

Implementing Contextual Teaching and
Learning:
Case Study of Rhonda, a High School
Mathematics Novice Teacher

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Abstract

The purpose of this study is to describe how a Rhonda, a novice mathematics teacher, used contextual teaching and learning (CTL) to enrich subject matter, engage students in learning, and increase student mastery. This study was conducted during Rhonda's student teaching and her first semester as a teacher. Research methods used included interviews with Rhonda and her supervisors, classroom observations, archival data (such as student documents and Rhonda's written reflections), and the researcher's own diary of the study.

Rhonda's CTL teaching experiences can be viewed via six themes: strategies, differences, student engagement, student mastery, facilitators, and barriers. Rhonda took full advantage of CTL strategies, using a variety of sources (such as movies and the Internet) to provide her with fresh ideas. (In one class she had the students correct the Scarecrow's misstatement of the Pythagorean Theorem in *The Wizard of Oz*.) A key difference observed between Rhonda's CTL math class and a more traditional one was that "constructive noise" and "structured chaos" were the norm. This was the result of her student-centric approach where cooperative learning with hand-on projects required more communication between students. This "noise and chaos" is the product of, and may contribute to, increased student engagement by allowing them to have greater control of their learning and giving them real-world tools to become their own teachers. CTL suggests the use of multiple assessment tools, and Rhonda followed that advice by doing projects and observations as well as traditional tests and quizzes. The strongest facilitators to Rhonda's experiences are her own support of and belief in CTL, her confidence in her ability to implement it, and her use of a variety of sources (including the students themselves) for ideas. Her biggest barriers were time needed to prepare lessons, classroom management, thinking of meaningful contexts, and a rigid curriculum schedule. Unlike most novice teachers, Rhonda was comfortable and confident in her role as teacher. While much of that comes from her own attitude and abilities, she suggests that "I learned more from my CTL classes about teaching than other classes at the university."

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“I think these things [CTL practices] are very important to make sure they are in my classroom now and next year and the years after.” (Rhonda, a novice teacher)

The purpose of this article is to provide a case study of a novice teacher’s continuing efforts to use contextual teaching and learning (CTL) strategies with high school mathematics students. For the purposes of this article, a novice teacher incorporates both the student teaching experience and the initial semester of first-year teaching. The article will have the following components: overview of contextual teaching and learning; methodology of case study; researcher’s experiences with CTL at UGA; novice teacher’s CTL experiences with the researcher; description of novice teacher’s classroom settings and teaching vignettes; analysis, and discussion. The article will conclude with recommendations for classroom teachers of CTL, facilitation of CTL in school settings, and recommendations for institutions of higher education emphasizing CTL.

Overview of Contextual Teaching and Learning

Contextual teaching enables learning in which students employ their academic understandings and abilities in a variety of in- and out-of-school contexts to solve simulated or real world problems, both alone and with others. Activities in which teachers use contextual teaching strategies help students make connections with their

roles and responsibilities as family members, citizens, students, and workers. Learning through and in these kinds of activities is commonly characterized as problem based, self-regulated, occurring in a variety of contexts including the community and work sites, involving teams or learning groups, and responsive to a host of diverse learners' needs and interests. Further, contextual teaching and learning emphasizes higher-level thinking, knowledge transfer, and the collection, analysis, and synthesis of information from multiple sources and viewpoints. CTL includes authentic assessment, which is derived from multiple sources, ongoing, and blended with instruction (Sears & Hersh).

Methodology of Case Study

According to Merriam (1988), the goal of qualitative research is to “understand the meaning of an experience” (p. 16). In this study, I want to understand the use of contextual teaching and learning principles and practices by a novice high school mathematics teacher. The qualitative research methodology utilized in this study is a case approach to data collection, analysis, and reporting. A descriptive case study design was selected because this design was a good fit for my research questions and the descriptive findings I desired. In this study, I used the case both as an object of study (Stake, 1995) and as a research methodology (Yin, 1994). Specifically, this study describes a novice mathematics high school teacher's (object of study) applications of CTL principles and practices. The methodology includes purpose and research questions, participant selection, data sources and collection, and data analysis.

Purpose and Research Questions

The purpose of this case study research is to better understand the applications of CTL strategies in an actual teaching context by studying the classrooms of a novice

teacher who participated in UGA's CTL preservice teacher education. Specific research questions asked included:

1. How does the teaching practice of CTL-trained novice teachers differ from more traditional approaches to teaching the subject matter?
2. Which CTL strategies do CTL-trained novice teachers use in classroom teaching contexts? Why? To what perceived or measured outcomes?
3. What are the facilitators and barriers to implementation of various CTL strategies in actual practice in school settings?
4. What effect does use of CTL strategies have on student engagement and mastery of subject matter content (i.e., selected measures of student achievement)?

Participant Selection

This study utilized purposeful sampling (Patton, 1990). Purposeful sampling “is based on the assumption that the investigator wants to discover, understand, and gain insight and therefore must select a sample from which the most can be learned” (Merriam, 1998, p. 61). I selected a novice teacher who had been in the cohort of preservice teachers participating in the UGA CTL contract and one with whom I had a comfortable relationship. For this study, the term “novice teacher” incorporates both the student teaching experience and the first semester of first-year teaching. Rhonda is a pseudonym for the novice teacher.

Data Sources and Collection

Data sources are determined by the researcher's questions and purpose for study (Merriam, 1998). I used multiple data sources to increase validity as the strengths of one source helps compensate for the shortcomings of another (Marshall & Rossman, 1989).

Interviewing, observing classroom teaching, analyzing archival data, and keeping a research diary were determined to be valuable data sources for learning more about Rhonda's applications of CTL strategies.

Interviews. As Patton (1990) stated, "The purpose of interviewing is to find out what is in and on someone else's mind" (p. 278). The interview process began two weeks into the student teaching semester and concluded at the end of Rhonda's first semester of her first year of teaching. I collected narrative data from Rhonda, her cooperating teacher, and the high school mathematics director from her student teaching semester. Three interviews were conducted with Rhonda during student teaching and three during her first semester of first-year teaching; one interview with Lois, the cooperating teacher during Rhonda's student teaching semester; and one interview with the mathematics department head at Rhonda's student teaching site. All interviews were unstructured and conversational in tone. I began each interview with Rhonda by saying, "Tell me how things are going." These interviews gave me an opportunity to follow up on questions that arose from classroom observations and from reading archival data.

Classroom Observations. Another source of data was classroom observations. I conducted three classroom observations during Rhonda's student teaching and three classroom observations during her first semester of teaching. After reviewing potential dates, Rhonda and I decided together which would be observational days. Our only criterion was to eliminate testing or quizzing days. Each classroom observation lasted one class period of approximately 50 minutes in student teaching and 90 minutes in first year teaching. During each observation I wrote notes, which became part of my research diary. Classroom observations provided a glimpse into classroom life. I gathered information

about the physical environment of the classroom and recorded information about the learning activities in which students and the teacher were engaged. Classroom observations provided a way to view student and teacher roles and interactions. Classroom observations also put into context what interviewees (Rhonda, Lois, mathematics department head) were saying during interviews.

Archival Data. Archival data used in this study refer to school documents, portfolios, and reflections. School documents, such as web sites and curriculum guides, provided contextual information. The portfolio Rhonda compiled during a UGA course provided data relative to her teaching philosophy and understanding of CTL practices and principles. Reflections written during student teaching provided additional insight into her thoughts about CTL.

Research Diary. A research diary (three-ring notebook) provided a way to keep my descriptions and reflections organized during data collection. Descriptions are the researcher's efforts to objectively record what happened (Bogdan & Biklen, 1992). Descriptions in my research diary included notes and drawings of my participant, her classroom, and activities as I observed them. My reflections included ideas, feelings, questions, and biases. I began my research diary at the onset of data collection and kept it throughout the study.

