spring 2008) six students self-selected to be participants due to the various acts of disrespect displayed by three males students in addition to students’ drive and motivation to improve their fluency in mathematics and successfully pass the GED mathematics test.

The cogen participants in the fall 2007 semester demonstrated that students who enter GED programs bring more to the classroom than the culture of schooling, that is, their prior knowledge and the rituals of schooling. Adult learners bring critical

pedagogical knowledge to the classroom such as their experience as learners, good lessons, and instructional constraints, which can be used to reconstruct the curricula and implement support structures needed to improve students' fluency in mathematics. Such insights regarding how adult learners navigate, accommodate, and resist artifacts such as computer-assisted instructed programs can inform teaching and learning of mathematics. Our initial experience with cogen opened a new world of teaching and learning of mathematics not only in a technology-enhanced classroom but also in traditional mathematics classes. It provided me with a dynamic method to re-teach mathematics to adult learners in a productive classroom environment that reflected the culture students brought to the classroom from various fields (prior education, careers, religious participation, and social experiences). Involving students in the teaching and learning process allowed the appropriation of new roles such as peer tutors, which began in the computer-assisted class and migrated to the traditional mathematics class. In addition, students took charge of their mathematics education in which they made critical decisions on when they wanted to take the pre and post GED tests to identify their weaknesses before the final examination. Viewed from these angles, the task of eliminating contradictions in the teaching and learning of mathematics is a dialogic activity between and among students and teachers to produce new practices and schemas within the classroom environment.

Most Successful Saturday Class

Of all the GED classes I taught on Saturdays this class became the most successful in which the majority of the students were nominated to the take the GED test. In my previous Saturday GED classes approximately five students would be nominated to

take the test however, of the eleven students who remained in the fall 2007 class, nine students met the requirements of achieving 410 or better on the official GED mathematics practice test administered as the final examination. Two students did not meet the requirements and Jasmine who participated in cogen was one of them. Although Jasmine did not meet the requirements to be nominated to take the test she did improve her mathematics skills as her official practice test score increased by 50 points. Jasmine acknowledged that she learned a lot of mathematics in ten weeks even though she was not nominated to take the GED test. It was evident the implementation of cogen helped Jasmine overcome some of her fears of mathematics and schools in which she confessed that certain experiences within a classroom setting could deter her from learning and attending school.

Out of the nine students who were nominated to take the official GED test seven passed the mathematics test while two students failed with a score of 400. In all, only four students out of the seven met the overall requirements to achieve their GED credential. Lorna, Joseph and Jerry were among the four students who achieved their GED credential. Lorna and Joseph scored 480 and 450 respectively on the official GED mathematics test while Jerry achieved a score of 560 indicating that he would be in the top 25% of his class rank. The other three students failed the language arts writing test. According to the GED Testing Service (2009) mathematics and writing are considered the two most difficult tests.

Lorna and Joseph's participation in cogen altered their perspectives of mathematics and the use of computers as instructional and learning tools. Joseph indicated that his mathematics skills have improved given his success on the official

GED test. Furthermore, in the fall 2008 semester Joseph enrolled in the Computerized Bookkeeping Program at the Downtown Center. This course focused more on computer-assisted learning of bookkeeping applications than a traditional classroom. From a phenomenological perspective, Joseph made a transition from being subservient to technology to becoming partners with technology (Galbraith, 2006). Joseph was able to develop a mutual understanding of the role of technology as a teaching and learning tool enabling him to control and improve his learning of mathematics. Joseph graduated in the spring 2009 semester with a certificate in computerized bookkeeping. Lorna also indicated that her mathematics skills improved and she enjoyed geometry, a content area she had previously disliked. After completing the GED program, Lorna enrolled in the Information Technology program at the Downtown Center in which she was exempted from a remedial mathematics class due to her high score in mathematics on the Test of Adult Basic Education (TABE). She has since graduated from the program and is currently seeking employment.

CHAPTER 3

Cogenerative Dialogues: Improving Mathematics Instruction in an Adult Basic Education Program

Adults Basic Education and Mathematics

Adult learners in the United States are returning to the mathematics classroom in overwhelming numbers to prove that they can learn the mathematics that they were unsuccessful at during their prior schooling experience (Ginsburg, 2005). Upon entering these classrooms many adults realize that academic history often repeats itself as the same curricula and teaching methods found in traditional K-12 educational settings are being used. A 'one size fits all' approach to teaching and learning is being applied in the Adult Basic Education (ABE) classroom. In a study of 271 adult literacy programs Donna D. Amstutz and Vanessa Sheared (2000) found that 73% of ABE programs serving adult learners were described as using activities and materials that were not related to students' lives. Additionally, Amstutz and Sheared (2000) found that instruction in the ABE programs were typically teacher directed and controlled rather than collaboratively planned and directed. Viewed from these perspectives, students in ABE classrooms were placed in positions where they must reject their cultural knowledge and ways of knowing in order to be successful in school.

Yet, adult learners bring a wealth of knowledge to the ABE classroom, regardless of how much time they spent in prior school settings. These students bring powerful images of the culture of schooling, which can be instrumental in the education/re-education, or training/re-training of adult learners. Students use their experiences, prior

knowledge and perceptions, as well as their physical and interpersonal environments to construct knowledge, which affects their thinking and learning. Students' worldview highly influences their learning processes. As students produce practices and schema (culture), they act on and with their environment in strategic ways to make meaning and meet their goals. These strategies provide meaningful learning experiences for adult learners that foster critical thinking and associated process skills. As such, adult learners construct knowledge in their preferred ways mediated by their culture, particularly their prior experiences and embedded worldviews.

This chapter focuses on the mathematical dispositions of four ABE students and me who participated in cogenerative dialogues (cogen). Throughout the chapter personal pronouns are used to represent Felicia Wharton's voice while collective pronouns are used to represent both authors' voices. The four students featured in this chapter came into the ABE program at different entry points and academic levels but enrolled in the same General Educational Development (GED) mathematics class in the spring 2008 semester. All four students self-selected to join this collaborative research involving cogen in order to improve the teaching and learning of mathematics in an urban ABE program. A priority of the research featured in this chapter is to understand how adult learners construct mathematical knowledge and develop the necessary process skills (e.g., practicing and assessing answer choices) for critical thinking and problem solving activities to gain a better understanding of domain knowledge and to pass the GED mathematics test. Students' participation within cogen enhanced my teaching practice of mathematics in which I have gained a better understanding of how adult learners approach, enact, and learn the mathematics necessary to achieve their goals of passing the

official GED mathematics test. The cogen, which ensued every week, focused on ways to enhance the current teaching and learning practices within the mathematics classroom.

In this chapter we analyze a vignette from a cogen session in the spring semester of 2008 to provide empirical evidence illustrating how adult learners understand, negotiate and develop the necessary process skills for enacting mathematics. This particular cogen took place in the fourth week of the spring semester in which the students had recently returned to school after a one-week break. The vignette is divided into four related episodes that are analyzed individually, but together they cohere and connect to illustrate salient themes for the improvement of mathematics teaching and learning in a GED classroom. We draw on theoretical frames from cultural sociology, sociology of emotions, and use conversation and prosodic analyses to describe students' experiences with mathematics in addition to the developmental shifts, which occurred among the participants, as the cogen became a central site for coteaching and learning mathematics. Evidence shows that cogen participants constructed a better understanding of how they learn mathematics and essentially became advocates for each other as they communicated, collaborated, cotaught and implemented positive changes in their learning environment. Thus, as active coparticipants in the planning, implementation, and informal assessment of their own learning and the mathematics curriculum, cogen participants began to enact culture to create a successful learning environment that met their goals and motives.

Adult Basic Education and The General Educational Development (GED) Test

ABE programs in the United States provide services and instruction for adult learners who are below a postsecondary level of education. These programs have assisted

many adult learners, age 16 years and older, to develop their literacy and numeracy skills, improve their chances of obtaining employment, and provide students the essential foundation necessary to participate in higher education (Amstutz & Sheared, 2000). Many of the students who enroll within ABE programs do not possess a traditional high school diploma. Hence, many students enroll within ABE programs to become prepared to take a five-part battery test to obtain their GED credential. For many students, obtaining their GED is imperative if they are to remain employed, have the opportunity to further their educational or career goals, or gain personal satisfaction from their success in passing this high stakes test.

The GED test currently comprises of five subject tests, which are science, social studies, mathematics, language arts reading and writing. In order to receive a passing score on the GED test students need to receive a minimum score of 410 on each subject test and a combined scored of 2250. However, out of the five subject tests, mathematics plays a central role. It is the subject area students fail the most in addition to the writing test (GED Testing Service, 2009). According to the GED Testing Service, more candidates achieved the standard score of 410 or better in the subject areas of science, language arts reading and social studies while candidates struggled to achieve the minimum score in the mathematics and writing tests. The candidates who succeeded in passing the mathematics test achieved a median score of 470 (GED Testing Service, 2008). To help students achieve a passing score on the GED test a new approach to mathematics education in GED institutions is required. Students should be central participants within the planning and implementation stages of curriculum and assessment processes, which provide students with experience of what it entails to be and become a

mathematics learner and teacher. Below we advocate and show that the enactment of cogen has become a vital and productive approach to mathematics education in a GED program.

Computer-Assisted Instruction and Getting Started with Cogen

In 2006, I was hired as a mathematics instructor at the Downtown Center an ABE program located in New York City. As a newly hired mathematics lecturer my first assignment was to improve the teaching and learning of mathematics within the GED program. Prior to my arrival, only a few students were nominated and successful in obtaining their GED credential. The majority of the students were failing the GED mathematics test. The GED program at the Downtown Center comprised of the Basic Literacy, the Pre-GED, and the GED programs in which students can spend a minimum of 10 weeks to a maximum of 30 weeks depending upon their entry point in the GED program. For instance, if a student entered the program in the Basic Literacy level and progressed to Pre-GED and then GED, they would have spent the maximum of 30 weeks in the department. The Basic Literacy program was designed to help students acquire the necessary skills to advance to the Pre-GED or GED level. Students were placed within one of the three programs based upon their entrance score on the official GED practice test in the subject areas of social studies, mathematics, and language arts writing. Incoming students qualified for the Basic Literacy program if their score on each part of the official GED practice tests fell in the range of 320-360. A minimum score of 370 on each of the official GED practice tests qualified students for the Pre-GED program while students with scores of 400 and above on each of the official GED practice tests qualified for the GED program.

In my first semester at the Downtown Center, I was able to raise the GED completions to approximately 75%. However, with each semester that followed the number of students passing the GED test decreased. The teaching strategies employed were not enhancing students' understandings of the mathematics required to be successful on the test. The teaching strategies I employed within the classroom had a 'shelf life' of 10 weeks and could not be utilized in the following semester. Fewer students were obtaining their GED credential and mathematics was again the nemesis.

The faculty and administration at the Downtown Center decided that an additional mathematics class was needed to improve students' chances of passing the GED mathematics test. In the fall of 2007, a Computer-Assisted Instruction mathematics class (CAI) was added to the GED program. The CAI became a supplement to the traditional mathematics class, and met once per week for three hours. Sara, a mathematics instructor, implemented the curriculum that was prepared by me and provided students with assistance in the lab using traditional and computer-assisted teaching methods. The CAI course offered students an additional three hours of mathematics instruction in which the students reviewed what was taught in the traditional mathematics class at their own pace utilizing the drill and practice exercises and the tutorial instruction from two computerized mathematics programs (McGraw-Hill *Contemporary (MHC) GED Interactive* (2002) and Houghton Mifflin's (2009) *SkillsTutor*).

As a leading advocate of the CAI class and the creator of the CAI curriculum, I was surprised that many of my students in the pilot stage did not believe that the CAI class could improve their chances of passing the GED mathematics test. The students conveyed their unfamiliarity with utilizing technology such as a mathematics-

computerized program to enhance their learning of mathematics, as “it was not human.” The computerized program was viewed as a virtual mathematics textbook instead of a resource to improve learning. In addition, my students perceived my role as the instructor of the traditional mathematics class as that of the authoritarian in which I held the most power with regards to curriculum and instruction, while Sara was perceived as a monitor instead of a teacher to “watch over” students making weekly reports regarding the completion of weekly assignment. There was also an interesting parallel regarding the students’ perceptions of themselves as powerless and any suggestions they made regarding both classes would not be taken into consideration given their prior experiences within a school setting.

My students’ questions, actions and perceptions of my identity and the curriculum I created bothered me. I was angry, hurt, and disappointed since I was a leading advocate for the additional class and wrote the curriculum, which the students obviously disliked. Listening to the students’ fears, concerns, and assumptions regarding the CAI, I understood their resistance for not wanting to attend class. However, I observed that the impromptu forum that took place contained many essential elements of cogen discussed in the following section. The dialogue between the students and me became a rich resource that utilized students’ understandings of the current shared classroom experience affording the reform of the classroom environment. From that initial discussion, cogen became for us a pedagogical tool to improve the teaching and learning of mathematics as it provided a forum that reflected students’ experiences of mathematics and the classroom culture where they were the central participants. Because of scheduling and

administrative conflicts, I met with Sara in one-on-one cogen and the group cogen with the students at a different time slot during the semester.

Three students self-selected to participate in cogen and referred to themselves as the "debate squad." To the students this metaphor for cogen symbolized their understandings of cogen and the approach we took in our weekly sessions where we discussed, evaluated, and cogenerated strategies to enhance the learning environment for the entire class. There were many beneficial characteristics that emerged from this initial application of cogen in which students enhanced their mathematical knowledge from actively being coparticipants in the planning, implementation and assessment of the curriculum. The rippling effects ultimately led to the majority of the students, those nominated to take the official GED test, acquiring their GED credential and enrolling in future mathematics courses. As such, the debate squad meetings became a metaphor for our first successful series of cogen at the Downtown Center in the fall of 2007. Building on these experiences, I chose to enact cogen in all my GED mathematics classes.

Cogenerative Dialogues

Cogen has become an essential pedagogical tool in a variety of formal learning settings (public, private, urban, suburban, K-12, and college) for the improvement of the quality of teaching and learning within science and mathematics classrooms (Martin & Scantlebury, 2009). Kenneth Tobin and Wolff-Michael Roth (2006) describe cogen as discussions among participants about shared experiences, such as learning mathematics, to identify and review what types of encounters and accompanying structures seem to work and what do not. We theorize encounters as sites for face-to-face interactions composed of structures where participants interact and also transact by appropriating

cultural resources (Pitts, 2007). As such, the main idea of cogen is that all participants are provided with productive opportunities to help cogenerate and enact forms of culture that will improve encounters and structures that support teaching and learning. These characteristics of cogen exemplify elements of critical pedagogy. Critical pedagogy attempts to minimize power differentials in shared conversation while interrogating and reconceiving the structures of social life in an emancipatory manner (Tobin & Roth, 2006). In particular, the power sharing characteristics increase the potential to reconceive and reconstruct; (1) the authority of all cogen participants, (2) the teaching and learning environment and (3) the agency and roles of both students and teacher. The changes made within cogen are agreed upon by the participants, those who are the immediate stakeholders, rather than waiting for recommendations from educators, administrators, researchers or policy makers.

Accordingly, teachers and students benefit from these dialogues as students gain a sense of ownership in their education in which teachers listen attentively to students' understandings of their learning environment. Additionally, teachers provide students with their perspective of what is occurring within the classroom whereby the culture and resources of the encounter are utilized to make positive changes within the learning environment (Bayne, 2009). As in the case of the first series of cogen at the Downtown Center, students identify their teaching and learning needs by means of self-reflection of their prior shared experiences in the classroom and other settings. The insights teachers and students obtain provide valuable feedback, which could help to increase chains of successful encounters within the learning environment. Cogen allows student voices to be heard and resolutions to be cogenerated within the learning environment offering a

plethora of possibilities for the improvement of teaching and learning. An important ripple effect is that mutual respect is established between the teacher(s) and the students as they work collaboratively to improve achievement trends, the curriculum and other related cogen and classroom structures. Thus, collaboration among math teachers and their students in cogen regarding each participant's lived experiences are utilized to improve the teaching and learning of mathematics to inform classroom practices.

