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19. LEARNING ABOUT AND FROM COGENERATIVE DIALOGUES: THE INITIAL STAGES

Abstract I document how cogenerative dialogue became an effective pedagogical tool to intercept the challenges students, the lab instructor and I encountered when a computer-assisted mathematics class was introduced within the General Educational Development program. The interpretive frameworks of cultural sociology, sociology of emotions, phenomenology, personal narratives and the transcript of a cogenerative dialogue session were used to examine the challenges and beneficence of computer-assisted learning. The use of cogenerative dialogue provides important insights regarding how educators in Adult Basic Education programs can improve the teaching and learning of mathematics in a technology-enhanced classroom when students are afforded opportunities to critique, co/plan and implement a new curriculum that aligns with how they learn mathematics as adults.

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, and Ross 2008). In ABE classrooms computers are used to deliver and improve instruction in the subject areas of mathematics, social studies, science, reading, writing, and workforce readiness similar to K-12 schools. Research reveals that computers have the potential to improve student proficiency in academic subjects such as mathematics, a subject in which students have exhibited poor academic performance (Ozel, Yetkiner, and 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 mediate how students are taught, learn, and enact mathematics in the classroom. Research indicates that technology enriches students' mathematical experiences providing students with ownership over 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.

K. Tobin et al., (Eds.), Transforming Urban Education, 321–340.

In this chapter I focus on the challenges faced by my General Educational Development (GED) mathematics class when a computer-assisted class was incorporated in the GED program to improve the learning of mathematics. The voices of my entire GED mathematics class, lab instructor, cogenerative dialogue (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 generated 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. In this chapter I outline a framework of how ABE programs can integrate computer-assisted learning 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 understanding of academic subjects. For instance, at the Downtown Center, 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 social studies, science, mathematics, writing, and reading the subject areas tested on the GED examination. 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 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 a 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, and Rouse 2008).

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 and Elias 1998). Students use a variety of skills 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. I assumed students' could use computer software to improve their mathematics process skills, had enthusiasm for learning mathematics in a non-traditional classroom, and could produce the wherewithal to combine knowledge from a teacher-led and computer-assisted class to achieve fluency in mathematics. These assumptions led to conflicts and contradictions for my students and me.

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 and were apprehensive about using computers to inform their understandings 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. Thus, the mature adults did not view computer-assisted learning as a tool to enhance their learning of mathematics, as it did not reflect their notion of teaching, learning, or their image of a traditional mathematics classroom. It was evident that these students were accustomed to traditional methods associated with teaching and learning in which the instructor lectures, provides course materials, students listen, take notes, and complete classroom and homework assignments. Jasmine, a mature-aged student within the class stated that she was accustomed "to doing stuff from the book … I [Jasmine] am from the old school." The mature-aged adults were socialized to value a teacher-centered approach to teaching and learning, probably based on their prior educational experiences. To these students computer-assisted learning was a foreign instructional tool, which explains the uncertainty students felt utilizing this tool to improve their fluency in mathematics.

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. Several surveys indicated that more than one half of young adults spend 9 hours a week on Internet activities (Owston 2009). These students represented a generation who used 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 he was satisfied with the current structure of the class. He felt at ease with computer-assisted instruction and favored this form of teaching and learning due to his age and mathematics ability. From his coursework it was evident that he was more advanced and knowledgeable in mathematics than the older adults. Yet, he 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 experienced by the mature adult learners were more projected towards the computers, Sara (lab instructor), and me (primary instructor), originating from students' unfulfilled expectations of teaching, learning, and understanding mathematics in a non-traditional manner. Jonathan Turner (2002) emphasized that expectations are the essential element within any encounter. When students enter classrooms they hold within their schemas (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 met, leading to the display of first order negative emotions such as anger, fear, and sadness.

