Experiencing the Activity of Teaching “At-Risk” College Mathematics Students: Perspectives of Two College Teachers

by

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A thesis submitted in conformity with the requirements for the degree of Doctor of Philosophy
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Abstract

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This study investigates how two mathematics instructors experience the activity of teaching ‘at-risk’ learners in preparatory college courses. This study was borne out of the need to understand and articulate how to engage and teach the ‘at-risk’ college mathematics learner.

This study employs qualitative methods to describe, analyze and compare the instruction of ‘at-risk’ college mathematics learners. The two case studies reveal the similarities and differences in experiencing instruction that arise when teaching ‘at-risk’ college mathematics learners.

Specifically, this study examined three areas with respect to teacher experience and understanding of: (a) teaching strategies; (b) non-cognitive/affective issues; and, (c) open and responsive learning environments. There are eight major findings that were influential in the participants negotiation of teaching ‘at-risk' college mathematics students as it related to the above areas: (1) Conferences are a good way to provide individual attention to ‘at-risk’ college mathematics students; (2) Both individualized or lecture style delivery methods could be used; (3) College instructors of ‘at-risk’ mathematics students believe that they could create positive attitudes about mathematics by using humour, using praise, being caring, being patient, engaging in personal life stories, recognizing confusion and frustration in their students and being sensitive to outside pressures experienced by students; (4) The positive learning environment created by
the College instructors of ‘at-risk’ mathematics students lead to self-regulation by the student. Providing conferences for personal attention, providing individualized educational plans and providing constant teacher feedback kept students focused on their end goals; (5) College instructors of ‘at-risk’ mathematics students believe that the emotional state of their students is important to their overall learning and that more could be done to access emotional support for students; (6) College instructors of ‘at-risk’ mathematics students used minimal technology and did not believe that the use of technology would enhance their instruction; (7) College instructors of ‘at-risk’ mathematics students were mindful and responsive to the individual differences among their students; and (8) By encouraging students to articulate their lack of understanding, instructors were able to identify areas of individual needs and assist their ‘at-risk’ students.
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Chapter One: Introduction

1.1 Introduction

The purpose of this research is to investigate how mathematics instructors perceive their experiences teaching ‘at-risk’ learners at the college level. The focus is on the stories they tell that relate to their ideal versus actual teaching experience.

I begin this investigation by first delving into the current literature. Then, I interview and observe two college mathematics teachers in their classroom to collect data to ultimately compare and contrast their teaching practices and experiences of teaching ‘at-risk’ mathematics students. I employ qualitative methods to describe, analyze and compare the instruction of ‘at-risk’ college mathematics learners. In particular, I employ case study as a tool to tease out the processes used by the college mathematics instructors to engage and teach the ‘at-risk’ college mathematics learner. These case studies help reveal any similarities or differences in instruction that may arise when teaching ‘at-risk’ college mathematics learners. This chapter outlines the formulation of my inquiry, the purpose of the study and the outline of this thesis.

1.2 Research Context

We have a fundamental drive to understand the world in which we live in. Each of us sees the world through a different lens and we make sense of our world through the experiences we have. John Dewey (1934) provides us with the formal tools in which to analyze each individual’s reality of how they experience the world. In his work, Art As Experience, he describes what experience means in relation to art (Dewey, 1934). Similarly, I have drawn comparisons to experiencing the act of teaching with Dewey’s (1934) vision of experiencing.

In general terms, Dewey (1934) describes experiencing as occurring “continuously, because the interaction of live creature and environing conditions is involved in the very process of living” (p. 1). With respect to this study, the “interaction of live creature and
environing conditions” can be perceived as the instructor in the act of teaching in the classroom. Dewey (1934) further articulates the notion of ‘doing’ and ‘undergoing’ as fundamental to the act of experiencing:

An experience has pattern and structure, because it is not just doing and undergoing in alternation, but consists of them in relationship. To put one’s hand in the fire that consumes it is not necessarily to have an experience. The action and its consequence must be joined in perception. This relationship is what gives meaning; to grasp it is the objective of all intelligence. The scope and content of the relations measure the significant content of an experience. (p. 5)

The instructor in an ‘at-risk’ college mathematics classroom is constantly experiencing this alteration of ‘doing’ and ‘undergoing’ in the act of teaching. An example might be that, in the act of teaching the addition of decimals, the blank faces in front of him/her may suggest that an additional example or examples are needed to further the understanding of the topic. As long as students connect the example to the rule, then the act (action) of teaching a lesson and its intended objective (consequence) can be perceived by the doer and observer. In essence, the teacher has to see each “particular connection of doing and undergoing in relation to the whole” (Dewey, 1934, p. 6) that he or she desires to create. The whole in this case can be a lesson, a chapter or an entire semester of work.

Another important idea that Dewey (1934) purports is the notion of intelligence, emotion and practicality in the act of experiencing. He considers these as adjectives of the experience (Dewey, 1934) and maintains that they should not be considered as entities but in relation to one another. This is made clear when he states that:

It is not possible to divide in a vital experience the practical, emotional, and intellectual from one another and to set the properties of one over against the characteristics of the others. The emotional phase binds parts together into a single whole; ‘intellectual’ simply names the fact that the experience has meaning; ‘practical' indicates that the organism is interacting with events and objects which surround it. (p. 11)
I take this to mean that the interplay of pedagogical content knowledge (intellectual), affective domains (emotional) and learning environments (practical) are all involved in experiencing the act of teaching. Each of these adjectives of experience is embedded in the act of teaching the ‘at-risk’ college mathematics learner.

In my thirty years of teaching, I have come to understand better the intellectual, emotional and practical relation that Dewey (1934) highlights in the act of experiencing that I have come to connect with the act of teaching. I have taught at the elementary, high school and college level in Ontario. Of those years, I have been involved with teaching mathematics to ‘at-risk’ students at the college level for seven years. These students often lack the necessary skills in mathematics and are therefore considered to be in danger of, or ‘at-risk’ of, not completing their program of study. Often, low raw scores on the Canadian Achievement Test, Third Edition (CAT 3) or College Placement Test scores (CPT) determine that some students need to take a remedial level or preparatory mathematics course prior to beginning their program of study.

This specialized group of students must obtain basic skills in mathematics before they can be successful in their chosen field of study (Brothen & Wambach, 2004; Carruthers, 2016; Goldrick-Rab, 2010; Roueche & Roueche, 1994; Saloojee, 2005). However, because many of these students have encountered countless years of frustration and lack of success, especially in mathematics, engaging them in the classroom can become problematic.

Mindful of the unique qualities of this group, there emerge questions regarding the instruction of these students. Although the NCTM Standards (2000) exist as a guide, there are no consistent program standards in mathematics across Ontario colleges (College Mathematics Project, 2008). Even though mathematics programs in the Ontario colleges have developed relatively independently of each other, all policies and procedures must adhere to the overall
framework, directives and policies established by the Ontario Ministry of Training, Colleges and Universities (College Mathematics Project, 2008). Each college, however, can interpret and implement these standards differently. Therefore, mathematics as a discipline falls into a prescribed set of skills demanded by each program of study in Ontario colleges (Byers, 2004). As a result, mathematics programs may vary according to different programs within and between some Ontario colleges.

The policies referring to standards offered by the Ontario Ministry of Training, Colleges and Universities are a series of broad, system-wide program standards for all colleges in particular disciplines. These standards have three elements that are similar regardless of programs of instruction. They include the following:

- Vocational standard (the vocationally specific learning outcomes which apply to the program of instruction in question);
- Essential employability skills (the essential employability skills learning outcomes which apply to all programs of instruction); and
- General education requirement (the requirement for general education in postsecondary programs of instruction). (Ministry of Training, Colleges and Universities September 2009)

Regardless of the program, however, I believe that college instructors should strive to balance the mathematics curriculum with the engagement of the learner. An important research issue that emerges is how best to teach the required mathematics skills necessary to this specialized group. It is hoped that, by observing college instructors of ‘remedial’ or ‘preparatory’ mathematics, a better picture will emerge as to what may constitute as ‘best practices’ in the field of ‘at-risk’ college mathematics’ instruction.