Continuing With Cogen (Spring 2008)

Despite differences in age, gender, ethnicity, educational background, and social experiences students enroll in ABE programs across the United States with the intent of obtaining their GED credential. The main purpose of the GED test is to certify that students aged 16 years and older have achieved the academic skills of a typical high school student. However, many adult learners struggle to achieve their GED credential due to the mathematics test. Thus, ABE programs have become popular with adult learners as it represents their last hope to acquire their GED credential. ABE programs have become social spaces that bring students together across boundaries of difference and shared interest to become high school graduates by means of an alternative certification. These are the students I encounter each semester whose collective history represents the images of today's ABE students.

Students from my spring 2008 GED classes (day and night program) took part in cogen in addition to the CAI instructor. I chose to introduce cogen in the CAI because it was important to have all the students present including the CAI instructor and me. At this point, a new CAI instructor replaced Sara. In a typical semester four to eight students participate in cogen. However, in this chapter, we will focus on the four students enrolled

in the GED day program that self selected to be participants within this research. The four students were Cathy, Jacinth, Janice, and Saul in addition to me (Figure 3.1). We attended weekly cogen sessions where we worked in a collaborative setting, to improve the traditional mathematics class, structuring the curriculum for CAI and identified the support structures that were needed to help students learn and enact mathematics successfully.

Figure 3.1: Cogen – Jacinth begins to talk about her problems with multi-step word problems.

Jacinth, the youngest participant, is a 20-year-old female who identifies as African-American. Jacinth has been tenacious with regards to attaining her GED credential. Initially she studied and registered for the official GED test on her own without enrolling in a GED preparation program. Her first attempt resulted in passing scores in the subject area of science, social studies, language arts reading and writing, but failed the mathematics test with a score of 330, which prompted her to enroll in the Downtown Center. When Jacinth was accepted at the Center in the winter 2008 semester her entrance scores on the official GED practice tests qualified her for the Pre-GED program. After successfully completing the Pre-GED program Jacinth advanced to the

GED day program. Jacinth is the only participant in the cogen group who took the official GED test and brought a distinctive capital (human and material resources) to the cogen, which was appropriated to meet her goals in addition to the collective motives. However, Jacinth positions herself as a weak student in mathematics, which will be explored in the following section. At the time of the research Jacinth was unemployed but her goal was to obtain admission to college and secure employment.

Janice, the second participant, is a 36 year-old African-American female who works as a security guard at the Downtown Center. Before enrolling in the GED program at the Center, Janice was enrolled in a GED program offered by a local public library. However, after securing employment as a security guard at the Downtown Center and assessing the programs offered, Janice enrolled in the GED program in the fall of 2007. Janice began her academic career in the Basic Literacy program, an introductory literacy service created for students who did not initially qualify for the pre-GED or GED programs. Janice advanced to the pre-GED day program in the 2008 winter semester followed by the GED program in the spring 2008 semester. Janice and Jacinth were acquainted with each other as both students were enrolled in the same Pre-GED classes in which I taught mathematics. Janice, like Jacinth, wanted to obtain her GED credential to increase her employment options.

The third participant, Cathy, a home aide attendant is a 50 year-old female of Jamaican descent who enrolled in the ABE program in the fall of 2007. Cathy received most of her formal academic training in Jamaica and immigrated to the United States in 2004. As a new immigrant to the United States it was essential for Cathy to obtain her GED credential because certain employers may not consider her high school diploma

from Jamaica valid. Cathy's low entrance scores on the official GED practice tests qualified her for the Basic Literacy night program. On successful completion of this program Cathy was promoted to the Pre-GED night program followed by the GED program in the spring 2008 semester. I also taught Cathy mathematics in the Pre-GED program. Subsequently, in the fear of not being assigned to my GED mathematics class Cathy transferred to the GED day program.

Saul, the fourth student participant in the cogen, is a licensed real estate agent. Saul is the only male in the group and is 52 years old. Saul identifies himself as Black; however, when one hears Saul speaks he has a noticeable Jamaican accent. Saul was born and grew up in Jamaica where he also received his elementary and high school education. In his early 20s he moved to Canada where he resided for twenty-seven years before relocating to the United States. Saul enrolled in the ABE program in the 2008 spring semester and, at that time, was the newest member to the Downtown Center. His entrance scores were above 400 allowing him to register for the GED day program. Saul's long-term goal was to obtain a college degree and a GED credential would be considered legally acceptable than Saul's high school diploma from Jamaica, a similar situation to Cathy.

As the fifth cogen participant in the initial role of teacher-researcher, I also brought my cultural background and associated dispositions to the cogen. I am a Black female of Barbadian nationality in my early thirties. I obtained the majority of my academic socialization in Barbados from primary school to university level, where I earned a bachelors degree in mathematics. As in the case of Saul and Cathy who came from Jamaica, a former British colony, I received my initial experiences with learning

mathematics under the postcolonial educational system inherited from Britain. Immediately after receiving my bachelors degree in mathematics I immigrated to the United States and in 2002 obtained my masters degree in pure mathematics from Hunter College, City University of New York (CUNY). In that same year, I began teaching math at the Downtown Center and in 2003 began to teach high school math while still working at the Downtown Center. Currently, I am teaching at Downtown Center and pursuing a doctorate in Urban Education specializing in mathematics education. As a current student and also a teacher, I understand my students' struggles, as I have experienced the mathematics classroom from a postcolonial Caribbean nation and American viewpoint. As such, I strive to help students become more mathematically confident and explore mathematics through culturally adaptive lenses.

Although each participant in the cogen entered the Downtown Center at different academic levels and institutional entry points (e.g., I as a university lecturer/GED instructor while Cathy, Jacinth, Janice, and Saul entered as students), they all participated in the 2008 spring GED day class and associated cogen. Each of the participants within the cogen group brought a different perspective and unique forms of capital to the sessions as they presented diverse educational experiences within the Downtown Center, educational backgrounds (African American and Afro-Caribbean), cultures, social experiences, ages, gender, socioeconomic status and ethnicity. However, all the student participants needed their GED credential for economic stability, social mobility, to enter higher education institution and, most importantly, to increase their life chances for success.

Key Approaches to Data Resources

Below, we present a vignette from a cogen session, which illustrates key outcomes when enacting cogen to augment teaching and learning of mathematics in a GED program. This vignette was purposefully selected because it exemplified important challenges adult learners face solving multi-step word problems. According to the GED Testing Service, problem solving and mathematical reasoning is one of the areas in the GED mathematics test that causes students the most difficulty. Thus, a central focus of this study was to explore how adult learners participating in cogen appropriated and enacted process skills to help them improve solving mathematics word problems and meet their goals and motives associated with passing the GED mathematics test. The vignette selected from the cogen is approximately one minute in length and is divided into four episodes that were analyzed individually, but together the episodes connect to illustrate salient and compelling themes to improve teaching of mathematics word problems in a GED program.

This particular cogen took place in the fourth week of the 2008 spring semester in which the students had recently returned to school after a one-week break. The analytical framework we use incorporates the standpoint that teaching and learning of mathematics, including process skills, is a form of cultural production. As such, the sociology of emotion and cultural sociology are used as interpretive frames to inform this standpoint. But more specifically, we theorize cogen as a site for the enactment of mathematics that allow access to participants' dispositions as they enact culture obtained in the classroom and other related fields. Encounters during the cogen provided participants additional means to build solidarity across boundaries of difference while co/constructing

knowledge about their mathematics learning in relation to shared experiences. Here, solidarity is theorized as a sense of belonging and affiliation imbued with emotional energy, which scaffolds encounters during the teaching and learning of mathematics. Cogen also provides opportunities for participants to gain fluency while enacting mathematics in timely, anticipatory and appropriate ways.

We recorded the cogen and used iMovie to process and view the videos at varying speeds. This facilitates a method in which researchers can access and review dispositions including the production of fluency, solidarity, speech and associated physical movements that would not normally be available for analyses. We use the alignment and misalignment of body gestures and prosodic markers, such as intensity (amplitude) changes, the production of pauses and overlapping speech, to illustrate fluency and solidarity (Tobin & Roth, 2006) and emotional energy (Scherer, 1989) within the vignette. A computer program known as PRAAT was used to analyze characteristics of participants' utterances and associated silence.

Procedurally, we analyzed the vignette by playing the video at normal (or real time speed) to conduct meso level analysis and, where appropriate, speed up or slow down the video to conduct micro level analysis. We also conducted macro analysis by analyzing research participants across multiple fields where associated forms of culture were enacted. The CAI and mathematics classroom became closely related and salient fields that were associated with and interpenetrated the cogen field. Together, meso,

micro, macro, and prosodic analyses were coordinated with the production of transcripts[2] from interviews and cogen to provide evidence for our claims.

Addressing Difficulties with Word Problems

In the vignette analyzed below, the conversation began with me asking Jacinth, Saul, Cathy and Janice their perspectives on the test that was administered before spring break. The test focused on data analysis in which students had to read and interpret line, bar, and circle graphs, use statistical data, calculate probability, solve one-step and multi-step word and percent problems. Cathy, Janice and Saul passed the test and were pleased with their scores but indicated they could have achieved better scores after reviewing their test. Jacinth was absent the day of the test however a make up test was scheduled in the CAI.

The shared discussion among the cogen participants regarding their test scores, the type of questions on the test, and the mistakes made afforded a meaningful conversation and a relaxed atmosphere observed by students' body orientation, eye contact, head movements and emotional energy. As a result, Jacinth felt comfortable to expand her agency as she appropriated the first turn at talk in the vignette to express the difficulties she has been having solving multi-step word problems.

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[2] We use transcription conventions employed by Roth (2005)

[	beginning of overlapping talk or gesture;
=	equal sign at the beginning of a turn indicates no appreciable gap between two speakers;
(2.5)	elapsed time in tenths of a second;
::	colons indicate lengthening of the preceding phoneme, approximately one tenth of a second for each colon used;
(db)	sound intensity measured in units of decibel;
-	a dash indicates sudden stop in talk;
(())	double parentheses (italicized) are used to enclose comments and descriptions.

Episode 1

01 Jacinth: You know what I think I have a problem with. Like um... (66.4 db; range 52.3 -74.3)

(0.54)

02 Jacinth: It will be a question and it would tell me to do one thing. (0.45) I don't know how to (73.4 db; range 53.4 – 80.9)((cogen participants begin to turn a focus on Jacinth))

(0.93)

03 Jacinth: continue the operation like the like the (69.7 db; range 56.5 – 75.5)

(0.51)

04 Janice: The two step. (75.8 db; range 58.7 - 83.8)

(0.05)

05 Jacinth: Yeah like the step process. (77.1 db, range 59.0 – 87.2)

06 Wharton: =Oh you mean when its [more than one step.](74.8,range 60.3 -83.2)

07 Jacinth: =[more than one step.] Yeah (75.8 db; range 53.4 - 83.7)

08 Wharton: Okay you're you're having a problem umm ok what should I do first and what should I do [second.] (70.9 db, range 57.8 – 84.6)

09 Jacinth: =Like (74.8 db, range 60.0 -79.3)

10 Janice: =[Yeah.] (82.7 db, range 70.1 – 86.3)

11 Jacinth: =[I would know what to do] first but second and third it would be a blurr to me. (77.2 db, range 54.9 – 86.4)

In this episode, Jacinth leads the conversation with a soft voice, as she positioned herself as the weaker student in the area of solving multi-step word problems. In turns 01 to 04 Jacinth uttered "I have a problem with… how to continue the operation like the like the two step." However, Jacinth's voice progressively becomes confident, controlled, and louder increasing from 66.4 db in turn 01 to 73.4 db in turn 02 as she begins to explain

the difficulties she has encountered when solving multi-step word problems. As the episode progressed the loudness of Jacinth's voice moved into a higher range from 56.5 - 75.5 db in turn 03 to 54.9 - 86.4 db in turn 11 signaling confidence in her interaction with the other cogen participants. According to Klaus R. Scherer (1989), emotions with high arousal and associated activity, in this case conversation about enacting mathematics, are characterized by increased variability and increased mean intensity (loudness). The structure of the cogen provided Jacinth and the other participants with a safe space to talk about the difficulties they had encountered with solving mathematics word problems. For instance, during the first three turns at talk Jacinth's three pauses created resources of ≥ 0.5 seconds between turns at talk affording others the opportunity to appropriate additional turns at talk, however, she was not interrupted. According to Kenneth Tobin (2006), pauses in speech production of 0.5 seconds or more provide resources to change speakers. Cogen participants are able to build trust and solidarity by easily retaining and also appropriating turns at talk without being interrupted.

Jacinth’s difficulties with solving multi-step word problems became a common point of reference, and helped to initiate a rich discussion about problem solving. Jacinth’s issue provided a topic for mutual focus among the cogen participants. This is evident by their attentiveness, synchronous eye focus and body orientation, in addition to sequential overlapping speech patterns among Jacinth, Janice and me in turns 08 through 10. As Jacinth begins to talk, Janice focused the camera on Jacinth and Saul, Cathy and me, the seated cogen participants, in which we simultaneously began to turn our heads and shift our bodies to focus on Jacinth (see Figure 3.1). Jacinth’s description of her lived experiences when solving mathematics problems resonated with Janice, which was

evident by her interjection of "yeah" in turn 10. Janice's agreement and identification with the concerns Jacinth explained to the group illustrated there may be other students within the class experiencing similar difficulties with word problems. Janice's verbal agreement with Jacinth's perspective promoted solidarity and entrainment (wide spread mutual focus) within the cogen group in episode 1. Entrainment occurred from the shared interest for Jacinth's perspectives regarding mathematics problem solving, which promoted a chain of successful encounters and talk about shared goals in episode 1. Thus, the cogen became a site where students could display their vulnerability when they encountered problems with any mathematical activity in the mathematics classroom, CAI, and homework assignments.

As I listened to Jacinth and Janice's shared concerns regarding solving word problems, I realized that I was initially unaware of the contradictions brought up in the conversation. From my point of view solving word problems should not be an issue for the students at this point in the course. At the beginning of the semester, I dedicated approximately four ninety-minute class sessions for deconstructing and solving single and multi-step word problems both in the traditional mathematics class and CAI. The students were taught the four-step problem solving techniques developed by George Polya (1957). I modified Polya's technique by splitting his step 2 (devise a plan) into steps 2 and 3. These modified steps included: (1) understand the problem, (2) select the appropriate information, (3) choose an operation, (4) carry out the mathematical computation, and (5) check answer for reasonableness given the situation described. These steps provided students with a consistent method for solving word problems in a low risk environment that allows students to make and learn from their mistakes in the

problem solving process. Consequently, during each class session I often asked students if there were any issues or problems with the content area. However, students never articulated having any difficulties.

One of the reasons I believe that students may not have indicated their continuing difficulties with solving word problems could be attributed to the large size of the class. This particular GED mathematics class had an enrollment of 36 students; one of the largest GED class I have taught at the Downtown Center. With a class this large in addition to having met for a period of six class sessions, students may have feared the reactions of their peers, perceived the classroom atmosphere as relatively new, and were adjusting to being in school after a long hiatus while also adjusting to my teaching practice. As an instructor in an ABE program I have heard students articulate feelings of shame and embarrassment when re-learning the mathematics they believed they should have learned during high school. However, shame also allowed students to try harder, to make amends, as they tried to meet society's normative expectations such as attaining their high school credential (Turner, 2002). Therefore, adult basic education learners' motivation to return to school is the first step in the confrontation of their academic fears as they prove that they can truly learn the mathematics they found difficult in high school.