Data Analysis

The method used to analyze data was constant comparative. Constant comparative is when the researcher compares constantly (Glaser & Strauss, 1967). To help me focus this study, I began data collection and analysis with themes (strategies, differences, student engagement, student mastery, facilitators, barriers) stemming from my four research

questions (Miles & Huberman,1994). I was searching for theme-related categories. As new data were collected, I compared the first set of data with the new data. These comparisons then lead to new categories. This recursive process continued until data collection was completed and no new categories were detected.

Analysis

This case study research examined how a novice mathematics teacher used CTL principles and practices with her students to a) enrich subject matter, b) engage students in learning, and c) increase student mastery of the subject matter. The analysis section includes the researcher’s experiences with CTL, novice teacher’s CTL experiences with the researcher, description of novice teacher’s classroom settings and teaching vignettes, and themes.

The Researcher’s Experiences with CTL at UGA

As the researcher in this study I must state my bias up front: I believe strongly in CTL practices and principles. In order to provide the reader with an insight into my beliefs, I will present several CTL-related experiences at UGA. These experiences will be presented in chronological order.

In 1998 there was a call at the University of Georgia for faculty participation in a three-year federal contract focusing on contextual teaching and learning strategies. The emphasis was to examine means for supplementing and enriching existing programs in teacher education. Specifically, the focus was to prepare prospective teachers to (a) relate subject matter to settings where it is used in “real world” life at home, work, and the community; and (b) to help future students transfer knowledge and problem solving skills

learned in school to other life contexts and prepare students for future careers, citizenship, or continued learning (Lynch & Harnish, 2002).

As a faculty member in the Middle School Program of the Department of Elementary Education, I was intrigued with the idea of an effort which would not only better prepare novice teachers for their actual teaching contexts, but also foster collaboration of faculty from across campus. I signed up for the duration of the contract. As a CTL faculty member, my responsibilities included committee work, teaching UGA CTL-designated courses (e.g., Service Learning, Community Seminar), team teaching CTL-infused courses in public school settings, interning with the local police department, participating in business and industry work site tours, conducting research, and sharing learning with others.

Committee Work

One of my first responsibilities was to participate in a committee whose purpose was to develop a UGA CTL framework. Committee composition was diverse and included representation from departments within the College of Education, as well as the College of Arts and Sciences. After a semester of reading, discussion, and debate about what CTL was and was not to us, the committee came up with 19 guiding principles.

These are listed in Table 1.

Table 1
Framework Principles of CTL at The University of Georgia

- Students are actively engaged.
- Students view learning as relevant.
- Students learn from one another through cooperation, discourse, teamwork, and self-reflection.
- Learning is related to “real world” and /or simulated issues and meaningful problems.

- Students are encouraged to take responsibility for the monitoring and development of their own learning.
 - Students are encouraged to become active participants in the improvement of society.
 - Student learning is assessed in multiple ways.
 - The perspectives and opinions of students are valued and respected.
 - Teacher acts as facilitator of student learning.
 - Teacher employs a variety of appropriate teaching techniques.
 - The learning environment is dynamic and exciting.
 - Higher order thinking and problem solving are emphasized.
 - Students and teachers are prepared to experiment with new approaches-creativity is encouraged.
 - The process of learning is as important as the context that is learned.
 - Appreciating students' diverse life contexts and prior experiences are fundamental to learning.
 - Learning occurs in multiple contexts.
 - Knowledge is interdisciplinary and extends beyond the boundaries of conventional classrooms.
 - Teacher accepts his/her role as learner.
 - Learning in multiple contexts allows students to identify and solve problems in new contexts.
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This framework fits neatly with my own philosophy of education. My teaching philosophy centers around the notion that while learning new things is important, application of that learning is equally important. I believe strongly in democratic learning: students and teachers making decisions about what is to be learned and how learning and assessment could occur, and students and teachers understanding the importance of that learning. Recognizing the responsibilities of the teacher (e.g., content

knowledge, accountability), I believe students can learn from each other as well as the teacher, and the teacher can learn from the students.

Academic Community Learning (Service Learning) Course

The service learning course, taught each spring semester, models CTL principles. Service learning is a philosophy and methodology involving the application of academic skills to solving real life problems in the community. The course is designed to examine the concept of service learning and to provide experiences with service learning. In the democratic fashion, the students and I use a consensus building process for making decisions about curriculum, instruction, and assessment.

Community Seminar

The Community Seminar was designed specifically to focus on the use of the community workplaces, government, social service agencies, and other community-based organizations for curriculum and instructional purposes. This one-hour credit course provided a format for community field trips, strategy understanding, brainstorming links between communities and schools, and avenues for identifying student needs, concerns, and interests.

Business and Industry Work Site Tours

For two summers I participated in faculty tours of business and industry work sites facilitated by UGA CTL project directors. Faculty took buses to work sites and spent a day or half-day learning about responsibilities, skills, content, and work ethics necessary for successful employment at the various work sites. I used this new information to help build curriculum for my classes at the university and in the public school setting.

Team-Teaching in Public Schools

I firmly believe in the necessity of professors staying up-to-date about public school teaching. Therefore, I team-teach with teachers in area schools. I view these experiences as opportunities for me to connect with students and learn from teachers. I use this learning in my own research and teaching at the university. During the CTL contract, I had the chance to teach with several teachers. One team-teaching opportunity was the Community Context Curriculum Project (CCCP) (Pate, Thompson, & Keyes, 1991).

The short-term goal of the CCCP was to understand whether and how middle school students learn about themselves, their community, and the workplace through curriculum. One objective of the CCCP included developing closer collaborations between area workplaces, the middle school, and the university. Over the course of a year, approximately 41 seventh grade (12-14 years of age) language arts students (83% African-American, 7% Hispanic, 10% Caucasian or Other; 59% female, 41% male) identified as average to low in reading and writing abilities collaborated with workplace workers from 19 area businesses, industries, and agencies.

Creating curriculum connecting workplace needs and middle school academics, and focusing on opportunities in which flexible knowledge transfers from one problem to another, and from one context to another, in school or in the workplace, was a second objective of the project. A third objective was to provide opportunities for students to use technology. In the CCCP, students utilized many forms of technology. A fourth objective was to create charrettes, a visioning process resulting in a short document, noting workplace information (e.g., history, philosophy, product or service), required academic

skills and knowledge (e.g., language arts, mathematics, science, social science, and technology), and workplace ethics (e.g., pride, responsibility, accountability).

Police Internship

While team-teaching in the CCCP, it became increasingly apparent to me that although I thought I knew the communities in which the students resided, in reality I did not. So, when the opportunity arose for me to design and engage in my own internship experience, I began to formulate a plan that would let me have access to inner city neighborhoods that I had not previously visited. The local police department allowed me to ride along with police officers during the 3 p.m. to 12 p.m. shift and the 11 p.m. to 7 a.m. shift in two police zones. This experience gave me greater insight into the total lives of students, and ways educators can build on the real-life experiences of their students during schooling.

Novice Teacher Research

In 2002 there was once again a call for faculty participation in the UGA CTL contract. This phase emphasized the examination of how a small group of novice CTL-trained teachers use CTL principles and practices with their students to (a) enrich subject matter, (b) engage students in learning, and (c) increase student mastery of subject matter (Lynch & Harnish, 2002). Primarily because I wanted to see for myself if novice teachers used CTL principles in their teaching, I signed up to participate. Throughout this study I was aware of my own biases regarding CTL and made every attempt to not let them color the findings of this study.