1.3 Purpose of the Study

The purpose of this study is to investigate how mathematics instructors experience the activity of teaching ‘at-risk’ learners at the college level. An emphasis will be placed on the experiences of the instructor teaching preparatory college mathematics courses, therefore, only a
cursory treatment of the learner will be made. Attending various workshops, forums and conducting ongoing research in the area of ‘at-risk’ students in colleges has led me to the following observations: the identification of ‘at-risk' students has been discussed at length over the years; even the stakeholders have been identified. This study was borne out of the need to understand and articulate how to engage and teach the ‘at-risk’ college mathematics learner.

As a college mathematics educator, I have been involved in the teaching of students deemed ‘at-risk’ and, as a result, the research questions that guide this study have been developed over the course of my teaching with the aim of helping me to better understand the processes involved in engaging the college mathematics learner. To facilitate this process, a review of the relevant literature was undertaken to help elucidate the space between the ideal teaching practices versus the actual teaching practices of mathematics instruction in the college classroom. The stories of the participants help to illustrate possible supports for these learners and the actual teaching practices of those instructing the ‘at-risk’ college mathematics learner are described. Understanding the experiences of those who teach will help one better understand the complex activity of college mathematics teaching.

1.4 Research Questions

The main focus of this research is how college mathematics instructors perceive the activity of teaching ‘at-risk’ learners. The research questions that help to tease out the actual teaching experience of the instructors are:

1. What strategies are used by the instructors to teach their ‘at-risk’ college mathematics students?
2. How does the instructor experience non-cognitive issues that affect the teaching of the ‘at-risk’ mathematics learner?
3. How does the college instructor create an open and responsive learning environment?
1.5 Significance of the Study

This study is designed to offer insight into the perspectives of those teaching and instructing ‘at-risk’ college mathematics students. It is important to understand the stories, efforts, struggles and frustrations experienced by teachers as they relate to a prescribed set of strategies that are currently in use. These insights may also be useful in general terms for those in the field of teaching and programming curriculum for ‘preparatory’ or ‘remedial’ education across broad areas of study at the college level. It is hoped that this study will be useful for those teaching ‘at-risk’ mathematics at other levels other than college. The pedagogical practices to teach ‘at-risk’ college mathematics students could apply to all university and secondary school ‘at-risk’ learners.

1.6 Background of the Researcher

I have been an educator in Ontario for more than three decades at various levels. There have been numerous occasions where I have tried to reconcile meeting the objectives of a mathematics curriculum with how best to teach it. In teaching elementary school and high school for 16 of those years, I discovered the pressure in meeting specific curriculum objectives as outlined by Ministry of Education and School Board guidelines. I imposed some of this pressure on myself. I tried to balance prescribed content with teaching for understanding. Often, the pursuit of a perfect lesson was misguided by unforeseen obstacles of a classroom that may have included situations out of my control such as fire alarms, P.A. announcements, interruptions at the door, or a sick student.

It was extremely important to deliver the prescribed mathematics content efficiently within the timeline of the school year. I can remember, in particular, developing the concept of lines and planes in three-space to my senior students in Discrete Math (a former mathematics
course in Ontario). Students had difficulty envisioning points, lines and planes in three-space. If I had used a Socratic method of delivery, I may not have reached some students. Instead, I challenged students to first build three-space models with straws and plasticine so that a broader understanding could be achieved before intersections of lines and planes in three-space could be specifically discussed. By the end of the unit, most, if not, all students could now relate to solving problems in three-space because they could envision it.

Although all of this took time and effort in co-ordinating, it was nevertheless valuable in gaining understanding and insight in a student’s own knowledge construction. It is not surprising that the NCTM *Principles and Standards for School Mathematics* (2000) tells us that “effective mathematics teaching requires understanding what students know and need to learn and then challenging and supporting them to learn it well” (p. 11). The challenge for me, then, was teaching for deep understanding in practice given the constraints of time and unanticipated interruptions of a busy classroom day.

I always had the desire to better my practice, but I also recognized the challenge of integrating subject matter knowledge and pedagogy in practice. To this end, I enrolled in a Master’s program in Mathematics — and later, a Ph.D. program in a Department of Curriculum, Teaching and Learning — to facilitate and enhance my teaching of the subject matter. Every level of teaching has afforded me the opportunity to challenge myself in that endeavor, whether it be teaching junior, intermediate, adult or senior students. While I have gained many insights along the way, I acknowledge that I am nowhere near the end of my journey.

More recently, I have been teaching mathematics at the college level. Over the past fifteen years, many questions have surfaced about the instruction of a particular type of student: the ‘at-risk’ college mathematics learner. These students lack the necessary skills in mathematics
and, because they are ‘at-risk’ of completing their program, they must take ‘preparatory’ or ‘remedial’ classes prior to beginning, and, in some instances, alongside their chosen field of study.

In the past, I have tried various strategies including journals, “math moments” (Farren, 2008), and the use of technology to better understand and teach this particular type of learner. Journals were used to record how students felt about particular lessons and ‘math moments’ gave me an insight into past mathematical experiences of my students. Through time, I found a real connection between past negative mathematical experiences with the current state of a student’s ability to perform mathematics.

While observation and anecdotes written at the end of the lesson served as informal methods in evaluating these strategies, I never formally measured the trend in how it may have affected their learning. My experiences in this type of classroom, however, taught me that, if I could make my classroom environment positive and inviting, then attitudes about mathematics could change for the better. My focus was directed at giving students confidence at learning mathematics, and I began to wonder if other instructors of college ‘at-risk’ mathematics students experienced the same. As a result, I have become increasingly preoccupied with how best to instruct these learners and, over the years, I have wondered about the impact that emotion has on learning mathematics. I have therefore included the perspective of instructors in my study.

1.7 **Key Terms**

**At-Risk**

The term ‘at-risk’ has a number of connotations in education today. It can be viewed as a term that applies to marginalized students in “precarious positions” (Mulvey, 2009), or a label given to students who are underprepared (CPM, 2008). The term ‘at-risk’ as defined by *The
Glossary of Education Reform (last updated August 29, 2013) can be used to describe students “who are considered to have a higher probability of failing academically or dropping out of school” (https://www.edglossary.org/at-risk/) and “who are poorly equipped to perform up to academic standards” (Horton, 2015, p. 84).

Horton (2015) identifies students who are more likely to be at-risk as being first generation college students. Horton (2015) defines college ‘at-risk’ students:

At-risk students may be (a) those who have made poor choices or decisions that negatively impacted their academics, (b) adult students who return to higher education after an extended absence, or (c) students with academic or physical limitations not identified before enrolling in higher education. (p. 85)

More specifically, in mathematics, ‘at-risk’ students have been described as possessing an “inadequate understanding of concepts that were first taught in elementary school – key concepts such as fractions, ratio and proportion, and percentages, among others” (Dion, 2014, p. 24). In higher learning, ‘at-risk’ college mathematics students are those students who have difficulty attaining an adequate level of basic skills in one or more of the following areas: arithmetic operations, math symbolism, geometry and measurement, functions, discrete math algorithms, probability and statistics, and deductive proofs (Arendale & Others, 2007; Shepherd, 2016). These students are in danger of failing or dropping out of their program of study as a result of their lack of attainment (Dion, 2014; Dziwak, 2014; Horton, 2015). For purposes of this study, an ‘at-risk’ student will be defined as those students who are in danger of failing or dropping out of their program of study because they do not possess the adequate level of basic mathematics understanding.

Open and Responsive Learning Environment

Research has suggested that students who are most likely to drop out of college are those students who feel a disconnect from the college environment (Shepherd, 2016; Smittle, 2003).
Students need to know that they are viewed as individuals and instructors should adopt strategies to promote feelings of belonging (Shepherd, 2016). The instructor must also be able to respond by providing feedback in a timely manner (Shepherd, 2016). As such, in this study, I define an “open and responsive learning environment” as an environment that is created by the instructor to promote teacher-student connectedness and awareness in responding to the student’s individual needs in the learning process.

1.8 Plan of the Thesis

This thesis is organized into five chapters. In Chapter One, I develop the evolution of the topic and research context. I also state the problem to be studied and provide the significance and limitations of the study. Chapter one concludes with my background.

Chapter Two contains a literature review. The literature review describes the principles of teaching mathematics within the three bodies of work as described earlier (NCTM, the AMTYC and the body of research in the area of ‘remedial’ or ‘preparatory’ mathematics at the college level). This chapter also identifies the principles of effective teaching of ‘at-risk’ mathematics students.

Chapter Three provides a description of the methodological basis for this research and the particular method of this study. I provide a rationale for case study, and comments on issues of validity, reliability and ethics.