Employing cogen within the GED classroom provided me with an insider's view of what was occurring within the classroom environment. Changes were made to the traditional and the CAI math curriculums to address the contradictions, which occurred in episode 1. A higher emphasis was placed on helping students improved their problem solving skills throughout the remainder of the semester in both classes and on homework

assignments. The curriculum utilized within both classes was developed by me and was not prescribed by the ABE program. Therefore, the curriculum was altered to remedy contradictions that occurred during the semester.

Mathematical Dispositions

In episode 2, Saul introduced the participants to the mathematical dispositions he used such as how he made sense of a particular procedure, concept, or the methods he used to remember specific rules. One of the mathematical depositions that Saul utilized in this episode was practicing (i.e., performing an activity repeatedly for the purpose of mastering or improving his mathematics process skills). Practicing helped Saul hone his problem solving skills to minimize careless mistakes, omissions and oversight when solving word problems. This enabled Saul to take risks when solving challenging problems in the math class, the CAI, and on homework assignments. Saul developed a work ethic that utilized practicing his mathematics, which led to his success in mathematics. Saul's sharing of the work ethic he employed along with the process skills he used provided him with symbolic capital (status). Accordingly, the capital Saul appropriated afforded his new identity and associated role as coteacher within cogen.

Episode 2

12 Wharton: Okay.

13 Saul: You know what. You know what is good for you. Try this. Try practicing it. Now practice don't make you better. Practice does make you better. It just make you [much better.]

14 Cathy: =[F.a.s.t]

15 Saul: At what you're doing.

16 Jacinth: Umumm

17 Saul: Understand?

18 Saul: It does not make you. Practice practice not perfect.

19 Jacinth: Umumm

20 Saul: It does not make you perfect it just make you better.

21 Jacinth: Umum

After Jacinth's turn at talk (turn 11) in episode 1, I looked at the group and uttered, "okay" in turn 12. This became a verbal structure to exchange speakers in which Saul appropriated the next turn at talk. In turn 13 (episode 2), Saul appropriated the role of coteacher and turned to Jacinth to explain how practicing more word problems could increase her process skills in mathematics. At first Saul suggested, "Try this. Try practicing it. Now practice does not make you better.'' Saul quickly became aware of the contradiction in the semantics of his utterances and repaired the flow of dialogue by specifying, "Practice does make you better. It just makes you much better." In turn 14, Cathy entered the conversation with overlapping speech by uttering the word "F.a.s.t." which helped to clarify and reinforce Saul's explanation. By "F.a.s.t.", Cathy agreed and identified with Saul's explanation that practice improves process skills when solving mathematics word problems. Saul proceeded to ask Jacinth in turn 17 "Understand?" deciding whether Jacinth comprehended or followed his method of thinking about how he learns mathematics. Jacinth responded by uttering "umumm" (turn 19) indicating agreement.

This episode revealed several outcomes of cogen regarding the teaching and learning of GED mathematics. Cogen provided a complementary model for coteaching. Coteaching enables teachers and students to become closer to the praxis of another (Tobin & Roth, 2006). Thus, it is a teaching and research method that provides

coteachers and other participants with opportunities to access and evaluate the teaching and learning experiences of their peers. In episode 2, cogen became a site for coteaching where participants gained agency and understandings as they appropriated the role of coteacher. Saul appropriated a lead role as coteacher whereas Cathy adopted a complementary role, assisting the group to understand how to develop the process skills necessary for solving word problems. This became evident as Saul expressed his thinking (schema) and associated repertoire of teaching practices. By sharing with the group his experiences and culture used in enacting mathematical practices Saul was simultaneously attending to the motives of the group. This was evident in turn 13 where Saul repaired his thought processes and in turn 17 when he inquired if Jacinth understood. Both Saul and Cathy grew up with similar academic socializations in the 1960s during the beginning of the British postcolonial era in Jamaica, which allowed both students to engage in similar practices leading to success in problem solving in the mathematics classroom. As a national from a British postcolonial island (Barbados), I also appropriated many of the dispositions that Saul and Cathy understood. As a coteacher, Saul also provided the group with access to his schema and practices that allowed him to achieve his goals in the classroom. By appropriating turn 13, Saul felt a sense of being and belonging with his peers as he exhibited concern for the participants in cogen to attain success in mathematics.

As coteachers, Saul and Cathy complemented each other by using verbal reinforcements such as “F.a.s.t” and associated nonverbal gestures such as attentiveness, which provide mutual focus and new knowledge for the participants in the cogen when Saul articulated his practices on how he learns and produces mathematics. Coteaching

enabled collective action in which students became closer to each others' dispositions as they made assessments and evaluations on the teaching and learning practices of the other (Pitts, 2007). This division of labor changed the dynamics of cogen physically, socially, and individually in which the students did not position me with the sole responsibility of providing answers to their questions but permitted different perspectives from their peers who were familiar with the shared experience. In other words, Saul created structures in the cogen that allowed other participants to talk about the way they used and developed process skills (see episode 4 below).

Interestingly, I observed that within the cogen Saul and Cathy exhibited similar ways of knowing and achieving fluency in mathematics such as utilizing rote practicing, which was taught to them in the school system in Jamaica. These practices and dispositions generated without consciousness, allowed Saul and Cathy to act and react in certain ways when engaged in mathematical activities. Rote practicing to learn mathematics was ingrained in the national academic mathematics curriculum in many Caribbean countries that were colonized by the British. Pierre Bourdieu (1986) used the term habitus to refer to dispositions to act. Bourdieu regarded habitus as both structured and structuring. Saul and Cathy's disposition were partly generated from their shared nationality, early academic socializations, beliefs, and perceptions regarding academics, particularly mathematics. The habitus that Saul and Cathy brought to the classroom and the cogen field were mutually and historically constitutive from their prior lived experiences in addition to the formation of new practices. Saul and Cathy's experiences enabled them to co/construct mathematical dispositions derived from their ways of interpreting, thinking and enacting mathematics constituted from their prior and current

practices within the classroom that provided success for solving word problems. Hence, Saul and Cathy's mathematical dispositions played an influential role on their enactment of mathematical practices and schemas within the classroom and cogen field. In all, Saul and Cathy provided the cogen group and their peers within the classroom with epistemologies that could enhance their success in mathematics. Accordingly, cogen can provide participants with access to different ways of being and enacting mathematics from being with the other as participants meet their individual goals as well as collective motives.

Intersection of Fields

In this episode, we explore how other fields such as the classroom, CAI and the homework field, interpenetrated the cogen to assist students in understanding how the practices enacted in the classroom could be modified to afford agency in other fields. From a sociocultural perspective, fields are social spaces where students can learn and enact mathematics at anytime. These learning environments are structured temporally and spatially providing resources that are material, human, social and schematic that can be beneficial to students. These fields are nested, interwoven and have borderless boundaries allowing other fields such as the classroom the ability to penetrate, in this case the cogen field, at any time and vice versa. These interwoven and nested fields are structures that come to hand as participants tune in and out to appropriate different field structures. Thus, as students enact mathematics they traveled within multiple fields such as the mathematics classroom, CAI, homework assignments, cogen as in episode 2, and past childhood learning experiences. These fields intersect each other either in a one to one

scenario or at times in a many to one scenario to afford students' agency in which they can access and appropriate new capital for immediate or future uses.

Evident in turns 22, 24 and 26, in episode 3 (below), Saul replicated the teaching method of solving problems from the classroom within the cogen field to help his peers understand how he became fluent in solving word problems. The intersection of these two fields served as a resource to examine how students utilized the culture from the classroom to improve their fluency in mathematics. As I am a central participant within both these fields, Saul's reflection provided a critical assessment and evaluation opportunity of how the strategies, which I employed in the GED classroom afford students' agency. The mathematics classroom is comprised of students at different levels; hence, it is of upmost importance to create an equitable learning environment for each student in the class. Each mathematical concept is introduced with a set of descriptive steps appropriate for each student's mathematical entry point within the class. Students have the option to utilize the steps, as they are predefine or modify the steps to fit their current style of learning and enacting mathematics such as Saul outlined in episode 3.

Episode 3

22 Saul: So if you do it like. If like when I get Ms. Wharton give me a certain ammm formula.

23 Jacinth: Umumm

24: Saul: And I use it one time.

25 Jacinth: Umumm

26 Saul: I try to use it two and three times.

27 Jacinth: …..Yeah.

28 Saul: And try to get it down. I try to do it another way then. So… if I can always turn it around.

Saul's strategies for learning and enacting mathematics provided his peers with new tools and resources for negotiating new ways of teaching and learning mathematics in other fields. In turn 22 Saul stated, "when I get Ms. Wharton give me a certain amm formula…And I use it one time… I try to use it two and three times…And try to get it down. I try to do it another way…I can always turn it around." The process skills that Saul acquired from the classroom field provided the mathematical dispositions and associated fluency needed for developing a good work ethic towards learning and enacting mathematics evident in turns 26 and 28. Saul's strategies provided the participants with access to new resources as process skills that could be reproduced, and transformed to improve their fluency in mathematics. The mathematical knowledge and practices that Saul shared within the cogen demonstrated his creative skills of altering the knowledge gained in the classroom to solidify his understandings of the mathematics he was currently learning. Thus, the process skills and other resources within the cogen field provided the participants opportunities to shape their practices by which they enact mathematics.

Saul's role within the cogen was transformed into that of a change agent. As such, he shared with the group the successful strategies that allowed him to achieve fluency in mathematics. As a change agent, Saul illustrated how the culture obtained from the classroom could be modified to catalyze each student's personal style of learning, which can be applied for immediate and future use in other fields. The process skills that Saul appropriated from the classroom field allowed him to verify and co/construct his identity as a successful mathematics student in which he felt at ease conveying his strategies to the group. As Saul shared his strategies, he also demonstrated his collegiality with his

peers as they collaborated as equals on a shared goal to improve the teaching and learning of mathematics within the GED classroom.

Cogen is a rich field that provides an alternative forum, to identify contradictions and patterns of coherence that occur within the classroom. An immediate insight into the production, reproduction, transformation and enactment of mathematics was provided, thereby creating an alternative framework for assessing and evaluating students' understandings of mathematics. In real time during the cogen, I obtained an informal assessment of students' practices and schema based on the resources and associated culture experienced in the cogen; that is, an interplay of observations, inferences, social signs, and emotions. As students described and presented their mathematical knowledge within this forum, I was able to make pedagogical decisions about students' mathematical thinking and practices instead of relying only on traditional assessment practices. The numerical grades students received on test, quizzes, or homework assignments can motivate or limit students' learning of mathematics (Gates & Vistro-Yu, 2003). Thus, grades have the potential to inscribe mathematical identities upon students implying who is a better mathematics student and who is not. The application of cogen in ABE classrooms provided access to students' mathematically thinking and afforded a holistic picture of each student's ability, illuminating how students learn or do not learn mathematics within the classroom environment and other closely related fields.

Checking Answers

In the ABE mathematics classroom students often fail to check their answers—the final step of problem solving activities. Numerous times on tests and assignments students would present unrealistic answers derived from automatic computation without

consideration of the real life aspects of the situation or word problem. Torulf Palm (2008) argues that students provide these unrealistic answers due to the sociocultural norms of schooling in which they consciously decide not to consider the realities of the situation described within a word problem, misinterpret the word problem, and at times they may not possess the dispositions and real world knowledge necessary to acquire correct or realistic answers to a problem. In episode 4, Jacinth shared with the participants that she now checks her answers when solving word problems to make sure they are correct, a process skill that was taught in class. For Jacinth, this process skill that she did not utilize before has currently proven to be a viable strategy in helping her acquire correct answers. As Jacinth continues to check her answers she will improve her fluency in problem solving.

Episode 4

29 Jacinth: Yeah you rea you taught you know what you taught me Ms. Wharton. You taught me how to like, like check my answers. To make see if there is right. To see if it's right.

30 Jacinth: And you're a good teacher.

31 Group laughter

In the final episode of the vignette, Jacinth proudly articulated to the group she now checks each answer "To see if it's right" (turn 29), a response that was triggered from Saul's previous explanation of how he became fluent in problem solving in episode 3. Jacinth has utilized an essential skill of problem solving, assessing her answer choices to determine their applicability to the problem, instead of hastily choosing an answer based on mathematical computations. The process of assessing the final answer choice is a proven strategy for Jacinth, which was under utilized when she solved word problems.

Thus, Jacinth now uses and applies the complete sequence of procedures for problem solving, enhancing her understandings of how to solve word problems. From episode 4, it became apparent that Jacinth only utilized the first four steps of problem solving: (1) understanding what she is being asked to find; (2) selecting the appropriate information needed to solve a problem; (3) choosing the appropriate operation; and (4) doing the computation. Although step 3 presented Jacinth with difficulties (evident from episode 1) step 5 of the problem solving algorithm, assessing the answer choice, gave Jacinth the information necessary to acquire the correct answer choice in some of her problem solving activities. Jacinth will improve her problem solving skills as she monitors the process skills being utilized during problem solving providing essential feedback to enhance her performance.

According to Alan Schoenfeld (1992) developing process skills such as monitoring and evaluating strategies used in problem solving is a difficult process for both students and teachers. Students and teachers must be open to unlearning associated methods and strategies from prior learning experiences, which are grounded within their historically, social, and cultural ways of enacting mathematics. Teachers have an additional responsibility of teaching these essential skills to students in which they must unpack the complexities of problem solving for students' understandings and utilization of the procedures and process skills. These small changes in students' problem solving activities create opportunities for students to enhance their mathematical skills. Thus, as Jacinth continues to check her answers to mathematical problems she will deepen her understandings of problem solving and the process skills necessary for learning mathematics—an important component of the learning process.

In this episode Jacinth took a moment to indicate to the group that I was a good teacher (turn 30) supported by group laughter (turn 31), which indicated a release of positive emotional energy among the participants. Jacinth's acknowledgement was supported by the simultaneous and synchronous group laughter indicating agreement and solidarity from all participants. The group laughter indicated sentiments of solidarity and cheerful feelings, which helped to co/construct my identity as a good mathematics teacher. As the cogen proceeded, Jacinth indicated that her previous mathematics teachers "Never took time out to come around to each student to see what kind of level they were on, are they progressing." Whereas I took time within my lessons to find out how each student was progressing in addition to the teaching the problem solving techniques and strategies students needed to be familiar with to be successful on the GED mathematics test. These characteristics of my identity influenced Jacinth's assessment of my teacher identity as she began to make sense of the mathematics she was learning for example checking her answers for reasonableness.

Cogen helped to engage students in the process of evaluating, analyzing, and interpreting their mathematical knowledge from sharing, coteaching, and helping each other understand ideas regarding problem solving in a collaborative setting. As each participant shared his or her knowledge and experiences about word problems, structures such as utterances, prosodic markers and emotions, were created that afforded opportunities to co/construct knowledge and identity with other members of the cogen. For instance, in episode 1 (turns 3 and 4) Janice helped Jacinth co/construct her explanation of the difficulties she was experiencing with two-step word problems as Jacinth simultaneously positioned her identity as a weak student in this area of

mathematics. Jacinth's repetitive utterances of the phrase "the like" directly following a pause of 0.51 seconds created a structure, in this case containing utterances, intensity, and a pause ≥ 0.5 as a resource to exchange speaker, that afforded an opportunity for Janice to co/construct knowledge and agreement about prior experiences with word problems. Janice uttered the words "the two step" while looking directly at Jacinth indicated mutual focus and synchrony during the encounter. Similarly, in turns 26 and 28 (episode 3) Saul indicated how he used the procedures explained in the math class to solve word problems and once he mastered these procedures he deliberately approached these problems differently to gain additional insights. At the beginning of episode 4, Jacinth appropriated the next turn at talk and agreed with Saul and also indicated that she now checked her answer after completing a problem. Accordingly, students made sense of the mathematical knowledge shared from reflexivity and mutual interdependence given the interactive nature of cogen. From the perspective that mathematical learning is considered a form of cultural production, learning transpired from students' individual constructions of mathematical knowledge in tandem with their collective understandings of their peer's mathematical dispositions. As such, students' dispositions to enact new and successful forms of mathematics culture fluently, (e.g. Jacinth now checks her answers after completing word problems and Saul attempts to find new ways to solve mathematics problems when he masters canonical forms) are embedded in the process skills they appropriate and practice. In other words, students' agency to enact mathematics successfully has increased.