The Novice Teacher's CTL Experiences with the Researcher

Rhonda (pseudonym) was one student in a cohort of novice teachers participating in CTL at the University of Georgia. Rhonda is diminutive at under five feet. Blonde, attractive, with an engaging smile, Rhonda is what I would call “a ball of fire.” She does not have a loud voice, yet when she speaks you pay attention. I had the opportunity of broadening Rhonda's understanding of CTL through the service learning and community seminar courses I taught. In both courses she was thoughtful, attentive, and participated fully in discussions.

Service Learning

During the spring of 2000, Rhonda, as a college junior, enrolled in the service learning course. Rhonda, along with two other CTL mathematics novice teachers, wanted to participate in activities that would not only increase their own mathematics content, but also enhance their understanding of how best to teach mathematics. The three collaborated on a project entitled interMath (<http://www.intermath-uga.gatech.edu>). According to their project abstract,

Our service learning project is interMath. InterMath was started by Dr. Jim Wilson, a professor in the Math Education Department at the University. Dr. Wilson and three doctoral students, Lou Ann, Evan, and Jon, are collaborating with us to design a web site for middle school math teachers. This web site is in the process of being built to provide online support, including real life math problems, a glossary of mathematical terms, and sample lesson plans for middle school math teachers. The purpose of this web site is to help middle school math teachers introduce real world problems into the classroom by using different types of technology, such as a computer based ranger (CBR) and graphing

calculators. The idea is that the teachers will adapt the problems on the web site to fit into their classroom curriculum. The web site also includes a question and answer site where teachers can correspond with other teachers for lesson plans. The site also offers ideas of how to adapt the problems to fit into a middle school math class.

Our main role in the interMath project was to help with creating workshops, to get feedback from the teachers involved, and to increase awareness of online support available for middle school math teachers. We also wanted to provide the makers of the web site with feedback from teachers about how to make the web site better.

The workshop we helped design was for the math teachers at [school]. In the workshop, we helped set up the equipment and then assisted Lou Ann, Jon, and Evan in teaching the workshop. In the workshop, we emphasized the TI-73 calculators, which are adaptable to most middle school classrooms. We also provided activities for the teachers to help them practice with the calculators and with the CBR. In small groups, the teachers worked on solving problems with this technology. As a large group, we then all used different methods to solve the same sets of problems using this technology. We provided the teachers with information on how to obtain this technology to introduce into their classrooms, and we provided them with real life problems that are easily adaptable into their classrooms.

We view this workshop as being successful in helping the teachers become more comfortable with the technology and introducing them to real world problems for their classrooms. Lou Ann, Jon, and Evan did the presenting, while we walked around the room assisting the teachers with the technology. This workshop

was a start to get these teachers familiar enough with technology to use these skills on the interMath web site.

Rhonda and her collaborators felt their project met the definition of service learning. According to the three students,

The project interMath meets this definition because we are performing a service for the collaborators involved to help them present real life problems to middle school math teachers to introduce into their classrooms. Not only are we learning applications in math and the technology is used to solve problems, but also the teachers involved are learning how to improve their technology skills and how to adapt real life problems to their students.

As part of their portfolio documentation, Rhonda and her colleagues discussed the dynamics of teaching and learning in their project. They wrote,

In our project, there are a variety of opportunities for teaching and learning to occur. All the collaborators involved are learning from and teaching each other in numerous ways. We are learning how to perform technology applications, how to make contacts, and how to prepare, plan, and perform a workshop. We are also learning how to interact with teachers through the graduate students, the teachers involved, and each other. The graduate students are learning how to improve their problems and workshops through responses from us and the teachers. They are gaining feedback for improving the web site through surveys and opinions. The teachers involved are learning technology skills and how to adapt those skills to real world applications that they can use in their classrooms. One of interMath's main goals is to provide an online support system so teachers can learn from other teachers across the country. The final goal of interMath is that the teachers will relay real world problems and technology skills to

their students, and in turn, the students will be able to transfer this knowledge to the real world.

According to Rhonda, the following academic connections were made as a result of her service learning project:

- Learning how to use different computer programs helpful in solving math problems, like Geo Sketchpad and Excel
- Learning how to present and lead workshops and how to decide what material to use
- Learning how to use the new TI-73 calculator
- Learning how to use different methods to solve “real world” problems
- Learning how to adapt problems so they may be used in classes of different levels
- Learning how to relate and work with other, more experienced students
- Learning how to create workshops for teachers
- Learning how to make connections in the business world
- Learning new methods to solve a problem, looking at a problem from a different angle, and finding a new solution and why that solution works
- Learning how to work with other people and how to schedule things so everyone can attend

A critical component of both service learning and CTL is reflection. Rhonda completed three formal reflections during her service learning project. Following are excerpts of Rhonda’s reflections that capture her understanding of the importance of CTL.

Reflection #1 2/16/00

...My favorite part of this project is actually taking this [interMath] program and introducing into the schools. I think it is going to help motivate students in math because not only is it something new, but it is also on the Internet. We are now in a day where everything is becoming technologically advanced and this is just one more thing to add to the list. ... The Internet is becoming a great teaching strategy and this is one more thing to add to that list.

Reflections #2 3/27/00

On Friday, we went to our first workshop....Overall, I think the workshop went well. All the activities were really thought out well and geared toward ... math teachers to use in their classes. I was a little disappointed with some of the teachers. Some of them seemed to have an attitude that they were not interested in learning new things. They seemed like they were just going to keep teaching the way they had been for years and were not interested in the problems we presented. However, most of the other teachers responded well to our workshop and seemed excited to learn about the new technology and ideas that they can use in classes. Some commented on how they thought their students would really like what we did and they think they would learn a lot from our demonstration. I think this workshop helped the teachers feel more comfortable with technology because when we first walked in, it seemed as if they were afraid of technology.

Reflection #3 4/21/00

We just completed our last workshop on the interMath project. The three of us prepared the lesson plans, which included a problem off the web site that used Excel.

He [a teacher at the workshop] seemed to like what we showed him although he was disappointed because he thought interMath was a teacher resource web site. However, interMath is a web site for teachers to solve the problems and then adapt them to fit into their lesson plans. His comment on this was that teachers do not have time to solve problems and then change them. They want problems that they can put right into their classes. I was able to learn about teaching from [teacher] and realized that you are never just a teacher, but you are always learning, too.

Community Seminar

The next semester Rhonda signed up for the CTL-focused seminar, Workplace and Community Experiences — Connecting Academic Learning to Out-of-Classroom Contexts. The seminar was designed to examine the unique nature of communities and ways in which communities and schools can collaborate. The course also emphasized the use of strategies in teaching. Strategies modeled during the seminar included: concept maps, surveys, chalk talk, brainstorm, think-pair-share, mapping, field trips, documentation, reflection, museum reflection, KWL, problem solving, share, inquiry, research, flow chart, diversity, and public demonstration of learning. According to Rhonda,

...those of us that took this course will be able to better relate to our future students because of all the things we have learned about the community. Most importantly we learned where to find out information about our community and different ways to have our students learn about the community.

Description of Novice Teacher’s Classroom Settings and Teaching Vignettes

Student Teaching

Rhonda student taught for ten weeks at Cooper High School (CHS) (pseudonym). Located in an affluent suburban-metropolitan setting, CHS epitomizes the typical multi-building site with accompanying “trailer park” in back. To me, the school surroundings resembled a Steven Spielberg movie setting, rows and rows of houses, each looking the same, manicured lawns, and polished cars.

As a visitor entering the high school, I was asked to check in at the main office. Immediately beyond the office was the school cafeteria. Each time I observed Rhonda it was 5th period, one of several lunch sections for the 3,500 CHS students in grades 9-12. Posters and banners of upcoming school events, along with school beliefs, were displayed throughout the cafeteria.

At first glance, I felt intimidated by the sheer number of high school students in one place. I had to walk right through the middle of the students to reach the classroom areas of the school. Even so, I immediately felt comfortable and safe.