Students' extreme anger, anxiety, and disapproval indicated that the computer-assisted mathematics class was not a productive learning environment but a site for struggle and resistance. Three weeks into the semester I learnt about the challenges my students endured in the computer-assisted class. Students 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 considered not attending class. It was apparent there were numerous issues regarding how computer-assisted programs were being used for educational purposes within this GED class. To resolve the conflicts and contradictions that emerged within the class I implemented cogen to bring students and teachers together to discuss the social dynamics of the computer-assisted class. My aim was to provide students with an equitable and productive learning environment that maximized the effectiveness of computer-assisted instruction, and to improve the learning of mathematics. However, from a curriculum and instruction viewpoint, in this chapter I endeavor to provide ABE instructors with some of the best practices for technology integration within their classrooms based on the perspectives of adult learners.

COGEN AND THEIR APPLICABILITY TO ABE

Donna Amstutz and Vanessa Sheared (2000) argue that curriculum and instruction in most ABE programs is teacher controlled and directed, rather than collaboratively planned with students. 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. This model of teaching and learning is flawed, as it does not allow for the production, reproduction, and transformation of knowledge or teaching of the other to create learning environments that support students' critical thinking skills. Critical theorists like Freire (2000) and Ira Shor (1996) have advocated for active dialogue and shared cogovernance within classrooms to end the teacher-student contradiction and improve the quality of education in schools.

The use of cogen challenges teacher-student contradictions 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 interrogate and reconceive classroom practices in an emancipatory manner (Tobin and 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 to improve the classroom environment. Thus, teachers are not solely responsible for teaching but are taught through dialogue with students who assume the role of teachers.

MY INITIAL EXPERIENCES WITH COGEN

In this chapter I focus on my initial experiences with cogen as a method to improve curriculum and instruction in a computer-assisted mathematics class. The vignette presented in the chapter is from my first initial cogen session and it highlights a variety of difficulties experienced by students with computer-assisted learning and the weakness and strengths of such instructional tools from the perspective of GED students. To make sense of what was occurring within this class I use interpretive frameworks from cultural sociology, sociology of emotions, phenomenology, personal narratives and a transcript of a cogen session to examine challenges and beneficence of computer-assisted learning to enhance teaching and learning in a GED mathematics class. Researching the use of cogen in a GED mathematics classroom provides important insights regarding how educators can improve the teaching and learning of mathematics in a technology enhanced classroom when students critique, co-plan, and implement a new curriculum that benefits how they learn mathematics as adults. The cogenerated solutions implemented changed how mathematics was taught, learnt, and experienced within this class. I address change and what constitutes effective teaching and learning of mathematics in computer-assisted classrooms. However, other outcomes were attained such as student agency, identity shifts, mathematics success, the adaptation of new roles and instructional tools for both teachers and students.

Allies in teaching and learning mathematics

This vignette acknowledges an incident that took place three weeks into the fall semester regarding the implementation of a computer-assisted class, which afforded the opportunity to implement cogen to resolve the difficulties students were experiencing within this 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. Those students who decided to participate in cogen were representatives of their peers given the diversity of students found in the class. As such, participants differed with respect to age, gender, ethnicity, religion, and mathematical ability in order to develop successful lessons and curriculum to improve mathematics teaching and learning of all adult learners. Essentially, the purpose of cogen was to identify characteristics within a computer-assisted class that afforded and prevented the learning of mathematics. Given the present 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 pm. 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 show 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 of 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 pm 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 pm meeting. At the front desk stood Lorna, Jasmine, and Joseph my first cogen participants.

“The debate squad” consisted of four participants, three students and me. The metaphor of “the debate squad” reflected the students’ understanding 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. I was perceived as the individual who held the most power with regards to instruction and curriculum. To Lorna, Jasmine, and Joseph cogen was a new pedagogical tool, such as computer-assisted instruction, in which they assumed they had to get their argument across in the form of a debate. These expectations were based on their prior experiences with teachers and urban schools. The idea of debating was quickly disposed of after the first cogen session as 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

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01 Wharton:  Today the 15th of October so we're going to have a
             conversation now ahmmm what Joseph said Saturday was
             correct. We gonna have a dialogue. And really what the
             ahmmm actual name for it is cogenerative dialogue. So
             there are some rules. Everyone has to have his or her
             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.
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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 participants in this forum. I wanted the participants to know that 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 shape instruction for a productive mathematics classroom. Each participant had a responsibility to contribute to the discussion whether s/he was responding, clarifying, or agreeing 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.