What was Learned from Cogen

In the initial stages of the research cogen was employed to improve student achievement in the GED mathematics class at the Downtown Center. However, the use of cogen evolved into helping participants assess and evaluate how they interpreted the mathematics being taught, in addition to how the mathematical culture of the classroom was appropriated in meaningful ways to learn mathematics. The shared experiences, which the students brought to the forum, were utilized to identify patterns of coherence and associated contradictions that allowed students and teachers to cogenerate and afford new roles and divisions of labor that reduced or eliminated unsuccessful encounters within the learning environment.

This chapter addressed the viable outcomes prompted from a cogen for the improvement of teaching and learning of mathematics in an ABE classroom. Each of the participants in the cogen experienced the events that occurred in the classroom in different ways. For example, as I cotaught with Saul in this cogen, I became aware of the perspectives of other participants regarding the concepts they were learning and their ability to access, appropriate, and realign available resources from the learning environment for successful teaching and learning of mathematics. In particular, I experienced how Saul accessed prior and unfolding educational experiences to enact cultural resources, such as prosody, utterances, emotions, and body gestures, that afforded the co/construction of process skills associated with teaching and learning and how to solve word problems. Similarly, as I assumed the role of classroom instructor, I obtained an insider's view of the contradictions that occurred in the learning environment rather than assessing students' understandings solely with exams or quizzes.

In addition, the structure of the cogen provided an environment where students felt comfortable discussing their difficulties across age, gender, culture, socioeconomic status, ethnicity, and prior academic socialization. For example, Jacinth, the youngest participant who received all her education in the United States and identified as an African American female, was receptive to the strategies and process skills shared by Saul who received most of his initial academic socialization in postcolonial Jamaica. Although Saul and Jacinth differed in age by 32 years, gender and initial academic socialization, they co/constructed culture along with other participants in the cogen in order to learn mathematics; however, as contradictions emerged, such as Jacinth's ongoing difficulties with word problems, tactical alterations were made to the curriculum for the next CAI class session in which extra review sessions on mathematical reasoning and word problems were scheduled to help all students in the class become better problem solvers.

As mentioned above, a complimentary model of coteaching emerged from cogen, which provided another form of assessment and evaluation. Instead of numerical grades, I was able to assess my students' process skills in real time as they shared the strategies and techniques that allowed them to learn and enact mathematics fluently. As participants shared their strategies and experiences while enacting mathematics a sense of emancipatory practice emerged among the students and me in a form of trust, respect and collective responsibility. A priority was to assess mathematics culture enacted in the classroom and other fields that penetrate the cogen to evaluate the teaching and learning practices enacted in order to minimize those structures, which truncated agency, participation and placed students at an oppressive disadvantage in learning mathematics.

From participating in and co/analyzing the cogen, it was evident that students felt positive about the transformative practices enacted in the cogen and classroom (e.g., assuming the role of a coteacher, checking answers, fluently appropriating more time at talk to explain mathematics, completing ideas in mathematics with overlapping speech and participating in synchronous group laughter). Students also exhibited expanded agency as they shared strategies and resources from the classroom and enacted roles to appropriate new and existing cultural forms to become successful mathematics students and teachers.

CHAPTER 4

What Must I do to Pass This Test?

In 2008, approximately 777,000 adults have taken either the entire five-part battery test or some part of the GED test. This was the largest increase of test-takers since 2003 and a 7% increase from the previous year. As a result, more than 493,000 adults have obtained their GED credential while more than 186,000 did not meet the passing requirements failing one or more parts of the test in 2008 (GED Testing Service, 2009). According to the GED Testing Service (2009), test-takers failed either the mathematics or language arts writing tests. These two tests are considered the most difficult tests within the battery of the five GED tests. The average standard scores of test-takers who passed the mathematics and writing tests were 496 and 505 respectively compared to the social studies and language arts reading tests in which test-takers passed with average standard scores of 540 and 565.

Adults' difficulties with the GED mathematics and language arts writing tests did not begin with the 2002 test series, but date back to the implementation of the1988 GED test. A study conducted by the GED Testing Service during the 1988 test series documents adults' difficulties with the GED mathematics and writing tests in which these two tests had the lowest scores in the five-part battery test. This early study did not provide any concrete information regarding the content areas within these tests that posed the most difficulties for test-takers (Tyler, Murnane, & Willett, 2000). Subsequently, when the 2002 test series was implemented the same trend continued with test-takers. However, it was the mathematics test that was of interest to educators, administrators and the GED Testing Service because it had the lowest pass rate among the five tests. Many

wondered why test-takers were unable to pass the GED mathematics test even though the format of the test was changed to include the use of a scientific calculator on a portion of the test. In 2003, the GED Testing Service conducted an intensive study of three of its operational GED mathematics test forms. The results of this study were published in 2005 and provided definite conclusions regarding the content areas and question types that were most problematic for test-takers. It was determined that test-takers lacked the ability to (1) set up or solve geometric type problems, (2) apply basic mathematics principles, (3) read or interpret charts and graphs, and (4) use a scientific calculator efficiently (Florida GED Plus College Preparation program, 2006).

Adult learners' inability to pass the GED mathematics test is an important issue in the GED community because this test prohibits many adults from obtaining their GED credential. As such, this chapter investigates students' mathematical experience taking official GED mathematics practice test and the mathematical errors they incur given the structure of the test. Students' mathematical experience refers to the methods, procedures and cultural knowledge used when taking test, quizzes, completing homework and in class assignments. To construct meaning of students' experience on taking the official practice test, I enact a dialectic process consisting of explanation and understanding. This approach attempts to understand events that occurred in the past and as they unfold in the present.

The process of explanation is achieved by the use of cogen in which students provide rich descriptions of their mathematical experience taking official practice test. Cogen is a field in which participants are able to listen to each other perspectives, comment on what was said, add more to the conversation, cogenerate solutions, and

produce, reproduce, transform and exchange culture (mathematics knowledge). As a result, participants provide each other with different ways of enacting mathematics to meet their goals and motives. Given that cogen is a face-to-face encounter participants provide each other with information in the form of talk but also through their body language, which is guided by their emotions. Jonathan Turner (2002) considers emotions as the driving force behind any face-to-face encounter because it provides information about our feelings towards the situation, others and ourselves both consciously and unconsciously. As a result, conversation analysis is employed to investigate the body gestures and prosody markers such as pitch, intensity, and utterance displayed by students and me during cogen. Wesley Pitts (2007) suggests that body gestures and corresponding prosodic expressions are resources for identifying the emotional climate of an encounter and whether the encounter will be successful or unsuccessful. Conversation analysis is a method of inquiry that allows the identification of different levels of solidarity, the emotional climate within the encounter and how it contributes to the production and reproduction of social life.

To understand students' mathematical experience I use the theoretical frameworks of cultural sociology, sociology of emotions and hermeneutic phenomenology. A sociocultural lens provides an understanding of how culture (schema and practices) and emotions afford or constrain students' agency and their ability to access and appropriate structures within an encounter. Students' relationship with mathematics is composed of their schema, cultural practices and the immediate structure of the field, which is temporal and historically constituted. As such, students exercise their agency to access and appropriate mathematics culture within fields to meet their goals and motives. Fields

are constantly changing and can become nested, intersected, or aggregated to create multiplex fields that can afford or constrain students' performance on high stakes tests. For instance, if a student experiences a traumatic event such as losing a family member this could affect their performance on a test or exam because the home field can intersect the school field. A hermeneutic phenomenology approach affords an understanding of the different contextual aspects of students' mathematical experiences. This theoretical framework presents a means to describe how students interpret the questions featured on official practice test and their mathematical lived experience taking these types of tests. Its purpose within this chapter is to amplify the mathematical experiences of students in GED classrooms as they bring different forms of capital (cultural, social and symbolic) and ways of knowing to the learning environment. By understanding students' mathematical experiences and the structural constraints that prevent them from doing well on these test will provide insight on how to help students approach, interpret, and enact the necessary mathematics process skills needed to solve the types of problems found on official practice test. At the Downtown Center, official GED practice test are used to determine students' readiness and would be success on the official GED test. The questions featured on these tests are similar in content, format and difficulty to the official GED mathematics test and can provide insight into students' weaknesses with regards to content, question types and their interpretation of questions. These test are used as performance indicators to determine students' eligibility to take the official GED test at the end of the semester.

Overview of Chapter

In the following sections I examine students performance on the official practice test administered at midterm. Cathy, Saul and me were the only cogen participants present as Janice and Jacinth could not attend the session for personal reasons. The cogen session is divided into six episodes, which capture the ways in which pauses and body orientation produce negative emotions creating unsuccessful encounters, the role of laughter as a resource to restructure encounters, and students understanding and analysis of the errors they incurred on the test.

A Snapshot of Students' Raw and Standard Test Scores

At midterm an official GED mathematics practice test was used to evaluate students' mathematical knowledge on the four major content areas that comprise the GED test, which are (1) number operations and number sense; (2) measurement and geometry; (3) data analysis, statistics, and probability; (4) algebra, functions, and patterns. To pass this test students needed to get 16 questions correct representing a GED standard score of 410. I was certain that students would have done well on the test given the content areas covered so far in the course. However, of the 26 students who remained in the class only six students achieved passing standard scores ranging from 410 to 590. The remaining students failed the test with scores ranging from 250 to 400 with the majority scoring 350 (11 question correct) and 360 (12 questions correct). The cogen participants' standard GED scores were within this range in which Cathy scored 370, Saul 360, Jacinth 350 and Janice 330. It was apparent that some contradictions occurred regarding which questions students should have been able to solve and their interpretation of the questions found on the official practice test. At this point in the course we covered

half of the content areas of the GED mathematics curriculum that is, number operations and number sense, data analysis, statistics and probability.

Table 4. 1: Midterm Scores

Raw Score	Standard Score	Percentage of Students
6	250	8%
7	270	4%
8	290	4%
10	330	8%
11	350	19%
12	360	15%
13	370	8%
14	390	8%
15	400	4%
16	410	8%
17	440	8%
22	540	4%
23	590	4%

Pauses and Body Orientation: Resources that Structure Encounters

I was quite surprise by the number of students who failed the official practice test and decided to use the upcoming cogen session to understand what occurred during the test that may have caused students to perform so poorly. From a hermeneutic lens, the cogen would provide an understanding of the cogen participants' situatedness with regards to "what was happening" and "why was this happening" as they made sense of the errors they incurred. Accordingly, I wanted to make sense of the obstacles students encountered on the practice test. Failure to understand students' errors and provide them with an awareness of their unconsciously mistakes would be detrimental to the students. A sense of awareness of the common mistakes and obstacles that students encounter on official practice test have the potential to expand students and teacher's agency of the ways in which students approach, interpret and enact the necessary problem solving skills need to solve the mathematics problems found on these test. In addition, it provides an understanding of the obstacles preventing students from passing official practice test and allow appropriate changes to take place within the teaching and learning of mathematics to meet the needs of the immediate stakeholders—the students. However, the conversation became difficult once the students realized they might not have pass the test, which led to a build up of negative emotional energy creating an unsuccessful encounter that disrupted the cogen.

Episode 1

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01 Wharton:  So (0.91) what I want to do today is I have your (0.64) your test
             back (0.19) and I want to talk about it (0.21).

02 Cathy:    Hmmm ((chuckling))

03 Saul:     (0.21) Not not not going to give us our scores though.
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04 Wharton:   (0.57)Huh
05 Saul:      Not not not give us the scores.
06 Wharton:   I will give you the scores (1.10) you are in my.
07 Saul:                                              =[Unless I pass.]
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In this episode, my unconscious pauses in my speech pattern in turns 01, 04 and 06 created structural resonances that mediated students' agency that is, their disposition to act within the encounter. As I began to speak in turn 01, I unconsciously produced a long pause of (0.91) after the word "so" followed by a medium pause of (0.64) and two brief pauses of (0.21) and (0.19). These pauses within my speech pattern provided the cogen participants of my intent for the cogen session to distribute and discuss their performance on the official practice test. Often in social life we are unaware of how the ways in which we speak, that is, our prosodic expressions become resources for others to construct knowledge of the intent of an encounter. As such, Saul and Cathy were able to use my speech pattern with regards to pauses and pitch to co/construct knowledge that they did not perform well on the test.

The pauses in my speech pattern were not intended to make Cathy and Saul feel sad about their performance on the test but were being utilized as a means to repair my utterances. Wolff-Michael Roth (2005) states that the concept of repair refers to the systematic measures undertaken to deal with various forms of trouble as the encounter unfolds. Accordingly, as I was speaking my thoughts of the situation at hand was unfolding as I attempted to find the right words to explain to the cogen participants my perspectives of their performance on the test. Long pauses within an encounter signify the process of thinking that changes during speaking given the current structure of encounter. As such, this episode provides evidence that encounters do not occur in isolation but are

mediated by the encounters that came before, during and those that come after. Students' perceptions of their performance on the test, my agency and body language during the cogen structured the encounter, which produce an unsuccessful interaction. The cogen participants' access and appropriated these resources to produce or reproduce different or unexpected responsive attitudes to the unfolding encounter in which an asynchronous encounter began to unfold. Asynchronous encounters are associated with differences in speakers' pitch, long pauses at turns at talk, breaking eye contact, holding one head down, frowning, which produces negative emotional energy. This was evident in Saul's response and body orientation in turn 07 in which he stated "Unless I pass" in which he began to hold his head down breaking eye contact with me as he co/constructed knowledge of his test score and the intent of the encounter.

Pauses in face-to-face encounters are resources that allow individuals to produce, reproduce, and transform their interactions with others in and through conversations, which is mediated by their emotions. In social life human beings have the ability to tune in to others gestures and emotions, which can produce asynchronous practices producing negative emotions that causes breaches in the flow of the encounter. As a result, the rate of my speech, length of pauses, pitch and intensity created schematic structures, which led to Saul's actions in which it seems he did not want to participate as he indicated "Unless I passed." Thus, our social relations in the encounter was being produce and reproduce in and through our interaction in which we negotiated and contested the structure of the field; a product of the encounter.

Laughter and its Role in Repairing Encounters

Roth (2005) states that the outcome of face-to face encounters cannot be predicted because the participants involve enact agency in unique ways to change the direction of the encounter at anytime. Because of the altered state of the cogen, Cathy appropriates her turn at talk and used her agency, that is, her power to access resources within the encounter for instance, laughter and humor to change the structure of the encounter. At this time, the encounter was being dominated by Saul's emotions in which the distribution of failing grades was creating a hostile encounter within the cogen.