Chapter Four presents the findings from two case studies. Chapter Five integrates the findings from the two case studies to answer the research questions presented in Chapter One, and links these findings to research in the area of “at-risk” college mathematics instruction. Chapter Five concludes with a discussion of the study’s implications and suggested areas for future research.
Chapter 2: Literature Review

2.1 Introduction

The purpose of this review is to describe the relevant literature at it relates to the instructing of ‘at-risk’ college mathematics learners. I will begin by defining ‘at-risk’. I will then elucidate some of the principles for effective teaching as it relates to the ‘at-risk’ learner. From these principles, I hope to introduce the context of this study.

2.2 “At-risk” Students in College Mathematics

It is important to locate a working definition of what I mean by an ‘at-risk’ college mathematics student. As previously stated, ‘at-risk’ college mathematics students are those students who have difficulty attaining an adequate level of basic skills in mathematics. These students are in danger of failing or dropping out of their program of study as a result of their lack of attainment. It is then critical that the identification and support of ‘at-risk’ students is done early so that we are able to better support these students in their college careers. Indeed, research has suggested that the first year of college seems to indicate a critical time for student’s success and degree attainment (Center for Community College Student Engagement [CCCSE], 2004; Dion, 2014; Dziwak, 2014; Kuh, 2009; Shepherd, 2016).

Remediation is one action of support while developmental education is an alternative idea. In general, institutions typically refer to postsecondary remediation as ‘basic skills’, ‘compensatory’ or ‘preparatory’ education and students are remediated in a specific discipline (Bahr, 2008; Tomlinson, 1989). Research has further indicated that remedial mathematics has the highest enrolment among the typical remedial courses of reading, writing, and mathematics (NCES, 2012; Parsad, Lewis, & Green, 2003; Bailey, Jeong & Cho, 2010; Shepherd, 2016). Developmental education, on the other hand, develops a broad range of learning strategies to

It is believed that developmental education situates itself in the broader context of remediation and involves a comprehensive approach to helping all individuals improve their learning skills (Kozeracki, 2002). These learning skills can be supported when services such as placement, orientation, study skills training, freshman seminars and critical thinking instruction are offered as part of a complete program of student development (Boylan, 1999b; Boylan, Bonham, & Rodriguez, 2000; Boylan & Saxon, 1998; McCabe & Day, 1998).

While remediation is believed to encapsulate only one potential component of developmental education (Boylan, 1999b; Kozeracki, 2002), in this thesis, I will include both actions as supporting ‘at-risk’ students toward success in program completion. I view the term ‘at-risk’ within the body of literature that supports remediation discourse, but I purposefully include developmental education discourse as I see its merit in helping to develop a framework in which to deconstruct effective teaching of ‘at-risk’ college mathematics learners. For this study, an ‘at-risk’ student in an Ontario college may be assessed as needing remediation skills or developmental learning strategy instruction due to their past or present mathematical performance in relation to their chosen career path.

In Ontario Colleges, an ‘at-risk’ college mathematics student may also be considered as a student entering a one or two-year college program in need of mathematics remediation or basic skills mathematics development prior to entering his or her course of study. In a study by the York-Seneca Institute for Mathematics, Science and Technology Education, it was found that nearly 50% of students taking the most common sequence of college preparation mathematics
courses in high school (MBF3C at Grade 11 and MAP4C at Grade 12) were found to be ‘at risk’ when they reached the college level – this rose to over 50% for students enrolled in technology programs (College Mathematics Project, 2008). The College Mathematics Project further found that one-third of all students in these programs are either failing or barely passing mathematics (College Mathematics Project 2008). In the view of the College Mathematics Project, it was noted that “these students are at risk of not completing their chosen programs, an outcome with negative consequences not only for the students, but also for colleges, taxpayers, and the Ontario economy” (College Mathematics Project, 2008, p. 7).

Indirectly, the research undertaken by the College Math Project makes a possible case for identifying ‘at-risk’ students early. It can make a difference in a student’s college career when the college proactively intervenes with preparatory mathematics courses early in a student’s college career. This can make a difference in the successful pursuit of a program of study for the student. Ultimately, the conclusions of the College Math Project (2008) were twofold:

Student achievement in first-semester mathematics in Ontario colleges needs to be significantly improved; and that the achievement of this goal requires concrete action by all stakeholders, including students and parents, secondary schools and teachers, colleges and faculty and the Government of Ontario. (p. 39)

This raises a question – what are the ‘concrete actions’ to be undertaken by the ‘stakeholders’? More specifically, what are the college teachers of ‘at-risk’ mathematics students doing to engage and improve student achievement in first-semester preparatory mathematics courses? Is there any urgency to address the issue of student engagement and student achievement of ‘at-risk’ college mathematics students?

There are two types of students that make up the group of ‘at-risk’ math learners: those who recently graduated from high school, and those who have been away from formal education for a while. Pansy Waycaster (2001) sheds some light on these two types of students when she
states that approximately half (56%) of the students enrolled in remedial courses were freshmen from high school and over one-quarter (27%) of entering freshmen in remedial courses were age 30 or older. Similarly, the College Math Project (2008) refers to these two groups as Recent Ontario Graduates (ROG) and non-ROG. The first group may include students that have experienced difficulty in understanding mathematical concepts and have performed poorly in formative or summative tests early in their schooling. These experiences often translate to negative feelings or attitudes about mathematics, and consequently, their high school mathematics career is a reflection of that negativity.

The second type of ‘at-risk’ math learner includes those students who have been out of touch with formal mathematics learning for a while. These mature students, although willing to learn, may lack the background necessary to be successful in math. Some may have also encountered negative schooling experiences. Smittle (2003) identifies these learners as lacking “the foundation and skills required for rigorous college curriculum and many of them have adult responsibilities that place excessive demands on their time and other resources” (p. 10). Both types of learners can feel inadequate and misjudged as overall weak students when it is specifically mathematics that gives them difficulty. The classroom then becomes a melting pot of two groups of ‘at-risk’ learners, who together must come to an understanding of what it means to know and do mathematics.

2.3 Principles of Teaching Mathematics

In mathematics education in North America, the cornerstone of mathematics instruction arises out of the standards of practice developed by the National Council of Teachers of Mathematics (NCTM). A number of documents have evolved to give direction to the teaching and learning of mathematics at the K-12 level in which students were envisioned as interacting with each other and the teacher while pursuing meaningful and stimulating mathematical tasks.

Numerous and various interrelated experiences which allow them to solve complex problems; to read, write and discuss mathematics; to conjecture, test, and build arguments about a conjecture’s validity; to value the mathematical enterprise, the mathematical habits of mind, and the role of mathematics in human affairs; and to be encouraged to explore, guess, and even make errors so that they gain confidence in their own actions. (p. 1)

The *Curriculum and Evaluation Standards for School Mathematics* (NCTM, 1989) and *Professional Standards for Teaching Mathematics* (NCTM, 1991) identify the teaching principles that should be attended to while, at the same time, maintaining that mathematical instruction be seen as a set of complex interactions between teacher, students, mathematical tasks, and materials (Roulet, 1998). In *Principles and Standards for School Mathematics* (NCTM, 2001), NCTM has incorporated a vision where:

All interested parties must work together to create mathematics classrooms where students of varied backgrounds and abilities work with expert teachers, learning important mathematical ideas with understanding, in environments that are equitable, challenging, supportive, and technologically equipped for the twenty-first century. (p. 1)

In this document, the NCTM has acknowledged that standards can play a leading role in guiding the improvement of mathematics education.

In Ontario, the approaches to teaching mathematics in grades K-12 are outlined in Ministry of Education documents and argue that diverse methods should be used in the teaching of mathematics:

Students in a mathematics class typically demonstrate diversity in the ways they learn best. It is important, therefore, that students have opportunities to learn in a variety of
ways – individually, cooperatively, independently, with teacher direction, through investigation involving hands-on experience, and through examples followed by practice. In mathematics, students are required to learn concepts, acquire procedures and skills, and apply processes with the aid of the instructional and learning strategies best suited to the particular type of learning. (Ontario Ministry of Education, 2007, p. 30)

2.4 Teaching Mathematics in the College Classroom

It has been recognized that “teaching mathematics is a profoundly human affair and, as such, should be steeped in human interaction” (Driscoll, 1987, p. 2). How we teach mathematics, then, deeply impacts the student’s understanding. The American Mathematical Association of Two Year Colleges (AMATYC, 2005) produced a paper entitled Beyond Crossroads: Implementing Mathematics Standards in the First Two Years of College, which emphasized the connection between human interaction of teacher and student. AMATYC (2005) recommends that “Effective mathematics instruction requires a variety of resources, materials, technology, and delivery formats that take into account student’s different learning styles and instructor’s different teaching styles” (p. 51). Teaching style refers to “an instructor’s content-independent, persistent qualities, attitudes and traits” and is “directly linked to the instructor’s educational philosophy and a subset of the instructor’s life philosophy” (AMATYC, 2005, p. 51). The instructor, then, must understand where they fit in the continuum of teaching styles so that the instructor can make informed decisions about teaching (AMATYC, 2005). This is the key difference between just simply teaching and becoming a professional educator.