Rhonda's classroom was in the "trailer park" in back of the school complex. To locate it, I had to traverse through the animated students, myriad of conversations, and half-eaten food. As I exited the back of the first building, I got my first glimpse of the trailer park. Luckily, Rhonda's trailer classroom was the first one in a row of six. There were about 50 classrooms in the trailer park. CHS is a relatively new school and is in one of the fastest growing metropolitan areas in the southeast.

The metal trailer, Rhonda's student teaching classroom, was white with wooden steps leading up to two doors. A window box of flowers graced the front entrance to the trailer, perhaps used as an identification marker so students and visitors could locate the classroom. Once inside the trailer, my first impression was that of claustrophobia. I took a mental note of it's contents; no windows, 24 student desks, two teacher desks, a table, three bulletin boards, another table with an overhead projector, a television mounted on the wall, a storage cabinet, two file cabinets, and a white board. Then there were the students, all 27 of them. Tall students, short students, fat and skinny students, students whose limbs were moving in opposite directions, watchful students, animated students,

males, females — students of every conceivable race and culture. Posted around the room was student work — elliptical balls, word names, poetry. Written on the white board were homework assignments. Because the classroom was compact, there was not much maneuverability. Rhonda was stationed at the front of the trailer by the white board and the overhead projector.

If Rhonda were not at the front of the classroom, you would not be able to pick her out from the students. Yet, when she was teaching, Rhonda had the command of her students. Perhaps it was the pace of her lessons, always fast and furious. Perhaps it was the level of the students she was teaching, 10th grade Honors Algebra. Perhaps it was her command of the subject area. Perhaps it was that she believed in what she was doing.

First Year Teaching

Rhonda targeted Allen High School (AHS) (pseudonym) as the site for her first year teaching. She went to a teacher job fair and was hired by that school on the spot. AHS is located in an urban/suburban location adjacent to a large metropolitan center in the southeast. Rhonda's teaching assignment was two classes of Honor's Algebra II and two classes of secondary mathematics, each taught in a block schedule.

When I arrived at the school for my first observation, I signed in at a desk situated by the front door and received directions to Rhonda's classroom. I walked past the language arts hall, the social sciences hall, and then arrived at the mathematics hall. When I got to Rhonda's classroom, I knocked on the door and waited until she unlocked it. Later I asked her why the door was locked, and she said it was her method for controlling tardies. The room was fairly large and consisted of 30 desks arranged in rows, a white board, floor lamp, storage closet, overhead table and projector, bulletin board, blackboard,

teacher desk, and computer desk. Mathematics posters and cartoons, as well as student projects decorated the walls. On the blackboard were the days and times Rhonda was available for extra help. For that week she was available on Monday at 8:00 a.m. and 3:40 p.m.; Tuesday at 3:40 p.m.; and Thursday at 8:00 a.m.. The room was not cluttered and felt relaxing.

The bell rang as students entered the classroom, and once again I saw eager, expectant faces of students from a variety of cultures. This was the Honor's Algebra II class of 25 students. Students greeted Rhonda, a few said hello to me and asked who I was. Students were laughing and sharing stories. Class had begun before I realized it. One girl went to the white board and began writing homework problem numbers down as students were calling out numbers. It felt like "structured chaos." After a listing was posted of all homework problems that needed clarification, those students who felt confident in their ability to work the problems began to make their way to the board. Each student took the time to write down all the steps that they had used to answer the problem. While this was going on, Rhonda walked around and helped students who needed individual assistance. After all the problems had been completed on the board, each student would "think out-loud" during their explanations to the class. I was impressed! The students were orderly, respectful, and genuinely seemed to want to help each other learn. Naturally, those students volunteering to work the problems were learning a great deal. Everyone knows that often the best way to learn something is to teach it. The students were teaching each other. This whole process took about 15 minutes out of the mathematics time block.

The next activity in the class was note taking. While Rhonda explained new material, the students wrote down notes. She told them they did not have to write down the whole example because there were ones just like it in the book. She mainly wanted them to *just pay attention*.

After the new concept was discussed and notes were taken, Rhonda had students work similar problems. I looked around and saw students working quietly in pairs or individually. Rhonda went from student to student monitoring their work and answering questions. After about 15 minutes, Rhonda asked if they were ready to go over the problems. Students volunteered to share how they worked the problems. The students were supportive and encouraging of each other, yet still retained aspects of adolescence. They were jovial, talkative, and ready for a quick laugh.

The rest of the class period was spent in review. Rhonda had a game organized that used problem solving and collaborative learning to help students prepare for the next day's quiz. Rhonda stayed after school that day and helped a student who had been out ill for a week, a student who was confused about a formula, and a student who missed the review for a test. Rhonda stayed until 6:00 p.m. that day helping those particular students. On the way out, she said that many of her students had *inaccurate prior knowledge — mostly from previous classes and tutors*.

Themes

Six themes framed the analysis for this study: strategies, differences, student engagement, student mastery, facilitators, and barriers. Explanations, categories, and supporting evidence will be provided for each theme.

Theme	Categories
Strategies	<ul style="list-style-type: none"> • Problem Solving • Projects • Inquiry • Collaborative Learning • Games • Note Taking • Authentic Assessment

Strategies

Rhonda used a variety of strategies reflective of CTL principles and practices. A strategy is a plan or course of action selected in pursuit of a specified goal or objective. Among the strategies Rhonda used were problem solving, projects, inquiry, collaborative learning, games, note taking, and authentic assessment. Some strategies were presented in isolation and some were blended together.

Category: Problem Solving. “Problem solving means engaging in a task for which the solution method is not known in advance.” (Principles and Standards for School Mathematics, p. 52). Although not identified specifically as such, Rhonda used Polya’s Problem-Solving Phases in her instruction (Polya, 1957). She helped students understand the problem, devise a plan with which to solve the problem, carry out the plan, and look back at the solution.

One example of problem solving Rhonda used with her students was the Wizard of Oz and the Pythagorean Theorem. According to Rhonda,

In the movie The Wizard of Oz, the scarecrow tries to recite the Pythagorean Theorem, but gets it wrong. It is towards the end of the movie when the scarecrow goes to get his brain and his diploma. After receiving his diploma he says, “The sum of the square root of any two sides of an isosceles triangle is equal to the square root of the remaining

side.” I show this clip of the movie to the students and then let them correct it based on what they know about the Pythagorean Theorem.

Category: Projects. Projects used as a strategy involves students applying their learning to situations that are more complex than simply solving mathematical equations. Project work engages students in construction of meaning and in developing understanding by cognitively engaging in the exploration of phenomena. Rhonda often used projects in her mathematics teaching. According to Rhonda, she got many of her ideas from the Internet.

One example of the project work was the Ellipse Project. This paper-folding project emphasized properties of ellipses. After their hands-on work, and to provide relevancy, Rhonda engaged the class in a discussion of where ellipses can be found. She told the students,

...the reflection property of an ellipse is found in something called the whispering gallery. If a person was standing in an elliptical room at one focus and he/she whispered, then only another person standing at the other focus would be able to hear him/her. This can be seen in the Capitol, where one of the rooms is elliptical. You know how the Democrats and Republicans sit on opposite sides of the room? Well, someone figured out where the foci were of the room and when one party was whispering at one focus, the other party could move to the other focus and hear them perfectly!

Project work was important enough to Rhonda for her to put the following on her course syllabi:

A few projects or labs will be assigned throughout the course and will be graded as class work, quizzes, or tests depending on the work required.