Episode 2

08 Wharton: ((Laugh))

09 Cathy: You pass it. You done know you pass it. ((Smiling and giggling))

10 Saul: No. If I don't pass it I don't want to hear nothing. (See Figure 4.1)

11 Wharton: The thing about this.

12 Saul: ((Big Laughter)) Ms. Wharton, give it to me. How much?

13 Wharton: Ok, so.

14 Saul: Did I pass Ms. Wharton?

15 Wharton: You passed the midterm.

16 Cathy: 370. Me fail it. ((Looking at her test))

17 Wharton: =[And you also pass the midterm.]

18 Cathy: It's fail

19 Wharton: =[You pass midterm grades but, if you look at your scores.]

20 Saul: Did I pass the test?

21 Carmen: Yes, you pass it 75, which is 400 and something. ((with humor))

22 Wharton: ((Laugh)) Let me see. 4 or 5.

23 Saul: I am not even looking. (See Figure 4.2)

24 Wharton: No, 360. You needed a 410.

Fig 4.1: Turn 10 – I don't want to hear nothing. ((Saul is looking down))

Fig 4.2: Turn 23 – I am not even looking. ((Saul is looking up))

In this episode, Cathy's agency directly impacted the structure of the cogen and affected the agency of others especially Saul producing a positive valence encounter. The social and symbolic capital that Cathy has built with Saul and me allowed her to use humor and laughter to consciously restructure the encounter. Cathy's agency was evident in turn 09 when she made fun of Saul in which she stated, "You pass it. You done know you pass it" even though it was evident that Saul was not in a playful mood given his body orientation and pitch. In turn 10, Saul comments, "If I don't pass it I don't want to hear nothing" in which his head was down and his hand was positioned over his brow while Cathy and I were smiling and our heads were upright (Figure 4.1). In this moment it was evident that Saul's body orientation and speech pattern are asynchronous with Cathy and mines. However, Cathy did not let Saul comments discourage her and again used humor in turn 21 in which she stated, "Yes, you pass it 75, which is 400 and something." At this time Saul's body orientation has changed as well as his emotional energy in which he was looking up and we were all looking at each other even though he stated "I am not even looking" (turn 23) as he refers to his test grade.

Humor and laughter became resources within the encounter that structured the agency of others and their participation in cogen. Gale Seiler (2002) argues that all individuals have agency in which they have the ability to change their own lives or exert control over a situation. As such, the emergence of laughter and humor across turns 08, 09, 12, 21 and 22 by Cathy, Saul and me created resources that were appropriated to disrupt hostility in the prior encounter leading up to turn 08. Christina Siry (2009) theorizes laughter as an individual act and a collective practice that has the ability to create social bonds, complete a communal experience, and contradict the current structure to create new possibilities. Hence, as we laugh at the immediate situation, others, as well as ourselves we define our agency. This was evident in Saul's case when he produced a big heartfelt laughter in turn 12 and stated, "Ms. Wharton, give it to me. How much?" in which he became aware of his agency and did not have to be the unhappy cogen participant but actively coparticipated in the encounter that was unfolding.

As joyful participants in the carnival of schooling a new encounter was created by means of laughter and humor. This permitted us to see beyond and through the guarded filters of daily life to construct a new understanding of the purpose of the encounter. Laughter became a universal resource that could be accessed in a variety of ways evident in episode 2 to restructure the cogen. Mikhail Bakhtin's writings on laughter suggest that through laughter we are able to view social life in a different light, which allows us not to take life or ourselves seriously, become obsessed with grades, and lose sight of emerging possibilities to improve and enhance our learning of mathematics. The enactment of laughter in the cogen created the ability to demolish fear and permit the investigation of

the object at hand (the official practice test) and allow learning to occur. The playful mood and the moments of laughter created positive emotions that canceled out the negative emotions and promoted a successful encounter. This provides evidence of synchrony, which is the coherence of the participants' practices in the encounter (Tobin, 2005). Synchrony is associated with eye contact, head movements, body orientation, smiles and positive facial expressions.

Laughter and humor within the cogen illustrated that the social bonds established by the cogen participants created a relationship based on respect and trust, which produced positive emotions. Emotions can control, maintain, or change mutual focus and as such reorient the structure of the encounter. Thus, we were able to repair and reorient the encounter to continue with the difficult conversation at hand that is, enhancing our understandings of the errors students incurred on the practice test. As the cogen proceeded we continued to laugh at the situation and ourselves evident in episode 3.

Rhythmic Patterns: A Form of Solidarity

After the encounter was reoriented we began to look at where Saul incurred errors on the official practice test. As Saul reviewed his test he was amaze of the simple mistakes he incurred on the test given his comments of "Oh shoot" and "I get that wrong!" This episode focuses on Saul and Cathy working together to understand why he had gotten this particular question wrong.

Episode 3

01	Wharton:	Look at number 5. Read it aloud.
02	Saul:	Okay the night before Tom. I get that wrong!
03	Wharton:	Yes, you did?

04	Cathy:	((Giggling))
05	Wharton:	((Laughing))
06	Cathy:	He can't believe he get it wrong. [inaudible]
07	Saul:	((stiupsin)) Okay, he went to bed at 9:15 P.M. He arose 4:45 A.M. 9:15, 10:15, 11:15, 12:15, 1:15, 2:15, 3:15, 4:15 that's seven hours and 30 minutes.
10	Cathy:	=[that's seven hours.]
11	Saul:	That's 7.5 what did I do?
12	Wharton:	Ahmmm Saul you told me the answer was D.
13	Saul:	Shoot no.
14	Cathy:	=[inaudible]
15	Wharton:	Okay Saul.
16	Saul:	I feel much better now.
17	Wharton:	Okay, so that's that's 13
18	Saul:	[inaudible]…I made stupid mistakes.

Episode 3 illustrated the mathematical procedure Saul used to solve question five. It was evident from the transcript that Saul was annoyed at himself because he stated, "I get that wrong" in turn 02 followed by a stiups in turn 07. Stiupsin is a sound made by clenching your teeth together followed by a sharp sucking motion. It is a cultural act done by West Indian nationals when they are annoyed with another, a situation or themselves. As Saul continued to read the problem, he and Cathy solved the problem together. Saul counted the time in one-hour increments from 9:15 P.M. to 4:15 A.M. and indicated the time elapsed was seven hours and then mentally calculated the remaining time from 4:15 A.M. to 4: 45 A.M. as thirty minutes. Saul indicated that the answer was 7.5 by converting time into a numerical number. Saul was dumbfounded by his answer choice on the test but remained in high spirits in which he indicated in turn 16 "I feel much better now" as he understands that he made a simple mistake that resulted in the grade he obtained on the test. However, as I listened to Saul solve the problem it became apparent where he may have incurred the error that lead to his incorrect answer choice of D. In

turn 07, Saul started to count from 9:15 P.M. rather than from 10:15 P.M., which may have influenced his answer choice because he included an additional hour.

Figure 4.3: Cathy counts along with Saul using her fingers.

This episode provides evidence that the encounter between Saul, Cathy and me were synchronous and indicative of solidarity. Synchrony denotes alignment of a successful encounter. For instance, as Saul solved the problem the rhythmic pattern of his speech as he counted the time was reproduced by the body gestures of Cathy as she counted along with Saul using her fingers (Figure 4.3). According to Wolff-Michael Roth and Kenneth Tobin (2009), these types of rhythmic patterns convey synchrony that is, the coherence of all participants' practices illustrating alignment and solidarity within the encounter. As a result, the encounter produced chains of successful interactions that connected and build on each other—entrainment. Entrainment generates and maintains the production and reproduction of mutual focus and positive emotional energy when solidarity is present within an encounter (Roth & Tobin, 2009). Solidarity is a form of cultural capital that grew from our social networks through cogen producing positive

emotions (Tobin, 2005) within the encounter even though Saul was shocked he had gotten such a simple mathematical problem wrong.

A View of Students' Mathematical Knowledge

The official practice test featured a fraction problem in which 81% of the students were unable to solve this problem correctly. Many adult learners have a built in fear of fractions because it is a concept they have not mastered due to its abstract nature. For example, many students fail to realize that between any two fractions there are infinitely many numbers indicating that the counting principle of fractions differs significantly from that of natural numbers (Stafylidou & Vosniadou, 2004). Saul was the only cogen participant to correctly solve this problem. Accordingly, he stepped into the role of coteacher to help Cathy solve this problem.

Episode 4

01	Saul:	What you have to do Cathy?
02	Cathy:	Add.
03	Saul:	What you have to do? Find.
04	Cathy	=[Count them differently, the difference].
05	Saul:	No, no, listen this is 3/8, 7/16.
06	Cathy:	So this would be 4 over.
07	Saul:	Hold on. How much more is this? How many, how many sixteenth in 3/8.
08	Cathy:	Two.
09	Saul:	No, for every eighth you have two sixteenth.
10	Cathy:	Yeah, you have two for this.
11	Saul:	For every eighth you have two sixteenth. For every sixteenth you have two thirty-second. You don't get it. If I had a ruler I would show you. Okay like me know how to read a tape measure like a [inaudible].
12	Wharton:	oh so you were using it like a tape measure.
13	Saul:	Well, I just find the difference between 3/8 and 7/16.
14	Cathy:	[inaudible] I could use it in [inaudible]
15	Saul:	=[and find 1/16 difference. It was in 1/16 increment.]

16	Wharton:	hmmmmmm
17	Saul:	and from 7/16.
18	Cathy:	=[yeah.]
19	Saul:	and it was 1/16 increment so I just [inaudible] take ½ and the 1/16.
20	Wharton:	Another way.
21	Cathy:	so you added them.

As a coteacher, Saul probed Cathy's understanding of the problem by asking her what must she do to solve the problem. Roth (2006) refers to this concept as formulating; a method used in face-to-face encounters in which one participant co-articulate what strategies they would use to solve an intended problem and the other participant tries to understand their intended method. As Cathy articulated her thoughts on solving the problem Saul tried to make sense of her strategy. In turn 04 Cathy stated, "Count them differently; the difference" in which Saul did not understand her answer. He rephrased his question by asking her "How many sixteenth are in 3/8?" (turn 07) in which Cathy replied "Two" (turn 08). Saul could not make sense of Cathy's method and decided to explain to her that for every eighth you have two sixteenth in which Cathy replied, "Yeah, you have two for this." Saul continued to explain to Cathy that "For every eighth you have two sixteenth. For every sixteenth you have two thirty-second. You don't get it. If I had a ruler I would show you."

This episode illustrates two students conflicting mathematical knowledge with regards to how their experiences and background served as resources for learning mathematics. In turns 08 and 10 Cathy formulated her answer of "two" in which she understood that the lowest common denominator was sixteen and to change 3/8 to a sixteenth she must multiply the entire fraction by two. Hence, Cathy was using the mathematician mathematics. However, Saul misunderstands Cathy's method because his

method revolved around his knowledge of construction, carpentry and repairs. Saul's experience and understanding of the question featured on the official practice test was based on and mediated by his social experience as a contractor when he lived in Canada— what Alfred Schutz referred to as "stocks of knowledge at hand."

The conversation between Saul and Cathy is a rich mathematical dialogue illustrating how these students solved the same problem by means of two different mathematical approaches. Saul used his stocks of knowledge at hand of being a contractor in which he stated, "If I had a ruler I would show you" while Cathy used the mathematician mathematics of finding the lowest common denominator. Both students used their stocks of knowledge at hand to justify their immediate understanding of the problem although they could not understand each other's method. However, Saul was able to adjust his approach by appropriating different stocks of knowledge, that is, the mathematician mathematics to explain to Cathy and me how he solved the problem by finding the difference between the two fraction, which was increasing by one sixteenth and add this to the half to find the missing value, which Cathy understood.

Data Analysis: A Problematic Content Area

In the Principles and Standards for School Mathematics (2000), the National Council of Teachers of Mathematics (NCTM) state that data analysis and statistics are content areas students need to be proficient in order to reason statistically and be informed citizens and intelligent consumers of products and goods. Accordingly, graphical representations can be considered a social practice given its prevalence in today's society. Newspapers, magazines and television display information in the form of tables, charts, line, bar, or circle graphs to consumers on a daily basis. Yet, as educators

we assume that individuals are able to read and interpret these graphical representations. The data analysis questions featured on the official practice posed some difficulties for the students in the class and the cogen participants. Cathy, Janice and Saul experienced the most difficulties with the concept of line graphs whereas Jacinth was the only cogen participant who did well in this content area.

The students were given a diagram that featured two line graphs that intersect and were asked three distinct questions about the graphical representation. One question that was challenging for the cogen participants asked them to identify at which point on the x-axis did the two lines shown in the graphical representation had the same value. Cathy, Janice, and Saul got this question incorrect and I was curious to find out how they interpreted the problem because they all chose the same answer choice.

Episode 6

01	Wharton:	Where in the graph?
02	Saul:	=[intersects here.]
03	Wharton:	Right, where it intersects. So, you just have to come down. But, you are in the middle. You are in the middle between 80 and 120. Which one would you use?
04	Saul:	80. No.
05:	Cathy:	ahhmm 90
06	Saul:	100
07	Wharton:	100, very good.
08	Saul:	Oh shoot.

This episode provides a glimpse into how Saul and Cathy read and interpret line graphs. It was evident that Saul was able to identify the point on the graph where the two lines had the same value. However, when he had to locate the corresponding x-axis value

it was apparent, this is where he and Cathy had some difficulties. In turn 04, Saul indicated that the value of x was 80 but quickly realized that his answer was incorrect because the intersection of the two lines fell between 80 and 120. Cathy interjected that the answer was 90, however, she did not examine the scale of the x-axis or look at the answer choices provided. Saul critically examined the x-axis and realized that the answer was 100 and understood where he made his mistake as he indicated, "Oh shoot" a term he frequently used when he notices his careless mistakes. It was apparent that Saul and Cathy made the same common mistake in which they did not understand how the measurement of the scale on the x-axis was defined given there were missing units. These students did not notice that the x-axis values were increasing by increments of 20 units.

In reviewing the data analysis questions that Saul and Cathy got incorrect it was apparent that they were unable to read, correctly extract and identify what information was needed to solve the intended problems. It is a well-stated fact that the GED considers the questions featured on their test reflect the lives of adult learners. However, Saul and Cathy could not solve some of the questions that utilized line graphs or charts that displayed information about real life situations. The difficulties students encountered with the graphical representations featured on the test could be attributed to the fact that these types of representations were not a central element of students' social and cultural capital. Adult learners do not use or analyze graphical representation in their everyday lives even though these artifacts are prevalent in today's society. Graphical representations do not exist in isolation but is mediated by students interpretation of what the graphs express about some aspect of the world and being familiar with the information being represented by the graph (Roth, Pozzer-Ardenghi & Han, 2005).

According to research conducted by Wolff-Michael Roth, Lilian Pozzer-ArdenGhi and Jae Young Han (2005) on critical graphicacy, students who where knowledgeable about reading graphs such as the scales, axis labels, legend, captions and the situation represented by the graphical representation were able to translate between the text (phenomena) and the graphs without incurring any difficulties solving these types of problems. Many adult learners do not posses these resources necessary to make sense of the graphing problems they are being asked to solve on the GED practice test, which accounts for the difficulties incurred.

The problems that Saul and Cathy encountered with the data analysis questions found on the official practice test are similar to those documented by the GED Testing Service in their analysis of three operational test forms. The GED Testing Service has indicated that graphs and charts were one of the content areas that test-takers incurred many difficulties on the test. Adults who took the GED test in 2003 and barely passed (410 standard score) and those who failed the official GED mathematics test lacked the ability to (1) read, interpret, and extract information from graphs and charts; (2) compare and contrast graphical information that represented different conditions; and (3) transition between texts and graphics (Florida GED Plus College Preparation program, 2006).

Looking Towards the Future

After reviewing the test Saul and Cathy acknowledged that the test was easy and they made careless mistakes as Saul continually stated throughout the cogen, “I made mistakes” and “I made a boo boo.” Saul and Cathy learned more within this cogen because they became aware of their unconscious mistakes such as not reading the questions carefully, misinterpreting questions and not judging the reasonableness of their

answers. Although the cogen was stressful in the beginning it prove to be beneficial to Saul and Cathy who left the session with positive emotions. They were able to identify and understand the structural constraints that affected their performance on the test, which in turn expanded their agency. According to Sonya Martin (2004) an increase of awareness removes determinism and reproduction affording a clearer understanding of the obstacles preventing students from meeting their goals and motives. I also came away from the experience with a better understanding of how students interpret the questions found on official practice test, how their culture mediates the procedures used to solve mathematics problem and what concepts needed revision such as analyzing multiple line graphs, reading charts, calculating time and percents. In the upcoming class I was able to sit with each student to discuss their GED standard score, show them where they incurred errors and create a list of mathematics concepts that needed to be reviewed before final.