As a collective, cogen participants bring different viewpoints with respect to their ages, gender, ethnicity, socioeconomic status, social experiences and formal education. For instance, cogen participants were mature-aged 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 mathematics in a computer environment.

As the computer-assisted class was the primary motive for the implementation of cogen I proceeded to ask participants for their perspectives regarding why 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 chief 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 five-part battery of tests that comprises the GED examination. The mathematics 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 pretest (25 questions), full-length posttest (50 questions), interactive lessons, and an on screen Casio fx 260 scientific calculator. The MHC program was supposed 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 teacher-led class and the MHC Interactive program. Thus, students amplified their understandings of mathematics. However, the students did not share my assumptions.

TESTING THE JOY OUT OF LEARNING

The computer-assisted class was considered 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 characteristics 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

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02 Lorna:   The quiz at the end of the lessons.
03 Wharton: uhmmm
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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 questions
08 Lorna:    That, that, yeah
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The episode above focused on a six-question quiz at the end of each lesson, which caused Lorna anxiety as she worked in the lab to improve her mathematics process skills. 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 are advanced 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 in cogen to the six-question quiz indicated that the built-in assessment feature at the end of each lesson undermined the purpose of the program as a resource to improve and enhance the understanding of mathematics. Lorna was not against testing but how the program was constructed to test students after each lesson aggravated the learning process. Lorna was already insecure about 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. Lorna used the grades she obtained on quizzes and tests to determine her mathematical ability and ascribe positive or negative identity markers upon herself. This was revealed in an interview at the end of the semester.

Lorna, like many of her peers, was unaware that the grades obtained in tests and quizzes were subjective and did not reflect their true mathematics ability or identity as learners. Similarly, Jerry's failure to achieve 100% on tests and quizzes reinforced his perception that he was not a strong mathematics student. Students placed great significance on grades without the understanding that these constructs are abstract symbols, which can be misused, abused, and often are misleading when they are not used to guide and scaffold students' learning to facilitate cognitive growth. Thus, I wondered where students' obsessions 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. Reflecting back on this experience, I realize it was the rubric I created to determine the final grade for the class that may have caused confusion 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 student input when I created the rubric. If these additional assessment features were included within the curriculum I would have eliminated some of the anxiety and frustrations experienced by Lorna and other students. Thus, 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. Thus, 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 I discuss 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 the other work done in the teacher-led 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 understanding of mathematics against a range of criteria not just marks or grades obtained from exercises in the MHC program. Students were able to make sense of their grades from associated feedback in a positive manner to 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 for learning rather than 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 to construct knowledge about students' performance and achievement while creating appropriate support mechanisms. Thus, learning occurs 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. Thus, assessment with its associated feedback (in the form of marks or grades) accompanied by teacher explanations and guidance provided students with the skills teachers used to clarify 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 understanding of mathematics. The immediate feedback feature supplied Lorna with the academic support needed to make adjustments 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 accessed 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 that all 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 teacher-led 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 not comparable, each had its own goals and motives. To the students the traditional class represented the norm and correct method for teaching and learning mathematics. Students were more familiar with this method of teaching and learning as it represented their expectations of a typical mathematics classroom originating from their years of academic socialization. In traditional classes students were aware of the division of labor 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 a "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 teacher-led class in which students developed their own epistemological beliefs resulting in these two classes developing their own trajectories and causing chaos.