A study by Messa et al. (2014) described three particular teaching approaches used by college mathematics instructors: traditional, meaning-making and student-support. They described a student-centred approach as “strategies that appear to be driven by instructors’ interest in attending to students’ cognitive, social, and emotional needs, seeking to give students a more prominent role in classroom activities” (p. 122). They describe the traditional approached
used by instructors as the “prioritization of content transmission” and the use of “mostly lecturing” (p.126). They place themselves as the authority in the classroom and emphasize covering the content and the importance of examinations” (p. 126).

A meaning-making approach is described as instructors who “prioritize students’ learning and use activities that encourage students’ participation in the classroom as these activities make students’ thinking about the content more visible” (p. 126). A student-centred approach is described as instructors who:

prioritize students’ needs (e.g., increasing their self-confidence) by, for example, making concessions about curriculum coverage or deadlines for assignments. They are highly empathetic to students’ life circumstances; for them, learning the content is secondary to students’ well-being in general. (p. 126)

Messa et al. (2014) were interested in “whether teachers who more frequently described student-centred approaches were more likely to use more challenging questions in their teaching than teachers more frequently describing content-centred (traditional) approaches” (p. 123). Their study concluded that:

Instructors who more prominently described content over student needs and difficulties expected their students to learn the material on their own and preferred to cover predefined content in a set time. What matters most to these instructors is that the students receive all the content that needs to be covered, even if their students cannot keep up with the pace of the lecture. (p. 134)

In addition, Messa et al. (2014) revealed what a student-centred approach looked like for the instructors:

Instructors who privilege a student-support approach do not place students’ mastering the content as the main goal of instruction. Rather, they focus on improving students’ self-confidence and in developing relationships among students and between the students and the instructor. (p. 135)
The acknowledgement of considering student needs in instruction indicates a subtle difference in what sets constructivist model of teaching apart from other teaching models where teachers become facilitators and guides in the co-construction of knowledge (Messa et al., 2014).

2.4.1 Constructivism

The interplay of culture and context in knowledge construction gives rise to debate between a social process versus a cognitive process of knowledge construction within the constructivist model. Simon (1995) describes the psychological constructivist analysis as where “learning focuses on individuals’ knowledge of and about mathematics, their understanding of the mathematics of the others, and their sense of the functioning of the mathematics class” (p. 116). The sociological analysis focuses on taken-as-shared knowledge and classroom social norms (Cobb, Yackel, & Wood, 1989). Both Simon (1995) and Cobb (1989) agree that the two perspectives should be considered when understanding knowledge development in the classroom. The harmonization of psychological and sociological analyses has developed into a body of discourse called ‘social constructivism’.

In many studies involving the learning and teaching of mathematics, a social constructivist view has been adopted (Burr, 2015; Cobb, 1988; Lampert, 1990; Prawat, 1992; Schwartz, 2007; Simon, 1995; Thompson, 2013). These studies are concerned with the nature of mathematical knowledge related to the cognitive and sociological development both in individuals and societies. Kim (2001) describes social constructivism as a learning theory with strong epistemological elements that include the following:

Reality is constructed through human activity. Members of a society together invent the properties of the world. People create meaning through their interactions with each other and the objects in the environment. Learning is a social process. It occurs when people are engaged in social activities. (p. 8)
Prawat (1992) maintains that “in all constructivist teaching-learning scenarios, the traditional telling-listening relationship between teacher and student is replaced by one that is more complex and interactive” (p. 357). Complexity is woven into discussions of reality and truth. Thompson (2013) maintains that “knowledge cannot be thought of as a copy of an external reality, and claims of truth cannot be grounded in claims about reality” (p. 96). He further reiterates via the work of Steffe et al. (1983, 1988) that the importance of this stance for mathematics educators “is to remind them that students have their own mathematical realities that teachers and researchers can understand only via models of them” (p. 96).

To this end, both AMATYC (2005, 1995) and NCTM (1991) are in agreement with respect to instructional strategies that support the construction of knowledge. Both confirm that students construct their mathematical knowledge from experience and prior knowledge (AMATYC, 2005, 1995; NCTM, 1991). In this way, the instructional strategies suggested in these documents can have a “dramatic impact on what students learn” (AMATYC, 1995, p. 15) and “the use of instructional strategies that provide for student activity and student-constructed knowledge” (p. 15) make for a richer understanding of what it means to learn and do mathematics.

Understanding how instructors make informed decisions about teaching was investigated by Shepherd (2016). In particular, Kathleen Shepherd (2016) explores the “influence, if any, of the types of faculty development, including faculty mentoring and institutional policies and procedures pertaining to academic support services and student services, on instructor use of best practices in teaching remedial mathematics” (p. 3). The study concluded that there were “nine significant predictors of overall use of best practices, four of which were influenced by instructor demographics, three by institutional policies and procedures, and two by professional
development” (p. iii). This research highlights the importance of integration and co-operation of all stakeholders at an institutional level in servicing the teaching of remedial mathematics.

2.5 Placement Programs

The basic requirement for consideration for admission to post-secondary programs in the Ontario college system is the Ontario Secondary School Diploma (OSSD) or equivalent. The OSSD requires that students have one senior (Grade 11 or 12) mathematics course for graduation, however, colleges may stipulate a requirement for a particular Grade 12 mathematics course. Colleges may admit a student under a Mature Adult Admission provision when the student lacks a secondary school diploma or equivalent, and is 19 years of age or more before the start of classes. Students admitted under mature status must demonstrate proficiency in meeting specific program admission requirements (College Mathematics Project, 2008; Ontario Ministry of Training, Colleges and Universities, 2004).

Once a student is accepted into a college program, placement evaluations may be required. Advocates for a uniform standard for placement and assessment contend that it: 1) prepares students for college-level courses, especially under-served populations; 2) improves placement accuracy; 3) helps institutions establish a common benchmark to measure college readiness; 4) facilitates student transfer between two- and four-year institutions; and, 5) helps to develop performance measures to assess the effectiveness of development education sequences across institutions (Melguizo et al., 2014; NCPPHE & SREB, 2010; Prince, 2005). There exists, however, research that suggests a tension between assessment and placement policies at college institutions (Melguizo et al., 2014; Zientek et al, 2014). In particular, Melguizo et al. (2014) has interpreted this tension at the college level in the following way:

For community colleges this tension is particularly acute since their policy for admission has traditionally been open access. Assessment and placement have thus become key
factors in estimating a student’s level of preparedness for collegiate-level coursework, and for holding community colleges accountable for their students’ success. (p. 7)

Further research has suggested that placement tests alone may not be the only indicator of student readiness and student success (Hughes & Scott-Clayton, 2011; Parsad, Lewis, & Greene, 2003; Scott-Clayton, 2012; Zientek et al, 2014). Zientek et al (2014) conclude that “factors that are important to student success, include time delay, mathematics skills, and dispositional and situational factors” (p. 14).

In colleges, placement tests can be either voluntary or mandatory. It has been argued that mandatory placement tests itself can have an adverse effect on success (Boylan, Bliss, & Bonham, 1997; Melguizo et al., 2014; Zientek et al., 2014). Melguizo et al. (2014) have argued that “getting placement wrong risks placing students in a needlessly labyrinthine series of remedial courses, and ultimately jeopardizes a student’s chances of enrolling in college-level coursework, obtaining an Associate’s degree, or transferring to a four-year institution” (p. 27). When placement is mandatory, a higher percentage of academically weaker and less motivated students are taking remedial courses (Boylan, Bliss, & Bonham, 1997). It is these students that are the least likely to be successful in remediation as they associate mandatory placement in remedial courses as a negative proposal (Boylan, Bliss, & Bonham, 1997; Melguizo et al., 2014).