Category: Inquiry. Inquiry engages students in “what if” scenarios and investigations to construct mental frameworks that adequately explain their experiences (Haury, 1993). Teachers and students read about, share, observe, critically analyze, and reflect upon that which is being studied to improve it, change it, and/or predict results (Crandall, 1994). One inquiry strategy Rhonda used was chalk-talk. Chalk-talk is a silent way to generate ideas, develop projects, check on learning, solve problems, and reflect. Done completely in silence, chalk-talk gives students a change of pace. It encourages contemplation, generates questions and ideas, and allows students to interact visibly and silently with each other. “I use chalk-talk. I taught a new chapter and I didn’t know what the students already knew.” Rhonda wrote questions on the board and students walked silently to the board to answer the questions. What resulted was a conceptual map. Rhonda and the students used this inquiry strategy to help determine prior knowledge, what was necessary for future mathematics learning, and suggestions for teaching and learning.

Categories: Collaborative Learning and Games. Collaborative learning is a strategy that uses small groups in which students work together to maximize their own and each other’s learning (Berns & Erickson, BGSU, 2000). Games are flexible teaching strategies designed to motivate and increase learning. They can be used for all grade levels and content areas and can be adapted to fit different situations and needs. Rhonda blended collaborative learning with games in her teaching when appropriate. Rhonda said she used games such as *I Have, You Have*, *Math-O*, *Group Rows*, and *Station Review*.

During one of my observations in Rhonda’s first year of teaching, she used *Station Review*. Prior to the class, she had prepared 20 sheets of paper. Each sheet was

divided in half. On the top half of each sheet was a mathematical problem and on the bottom half was an answer to a different problem. She posted these on the walls throughout the room and referred to them as stations. Her directions to the students were,

Okay, we're going to play a review game. Remember, we've done this before. I'll review the rules for you. Find a partner. Around the walls you will see 20 stations. Pick whichever station you and your partner want to start with. Go to that station and solve the problem. Find your answer at another station. Go to that station and then solve that problem. Continue until I call time.

The excitement was high! Students picked partners and walked to whatever station they wanted. The pairs of students helped each other out and only called upon Rhonda for assistance if they became stuck. At the end of the allotted amount of time, Rhonda asked pairs to metacognate, or "think out loud" how they worked the problems. The game winners were given a small piece of candy.

Category: Note taking. Note taking is a strategy in which students record brief information consisting of comments, facts, and explanations. Note taking involves writing down information in order to make sense of it, remember it, and recall it in the future. Of all the CTL-related strategies Rhonda used, the note taking strategy was used most consistently. Rhonda kept a three-ring notebook with all of her notes on overheads. At the beginning of new conceptual teaching, she would share her overheads and instruct students to copy the notes. "I write the notes on an overhead. When I type the notes the students complain. They like it color-coded." When the notes are too complex, she makes copies and then gives them to the students.

Category: Authentic Assessment. Authentic assessment is considered a strategy when it is specifically used to directly examine student performance on worthy

intellectual tasks. Authentic assessments attend to whether the student can craft polished, thorough, and justifiable answers, performances, or products (Wiggins, 1993). Examples of authentic assessments include “scores” or evaluative commentary from portfolios, demonstrations, oral and written reports, work-based activities, student productions, term papers or projects, essays, student critiques of literary and technical work, paper-and-pencil tests, employers’ and teachers’ formal and informal observations, case study analyses, and so forth (Lynch, 2000).

Rhonda used multiple means for assessing student learning. For example, she used projects and labs, quizzes, observations, and tests.

Differences

Theme	Categories
Differences	<ul style="list-style-type: none"> • Constructive noise • Structured chaos • Technology-integrated instruction

The theme of differences refers to ways in which a CTL focused classroom differs from a more traditional classroom. Rhonda’s classroom differed in three ways: constructive noise; structured chaos; and technology-integrated instruction.

Category: Constructive Noise. Constructive noise was the norm in Rhonda’s classroom. Constructive noise refers to instruction-related talking, discussing, questioning, and sharing. One of her course assignments during student teaching was to have another student teacher come and observe her teaching. The student made a comment that Rhonda’s classroom was noisy. Rhonda’s reaction was,

Yes, but keep in mind she has a very traditional view of classrooms...where students are silent and you can hear a pencil drop. I

don't have that view! To her my classroom was loud and to me it was normal.

Category: Structured Chaos. In an interview during the first year of teaching,

Rhonda said,

I don't mind having "structured chaos" in my classroom. I see other teachers lecturing all the time. I like having my students teach. I try harder to think of hands-on, creative activities that will help them understand. My tests are different — they are open-ended — I make them look into things deeper as opposed to [another teacher at the school]. I try to pull in what we talked about in the community class [UGA Community Seminar]. Remember the ride-alongs? I think about what the kids do and don't do...I try and think why...what is their background? If they come to me and are genuinely concerned, I'll give them more time. I get told I'm too nice.

Category: Technology-Integrated Curriculum. Rhonda often integrated technology into her instruction. For example, while studying the concept of probability, Rhonda used calculators programmed with the game "Let's Make a Deal." Another example of technology-integrated curriculum was an Internet activity, in which students were instructed to visit three URL addresses and follow specific directions.

Student Engagement

Theme	Categories
Student Engagement	<ul style="list-style-type: none">• Learning with them• Real world applications• Students discover• Understanding student needs• Not crossing the line

Researcher: If I were to observe in your 5th period class, what would I see?

Rhonda: Depends on what day you come, what I was teaching, and what kind of day my students were having. You would definitely see a lot of student involvement, no matter what day you came.

Researcher: Elaborate on what you mean by “student involvement.”

Rhonda: I try not to be sole provider of information. I try to let my students discover a lot on their own, without my feeding it to them - or if one student understands a problem and another doesn't, I'll let that student explain it to the class. I don't want my students to see me as all knowing. I want them to see me as learning with them. You'll also see a lot of student interaction and I'll just kind of sit back to the side and interject when appropriate, like if they get a term wrong, I'll interject a question to see if they correct themselves.

Category: Real-World Applications. Helping students see the relevancy of their learning was important to Rhonda.

I will make sure to include real world applications for the mathematics that is being learned. I want to always be able to answer the questions, “why are we learning this?” I feel that students will be more interested in learning if they can see where they are going to use this in real life. This will help them prepare for other activities because I will have trained them to always apply what they learn to other subjects or areas of interest. Then no matter what they are learning, they will always be able to transfer that knowledge to something that interests them.

Category: Student Discovery. That students discover was another theme evident in Rhonda's teaching practice.

I think it is important that students discover some of the mathematics on their own. By guiding the students to finding their own solutions to problems on their own, they can feel ownership of the problem. When students feel ownership of something they usually treasure it more and get higher expectations of themselves and they will strive to keep discovering things. Also, by letting the students discover the mathematics, I will be

preparing them for the type of thinking they will need when they are out of high school, whether they go to college or straight out into the real world. In addition, when students come up with something on their own they are more likely to remember that information because they found it in the first place.

Category: Understanding Student Needs. A central component of Rhonda's philosophy is the need to get to know the students. This component is reflected in the theme of *understanding student needs*.

I think it is very important to get to know your students. However, it is not only important to get to know them inside the classroom, but outside the classroom as well. If you can find out what their interests are and what they want to do eventually it can help you gear the lessons towards those students, and even keep their interest in the subject higher. I would also get to know my students well enough to find out what type of mathematics they are going to need to know to help them reach their maximum potential.

I would make sure I get to know the community I am teaching in and what demands that the community places on those students. I would see what types of jobs are offered in the community and what types of college students in the community go to, to help prepare them for what is ahead. If I know I have a class full of students who are not going to go to college, but they are going to go back and work in that community, then I would gear my lessons to real life mathematics that they can apply to their lives outside of school. However, at the same time if most of my students were going to go to UGA, I would make sure I teach them not only what is applicable outside of the classroom, but also what they will need to be competent in to be successful at UGA.