Episode 3

09 Joseph:	Okay. Far as I figure out the ahmmm the lab. If you know at first. If the pers… If it is explained to you.
10 Wharton:	Uhmmm
11 Joseph:	Exactly what's going on with the programs? Exactly what is expected of that particular student?
12 Wharton:	Uhmmm
13 Joseph:	Exactly how you should take a step from step 1 to step 4, step 5.
14 Wharton:	Uhmmm
15 Joseph:	It becomes to be. It becomes easy. 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 her…Okay to us this was told right. But.
16 Jasmine:	Without being tutored
17 Joseph:	But like myself I didn't expect it to be the way it is like when I got into the program
18 Jasmine:	[like sit at the computer]

Joseph, who identifies himself as African American is in his early fifties, appropriated 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 such as him who were not familiar with using a computer-assisted program to support mathematics learning. Joseph stated in turn 11 that he needed to know "exactly what's going on with the programs. Exactly what is expected of that particular student? Exactly how he should proceed from step 1 to step 4, step 5." Joseph's comments suggested that he lacked the knowledge necessary to navigate and productively use the mathematics program. Joseph, like his peers, the mature-aged adults of the class, found the computer-assisted class a site for struggle because they were accustomed to the dominant mode of schooling in which they used cultural tools as resources (e.g., pencils, paper, textbooks, 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, he 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 teacher-led and computer-assisted class to inform their learning and understanding of mathematics. A training session provided 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 a 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 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. I realized that in the teacher-led class students were provided with the objectives and potential outcomes 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 16, was not what the class had envisioned, thereby creating discontent among the students regarding 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 has worked, what didn’t work, what did they like, what they disliked, and what changes in routines they preferred. 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. My questions encouraged crosstalk between participants and me, which provided answers that assisted me in understanding the students’ interpretations and experiences of the computer-assisted learning environment that accommodated their learning of mathematics. Cogen was a site for mediating contradictions concerning the learning environment and mathematics. Thus, a central focus was to explore and create a learning environment that was flexible and adaptable to the needs of all adult learners.

The first cogen session prompted immediate changes as the participants articulated many difficulties (episodes 2 and 3) within the computer-assisted 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 in a technology enhanced learning environment. Using this feedback, we collectively made adjustments to accommodate how students enacted mathematics in this classroom environment. One of the adjustments made to the class was that of 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 teacher-led 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 to enhance their understanding 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 are mini tutoring sessions within the lab that supported individuals or groups of students who did not fully understand previous topics covered in the lab or the teacher-led 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 opportunities 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 size 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. Huddles broke down some of the barriers students erected concerning learning mathematics.

A third strategy proposed by the cogen participants was the implementation of SkillsTutor in the class. SkillsTutor is an online tutoring tool that 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 examination. The Downtown Center acquired a license of this web-based program in fall 2007 semester, to provide academic support to the entire school population that could be utilized from home. The program offers over 1,600 lessons that teach basic skills or thinking skills. Basic skills provided students with a brief interactive tutorial of a single academic concept such as dividing decimals followed by multiple-choice problems that reinforced and supported students' learning with hints and feedback throughout the simulation. Thinking skills modules provided students with scenarios in which they use critical thinking and computational skills to solve problems. For example, in thinking skills problems students are given tasks such as choosing the most economical rental agency to hire a car for a three-day trip. They are provided with daily rates charged, rates per mile, and distance traveled in which they use their whole number and decimal computation skills as well as their comparison skills to arrive at a solution in a step-by-step format. Thinking skills modules allow students to use multiple mathematics skills to solve problems similar to the GED examination however, there were not many of these modules within the program.

Cogen participants preferred SkillsTutor than the MHC Interactive due to its user-friendly format. In addition, 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 interactive or advanced as SkillsTutor. MHC prescriptions directed students to lessons in the McGraw-Hill Contemporary recommended textbooks, which students did not possess. However, it was emphasized to 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, which students could complete in class. All students welcomed an approach that allowed some students to work on these assignments in the lab with Sara while others took the assignments home and completed them as homework. Introducing worksheets was a great idea contributed by the student participants 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.