Further, the relationship between mandatory placement and student retention is harmful. Findings suggest that retaining students who are placed in mandatory remedial courses is difficult in comparison with those students who voluntarily choose remedial courses (Boylan, Bliss, & Bonham, 1997). When placement is voluntary, the students:

tend to be more highly motivated or to recognize the need for developing their skills before pursuing curriculum courses. They are also more likely to be successful than less motivated and less realistic students. (Boylan & Saxon, 1999, p. 5)
The American Mathematical Association of Two Year Colleges (AMATYC) recommends creating a mathematics placement team that considers a number of measures such as tests, transcripts and interviews to place students in a particular course (AMATYC, 2005). AMATYC (2005) acknowledges that standardized testing alone may not be the best predictor of course placement:

> While testing provides important information for placement into mathematics courses, a mandatory placement policy based only on standardized test scores may effectively deny access to necessary courses for some students. (p. 19)

Consistent mandatory placement policies, while innovative, have yet to be implemented in practice across all Ontario Colleges. However, insight gleaned from the College Student Achievement Project (2013) has recommended that a feasibility study of a system-wide approach to assessing the skills of incoming students (in mathematics) be undertaken (CSAP Feasibility Study, 2013). The idea of informal/formal models of assessment to support student’s learning as a pilot project began in 2014 (CSAP Feasibility Study, 2013). The focus was to provide feedback and build self-confidence prior to entering first year college by using a volunteer self-assessment data base to practice skills.

> The intention was to reduce the number of students needing remediation or in danger of being ‘at-risk’ in Ontario Colleges (CSAP Feasibility Study, 2013).

The Assessment Development Project (ADP) is developing an assessment for use in measuring the numeracy skills of post-admission college students across the college system. The assessment will also be available for students prior to their application to college as a diagnostic tool with which to identify their own strengths and weaknesses. In this mode, the assessment will also be linked to a set of remedial instructional modules, which students can use to upgrade their knowledge and skills where necessary. The intention underlying this assessment is that colleges will be making a clear statement to students and schools about the mathematical skills that are expected of them as they enter college but that the colleges are also providing the means for students to ensure that they have those skills prior to entering college programs. (CSAP Final Report, 2013, p. 9)
Further, from email surveys and teleconferences, it was revealed to the Assessment Development Project (Orpwood & Brown, 2014) that:

There was found to be a great variety of uses for the assessment, including student profiling, course exemption, student advisement and college statistics, among many others. The principle use was as an administrative tool for the college and in many cases, students remained uninformed of their results. (Orpwood & Brown, 2014, p. 4)

The task was undertaken by the ADP team to develop a system-wide approach to assessing the mathematics skills of incoming college students. Four principles were used to guide the implementation of the system wide assessment:

1. The primary purpose of the assessment should be to support students’ learning
2. The focus of the assessment should be on high levels of competence on basic numeracy skills
3. The assessment should be developed and operated according to high standards of quality
4. The assessment should be as cost-effective as possible. (Orpwood & Brown, 2014, p. 5-6)

The authors of the system-wide implementation report that:

The Colleges Mathematics Assessment Program, as it has now become, is now ready for implementation. The college administrations are continuing to work together to find an appropriate administrative and business model to enable the use of the assessment both by the colleges themselves and by students and the wider educational community. (Orpwood & Brown, 2014, p. 1)

Fine, Duggan and Braddy (2009) found that “remediation of incoming college freshman students is a national concern because remediated students are at higher risk of failing to complete their degrees” (p. 433). The results of their study supported the idea of “taking a senior-year high school mathematics course” (p. 444). They concluded that this would “significantly increase the proportion of students who do not require mathematics remediation in college” (p. 444). Other studies have suggested that testing student readiness while still in high school is a proactive option (Adams, 2011; Howell et al., 2010; Melguizo et al., 2014), while other studies suggest that adding diagnostic capabilities to their assessments may provide faculty detailed
information on each of their students’ specific learning needs (Burdman, 2012; Melguizo et al., 2014). From experience, however, there are instances when course coordinators and instructors will dialogue with the student informally to decide on the best course of action with regards to level and appropriateness of courses or remediation.

When students acknowledge that they are in jeopardy of not meeting program requirements, it may be too late. They can perceive mathematics as holding them back from their life ambition. In some cases, they may even be forced to divert career plans that can have severe consequences as observed by Berenson, Carter and Norwood, (1992), who note that, “the lack of mathematics success may contribute to an at-risk student’s decision to drop out of college” (p. 55). Understanding the complexities surrounding the nature of assessment and placement in today’s college system can be a good predictor of student’s preparedness to succeed at college. Therefore, effective placement programs must be in place to support and guide the successful preparatory college mathematics experience. Without it, a disservice to all at stake can result.

2.6 Identifying the Principles of Effective Teaching of ‘At-Risk’ Mathematics Students

Teaching and learning are complex activities and there are no easy answers in helping teachers become effective (NCTM, 2000). Nevertheless, the National Council of Teachers of Mathematics (NCTM, 1991) presented six standards for the teaching of mathematics. These six standards addressed the following:

- worthwhile mathematical tasks;
- the teacher's role in discourse;
- the student's role in discourse;
- tools for enhancing discourse;
- the learning environment;
- the analysis of teaching and learning. (p. 1)

NCTM (2000) further builds upon these standards to address effective teaching principles to shed some light as to what the practice of effective teaching should require:
1. Effective teaching requires knowing and understanding mathematics, students as learners, and pedagogical strategies.
2. Effective teaching requires a challenging and supportive classroom learning environment.
3. Effective teaching requires continually seeking improvement. (p. 17-19)

The above three statements permeate both NCTM and AMATYC standards for effective practice in mathematics education.

Principles of effective practice in the teaching of remedial or developmental education programs are available. Boylan and Saxon (1999) identify twenty characteristics that detail the practice of those who work with underprepared students on community college campuses. After reviewing over 600 books, articles, and technical reports on the topic of developmental education published in the past 30 years, the authors isolate eight characteristics specifically related directly to teaching that should guide their practice:

- variety of teaching methods, sound cognitive theory-based courses, computer-based instruction to supplement regular classroom activities, classroom/laboratory integration, developmental course exit standards that are consistent with entry standards for subsequent courses, strategic learning that teaches students how to monitor their comprehension and think strategically about learning, professional training for faculty and staff who work with developmental students, and critical thinking that focuses on the types of thinking required in college-level courses. (Boylan & Saxon, 1999, p. 8)

With respect to a variety of teaching methods, Boylan and Saxon (1999) add that the use of mastery learning techniques as well as the provision of a high degree of structure should be reflected in remedial courses.

In a similar vein, Barak Rosenshine (2012) summarizes seventeen active teaching and learning strategies to help students learn and be successful. They serve as a guide for discussing the general nature of effective instruction and include the following:

1. Begin a lesson with a short review of previous learning;
2. Present new material in small steps with student practice after each step;
3. Limit the amount of material students receive at one time;
4. Give clear and detailed instructions and explanations;
5. Ask a large number of questions and check for understanding;
6. Provide a high level of active practice for all students;
7. Guide students as they begin to practice;
8. Think aloud and model steps;
9. Provide models of worked-out problems;
10. Ask students to explain what they have learned;
11. Check the responses of all students;
12. Provide systematic feedback and corrections;
13. Use more time to provide explanations;
14. Provide many examples;
15. Reteach material when necessary;
16. Prepare students for independent practice;
17. Monitor students when they begin independent practice. (Rosenshine, 2012, p. 19)

Rosenshine (2012) advocates for the importance of guided practice in the construction and reconstruction of knowledge:

Although most teachers provided some guided practice, the most successful teachers spent more time in guided practice, more time asking questions, more time checking for understanding, more time correcting errors, and more time having students work out problems with teacher guidance. Teachers who spent more time in guided practice and had higher success rates also had students who were more engaged during individual work at their desks. This finding suggests that, when teachers provided sufficient instruction during guided practice, the students were better prepared for the independent practice (e.g., seat work and homework activities). (p. 16)

In understanding the above teaching and learning strategies, Hadgedorn, Sagher and Siadat (2000) conclude that:

adjustments in teaching methodology in mathematics can result in gains, not only in mathematics, but also in other areas of general education. Important skills such as working with increased concentration may improve from innovative teaching of subject content. Furthermore, teaching methodologies can have a significant effect on the classroom retention rate. (p. 151)