Final Examination

On the final exam, which was an official GED practice test 50% of the students obtained passing score of 410 or better. This was a substantial improvement compared to midterm in which only 23% of the students passed. The minimum standard score was 340 and the maximum standard score was 690 (refer to Table 4.2). Cathy, Jacinth and Saul obtain a standard GED score of 410 and passed the other subject area, which secured their seat to take the official GED test. However, Janice was not successful in obtaining the minimum passing score. Janice obtained a standard GED score of 380, which was a great accomplishment when compared with her midterm score of 330. She decided to repeat GED mathematics in the fall semester and was nominated to take the official GED test.

Table 4.2: Final Examination

Raw Score	Standard Score	Percentage of Students
11	340	4%
12	350	8%
14	380	27%
15	400	12%
16	410	23%
17	440	4%
19	490	4%
20	510	8%
21	530	8%
24	690	4%

Cogen Participants Performance on the Official GED Mathematics Test

Saul and Cathy were among the 493,000 test-takers to obtain their GED credentials in 2008 while Janice and Jacinth were among the 189,000 who failed one or more parts of the test. Saul obtained a GED standard score of 520 and Cathy obtained a score of 450. Jacinth and Janice both obtain a standard GED score of 390 on the mathematics test. However, they have successfully passed the science, social studies,

language arts reading and writing tests. Janice has not given up but continues to work on her mathematics in which she uses the tutoring services offered at Downtown Center. She hopes to retest in three months. Jacinth is currently employed and will retest at a later date.

CHAPTER 5

Adult Learners' Perspectives on Mathematics Teaching and Learning in a GED Program: A Metalogue

The following metalogue is a conversation among four cogen participants featured in chapter three that is, Cathy, Jacinth, Saul and me regarding mathematics teaching and learning in a GED program. This interactive narrative presents an opportunity to reflect on what was learned in chapter three in which cogen afforded students the opportunity to evaluate, analyze, and interpret their mathematical knowledge in the form of sharing, coteaching, and helping each other understand ideas regarding problem solving in a collaborative setting. The unfolding narrative presents a public debate regarding specific issues on mathematics teaching and learning in a GED class, which afforded an opportunity to reanalyze chapter three. As such, a central focus of this metalogue is to learn more about ourselves as students and teachers of mathematics, the roles we embrace, and to reanalyze the data from the perspectives of the stakeholders.

In constructing the metalogue I sought theoretical guidance and methodological support from the works of Wolff-Michael Roth and Kenneth Tobin (2004). Roth and Tobin began their use of metalogues in the late 1990s as a means of 'ratcheting-up' the conversation of their prior work to gain an in depth understanding of the themes they unearth in their first analysis of the data set. As such, both scholars use of metalogues developed into a method of inquiry, which permits the reinterpretation, reflection, and discussion of prior data with immediate stakeholders who provide their perspectives on salient issues that emerged in the research.

My approach in constructing this metalogue differs slightly from the method undertaken by Roth and Tobin who have used this form of writing in numerous articles and book chapters. In essence, the metalogue was constructed in four stages given the data we were reflecting on was collected a year ago and the student cogen participants had since graduated and moved on with their lives. In the first stage, each of the student participants were given chapter three of the dissertation to read in which they made notes of concepts they did not understand such as theoretical frameworks as well as the interpretation of the transcribed cogen session in which they were central participants. Secondly, we met as a group to discuss and clarify any issues that arose from students' reading of chapter three. From our meeting, I developed questions based on salient issues that students found noteworthy of their reading and understanding of chapter three regarding how cogen improved the learning environment. In the third stage, I met with participants to obtain their perspectives on the questions developed from our discussion in which I video and audio taped participants' responses. In the final stage, I took on the task of formatting participants' responses in a concise and logical order.

The proceeding metalogue represents the voice of each participant as they speak from an emotional, intellectual, subjective, and intersubjective perspective regarding salient issues that emerged from their reading of chapter three, a central element of the ontological authenticity criteria. Ontological authenticity pertains to the stakeholders' interpretations of the data and analyses of the chapter. As such, the multiple voices of participants provided an additional layer of complexity to chapter three of the dissertation and afforded agency to the cogen participants through coauthorship (Edmin, 2007) as

they provided their perspectives and opinions regarding salient issues on mathematics teaching and learning.

The metalogue is divided into four sections representing themes that the research participants regard as relevant from their reading and understanding of chapter three. In the first section, Words and Actions of Mathematics Destruction/Indestructibility, we engaged in dialogue regarding our personal experiences with mathematics and how these experiences shape our interactions with mathematics today. In the second section, Essential Elements of Effective Schooling, we provide insights into our experiences at the Downtown Center and the essential features of the program that ensured a successful learning environment. In the third section, Difficulties with Word Problems, we revisit this contested area, which posed extreme difficulties for some students such as Jacinth. In this section the participants provide their own interpretation of the word problems encountered on assignments and the GED test. In the final section, Cogenerative Dialogues (cogen) in a GED Program, we reflect on our experiences with cogen as a pedagogical tool and the emergence of coteaching in cogen and the mathematics class.

Words and Actions of Mathematics Destruction/Indestructibility

Saul: My first bad experience in math was in 1962 when I was about seven years old. I was being taught sums referred to as arithmetic in the United States and Ms. Forbes was my teacher; she is deceased. I can't recall if it was my first day of school but Ms. Forbes placed some sums on the board and asked us to solve them. I had a new exercise book at the time and on the first page I wrote exactly what Ms. Forbes had placed on the board. When I took my book to Ms. Forbes' desk for her to mark or look over my work I remember her taking a red pen and making a big X in my book like she was going to play

tic-tac-toe. The force used to make the X tore the page in my book and I felt very embarrassed. As a child I never forgot that moment and it turned me off from arithmetic for a while. I never forgot that incident. I believe that incident had a psychological effect on my learning of math for a long time.

Jacinth: Math became my weak subject in eighth grade. I had a teacher Mr. G who was from Russia who I did not understand due to his accent. He could not even pronounce my name correctly. As a result, I cut class many days unless he was teaching charts and graphs. In class Mr. G never took the time to go over math problems with those students who did not understand. Similarly, another math teacher Mr. Williams also had an accent and I did not understand him either. His way of teaching was for us (students) to do the work, he puts it on the board, and just kept it moving. The bell would ring and we would leave. This was the routine everyday and honestly I never understood what was going on in class. I just got accustomed to going to class and sitting there looking at my friend's work. However, she passed the class and I did not because I copied her work. In another math class my teacher Ms. Bois gave me all the answers. Each time I told her I did not understand she would come over to my desk and instead of showing me the procedure she would do the entire question. At the end of the school year Ms. Bois passed me. I did not think it was right for her to pass me.

Cathy: I can't recall any bad experiences or any person who made me dislike math such as Saul and Jacinth. I had all good experiences in my math classes because I like math. At the Downtown Center I had great math teachers such as Mr. Luck, Ms. Wharton, Ms. Lee and Ms. Amos. However, it was Ms Amos who taught Business math in the Information Technology Processing (IPT) Program, which I enrolled in after

completing the GED program who made comments such as I am going too fast and that I wanted to teach the class because I knew the work. I felt embarrassed when she tried to shut me down because I knew my math. Ms. Amos didn't want the bright students to answer questions she posed. But that did not deter me from learning math. I simply moved from the front of the class to the back. But she did assign me the duty of class monitor. If I had to return to school to further my studies it would because of math. I love math.

Jacinth: From elementary to seventh grade I was doing well in math. I always passed even if it was the minimum passing grade. Eighth grade to high school was not a good experience but now I am more confident with my math skills. I even calculate how much change I should receive when I buy items in stores. Before I would just collect my money without counting or checking, which resulted in being cheated just because I did not care to check my change. Now I take the time. I closed myself off from math for so long but now I am opening up myself to topics such as algebra and word problems, which I found difficult. Now I am seeing math in a different light.

Saul: Over the years I have developed strategies to help me overcome the psychological damage that occurred during my primary years. When I entered any classroom I always try to pair with students who are weak in English but strong in math and develop a sort of buddy system based on my strengths and their weaknesses. This has allowed me to be successful in school.

Jacinth: In school I also tried to sit with the students who were strong in math but they would not allow me in their group because they knew I was weak and did not want

to help me. So, I stopped trying to understand and I did not want to do any math because I felt that I was not getting the help I needed.

Saul: My turning point in math came when I was 16 years old when I met Mr. Thomas who taught math and Mr. Rose who taught physics. Mr. Thomas was a wizard when it came to math and the things he taught me has helped me up to this day. When it comes to math teaching Mr. Thomas and Ms. Wharton can be placed in the same category of being good math teachers. They teach hands on and are able to explain math in a simple manner. They relate math to life and real world experiences that is how I understood. I can definitely say that my positive experiences in math came from Mr. Thomas and Ms. Wharton while Ms. Forbes was my only negative experience. But I believe that from any negative experience there must be a positive outcome. I would not change the experiences I had in math for anything. Overall my experiences were wonderful thanks to my many teachers.

Wharton: Each semester there is always one student who asks, "How you become so good at math Ms. Wharton?" which allows me to tell of my experience with mathematics. Many students have preconceived notions that I have a "gift" or "math gene" but I was actually not a good math student in high school. I barely passed my math test and final exams by obtaining the minimum-passing grade necessary for promotion. But like Saul, my turning point came in Fourth form when I was fourteen years old when my math teacher Mr. Roberts noticed that I was excelling in physics and chemistry but barely passing math. I recall sitting in his office discussing my marks (grades), as math is the foundation of physics and chemistry. Mr. Roberts was shocked when I told him I do not study, review or look over my math. My impression of math at that age was that you

did not need to study, which led to my poor scores. Mr. Roberts challenged me to study for my next test similarly to how I study for my physics test. For the upcoming math test I studied, practiced, did extra problems and was able to improve my math scores significantly. Practicing helped me to hone my skills and remember equations and procedures necessary to solve problems, which led to a love of math. Math became my new favorite subject as I got an adrenaline rush when I got the correct answer especially on challenging problems. Mr. Roberts was instrumental in changing my perception about math and providing the necessary support I needed. Claudia Henrion (1997) posits that women internal motivation to study mathematics is at times activated by teachers or family members. Mr. Roberts encouraged me to pursue mathematics because he believed that I could be a great math student such as my peers. After graduating from high school I was able to use many of the strategies I accumulated to be a successful math student at the university level and was encouraged by Professor Grinnel to pursue a master's degree in pure mathematics.

Mathematics is a critical component of my identity and sense of self as I have chosen a career as a mathematics educator to help students see the beauty of mathematics. The mathematics community describes the field of mathematics as an endless ocean with many discoveries that lie below the surface (Henrion, 1997). Accordingly, I want my students to see the elegance of mathematics rather than the repulsive image they have come to known due to prior experiences. As a result, I pay attention to the stories students retell of their prior math experience because this influences how I teach math. These stories whether positive or negative travel with students as they change learning environments highlighting students' changing identities

as math learners. Each learning environment has a direct affect on students' identity as they adopt new schema and practices associated with the structure of the field, which illustrates their growth and emergent praxis. This was evident with Cathy, Jacinth, and Saul whose math identities were mediated by their encounters within a specific field and the schematic resources that structured the teaching and learning environment. Thus, students' identities were constantly being produced, reproduced and transformed in classrooms and their lifeworlds with regards to place, time and the individual who was their teacher.

Essential Elements of Effective Schooling

Jacinth: When I first started at the Downtown Center I did not think I would have gotten this far in my education. The Downtown Center is the best school I have ever attended and I been to schools in all the five boroughs of New York City. Even though my time there was only 20 weeks it felt like I been there for years. I loved all my teachers because they were dedicated and helped me stay focused on my goals. At the Downtown Center teaching and learning was organized and there were resources in place that allowed students to achieve their respective goals. I never had to worry because I knew what was happening in every class during school hours. They were never any surprises.

Saul: I had a wonderful experience at the Downtown Center from the first day I enrolled to the last day when I graduated. It was evident from orientation that the faculty and staff care for the students in the program. These folks care about your learning experience and personal affairs. If they can help you in anyway they will in a professional manner. They go above and beyond their job description to assist students in the program. I cannot describe the helpfulness I received from my teachers and counselors like Ms.

Batson, Ms. Wharton, Ms Dickson, Ms Bourne and other folks who work at the school. These folks cared not only about my learning experience but my life experience. For instance, many years ago when I lived in Canada I dropped out of college after three months due to family issues and not a single person from that institution called to find out why I did not return. But at the Downtown Center these folks care and they would call you to find out why you were absent. They care about your learning and also your personal life. I had a blast at the Downtown Center it was fun.

Cathy: Unlike Saul and Jacinth I began in the Basic Literacy Program and had three semesters (30 weeks) at the Downtown Center in which I met and learned from a diverse pool of teachers. My first teacher was Mr. Luck. He was strict and jovial but you could not play around when it came to learning or your homework. He was an excellent mathematics teacher even though at times he made you cry or laugh. He taught the basic principles and understood the West Indian math methods. He would always insist that I was going too fast and wanted to run the class because I practiced constantly and finished a semester's worth of assignments before the due date. When I entered Pre-GED I heard about Ms. Wharton the young math teacher. She was a splendid mathematics teacher. I recall when she taught probability and I told her that I was not going to get this because I don't gamble. I thought I would never learn or understand this concept but Ms. Wharton insisted that I will learn and patiently worked with me until I understood. The way she taught mathematics was in depth and she creatively related each concept to students' real life experiences. Mr. Murad was a great English teacher he taught me how to write great essays even if the topic was very vague. I learned a great deal from the teachers at the Downtown Center and gained many new friends such as Saul, Jenny and Ruby who I

communicate with regularly. In all, the faculty and staff at the Downtown Center really cared for their students. If a teacher was absent there was always a substitute who was there to teach us. We never lost a class session due to unforeseen circumstances. If I had to choose a word to describe the Downtown Center it would be home due to the support students receive, care and the feeling of community.

Wharton: In their description of their learning experiences at the Downtown Center Cathy, Jacinth and Saul identified four components of caring in relation to education proposed by Nell Noddings (1996), which are modeling, dialogue, practice and confirmation. Saul commented on engaging in dialogue with folks at the Center with regards to absence, Cathy verified practice in which she engaged in critical thinking and enhancement of her academic skills, while Jacinth alluded to the element of confirmation with regards to feedback as her teachers helped her stay focused as she tried to achieve her goals. The Downtown Center provided students with the essential elements conducive for teaching and learning, which allowed students to achieve their goals. Each participant described an enthusiasm for attending and enhancing their knowledge at the Downtown Center, which led to their respect for teachers, a feeling of being supported and a motivation to enroll in other academic programs offered at the Downtown Center an indicator of modeling. Modeling indicates the growth of students as carers and care-fors evident by Cathy's choice to enroll in one of the Comprehensive Career Programs at the Downtown Center, that is, the Information Processing Technology Certificate program.

Caring and learning are inseparable and highly influence the quality of teaching and learning in an Adult Basic Education (ABE) Program. Adult learners bring their prior schooling experience, perceptions and emotions (positive and negative) to the ABE

program, which are critical determinants that influence if students will "buy in" to the institution and invest their time. It's always a challenge for ABE programs to prove to students that they will receive a different type of education than their prior experience in an educational setting. Accordingly, adult learners are always assessing the climate and usefulness of ABE programs before, during and after their enrollment. ABE programs have alarming dropout rates in which students often do not stay long enough to achieve their academic goals (Amstutz & Sheared, 2000). Retention is an ongoing problem that many ABE programs such as the Downtown Center are currently struggling with. Each semester we implement various strategies to retain our student population and truly try to help the students we are intended to serve.