Cogen participants and I cogenerated many successful strategies that allowed us to create a mathematics curriculum and learning environment relevant to adult learners' individual needs and develop collective motives to succeed in a computer-assisted learning environment. Technology use within classrooms will become unavoidable in the near future as new devices are created to improve teaching and learning. Thus, teachers and students must work together to create and sustain learning environments that support and encourage the use of technology to improve learning. As a cogen group, we were able to create a technology-enhanced learning environment that allowed students to choose activities that fitted their academic needs. Thus, students tuned in or tuned out to the academic resources on an as needed basis to achieve their respective goals for learning mathematics.

The adjustments made to the curriculum and class structures 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 the huddles, teacher interaction with mini lessons, additional activities such as SkillsTutor and worksheets allowing a shifting of academic gears to keep students motivated and focused throughout their lessons. The idea of changing activities was a recurring theme within all our strategies, as it seemed the students welcomed a change of activities within this three-hour class period to make the learning of mathematics more engaging and enjoyable.

Cogen afforded opportunities 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. As Joseph indicated, "Everyone is taking the challenge the way it was designed." Students were more willing to take the initiative to use computers to improve their learning of mathematics after supportive measures were implemented to improve the quality of teaching and learning. Hence, cogen was a social and communicative activity, which established a classroom community of student-teacher and teacher-learner, enabling participants to resolve numerous contradictions. Many of the strategies cogenerated such as pencil-paper assignments, SkillsTutor, progress reports, and mini-lessons are currently used in all computer-assisted mathematics classes at the Downtown Center.

REACTIONS TO COGEN

Cogen provided a forum for Sara and me to freely discuss students' resistance to the computer-assisted mathematics class, the social and symbolic violence students inflicted upon Sara when they refused her help within the class, and what aspects of the curriculum impeded students' 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 us through interactions. 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. She was not considered a monitor but viewed as the instructor of the class as she applied traditional pedagogical strategies the students were familiar with in which they began to tune in to Sara's efforts to help them. Joseph indicated, "It came up a lot that ahmmm she don't seem 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."

Interestingly, Sara noticed the effects of cogen on students, especially their attitudes towards using computers to enhance the learning of mathematics as well as to her. Sara indicated that 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, having mini tutoring sessions between Sara and students, which afforded active peer tutoring within the lab even though students 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. 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 nominated for and pass the GED mathematics 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 transformation 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 credentials. For Jasmine, my role as cogen participant, collaborator, listener, and willingness to make the necessary changes to the curriculum and classroom structures was appreciated as she indicated; "it was very helpful personally to me." Cogen altered the way I taught, and enacted mathematics as an instructor in the GED program. This exercise allowed me to learn many things about and from my students with the intention to improve how they interacted with computers in order to enhance their learning of mathematics, resistance to the curriculum I created, and reasons for returning to school to acquire their GED.

The positive experience with the "debate squad" inspired me 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 structural features within the learning environment. In the winter 2008 semester, I held whole class cogen in the first 15 minutes of class to obtain a collective understanding of the mechanisms that supported or constrained mathematics teaching and learning. 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 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 experiences as learners, and instructional constraints, which can be used to reconstruct curricula and implement support structures needed to improve students' fluency in mathematics. Such insights regarding how adult learners navigate, accommodate, and resist artifacts introduced in the classroom to enhance teaching and learning of mathematics are critical to the success of classroom encounters. Our initial experience with cogen opened a new world of teaching and learning mathematics not only in a technology-enhanced classroom but also in traditional mathematics classes. It provided me with a dynamic tool to re-teach mathematics to adult learners in productive classroom environments that reflected the culture the 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 them to enact new roles such as peer tutoring, which began in the computer-assisted class and migrated to the teacher-led 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 weak areas before the final examination. Viewed from these angles, the task of addressing 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 examination. In my previous Saturday GED classes approximately five students would be nominated to take the test however, out of the eleven students who remained in the fall 2007 class, nine students met the requirements of achieving 410 or better on the GED predictor test administered as the final examination. Two students did not meet the requirements and Jasmine who participated in cogen was one of these students. Although Jasmine did not meet the requirements to be nominated to take the test she did improve her mathematics skills as her official predictor score increased by 50 points. Jasmine acknowledged that she learnt a lot of mathematics in the ten weeks of being in the class even though she was not nominated for the GED test. It was evident that the implementation of cogen helped Jasmine overcome some of her fears of mathematics as she confessed that certain experiences within a classroom setting can " turn me [Jasmine] off …and drop out of the class" such as the previous GED program in which she was enrolled.