Chickering and Gamson’s (1987) guideline adds another dimension to effective teaching. Many recent studies have utilized the seven principles advocated by these authors to guide and inform their practice (Bali, 2014; Çakiroğlu, 2014; Crews, 2015; Seifert, 2014; Shepherd, 2016; Thomas & Higbee, 2000). The research of Chickering and Gamson (1987) has stood the test of
time in providing a treatise on what constitutes good practices in undergraduate education to improve teaching and learning:

Encourage student-faculty contact, promote cooperation among students, encourage active learning, give prompt feedback, emphasize time on task, communicate high expectations and respect diverse talents. (Chickering & Gamson, 1987, p. 3)

Smittle (2003), on the other hand, is more specific about effective teaching as it relates to developmental education at the undergraduate level. Smittle (2003) asserts that effective teaching in developmental education is one of the most challenging jobs in the college teaching profession. She provides us with six principles that “focus on key elements that teachers may use to support effective teaching” in the developmental education classrooms (p. 10). They include the following:

Principle #1: Commit to teaching underprepared students
Principle #2: Demonstrate good command of the subject matter and the ability to teach a diverse student population
Principle #3: Address non-cognitive issues that affect learning
Principle #4: Provide open and responsive learning environments
Principle #5: Communicate high standards
Principle #6: Engage in on-going evaluation and professional development.
(Smittle, 2003)

Smittle believes that applying these principles is effective in helping teachers deliver the best education to their developmental students.

After close consideration of the various guidelines and principles that best situate the instruction of the ‘at-risk’ mathematics learner in college, resonance can be found in the fusion of strategies proposed in the aforementioned works. There emerge three areas worth pursuing as it relates to the experiential nature of teaching ‘at-risk’ college mathematics students. These areas of focus include: Pedagogical Content Knowledge, Affective Domains and Learning Environments. Investing effort in examining these concepts can help one better understand the relationship between theory and practice in the activity of teaching ‘at-risk’ college mathematics
students. As a result, Pedagogical Content Knowledge, Affective Domains and Learning Environments will provide a framework in which I look at best practices in the field of instructing ‘at-risk’ college mathematics students. The teaching experiences and efforts of the instructors are voiced as it relates to these three areas of interest. The spirit and intent of both the documents from NCTM as well as AMATYC also guide the rationale for this thesis.

2.6.1 Pedagogical Content Knowledge

The role of theory and practice in education has gathered considerable scholarship and debate over the years. Much has been written regarding the tension that exists between theory and practice (Balboa & Stiehl, 1995; Ball, 1988, 2000; Ball & Bass, 2000; Cobb, 1988; Dewey, 1916/1964; Fernandez-Balboa & Stiehl, 1995; Harr et al., 2014; Piccolo, 2008). One particular conflict arises out of the notion between knowing how to teach (pedagogy) and knowing what to teach (subject matter). Other terms that have been used in this comparison include ‘method versus subject matter’ and ‘pedagogy versus content knowledge’. Is there a strategy that would assert the importance of pedagogy over the subject matter? Or is this distinction even necessary? The answers lie in an investigation of the tension between pedagogy and subject matter that still remains in teacher education and in the day-to-day lives of the practitioner (Ball, 1988; Ball & Bass, 2000; Harr et al., 2014; Piccolo, 2008; Shulman, 1986).

John Dewey used the terms “method” and “subject matter” to reflect the aim of successful teaching and learning. He believed that the separation of substance from method distorted knowledge and he believed that “good teachers were those who could recognize and create ‘genuine intellectual activity’ in students, and he argued that methods of such activity were intimately tied into disciplines” (Ball & Bass, 2000, p. 85). Knowing how to teach
(pedagogy) together with what to teach (subject/content matter) were thus seen as activities that contributed to successful teaching practices.

It was further indicated by Harr et al. (2014) that, in teacher preparation, the separation of content knowledge and pedagogy run the risk of “knowledge compartmentalization” and of “being stored with little reference to each other in largely unconnected memory parts” (p. 2). In their study, they made the case for an integrated teaching approach and identified two key advantages of such a method. The authors, however, warn that “low prior-knowledge learners might be overwhelmed by the demand to integrate different types of knowledge” (p. 2).

Ball and Bass (2000) articulated that the challenge for teachers is how to integrate subject matter knowledge and pedagogy into the context of their teaching. They also asserted that “teachers’ own knowledge of the subject affects what they teach and how they teach” (p. 86). Finally, Ball and Bass acknowledged that “although conceptions of what is meant by ‘subject matter knowledge’ as well as valid measures thereof, have been developing, we lack an adequate understanding of what and how mathematical knowledge is used in practice” (p. 86).

L.S. Shulman (1986) merged the idea of pedagogy and subject knowledge as “pedagogical content knowledge” (PCK). In his treatise, he asserted that pedagogical content knowledge “goes beyond knowledge of subject matter per se to the dimension of subject matter knowledge for teaching” (p. 9). He further emphasized that PCK:

includes an understanding of what makes the learning of specific topics easy or difficult: the conceptions and preconceptions that students of different ages and backgrounds bring with them to the learning of those most frequently taught topics and lessons. (Shulman, 1986, p. 9)

An interpretation of Shulman exists in the work of Piccolo (2008). She further described pedagogical content knowledge as the “blending of content and pedagogy into an understanding
of how particular topics, problems, or issues are organized, represented, and adapted to the
diverse interests and abilities of learners, and presented for instruction” (Piccolo, 2008, p. 46).

Another elucidation of PCK exists in the work of Fernandez-Balboa & Stiehl (1995). They define pedagogical content knowledge as “teachers’ pedagogical decisions and strategies with regard to representing their subject matter to their students” (Fernandez-Balboa & Stiehl, 1995, p. 293). Fernandez-Balboa & Stiehl (1995) explored types of interpretative frameworks that university professors used in constructing and implementing PCK. The purpose of their study was to better understand the general nature of PCK among exceptional university-level teachers (Fernandez-Balboa & Stiehl, 1995). Fernandez-Balboa & Stiehl (1995) concluded that there emerged five common components of professors’ knowledge about PCK, and that their understanding of PCK centred around knowledge regarding: “a) the subject matter, b) the students, c) numerous instructional strategies, d) the teaching context, and e) one’s teaching purposes” (Fernandez-Balboa & Stiehl, 1995, p. 297). These insights on good teaching seemed to echo the research of Porter and Brophy’s (1988) notion of “pedagogical intelligence” as well as the findings of Grossman (1990) and Jang (2010).

Pedagogical content knowledge has many components to its structure but nevertheless provides the basis for successful mathematics teaching and learning. In understanding how and what to teach, instructors of ‘at-risk’ college math students may additionally want to consider the following: pedagogy within the ‘at-risk’ classroom, commitment to teaching underprepared students, communicating high standards, professional development and assessment of student achievement using a pedagogical lens. These areas will be investigated further as it relates to the experiences of instructors of ‘at-risk’ college mathematics students.
2.6.1.1 Pedagogy Within the ‘At-Risk’ Classroom

It has been documented that “proficiency in subject matter is critical for developmental education teachers” (Smittle, 2003, p. 11). Hiring policies differ from college to college, but most college hiring practices may include hiring instructors who have a baccalaureate degree in the discipline related to their teaching assignment. When a teacher has the qualifications and confidence in the subject matter, it helps to present the subject matter in different ways. But, proficiency in subject matter is not the only thing that matters in teaching. Ball (2000) illustrates the importance of the distinction between knowing how to do math and knowing it in ways that enable its use in practice. She asserts that this distinction is key to understanding how mathematics knowledge matters in good teaching (Ball 2000).

In terms of college mathematics instruction, pedagogical content knowledge has further been described as relating to:

- subject matter knowledge in that it draws on the foundations of mathematical approaches to thinking (e.g., reasoning, proof, and problem-solving) but is different from such content knowledge in that it involves using these ideas in the context of working with people (rather than in working with mathematics). PCK includes knowledge about formal and informal mathematical discourse and at its core are (a) a teacher’s anticipations regarding students’ engagement with curricular content (including confusion) and (b) how to turn teacher intentions into actions. (Tsay, Judd, Hauk & Davis, 2011, p. 209)

The American Mathematical Association of Two-Year Colleges (2005) published a document which states that “Mathematics faculty will use a variety of teaching strategies that reflect the results of research to enhance student learning” (p. 51). In this document, they further challenge faculty to “recognize their own teaching style(s), reflect on the implications of their style on their students’ learning styles, and use that knowledge and other research to make informed decisions about the selection of multiple instructional designs and their classroom
management” (AMATYC, 2005). The recognition of a personal teaching style in relation to the student’s learning style has major implications for the teacher of ‘at-risk’ mathematics students.