Computer-Assisted Learning in GED Mathematics

Cathy: Working in the lab with the computer-assisted program was like studying with a good friend. It was a private math conversation where you just whisper your answer to the computer and no one knew if your answer was right or wrong. To me it was like playing a game in which the computer allowed us to keep trying until we got the right answer. I kept a notebook of all the work I did in the lab whether I got my math right or wrong. However, it was the concepts I did not understand that I practiced constantly until I mastered them. The computer lab provided extra time for us to practice the math we were currently learning in the teacher-led class each week. Ms. Lee our lab instructor was an excellent teacher and a nice lady. She went the extra mile to help us improve our math skills.

Wharton: I agree with Cathy that a major purpose of the computer-assisted class was to provide students with an additional three hours of instruction. Before this class

was added to the program students only received three hours of mathematics instruction, which was not enough to improve their math skills. Adult learners have many responsibilities such as careers and families, which may not afford them extra time to study and review what was learned in class. Many times students would mention they did not have the time to complete homework assignments or study for an upcoming test. The computer-assisted class solved many of these issues as it provided students with a classroom environment different from a traditional classroom in which students can complete homework, review, and most importantly have an instructor (Ms. Lee) present to help them with their math. Computer-assisted instruction afforded students ownership in learning of mathematics because they controlled the learning environment. Students had the freedom to work at their own pace, repeat lessons if they did not fully grasp the concept, and move to the next lesson when they felt ready and competent. From a sociocultural perspective computer-assisted instruction was an additional cultural resource such as a textbook that mediated how students learn and apply their mathematical knowledge.

The success of computer-assisted instruction in ABE programs depends on how students will interact with the program and the modification of the curriculum to fit the needs of the students it is intended to serve. Cogen was instrumental in establishing a learning environment that fit the needs of adult learners. The first cogen participants (debate squad) implemented successful strategies such as mini lessons, a progress report and pencil and paper assignments, which shaped and molded computer-assisted instruction to benefit themselves as well future adult learners by creating an equitable learning environment to meet their goals and motives.

Saul: The computer-assisted math class was a great addition to the GED program. I enjoyed working on the computer weekly and how the curriculum for the computer program was set up. It allowed us to be in step with what we were currently learning in math class in which we used prior knowledge from class to help reinforce our math skills. If you get an answer incorrect the computer showed you where you were going wrong in a step-by-step format illustrating why your answer was incorrect and which solution was the correct choice. I loved that it was hands on learning and we did not have the teacher at the board telling us to do this or that. We were able to work privately to improve our math skills in which we learned from our mistakes. Ms. Lee was also a great resource in the lab in which she came over to help you if you had issues with the computer or did not understand how the computer came up with their solution. Ms. Lee was always present in the lab to help and guide you in the right direction.

Jacinth: I loved the computer-assisted program because it helped me improve my math skills in addition to my confidence of doing math. If I got a problem incorrect the computer showed me step by step how to achieve the correct answer. It provided us with principles and procedures first followed by examples for us to practice before we took the lesson quiz. The computer allowed you to practice as long as you wanted before attempting quizzes or tests. I liked this feature of the program because I could hone my skills by practicing, which allowed me to do well on my test. Ms Lee helped me in the lab; she was nice and helped each student. She provided us with different approaches to solve math problems because at times I did not understand the methods used by the computer program. The computer was a great support mechanism for many students like myself who found math challenging at times.

Difficulties with Word Problems

Wharton: The GED claims that the questions featured on the test are rigorously reviewed and designed to be relevant to the lives of adult learners in a practical and realistic manner. The questions featured on the GED test are word problems that are related to the world of work, consumer situations, technology, and family experiences. Yet, students continually struggle with this area of mathematics, which assess students' abilities to apply mathematical principles and problem solving strategies while evaluating whether or not an answer choice is reasonable. Did you have an issue with the word problems encountered on class assignments and the official GED test? Did these questions represent your lived experiences? Have there been times that you did not relate to the word problems on class assignment and the GED test and what strategies did you use to arrive at the correct answer?

Saul: With regards to word problems I really did not have any problems or issues. Word problems represent one's lived experience as its part of one's daily living. Everything is mathematics and mathematics is everywhere you go. For instance, if you buy an item in a store and take it to the cashier mathematics is present. Mathematics is a universal subject wherever you are in the world. Your entire life encompasses mathematics. Hence, I used many of my prior experiences from my West Indian academic training in Jamaica and my life experiences to help me relate and solve many of the word problems I encountered in class, on assignments, and on the GED.

Jacinth: Word problems continue to be one of my biggest challenges in math. My problem arises when I am unsure of which operation comes first, next or what equation to use to solve a problem. But, I have come a long way since my early days thanks to Ms.

Wharton. The only problem I still struggle with is the last step of problem solving in which I must determine if my answer makes sense. I find this step difficult when I do not understand the wording in the problem. It is such cases that I have difficulties obtaining the correct answer, as I am not able to relate to the word problem. I am still weak in this section but I am working on it. But I have come a long way.

Cathy: At first I had difficulties with word problems such as the two-step problem. I would get confused about which operation goes first especially if multiplication and division were involved. However, I overcame that problem after Ms. Wharton taught the steps to successful problem solving in addition to providing the class with key words and phrases to help us identify which operation to use in solving word problems. I found that the essential element in solving word problems is reading and comprehending what the question is asking you to find. Word problems are usually related to real world situations and at times you may not need mathematics to solve them. I recall at midterm there was a question related to a scatter point graph that required students to identify the relationship between ducks and bushels of food. Saul and I got this problem incorrect but the correct answer was you would have more ducks if there were more food. This question did not need any mathematics to solve because it was common sense. However, I must confess there were times I did not relate to some of the word problems.

Saul: I agree that the word problems on the GED test are based on students' lived experience. In the classroom I used a lot of my prior math knowledge that I accumulated over the years to solve many math problems. The math knowledge I retained came from my many educational and life experiences in Jamaica and Canada. I can recall the math

principles and procedures I learned in primary and high school, a course I took after high school which introduced the concept of logarithms and advanced algebra, to the mathematics I learned in a maintenance repair program in which I had to build objects from the ground up whereby precision and accuracy were essential.

Initially when I started at the Downtown Center it took me a while to get into the swing of things because I was not in a formal classroom for approximately 20 years. However, my mathematics training came back to me after my teachers explained certain math procedures. Any problems or issues I had with math were addressed in the classroom and I kept practicing to hone and improve my math skills.

Jacinth: Before enrolling in the Downtown Center my prior experiences with math did not help me in the classroom. My past history with understanding math was incomplete. None of my prior teachers showed me any strategies or procedures that helped me or that I retained. So when I had to choose an answer or solve a problem the answer I arrived at was my only answer.

Cathy: At first I thought the mathematics on the GED was difficult. But it occurred to me one day when I was in the public library that the teachers in the United States simply used different mathematics terminology. For instance, in Jamaica we say LCM lowest common multiple but in the United States it is referred to as LCD lowest common denominator. Once I made the connection between the American mathematics terminologies and how I was taught mathematics in Jamaica, learning and understanding the GED mathematics became simple and much easier. I began to teach many of the students in the class, mainly those of West Indian descent who found the American

mathematics method difficult such as solving fractions. They began asking for my help, me, the weakest student in the class.

Jacinth: Students from the Caribbean learn math differently than students in the United States. I found that most of my friends who grew up in the Caribbean understood math better than I did. It was easier for them some how. At times I felt left out or cheated that I did not get that type of schooling in math. However, Ms Wharton made me appreciate math even though I did not like it at times. Having her, as my teacher was the best math experience I had at the Downtown Center.

Wharton: Cathy, Jacinth and Saul had different perspectives regarding the GED claim that the problems featured on the mathematics test represented students' lived experiences. It was evident that each student possessed different capital, which served as a resource to solve mathematics problems and choosing the correct answer choice. Saul and Cathy indicated that their academic preparation in the Caribbean was a great resource in solving the word problems they encountered on tests in addition to their life experiences. Jacinth, on the other hand, felt she did not have the same resources as these students because her academic preparation occurred in the United States and she did not have a positive experience learning mathematics. Hence, mesostructures such as age, prior academic preparation and lived experiences afforded success and failure when students solved word problems that represented the world of work, consumer situations, technology and family experiences.

Cogenerative Dialogues in a GED Program

Saul: Even though cogen was a new concept to me I decided to participate in the weekly meeting every Wednesday. It was a new experience and I enjoyed meeting every week to discuss the features of the classes that we liked or disliked. With cogen we were able to learn more and increase our mathematics skills because as a group we were able to discuss how we could solve math problems in a proper, better and easier method although we disagreed at times. However, at the end of the session we always came to a consensus because our goal was to improve the math class. We got ideas from each other and saw how we each took different approaches to solve certain math problems from the math class.

Jacinth: I like the cogen meetings each week because I learned about other participants' problems in math as I was overcoming my own problems. I enjoyed the discussion we had each week about math, our weaknesses, the midterm practice test we took, questions we got correct and incorrect and how we were able to overcome our math barriers, which was different for each person. Saul and Cathy were confident with their math skills and knew a little bit more than I did. They knew the procedures necessary to solve math problems, especially Saul who went out of his way to explain to me how I should go about solving certain math problems. They also provided me with a lot of support and the confidence that I could indeed learn math. I never had that kind of experience in high school where a group of kids would sit down and talk about math, a subject I find challenging. Cogen helped me a lot. It was helpful.

Saul: Cogen had a positive effect on the group itself because we were not in a classroom setting and we were able to express our concerns and fears about math if we

had any. For me, cogen helped improve my knowledge of math because when I went back to class the following day concepts, which I was unsure of started clicking and falling into place like a puzzle, everything came together as one. It was a wonderful feature of the class—us as a group getting together and discussing the classes. I would recommend cogen to be used in future classes and added to the curriculum.

Cathy: We were able to look back at previous math classes and examine how we learned and understood math. At times in class we get frustrated with math or the behavior of certain students and cogen help to improve the atmosphere of the class. Ms. Wharton always asked us questions in which we could relate our concerns and issues. For example, if there were a concept we did not understand in the next class session Ms. Wharton would teach the concept differently so that we had a clear idea or understanding of the concept.

We also got to know each other better with regards to our weaknesses and strengths. For instance, Janice would talk about her difficulties in math, as she was not afraid or embarrassed. I recall Saul helping Janice by showing her how he approached and solved math problems that she was having difficulties with. In addition, Jacinth commented about her difficulties and Saul advised her to practice her math to hone her skills. As a cogen participant I learned from my peers and them from me. We were not embarrassed or afraid to share our weaknesses or strengths.

Saul: If my peers were having difficulties I took it upon myself to try to explain the concept to the best of my ability in layman's terms that they could understand and grasp the concept better. In this process, I also improved my mathematics skills because I

could communicate my way of solving math problems in an efficient manner to my peers. This was beneficial to both parties the coteacher and the student I was helping whereby I learned by doing and the students learned by listening. We all learned from each other as this process was a two way street. I felt confident talking about my strategies and ways of enacting mathematics. As students we all have ideas and different methods of solving math problems in which we can share with our peers to help them be successful in math.

Jacinth: Saul was really helpful teaching other students the approaches he used to solve his math problems. He was one of the stronger math students in class as he learned Ms. Wharton's way and tailored it to his way of thinking. His method was different and faster and I understood at times. Elvis was terrible in class due to his behavior but I must give him credit he knew his math and also Karl. I would try to sit with them and let them help me with the math. At times we all had the same answer and I would be so happy because I was doing something right. Karl helped me more than Elvis. He explained math concepts in a simple manner that I could understand. These students were confident, which is why they taught the class on several occasions.

Cathy: Saul was brave to get up and teach the class in math and also English. Other students also taught the class such as Elvis who knew his math but misbehaved at times in class. I remember when Ms. Wharton gave a question in which we had to determine how many triangles were there in the figure. They were 10 but the way she explained it to the class we did not get it. But Elvis stood up, came up to the front of the class, took the chalk and explained it easily. After his explanation I understood where Ms. Wharton got the answer of 10 triangles. Tina, the Indian girl assisted us at times in

the computer-assisted class in addition to Julie from Trinidad, both girls were good in math. The students who went up and taught the class were brave and were learning in the process as they helped others. They increased their understandings and those they were helping also increased their knowledge.

Saul: Sometimes in class the teacher would be the only person talking and some students would not ask questions. However, I believe that in a classroom there should be dialogue in which the teacher and student converse with each other in an open forum. Students don't learn unless they speak up and ask the teacher questions about topics they don't understand. Students need to be brave, not feel embarrassed or intimidated and talk more in class. This will help improve their learning and understandings. Talking in class with my peers and the teacher helped me improve my skills not only in math but other academic subjects. I decided to step up and ask questions because I learned that you should ask questions even if you think it may be stupid or irrelevant.

Cathy: But Saul there were some students who never asked questions or tried to teach the class such as Corey and Andy. I felt these students lacked confidence and were ashamed because they did not know how to do the math. They did not want to embarrass themselves. Even though at times I got some of my problem wrong I always asked questions. I did not care. Similarly, Janice always asked questions if she did not understand and always wanted to go up to the board. She was brave and wanted to learn such as myself because I came to the Downtown Center to learn and earn my GED.

Wharton: Its great hearing such testimonies of the beneficence of cogen from student cogen participants. These testimonies addressed the educative, catalytic, and

tactical authenticity of this study due to validity of students' voices in cogen to restructure classroom practices. The educative authenticity criterion evaluates participants' understandings and appreciation of their peers' perspectives— a salient characteristic of cogen. Cogen privileged the voices of the student participants, allowing them to exchange methods and strategies of how to solve mathematics problems using the simplest methods possible. As such, each participant including me, learned from others' experiences with mathematics as well as from students who were not part of the research. Jacinth indicated that she worked with two students Elvis and Karl, who helped her understand the mathematics she was currently learning. In addition, Jacinth and Cathy found Ernest's behavior to be inappropriate at times but they looked beyond this negative attribute and considered him to be a resource to the class because he was a good math student. As indicated by both students Elvis was able to teach the class successfully on certain occasions. Educative authenticity was demonstrated by students' perspectives on the effects of cogen and the improvement of mathematics teaching and learning in a GED program. As such, educative authenticity is connected to the ontological authenticity criterion as it documents students' changing ontologies. The discussions each week regarding what students liked, disliked, cogenerated strategies and changes to the curriculum and mathematics classes were essential to the ontological authenticity criterion. Cogen was seen as a safe space for participants to talk about their shared experiences of the classroom such as their weaknesses, difficulties with mathematics and their approaches to solving specific problems. As a result, students expanded their agency as they embraced new roles such as coteaching, which produced positive changes both in cogen and the classroom. Cogen allowed students to take control of their learning of

mathematics as they assumed the role of teachers to plan, enact and implement curricula that support their learning needs—the heart of the tactical authenticity criterion. Tactical authenticity addresses how participants brought about positive changes in the classroom as they expanded their agency.

Metalogues: Understanding the Complexity of Mathematics and Schooling

The use of metalogues provided a deeper understanding of the complexities of teaching and learning of mathematics in a GED program from the perspectives of the stakeholders, that is, the student cogen participants. It served as a means of peer debriefing in which I became aware of students' identities as math learners, their beliefs of what is good teaching and learning in a GED program in addition to obtaining clarity on students' perceptions of the word problems featured in class assignments and the official GED test. Metalogues afforded the cogen participants agency to provide their opinions and perspectives on the research product rather than privileging the voice of the primary researcher (Edmin, 2007). As a result, the ontological, educative, catalytic, and tactical authenticities were addressed as a means of judging the research, which emerged organically.