Out of the nine students who were nominated to take the official GED test seven passed the mathematics section while two failed with a score of 400. Lorna, Joseph, and Jerry were among the four students who achieved their GED credentials. Lorna and Joseph scored 480 and 450 respectively on the official GED mathematics test, while Jerry scored 560 indicating that he would be in the top 25% of his class rank. The other three students failed the writing section of the GED examination.

Lorna and Joseph's participation in cogen altered their perspectives of mathematics and use of computers as instructional and learning tools. Joseph indicated that his mathematics skills have improved and his comfort level in interacting with mathematics is evident in his success on the official GED examination. Furthermore, in the fall 2008 semester Joseph enrolled in the computerized bookkeeping program at the Downtown Center. This course focuses more on computer-assisted learning of bookkeeping applications than a traditional classroom. Thus, from a phenomenological perspective Joseph made a transition from being subservient to technology to becoming partners with technology (Galbraith 2006). Thus, Joseph was able to develop a mutual understanding 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, and was exempted from a remedial mathematics class due to her high score on the Test of Adult Basic Education (TABE). She has since graduated from the program and is currently seeking employment.

REFERENCE

Amstutz, D. D., & Sheared, V. (2000). The crisis in adult basic education. *Education and Urban Society, 32*, 155–166.

Barrow, L., Markman, L., & Rouse, C. E. (2007). Technology's edge: *The educational benefits of computer-aided instruction* (Working Paper Series: WP-07-17). Federal Reserve Bank of Chicago.

Freire, P. (2000). *Pedagogy of the oppressed.* New York, NY: Continuum.

Galbraith, P. (2006). Students, mathematics, and technology: Assessing the present challenging the future. *International Journal of Mathematics Education in Science and Technology, 37*, 277–290.

Houghton-Mifflin. (2009). *Skillstutor* [computer software].

Lowther, D., Inan, F., Daniel Strahl, J., & Ross, S. (2008). Does technology integration "work" when key barriers are removed? *Educational Media International*, *45,* 195–213.

McGraw-Hill. (2002). *MHC Interactive GED* [computer software].

National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics*. Reston, VA: National Council of Teachers of Mathematics.

Osei, M. A. (2001). Can you do what I do? A case study of computer-assisted instruction for adults participating in an adult education program. *Adult Basic Education*, *11*, 150–161.

Owston, R. S. (2009). Digital immersion teacher learning, and games. *Educational Researcher*, *38*, 270–273.

Ozel, S., Yetkiner, Z. E., & Capraro, R. M. (2008). Technology in K-12 mathematics classrooms. *School Science Mathematics Journal*, *108*, 80–85.

Rachal, J. R. (1993). Computer-assisted instruction in adult basic and secondary education: A review of the experimental literature, 1984–1992. *Adult Education Quarterly, 43*, 165–172.

Shor, I. (1996). *When students have power. Negotiating Authority in a critical pedagogy*. Chicago, IL: The University of Chicago Press.

Souter, M. T. (2002). Integrating technology into mathematics classroom: An action research study. *Action Research Exchange.* Retrieved July 5, 2009, from http://chiron.valdosta.edu/are/Artmanscrpt/vol1no1/souter_am.pdf

Tobin, K., & Roth, W.-M. (2006). *Teaching to learn: A view from the field.* Rotterdam, NL: Sense Publishers.

Turner, J. (2002). *Face to face: Towards a sociological theory of interpersonal behavior.* Stanford, CA: Stanford University Press.

Yonder, Z., & Elias, J. S. (1998). A case for using computer-assisted learning in mathematics to im-prove instruction in formal GED programs. *PAACE Journal of Lifelong Learning, 7*, 67–72.

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