Category: Interest in Mathematics. One of Rhonda's goals was to have students develop an interest in mathematics. As she stated,

I would also make sure I always keep my students interest in mathematics high. When interest in a subject starts to drop, then so does their attitude towards learning and their desire to learn new and interesting mathematics. I want my students to see math as a subject that is applicable to them and my making math interesting I think they will portray it as an applicable subject matter.

Category: Not Crossing the Line. Yet another theme evident in Rhonda's thinking and classroom practice was *not crossing the line*.

Connecting with students academically and personally, without crossing the line between teacher and friend. This has been a topic that has always been in the back of my mind as I teach. I think it is important to connect to your students academically and personally. It not only makes them more interested in what you are teaching, but it makes them feel as if you really do care about them and you are not just paid to stand at the front of the room and make them learn.

The "line" between teacher and friends is a hard line not only to find, but it sometimes takes a lot of thinking to not cross it. With me being such a young teacher this makes not crossing that line a lot more important. My students see me as someone close to their age that they may want to consider me a friend instead of a teacher.

I try to always turn certain questions back to math, so that I don't cross that line. Also when a student will tell me stuff about their lives I will listen to what they have to say, but I will not ask questions or get involved in their lives. For example, I have a student who always insists on asking me what type of music I listen to. He will sometimes in the middle of class list bands asking me if I like them or listen to them. I replied to this student that the only type of music I listen to is math. This got him to stop asking me, which is what I wanted!

I do feel that I know a lot about my students academically, by just teaching them for these past seven weeks, but I also know a little about

them personally through observations of their behavior or from what my mentor has told me. This helps me relate what I am teaching to their lives, so that they can see why they would use this topic not just in my classroom or other subject areas, but also in their daily lives outside of school. For example, a lot of my students are involved in sports here at Cooper High School, so when I am teaching I try to find ways to relate the material to a sport. I try to pull in examples using things they would see outside in their community, and problems they may be faced with outside of school.

I feel like I have done a good job connecting with students both academically and personally without crossing the line between teacher and friend. I feel that there are a lot of teachers, mostly the younger ones, who think that becoming friends with the students will make them respect them more, but I have found the opposite to be true. I feel that even though I am not best friend with my students, they respect me just as much as they do their other teachers. I think I have found the right balance between teacher and friend for my students this semester. I am happy with the relationships I have with my students and I think they are happy with it too.

In the final interview, I asked Rhonda to tell me the effect she thought CTL has on student engagement. Rhonda replied,

It promotes it. It's not my class, it's their [the students] class. It opened my eyes. I don't have to know everything...I can learn from them. Like when Janet did that problem today. I would never have worked it that way. I'll take her ideas back to second period and share it with them. CTL has given me the flexibility to think of other ways to explain quickly to change lesson plans.

Student Mastery

Theme	Categories
Student Mastery	<ul style="list-style-type: none">• Assessment Tools• Metacognition

Student mastery refers to a student's demonstration of mathematical knowledge. Two categories were identified in Rhonda's teaching practice: assessment tools and use of metacognition.

Category: Assessment Tools. Rhonda used a variety of assessment tools to determine mastery of mathematics knowledge. For example, she used quizzes, tests, projects, observation, and homework. Following are excerpts from an interview in which Rhonda discusses student mastery:

Researcher: Rhonda, would you please describe your 5th period class today?

Rhonda: I gave a quiz today, unannounced. They wanted a quiz halfway through the chapter, so they would be able to test themselves to see what they know rather than waiting until the end of the chapter. It was on rational functions and rational expressions. I made up the test. I always make up tests. I always have a challenge question to see if they take what we learn and can apply it to something else. Geometry kids have a M&M lab for probability. I gave them a week. They have to develop their own probability project. It's due on Monday.

Researcher: How will you grade it?

Rhonda: On accuracy. I want to see if it really addresses probability. And on creativity, which is really hard to grade. It will be 25% of the project.

When I asked Rhonda to tell me what effect CTL had on the mastery of math she said,

Like from the review game. It's not mastered unless they can do it in 5 seconds. When they explain problems at the board, if you can explain it, you have 100% understanding. I monitor when they work on problems. I walk around and glance at papers. The students get confident. There are

fewer questions on homework or they'll go "Ahhhhhhhh" or they'll have facial expressions that tell me they understand.

Category: Use of Metacognition. Rhonda often had her students "think out loud."

Each day the class began with Rhonda or a student asking if anyone had problems completing homework. Students would call out specific homework problems that needed clarification. Students that were confident they had completed the homework problem successfully would volunteer to work the problem on the board. They would then metacognate, or "think out loud" the steps they used or the process used in solving the problems. To Rhonda, this use of metacognition indicated subject mastery.

Facilitators

Theme	Categories
Facilitators	<ul style="list-style-type: none">• Philosophy• Confidence• Relationship with cooperating teacher• Opportunities for ideas

The sixth theme associated with Rhonda's use of contextual teaching and learning principles and practices is facilitators. Categories associated with the facilitators theme include: philosophy, confidence, relationship with cooperating teacher, and opportunities for ideas.

Category: Philosophy. Rhonda had a strong philosophical stance that guided her teaching and embraced CTL. As stated in her educational philosophy,

As I strive to become a successful teacher, I have many goals for myself, and the students I will teach. One of my main goals is for the students to not only learn the required curriculum, but also be able to apply the information learned to their lives outside of the classroom. It is important to me that students truly learn the information and the meaning behind it. One way of obtaining this goal is for

me as the teacher to not be the prime source of information, but rather to guide the students so that they are in control of their own learning through problem solving activities. I will set high standards for my students in hopes that it will ensure that each student will reach his or her highest level of learning. I want my students to be able to think about the big picture instead of only focusing on the small components. I will always push my students to explore problems more in depth and go beyond what is expected of them through unique teaching methods, such as problem solving and hands-on teaching.

It is also my goal to teach my students using cooperative learning techniques. I believe that through cooperative learning students can gain a better understanding of the material while at the same time learning to respect other people and their ideas. Using cooperative learning, students are in charge of their own learning through problem solving and explorations. Having students working together allows the students to communicate and spread ideas around. In groups students can easily gain knowledge from each other and discover new ideas that may not even be mentioned by the textbook.

Part of my educational philosophy is to attain high standards in my classroom. I want my students to feel comfortable [and] to be able to discuss ideas in the classroom. I believe that it is important for students to learn not only from the teacher, but also from others in the classroom. I want my classroom to be a blend of teacher-centered and student-centered learning when it is appropriate. I am aware that there will be days when I will have to change the set-up of my classroom and teaching to accommodate all the students, and I am willing to do that. I will also be sure to include hands-on activities and the use of technology when I feel it will enhance the students understanding of the material. My lessons will focus on making sure the students learn the required curriculum. In addition, they will learn problem-solving skills, and they will learn other skills that will help them in the future both in school and outside of school.

Category: Confidence. Rhonda's confidence in her ability to prepare and teach was high.

Rhonda: All my friends in my program are all very jealous...they think I'm more prepared than they are [to teach].

Researcher: Do you think you are?

Rhonda: Oh, yeah, 100%. I told the head of the math department (at Cooper High) about C.L. [contextual learning]. She interviewed me and offered me a job. She asked me if my classes at the university have prepared me for my student teaching and I told her. She was getting a biased opinion of me because I was part of the C.L. program, and I told her what I thought it was. I learned more from my C.L. classes about teaching than other classes at the university.

I think these things are very important to make sure they are in my classroom now and next year and the years after. I do not ever want my student to walk out of my classroom feeling unprepared for what is to come next. Secondly, I do not ever want my students to think that their race or ethnic background is what is holding them back from reaching their maximum potential.