Ontological authenticity criteria emerged early within the metalogue and in the section *Cogenerative dialogues (cogen) in a GED program* along with educative and tactical authenticity criteria. However, catalytic authenticity is woven in throughout the metalogue. Catalytic authenticity addresses how the cogen participants appropriated changes in their lifeworld due to their participation in cogen, which was evident from each participant's perspective. Cathy acknowledged that she did not let Ms. Amos's comments discourage her from continuing her studies in mathematics but decided to sit in

the back of the class rather than her preferred choice of sitting in the front. Jacinth indicated that she was opening up herself to learning and understanding math because of her participation in cogen while Saul advocated that cogen should be part of the GED curriculum due to his positive experience as a participant. Thus, the metalogue met all four criteria proposed by Guba and Lincoln, which indicated that the research was fair and trustworthy.

Metalogues in conjunction with cogen afforded the cogen participants and me with a powerful pedagogical and research tool that allowed us to learn from each other differences by actively listening to all perspectives, commenting on what was said, and adding more to the conversation (Tobin, 2010). Learning is a social activity in which teachers and students can acquire knowledge from their interactions with others which acknowledges, encourages and celebrate the multiple perspectives and ontologies that all participants bring to the learning environment (Siry & Alu-Khan, in press). Teaching and learning does not occur in isolation but through communication and the relationship we have with others. The insights gained from metalogues and cogen can help adult educators and students in ABE classrooms build successful encounters that afford new culture (schema and practices), identity, and solidarity (sense of belonging and affiliation) across boundaries of difference (Pitts, 2007).

CHAPTER 6

The Metamorphosis of Teacher and Students

During my career as a mathematics educator I naively believed that to successfully teach mathematics to urban students I needed a teaching portfolio constructed of mathematics content knowledge, an abundance of resources and materials, the ability to incorporate technology within my lessons, a variety of assessment and evaluation practices, and most importantly excellent classroom management skills. However, I came to realize that the teaching resources I accumulated throughout the years did not afford some of my students' academic achievement in mathematics. Some of my resources had a shelf life that is, a use by date, which was often ten weeks (a semester) and afforded limited educational gains. My teaching portfolio lack diversity, that is, the voices of my students as a means to improve and enhance curriculum and instructional practices within the classroom. I became aware of this facet in the fall 2007 semester after my GED mathematics class expressed their discontent with a computer-assisted class that was added to their program. My students' resentment to the curriculum I created together with their apprehension and frustrations of using computers to enhance their learning of mathematics was the catalyst that motivated me to enact changes within my teaching practices.

This dissertation chronicles my journey with cogenerative dialogues (cogen) for a period of a year in which my students and I engaged in critical discourse to identify practices that alienated them from learning mathematics and co/creating productive curriculum and instructional practices to improve the quality of teaching and learning within GED mathematics classes. Cogen became an additional pedagogical tool within

my teaching portfolio, improving my teaching practices with adult learners but most importantly affording students ownership in their education. This was important because they were the major stakeholders. Each cogen session provided participants with structures that allowed them to produce, reproduce, and transform culture (mathematics learning) for successful encounters in the classroom. As a result, teaching and learning of mathematics became a form of cultural enactment composed of schemas and practices (Tobin, 2005) that were responsive to the unfolding events that occurred within the mathematics classroom.

Cogen and its Impact on the Field of Adult Mathematics Education

This critical ethnography focuses on two cogen research squads; the debate squad (Lorna, Jasmine, and Joseph) and the spring squad (Cathy, Jacinth, Janice, and Saul) whose suggestions, perceptions and shared experiences within the classroom provide critical insight on how to better teach mathematics to adult learners. Cogen augmented the teaching and learning of mathematics in which it became a site to question the assumptions and perceptions put forth by administrators, faculty members and students. As a research group, we created an authentic environment that shaped the agency of students in different ways such as appropriating new roles within the classroom. For instance, for the spring research squad, cogen became a site for coteaching where participants gained agency and understanding as they appropriated the role of coteacher. The debate squad members appropriated roles of peer tutors to help their peers understand the mathematics they were currently learning. In all, the use of cogen in GED mathematics classrooms produce successful encounters in which difference provided a foundation to improve and enhance teaching and learning. Each participant was a

macrocosm with their own ideas, ways of knowing, learning, personal secrets, treasures and measures of success in mathematics.

There were many indicators of success documented in this research in which students and teachers exercise their agency in different ways, had a change of perspectives with regards to mathematics, teaching and learning, and most importantly their perseverance to obtain their GED credential even when they failed the GED mathematics test. Thus, success is not solely based on students grades or passing the GED mathematics test, but is illustrated by students' developmental shifts in attitudes (social and academic), roles appropriated in the classroom such as coteachers and peer tutors, and valuing the perspectives of others different from themselves with respect to age, gender, nationality, ethnicity and ways of enacting mathematics. These indicators of success provide evidence of students' growth as mathematics learners. In addition, my growth as urban mathematics educator was also highlighted within this research. As a participant in cogen I collaborated with students to plan and implement curriculum and instructional practices that improve and enhance how they learn mathematics as adult learners, altered the curriculum in the traditional mathematics class and the computer-assisted instructed class to remedy any contradictions that occurred during the semester, and recognized the beneficence of students' voices as a means of improving the quality of teaching and learning in a GED program.

My research on cogen in GED mathematics classroom have changed some of my colleagues perspectives of what constitute good teaching and learning. In the fall 2007 semester I presented my research findings to the GED faculty and administrators of the Downtown Center regarding the beneficial properties of engaging students in the

planning and implementation of curriculum and instructional practices in the computer-assisted instructed mathematics class. The cogenerated strategies implemented by the debate squad helped to retain many students within this non-traditional mathematics class even though some were apprehensive of using computers as a means to learn mathematics. As a result, all GED mathematics instructors at the Downtown Center utilize many of these support structures such as SkillsTutor, progress report and the associated curriculum developed by the cogen participants and me. Subsequently, I was afforded the opportunity to be part of two focus group meetings with GED faculty and administrators of the nine sister Centers to review the current structure of our GED program with regards to student enrollment, registration, and instructional service. In relation to instructional services we recommended affording students opportunities to coteach, peer-teach or team teach, implement student panels to provide insight of how to effectively teach adult learners, and create positive and equitable learning environments that fit the needs of all adult learners enrolled in GED classes similar to the findings depicted within this study.

Re-examining the Research Questions

In chapter 1 of this dissertation I presented three questions that guided this research. They were, (1) What support structures were implemented for successful mathematics teaching and learning in a GED classroom? (2) How do students reconstruct their identities as mathematics learners in a collaborative learning environment? (3) Did cogenerative dialogues transform the learning environment and the curriculum in a GED mathematics class? In the following section I will re-examine these questions and identify the strengths and limitations of this research and my future steps.

What Support Structures were Implemented for Successful Mathematics Teaching And Learning in a GED Classroom?

Cogen is collaborative research in that it is done with others rather than on others. In the case of the initial cogen participants (see chapter 2) we were able to cogenerate a variety of learning resources from students' self-reflections of how they learn and understand mathematics to improve how technology was incorporated in their mathematics class. Students implemented small tutoring groups called huddles for students who did not understand certain topics; mini-lessons at the beginning of the class to review mathematical principles, vocabulary, and procedures they would encounter in the computer-assisted program; paper and pencil assignments for students who did not want to use the computer-assisted program for the entire class period; SkillsTutor a web-based educational and tutoring program for students who wanted to improve their skills in specific mathematics concepts; and a weekly progress report that monitored student progress providing a holistic assessment of their mathematical ability rather than using only numerical grades. Despite the fact that these students were apprehensive about using computers to inform their learning of mathematics they used their prior academic experiences to co/create an equitable and productive learning environment that maximize the use of computer-assisted instructed programs to improve their learning of mathematics as well as for future GED classes. The collaborative nature of cogen contributes to the ontological authenticity of this research based on the multiple perspectives of the participants.

How do Students Reconstruct their Identities as Mathematics Learners in a Collaborative Learning Environment?

Students' identities as mathematics learners are based on their interactions with the subject and the learning environment. As a result, students' identities are in a state of flux, that is, dynamically changing given the structure of the field. As students' access and appropriate resources they expand their agency and reconstruct their identity to meet their goals and motives. For instance, in chapter five Saul talks about his experiences in mathematics in which he reflects on the incident with Ms. Forbes his elementary school teacher. It was evident this incident had a psychological effect on Saul's learning of mathematics. As a result, Saul adopted strategies such as buddy systems in order to learn mathematics and be successful in school. In addition, Saul credits Mr. Thomas, Mr. Rose (high school) and me (GED program) in changing his beliefs and perspectives about mathematics. He indicated that it was our particular methods of teaching mathematics, which was hands on and relating mathematics to students' lived experiences that influenced how he learned mathematics. Saul experiences (positive and negative) in addition to supportive teachers were instrumental in shaping his mathematics identity as a successful student. Saul's identity is a reflection of his agency and the appropriation of new schema and practices, which allowed him to build and rebuild his identity illustrating his growth and emergent praxis.

Similarly, Jacinth described her struggles with mathematics, which began in the eighth grade. Jacinth gave up on learning mathematics because she did not receive the necessary support from teachers or some of her peers. However, Jacinth credits cogen for changing her perspectives and attitudes about mathematics and wished she had this form

of support in high school. Jacinth indicated that the cogen participants provided her with support and the confidence that she could learn mathematics. For instance, Saul taught her the methods he used to solve his math problems and Janice identified with many of Jacinth's difficulties. As Jacinth became more receptive towards mathematics she exercised her agency to form a buddy system with Karl and Elvis, two successful mathematics students even though she had a negative experience implementing a similar system in high school. Today, Jacinth is opening up herself more to mathematics as she counts her change when she buys items from the store and tackles topics she finds difficult such as algebra and word problems. Jacinth's negative experiences in high school influenced how she positioned herself in the mathematics classroom. Despite these negative experiences, Jacinth was able to reconstruct her identity as she exercised her agency, achieve success in mathematics and form social networks with her peers.

Saul and Jacinth's diverse experiences with mathematics provided excellent examples of how adult learners negotiate their identities as mathematics learners on a daily basis. Students' identities are mediated by their social interactions, prior experiences and external factors such as teachers, peers, and traumatic experiences, which influence how they learn and interact with mathematics. As result, identity is a product and by-product of students' activities with mathematics and the structure of the field. Identity is a personal and social construct and is the lens that we use to view ourselves as learners and individuals.

Did Cogenerative Dialogues Transform the Learning Environment and the Curriculum in a GED Mathematics Class?

According to Kenneth Tobin and Wolff-Michael Roth (2006) cogen centers around the social aspects of teaching and learning. The co in cogen embodies the collective and collaborative nature of a social activity in which informal teaching and learning of mathematics occur. For students and me, cogen became a safe space, away from the classroom environment, to engage in dialogue regarding issues we were having with mathematics, student behavior, achievement, as well as becoming aware of the ways we were similar but yet different with regards to mathematics and social life. Chapter three provides many examples of students' comfort in cogen in which they courageously discussed their difficulties and success with mathematics. Examples include Jacinth's first turn at talk in the vignette to discuss her difficulties with solving multi-step word problems. This resonated with Janice by her interjection of "yeah" indicating agreement and shared interest of Jacinth's perspective with word problems. Students were also receptive to their peers' ways of approaching and enacting mathematics evident by their attentiveness when Saul explained how he learned and produced mathematics, which provided mutual focus and new knowledge for the participants. Cogen sessions were imbued with positive energy such as laughter, empathy for others, sharing of experiences, and new ways of interacting with others and mathematics— a subject some participants found difficult to understand and learn. Thus, the cogen participants constructed a better understanding of how they learn mathematics and essentially became advocates for each other as they communicated, collaborated, coteach, and implement structural changes to curriculum and instructional practices.

As a participant in cogen I obtained an insider view of students' difficulties with problem solving, the curriculum, and the structure of the technology-enhanced mathematics class. The constructive feedback I received each week concerning structures that truncated student agency, participation, and their learning of mathematics helped me to improve and enhance my teaching practices with adult learners. For example, after I became aware of Jacinth and Janice's difficulties with word problems (see chapter 3) I immediately made changes to the curriculum by placing a greater emphasis on problem solving in both classes (traditional and computer-assisted) to rectify this contradiction. In addition, cogen afforded an opportunity to understand how students access, appropriate and realign the resources available for successful teaching and learning of mathematics such as how Saul modified my mathematics procedures to fit his personal style of learning mathematics. In chapter two, I abandoned the ways students were assessed in the computer-assisted mathematics class and provided them with a holistic approach to assessment that was not solely based on numerical grades but on their developmental shifts in attitude, motivation, comprehension, confidence, and other academic activities. Had I not been willing to implement cogen I would not have had the opportunity to engage in critical dialogue with my students and discover new actualities regarding adult learners and mathematics.

The role of cogen as a pedagogical tool informed how I taught mathematics to urban students because it forced me to examine my assumptions, perceptions, and the methods I used to teach mathematics. I am now a collaborator and co/learner with my students rather than the authoritarian teacher who appropriated the institution's rules to assert my identity over students. For students, the impact of cogen was remarkable

because it changed their perceptions regarding mathematics teaching and learning. In chapter five, Jacinth acknowledged that she now sees math in a different light, Joseph indicated in chapter two that his mathematics skills had improved and he was not apprehensive in using computer-assisted programs to inform his learning of mathematics while Lorna indicated that she now enjoys geometry a content area she previously disliked, testaments to our transformations. These testimonies address the catalytic authenticity of this research, which are woven throughout this document in which participants appropriated changes in their lifeworlds due to their participation in cogen.

Cogen was an emancipatory practice for students, providing them with a sense of ownership in their education as they examined their learning experience, evaluated it, and recreated it to meet their respective goals. As active coparticipants in the restructuring of the curriculum and the learning environment students exhibited an increase in their agency as they appropriated new roles. For example in chapter three, Saul appropriated the role of coteacher to explain to the group his strategies for learning and enacting mathematics. In chapter two, cogen participants as well as their peers took on leadership roles such as peer tutors to help students who were struggling with certain mathematics concepts. The appropriation of new roles by students altered the traditional format of classroom practices of the singular teacher to one of multiple teachers. Each research squad illustrated that agency assumes various forms and was employed differently with regards to the individual and class (Wassell, 2004). Cogen afforded students the ability to appropriate new and existing culture to become successful mathematics students and teachers. A classroom community built on trust, respect, fairness, honesty and collective

responsibility among students, the lab instructor and me was established in which there were minimal acts of resistance towards the learning environment.

Strengths and Limitations of this Research

Although this study provided insights on how cogen enhanced the quality of curriculum and instruction within an urban GED program there were limitations. One limitation that emerged from the research was the minimal engagement of younger students (18-24 years) in cogen. Some of these students had excellent mathematics and technology skills such as Jerry (fall 2007) and Karl (spring 2008) yet their voices were absent in the restructuring of curriculum and instruction practices. I always wondered what additional resources could have been implemented to enhance the learning experiences of these high achieving students enrolled in GED mathematics. Another limitation that emerged was the lack of participation of male students in cogen. Both cogen research groups had a single male participant who was a mature adult. The perspectives and suggestions of a diverse population of males in cogen with respect to age, ethnicity, race, nationality, and academic preparation would have provided insights on how to better serve this population of learners who may have experienced social and academic discrimination in their prior schooling. The limitations posed here continue the conversation of how cogen could be used to improve the quality of education for underrepresented male students in GED programs and new immigrants who are enrolling within GED programs to earn their alternative high school credential in order to pursue higher education.

GED 20/20

In October of 2009, the GED Testing Service announced the cancelation of the GED 2012 test and the development of a more rigorous test that would prepare students for postsecondary education and careers that provide a sustainable living. From this statement it is evident that the new test will be more challenging than the current test (2002 series), which continues to challenge many adult learners. However, a greater opportunity now exists for more research in the area of Adult Basic Education with regards to effective instructional practice for GED preparation especially in the area of mathematics, as this will be the subject that presents the most difficulty for students. The GED community of educators, administrators, and institutions will be looking for current research in the field of adult mathematics education to ensure academic success for their students when the GED 20/20 test is introduced.

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