The teacher of ‘at-risk’ mathematics students must be aware of the content and also be mindful in the ways in which they engage these learners. They must be aware of the teaching styles, learning styles, content and student engagement in a diverse student population. Prichard (1995) suggested that: “by employing instructional methods that directly involve more students, especially those under represented in traditional curricula, and by offering courses that strive to improve students' reasoning and problem-solving skills, community colleges could increase students' employment and academic opportunities” (p. 26).

Subject knowledge and commitment to teaching are ideas that are reaffirmed in NCTM (2000):

To be effective, teachers must know and understand deeply the mathematics they are teaching and be able to draw on that knowledge with flexibility in their teaching tasks. They need to understand and be committed to their students as learners of mathematics and as human beings and be skillful in choosing from and using a variety of pedagogical and assessment strategies. (p. 16)

This reflects NCTM’s voice in the importance of affirming the need for teachers to continually increase their knowledge about mathematical content and pedagogy.

Understanding the learning styles of the students in the classroom is one way in which instruction can be enhanced. It is important to know if students are visual, auditory or tactile learners so that proper teaching strategies can be employed. For example, teaching strategies from various research suggest that the instructor of ‘at-risk’ mathematics learner must provide for the following needs: provide feedback on a daily basis, present new material in small steps, closely monitor student progress, eliminate failure through practice, and provide consistent and regular review of material (Hagedorn et al., 2000; Rysz, 1999; Smittle, 2003).
These teaching strategies are in keeping with Smittle’s account of what teachers of developmental classes must consider in their instruction. The teaching strategies that Smittle proposes include: clearly stating standards and highly structured instruction; allowing for time-on-task; relating curriculum to the real world and specific interests; presenting information in small chunks allowing for linking new material; allowing for mastery of important content; frequent testing and immediate feedback; teaching students how to pace their work and develop specific plans (Smittle, 2003).

Knowing that some students are tactile, auditory or visual learners can help the teacher present new material in ways that are meaningful to each type of learner. Often, awareness of students’ understanding and motivation levels in a classroom can further the learning process. Fernandez-Balboa & Stiehl (1995) emphasized that:

for successful teaching to occur, [teachers] must be able to detect students’ boredom and frustration levels as well as their misunderstandings of the subject matter. They suggested several strategies, such as verbal interactions with students (e.g., asking questions) and visual scanning of students, especially focusing on their facial expressions and body language. (p. 300)

Further, engagement can be meaningful and positive when tasks are made in such a way that students can experience success. Successful experiences are in keeping with results of a study, which reported that “to enhance learning, one must provide opportunities in which students are engaged in academic tasks that give rise to low error rates” (Friedman & Stomper, 1988, p. 173). In other words, providing an environment for success, whether it be in questioning, assignments, group work or summative evaluations in the classroom, is the key in helping move these students along because it provides spaces for them to become more confident in their understanding of mathematics. A teacher who knows the material, and who is aware of the student population, might have a better idea where these spaces might be.
2.6.1.2 Commitment to Teaching Underprepared Students

Literature suggests that only teachers who are interested in teaching underprepared students should be hired to teach this group (Austin-Hickey, 2013; Boyer et al., 2007; Kozeracki, 2005; Patterson & Sallee, 1986; Roueche & Roueche, 1999; Smittle, 2003). Boyer et al. (2007) maintain that faculty who teach in remedial programs should have pedagogical training that supports good instruction, while Kozeracki (2005) asserts that “central to developmental students' academic success is the presence of a well-trained, dedicated, and respected faculty” (p. 39). A study by Patterson and Sallee (1986) echoes the same sentiment when they state that:

the lack of long-term commitments to program funding and to the people who develop and run the remedial courses have been major reasons for both the lack of development of effective remedial programs and the early demise of many successful ones. Developing and co-ordinating effective remedial programs requires a great deal of time and energy from a dedicated, creative faculty member. (p. 724)

Austin-Hickey (2013) further investigated development math faculty commitment in colleges. The purpose of her study was to examine the relationship between characteristics of developmental math faculty at Florida's community colleges and their organizational commitment perceptions. Austin-Hickey defines commitment as “the intent to persist in a particular course of action” (p. 11). Austin-Hickey (2013) further develops the work of Meyer and Allen (1997) to include the notion of affective commitment, continuance commitment and normative commitment. Austin-Hickey (2013), along with Meyer and Allen (1997), describe the three forms of commitment under the branch of organizational commitment in the following way:

Affective commitment addresses an individual’s emotional attachment to their place of employment. Continuance commitment entails a conscious choice to remain with an employer due to financial or other costs associated with leaving the organization. A sense of obligation drives normative commitment. (p. 11)
Austin-Hickey further asserts that “the commitment of development math faculty is critical to the success of community colleges and overall degree obtainment” (p. 12), and that it is “vital that administrators employ the most committed development math faculty” (p. 13). Participants in Austin-Hickey’s study (2013) mention that obligation to their students is what drives their overall commitment to teach and that “caring about the students, backing them up, being accessible outside the class, and being fair and objective were among the specific obligatory commitments to students” (p. 103). When faculty is committed to teaching in remedial programs, it may translate to a program of success for both teacher and student.

Battistich et al. (1997) concluded that there existed a relationship between a strong sense of community within the teaching environment and teachers’ experience of strong commitments to teaching. Further research by Wambach et al. (2000) concluded that:

When teachers had been successful in creating a caring environment, students scored higher on measures of attitudes toward school and learning, were more task oriented, had higher educational aspirations, had improved skills, had greater trust in and respect for teachers, and had more prosocial attitudes. In addition, they had an improved sense of autonomy and efficacy. (p. 4)

Ultimately, when faculty are caring, committed and dedicated, this leads to a more productive and positive learning environment. The implication for developmental educators, according to Wambach et al. (2000), “is that authoritative (competent, demanding, and responsive) teaching has a powerful effect on students’ academic integration, persistence, and effort” (p. 6).

**2.6.1.3 Communicating High Standards**

Studies have suggested that communicating standards of college curriculum should be a focus in the ‘at-risk’ classroom (AMATYC, 2005; Brothen & Wambach, 2004; Chickering & Gamson, 1987; Shepherd, 2016; Smittle, 2003). When students are aware of clear and consistent high performance standards, it can have a positive effect on their academic success and
achievement (AMATYC, 2005). Communicating standards become easier when faculty help students take responsibility for their learning. The importance of and the need for self-regulation and self-efficacy in the ‘at-risk’ classroom have been documented earlier (Bandura, 1997; Shepherd, 2016; Smittle, 2003; Stahl et al., 1992; Wambach et al., 2000; Zientek et al., 2014; Zimmerman, 1989).

Smittle (2003) acknowledges that communication of standards be established in cooperation with the college level curriculum. This idea is furthered by Brothen and Wambach (2004), who conclude that students “need to believe they are taking college level courses consistent with their goals. If they do not, they are likely to become discouraged and drop out. This means they should receive challenging course material” (p. 20).

When students are made aware of high performance standards, it can have a positive effect on them. AMATYC (2005) has suggested that faculty “set high academic goals for all students, complemented by programs and processes that help students achieve those goals” (p. 26) and that mathematics faculty “clearly define high expectations and communicate these to all students” (p. 27). In doing so, AMATYC (2005) suggests that faculty may need to help students “learn how to take responsibility for their own learning” (p. 17).