Category: Relationship with Cooperating Teacher. Rhonda felt her relationship with her cooperating teacher facilitated her teaching performance. As Rhonda said,

Lois [cooperating teacher] is interested to learn more C.L. [CTL]. She loves the activities. She's seen a lot of what I have done. She likes to learn new things. She is in her 8th year of teaching. Prior to teaching she was with AT&T and this is her way [of teaching]. She has an engineering undergraduate, a Master's, a Specialist, and has gifted certification. I am her 3rd or 4th student teacher in a row. She says it is good for her students to have a break.

I feel that I have achieved what I wanted to learn from my mentor. I am not saying that they is nothing else to learn, but by watching Lois teach, I have definitely learned a lot that I did not know before and that I had hoped to gain during my student teaching. I have learned how to see math topics from a different viewpoint, Lois has helped me with this because

everyday after I teach, we talk about what I could have done differently or how she used to teach it. We never say that one way is right or wrong, it is just a different viewpoint of the mathematical topic. The same is true about learning different ways to explain the mathematics. Sometimes after Lois lets me know a different way of explaining a topic, I will go back to my class the next day and show them the other way that I have just learned. It never hurts the students to hear something twice!

I would say that my mentor has learned almost all of the same things from me just from us working together. It helps to just talk about situations and, since we are different people, both of us bring a new light onto the topic we are discussing. I know Lois had learned all of the same things because now that I am observing her more these days, I can see some of my ideas that she incorporated in her class. For example, she has been using my grouping ideas in some of her classes that she never used to do when I observed her last semester or even at the beginning of this semester. My list of things that I thought Lois would learn from me were very similar to what I wanted to learn from her, and the reason is because I think we are both in this learning process and we are both learning from each other as we go. You never stop learning no matter how long you have been doing something.

Category: Opportunities for Ideas. Another facilitating category was the *opportunities for ideas*. Rhonda, during an interview in her first year of teaching, said she got CTL ideas from a variety of sources, including students and the text. Rhonda said,

I can think of a few [facilitators]. First, there are the students. They give me ideas. They'll ask why something works the way it does. We'll stop and explore why and other ways of solving the problems.

The textbook is another place where I get ideas. It has inclusion ideas, strategies for kinesthetic learners, rationales for teaching certain concepts, and real world problems. However, I do have to say that some of

the real world problems are stupid, and there is at least one problem worked wrong in every section.

Barriers

Theme	Categories
Barriers	<ul style="list-style-type: none">• Time requirements• Classroom management• Thinking of a context• Same page, same day mandate

Barriers refer to inhibitors to implementation of CTL practices and principles. Categories associated with the theme of barriers include: time requirements, classroom management, thinking of a context, and the same page, same date mandate.

Category: Time Requirements. During both Rhonda’s student teaching experience and her first year of teaching, I asked her about barriers to CTL. She said,

Time has been one of my biggest problems in the classroom. In the beginning [mentor teacher] would tell me about how long something should take and now, based off the experience, I can now judge for myself how long a lesson or a test should take the class. I think one of the biggest obstacles to CTL is time, planning time. It takes more time to plan CTL in the classroom.

Category: Classroom Management. Classroom management was identified by Rhonda as another barrier. Rhonda discussed this during her student teaching experience.

Lois has also helped me deal with classroom management. Every time a situation comes up in our classroom, we make sure to talk about all the different views of the situation and all the different ways to handle that situation. This helps that there are two of us, since sometimes one of us will see it in a different light than the other. Also, Lois is more experienced in the classroom and knows more of the procedural issues than I do, so she has really helped to inform me about school policy about certain issues.

Category: Thinking of a Context. Thinking of a context was sometimes an obstacle for Rhonda during her student teaching.

I have also learned a lot about bringing math into context for the students. This is a very important issue for me because of my involvement in the CTL program. However, sometimes it is hard to think of a context for some of the mathematical topics I am introducing in my classroom. In this case, Lois will generally have an idea that I will be able to use in the classroom. Sometimes, I will think of a context, but I will not be sure of how I can bring it into the classroom and then Lois can help me with those issues.

Rhonda reemphasized this barrier during her first year of teaching. As she said,

Sometimes it's hard to find or think of activities that go along with the math that I am teaching. It is especially hard when I have to teach a certain topic when I don't really like it or understand why they have to learn it.

Category: Same Day, Same Page Mandate. Rhonda was extremely frustrated by the county's rule that required all teachers to teach according to a curriculum schedule.

As she vented,

I'm so frustrated...there is no time to go deep with their math learning. These students are brilliant. The class average is 91. According to the curriculum guide, I'm already a chapter behind. I need enough time to get through the section with notes to adequately cover the material...not the few days in the curriculum guide. The students deserve more. For example, you have to cover Chapter 10. You have to stay up with where the other teachers are [all math teachers in Cooper High School and within the entire school district have to stay together]. I understand, but you have to go so fast. You have to think for yourself as a teacher. Decide what is important and what you need to get through. There is not enough time to do anything in class. My curriculum is so packed; an activity or something

little throws me off track. It takes time to plan and the students take me at face value. They don't necessarily know how hard I work at it.

Discussion

This study sought to examine the use of contextual teaching and learning principles and practices by a high school mathematics novice teacher. In this discussion of findings, I examine the four research questions, one at a time.

Research Question #1: *How does the teaching practice of CTL-trained novice teachers differ from more traditional approaches to teaching the subject matter?*

I asked a student sitting in front of me during an observation in Rhonda's first year of teaching what he thought about his teacher.

Researcher: What do you think of your math teacher?

Student: Very smart, very cool, definitely my favorite teacher. She's real laid back. For the past two years I've made C's in math. This year I'm making A's.

Researcher: Anything else?

Student: She's personable. She adequately relates to the youth of this high school. She knows the material; she definitely has a good grasp of it. And, she's not boring.

So, according to one student, Rhonda, unlike other teachers, was not boring.

Rhonda's classroom also differed in at least three other ways. Constructive noise was the norm in Rhonda's classroom. Constructive noise refers to instruction-related talking, discussing, questioning, and sharing. Rhonda felt that for learning to occur, noise levels would rise. And she was fine with this, as long as it was constructive noise. Rhonda also did not mind having "structured chaos." At times, students were all talking at once, as in working the previous night's homework problems, walking around the room, as in the review game, or helping each other with learning new concepts. Rhonda also integrated

technology into her instruction. She used calculators and the Internet in creative ways to help her students learn and transfer mathematics information.

Research Question #2: *Which CTL strategies do CTL-trained novice teachers use in classroom teaching contexts? Why? To what perceived or measured outcomes?*

Among the strategies Rhonda used were problem solving, projects, inquiry, collaborative learning, games, note taking, and authentic assessment. Strategies can be divided into two major types: task-limited and across-domain. Rhonda used a combination of task-limited and across-domain strategies with her students. Task-limited strategies are used only in very specific situations in a particular content or domain. A mathematics task-limited strategy Rhonda used was Poyla's Problem Solving Phases. Across-domain strategies are used to accomplish particular goals. They are general strategies that can be applied broadly across content or domains. An across-domain strategy Rhonda used was collaborative learning.

Task-limited and across-domain strategies can also be sorted into four groups by purpose: directive, generative, meditative, and collaborative. Directive strategies are used to acquire and retain important facts, ideas, and skills. An example of a directive strategy used in Rhonda's class was note taking. Generative strategies are designed to help develop new solutions, insights, and creativity. Chalk-talk was an example of a generative strategy that Rhonda incorporated into her teaching. Meditative strategies are used to help develop reasoning, concepts, and problem solving processes. Rhonda used inquiry, problem solving, projects, and authentic assessments as meditative strategies. Rhonda also used a variety of collaborative strategies. Collaborative strategies are used to help students learn to relate to each other and work cooperatively in groups. Examples of

collaborative strategies Rhonda used included cooperative learning and reciprocal teaching.

Purposeful use of CTL strategies was inherent in Rhonda's teaching. The variety of strategies Rhonda used in her teaching was important to her and her students. Strategies were adapted to fit different situations and needs. Rhonda used strategies effectively to increase student involvement, interest, and motivation. They helped students develop decision making, problem solving, interpersonal, and communication skills. The strategies Rhonda incorporated into her teaching provided students opportunities to deal with complex problems in often concrete ways. Use of these strategies helped students gain confidence in their learning, which ultimately helped Rhonda gain confidence in her teaching.

In the final interview, I asked Rhonda the following question: How do you know if strategies you use work? Without a pause, she responded,

They [strategies] don't all work. If they don't work I get blank looks and I don't use them again. I'll come up with a better way to explain it. My second period students are my guinea pigs.

Research Question #3: *What are the facilitators and barriers to implementation of various CTL strategies in actual practice in school settings?*

Rhonda's use of contextual teaching and learning principles and practices was sometimes facilitated and sometimes thwarted. Her own teaching philosophy, her high level of confidence, her relationship with the cooperating teacher during student teaching, and her search for ideas were identified as facilitators of CTL. Rhonda's confidence in her ability to prepare and teach was high. She felt her relationship with her cooperating

teacher facilitated her teaching performance and said she got CTL ideas from a variety of sources, including students and the text.

Barriers to implementation of CTL practices and principles included time requirements, classroom management, thinking of a context, and the same page, same date mandate. Thinking of a context was sometimes an obstacle for Rhonda during both her student teaching and her first year of teaching. Rhonda was also frustrated by requirements that forced all teachers to teach according to a rigid curriculum schedule.

Research Question #4: *What effect does use of CTL strategies have on student engagement and mastery of subject matter content (i.e., selected measures of student achievement)?*

Rhonda engaged her students through a variety of means. She was a learner along with her students and encouraged student interaction. She made learning relevant using real world applications. She provided opportunities for students to discover mathematics. She took time to get to know her students and understand their needs. She then used this knowledge to prepare appropriate lessons. She understood the line between friendship and teacher and was careful not to cross that line.

A central focus of Rhonda's teaching in both settings was her desire to increase student mastery of subject matter. However, before she could expect her students to master the subject matter, she had to master it herself. Rhonda's mathematical content knowledge was impressive. Rhonda had a keen sense of both content standards and performance standards, necessary knowledge for increasing student mastery of mathematics. A content standard is a broad learning expectation, often stated as a school-wide or grade-level expectation, such as mathematical operations. A performance

standard is a subset of the content standard and defines the learner expectation at a learning unit level, and sometimes grade level. What was impressive about Rhonda's teaching was her ability to translate her knowledge of mathematics to students in a way that facilitated student mastery.

Generally, I think of a novice teacher as in an exploratory mode, exploring and coming to understand her or his own philosophy of teaching, thinking about what to teach, how to teach, how to know when a student begins to understand. Rhonda was different than most other novice teachers I have observed. From the beginning of her student teaching, Rhonda knew who she was as a teacher. There was no, "When I get my own classroom..." or "I'll be able to do this after my first year..." or "Once I get my master's." Rhonda was 100% sure of herself as a teacher. How did this happen? She said it was her foundation in contextual teaching and learning at the University of Georgia. According to Rhonda,

I learned more from my CTL classes about teaching than other classes at the university. I had Foundations with A., Psychology with K., Seminar with S., Seminar with T., Community Seminar with you, and Academic Community Learning [service learning] with you. Dr. S.'s seminar helped me see different types of learners and how to approach each type. The Academic Community Learning class helped me to see how to apply math outside of the classroom and to different disciplines. That class helped me to see how to use technology and other resources in the classroom other than the text. The Community Seminar helped me to see that you can't relate the topic to your students if you don't know the students. A few math methods classes gave me project ideas...things I could twist into CTL. My math [content] classes did not help with CTL at all.

In my first interview with Rhonda, I asked her what I would see if I observed in her class.

She said,

Depends on what day you come, what I was teaching, and what kind of day my students were having. You would definitely see a lot of student involvement, no matter what day you came.

That is exactly what I saw in Rhonda's classrooms, both during student teaching and during her first-year teaching. I saw students engaged in mathematics. I saw a teacher's belief in CTL principles and practices.

Recommendations

For Facilitation of CTL in School Settings

- Offer CTL principles and practices mentoring
- Create student portfolios that capture CTL learning
- Provide mechanisms for community understanding
- Recognize student and teacher involvement in CTL through public demonstrations of learning
- Create opportunities for service learning
- Provide professional development opportunities focusing on CTL principles and practices

For Institutions of Higher Education Emphasizing CTL

- Provide a variety of courses designed to enhance CTL strategies of prospective teachers
- Encourage collaborative opportunities for preservice teachers and professors
- Recognize student and professor involvement in CTL
- Facilitate documentation and communication strategies to stimulate networking
- Provide professional development opportunities for increasing confidence levels of preservice teachers
- Provide CTL professional development opportunities for faculty

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Appendix A

Honors Algebra II Curriculum Outline

Honors Algebra II
Fall 2002
Leon Springs High School

Semester 1: August 12, 2002-December 20, 2002

Textbook: *Algebra 2*, Holt, Rinehart and Winston, 2001

Course Outline:

- Chapter 1: Data and Linear Representation
- (Quarter 1) Chapter 2: Numbers and Functions
- Chapter 3: Systems of Linear Equations and Inequalities
- Chapter 4: Matrices
- Chapter 5: Quadratic Functions
- Chapter 6: Exponential and Logarithmic Functions
- Chapter 7: Polynomial Functions
- (Quarter 2) Chapter 8: Rational Functions and Radical Functions
- Chapter 9: Conic Sections
- Chapter 10: Discrete Mathematics: Counting Principles and Probability
- Chapter 11: Discrete Mathematics: Series and Patterns
- Chapter 12: Discrete Mathematics: Statistics

Grading Policy:

Tests 40%	90-100	A
Quizzes 25%	80-89	B
Homework/Classwork 20%	70-79	C
Final Exam 15%	69 and below	F

Assignments:

Homework/Classwork: Practice plays an essential role in the learning of mathematics.

Homework/Classwork will be assigned daily and must be entered into the notebook and will be checked in a variety of ways.

Tests:	Tests will be given at the end of each unit.
Quizzes:	Approximately 1-2 short quizzes will be given per unit.
Projects/Labs:	A few projects or labs will be assigned throughout the course and will be graded as classwork, quizzes or tests depending on the work required.
Expectations:	Be on time to class. Come to class equipped with paper, pencil, homework, 3-ring binder and text always. Speak respectfully to your peers and teacher.
Attendance:	Attendance is extremely important in a mathematics course, especially with block scheduling. If a student must miss, he or she is responsible to do the required make-up work in accordance with the Student Handbook.
Discipline:	Disruptions will not be tolerated. If a student is disruptive in class, he or she will be given one verbal warning. On the next occasion, the student will be given detention. Inappropriate language as well as eating in class will result in an immediate detention (no warning). If problems persist, parents will be contacted for further action.
Honor Code Violation:	When a student is found cheating, the teacher <i>must</i> issue a grade of zero for the assignment and complete an Honor Code Violation form.
Recovery:	I will comply with the recovery policy stated in the Student/Parent Handbook. It is the student's responsibility to initiate contact for recovery.
Extra Help:	Each Monday I will write the times I will be available on the chalkboard for that week. Furthermore, my email address is.... if anyone wishes to email me a question or concern. I have found this to be a convenient means of communication.
High School Graduation Test Objectives:	This course addresses objectives 10-16, 33-36, 38, 41-44.

Appendix B

Ellipse Lesson Plan