In addition, Hall (2002) compared the self-efficacy of developmental mathematics students to non-developmental students and found that:

- enhancing mathematics self-efficacy should be the beginning of any effort to aid in the academic growth of students enrolled in lower level classes of mathematics. Enhancing self-efficacy can be accomplished by providing positive experiences for students. (p. 74)

The notion of taking responsibility for learning has been further documented by some researchers as self-regulation in the classroom (Bandura, 1997; Shepherd, 2016; Smittle, 2003; Stahl, Simpson, & Hayes, 1992; Wambach et al., 2000; Zimmerman, 1989). The task of
developing self-regulation is a critical skill that is often lacking by the ‘at-risk’ student. Zimmerman et al. (1996) describe self-regulation as “self-generated thoughts, feelings, and actions that are directed toward attainment of one’s educational goals” (p. 141). Wambach et al. (2000) theorize that, if the student can learn self-regulatory behaviours in demanding situations, then that can help them take responsibility for their own actions and learning. The need for self-efficacy and self-regulation as a component of ‘at-risk’ student behavior is supported by Stahl, Simpson & Hayes (1992), Zimmerman (1989), Bandura (1997), Wambach et al. (2000), Smittle (2003) and Shepherd (2016).

In her study, Smittle (2003) recognizes a connection between developing self-regulation and developmental education. She quotes Wambach et al. (2000) in this matter: “the conscious development of self-regulation is the task that might distinguish development education programs from other postsecondary education programs” (Smittle, 2003, p. 12). The aforementioned researchers have suggested that developmental educators can and should support students in developing self-regulation in the classroom. By doing so, academic success can be generated beyond the developmental classroom and into specific fields of study.

2.6.1.4 Evaluation and Professional Development

There has been a plethora of academic research that on-going evaluation and professional development are key to the success of effective teaching (Baiocco & DeWaters, 1998; Boylan & Bonham, 1998; Desimone & Garet, 2015; Kilpatrick, 2014; Maxwell, 2000; NCTM, 2000; Roueche & Roueche, 1993; Shepherd, 2016; Wilson & Berne, 1999). Professional development can take different forms: formal or informal. Formal professional development examples can include: attending workshops, conferences, symposiums, writing professional articles and individual learning opportunities in higher learning and graduate-level programs.
Informal professional development can include self-reflection, program evaluation and can also include instances of the workday, in “conversations with colleagues, passing glimpses of another teacher's classroom on the way to the photocopying machine, tips swapped in the coffee lounge, not to mention the daily experience of the classroom” (Wilson & Berne, 1999, p. 174). Wilson and Berne (1999) further note that we know very little about what teachers learn across those multiple opportunities (p. 174).

In a paper presented at the Council on Post-Secondary Education Developmental Education Task Force in 2006, Spann (2000) asserted that policy makers should include policy that “require initial training and ongoing professional development by educators working with under-skilled students in a multicultural society” (p. 3). He states that “In an increasingly pluralistic society, remedial educators require not only specialized training in the content and processes of effective teaching but also preparation in the understanding and appreciation of cultural and ethnic differences” (p. 3). While Spann’s paper is concerned with on-going evaluation and professional development, it is not the purpose of this study to analyze and debate the merits of professional development, but to see it in light of one of the key factors in the effective teaching of ‘at-risk’ college mathematics learners. This study will be concerned with how the instructor of these students engages in on-going evaluation and professional development to experience their practice.

The inquiry of self-reflection and self-assessment as a tool in a teacher’s professional development has been a consideration for some. Ross and Bruce (2007) outline a theory of self-assessment as a mechanism for professional change and growth. In their findings, they propose that “teacher change occurs through reflection on experience and that self-efficacy beliefs mediate the influence of self-assessment on teacher practice” (p. 3). While predominantly
focused on elementary and high school mathematics teacher’s professional development, their study has strong implications for the college mathematics instructor as well. Their model integrates three processes of self-regulation that professionals use to interpret their behavior:

First, teachers produce self-observations, focusing on aspects of instruction relevant to their subjective standards of success. Second, teachers make self-judgments in which they determine how well their general and specific goals were met. The primary data are teacher perceptions of changes in student performance gleaned from student utterances, work on classroom assignments, homework, and formal assessments. Third, are self-reactions, interpretations of the degree of goal attainment that express how satisfied teachers are with the result of their actions. (p. 3)

Carney et al. (2014) “examined the impact of a state-mandated K-12 mathematics professional development course on knowledge, self-efficacy, and beliefs of nearly 4,000 teachers and administrators” (p. 1) and found that the Mathematics Thinking for Instruction (MTI) Project:

was deemed a success in that it changed teachers’ beliefs about the nature of mathematics, increased teachers’ pedagogical knowledge, and increased student achievement in both the classroom and on standardized tests. (p. 2)

Carney et. al (2014) concluded that a “facilitator-directed professional development” (p. 25) indicated a “usefulness as one of the many tools in influencing teachers’ knowledge, beliefs, and self-efficacy” (p. 25). It is not surprising to see a correlation between teacher beliefs about the nature of mathematics and teachers’ pedagogical knowledge as it relates to professional development (Carney et al, 2014). When teachers are given the opportunity to reflect and change their practice, many can be successful in teacher learning and growth in multiple domains (Carney et al., 2014; Clarke & Hollingsworth, 2002; Desimone, 2009; Desimone & Garet, 2015; Loewenberg Ball, Thames & Phelps, 2008).
2.6.1.5 Evaluation of Students

The evaluation of student achievement has always been an important consideration for instructors at all levels of education. In general, McMillan (2013) describes classroom assessment as:

A broad and evolving conceptualization of a process that teachers and students use in collecting, evaluating and using evidence of student learning for a variety of purposes, including diagnosing student strengths and weaknesses, monitoring student progress toward meeting desired levels of proficiency, assigning grades and providing feedback to parents. (p. 4)

The American Association of Two Year Colleges state “assessment at each level is the responsibility of all faculty. Assessment should reflect not only student knowledge of facts and procedures, but also critical thinking and ways of thinking about and communicating mathematics” (AMATYC, 2005, p. 30). Instructor’s pedagogical content knowledge plays a vital role in student assessment. An NCTM position paper on Formative Testing (2013) takes into account an instructor’s knowledge about content and pedagogy in order to make adjustment in student evaluation:

Linking assessment to everyday classroom instruction requires teachers to make a shift in both their thinking and their practice. When assessment focuses on evidence of student learning, teachers must plan and work in new and different ways. Their planning must be flexible enough to allow them to adjust their instruction to take into account the results of assessment. (p. 1)

Although it is evident from the above statement that instruction informs assessment, it can also be said that assessment informs instruction. In this way, assessment can be seen as a dynamic process whereby adjustments are made based on the learning that is occurring.

AMATYC (2005) provides further direction on how assessment of student achievement and instruction should be considered:

Assessment of student learning is a process of helping mathematics faculty adapt instruction to the needs of students. Assessment provides the mathematics department
with information to make informed decisions about course content. It is also the process by which a college assesses what mathematics students know at the end of a student’s course or program. Assessment is an ongoing activity that leads to improvement in student learning by providing data necessary for making informed decisions at the class, course, and program levels. (p. 29)

There is evidence linking assessment to positive student behavior and performance. If assessment can be acknowledged as an ongoing activity, then it can also contribute to positive impact on student behavior and performance (AMATYC, 2005; Fernandez-Balboa & Stiehl, 1995; Peterson & Einarson, 2001; Wolff, 1992).

Recent discourse suggests that there should be a close connection between assessment and meaningful instruction (AMATYC, 2005; NCTM, 2000; Schoenfeld, 2015; Shepard, 2000). AMATYC (2005) suggest ways in which the instructor can make meaningful connections between instruction and assessment. AMATYC (2005) recommends that faculty actions include the following to aid in the authentic assessment of students:

- incorporate classroom assessment activities into class activities on a regular basis;
- provide feedback at times and in ways that are most helpful to students;
- adjust classroom activities in response to assessment information;
- discuss assessment results with students and explain how the information is being used to make instructional decisions. (p. 32)

There are other suggestions that make an assessment meaningful and authentic. AMATYC (2005) suggest that, after student learning outcomes are first discussed, classroom assessments can then include “student demonstrations to the class, discovery-oriented activities performed in groups, one-minute papers, or other classroom assessment techniques” (p. 32).

Alan Schoenfeld’s (2015) recent work is the culmination of over twenty years in the development of mathematical assessment. In it, he emphasizes the advantages of uniform assessment practices “designed to help teachers build up student understandings through
focusing on student thinking while engaging in rich mathematical tasks” (p. 2). Schoenfeld (2015) maintains that:

The core idea is that conceptual understanding and procedural fluency, the main foci or prior instruction, are not enough; true mathematical proficiency also includes developing a positive disposition toward mathematics, the ability to approach new problems and use the knowledge one has developed in other contexts, and to do so strategically. (p. 4)

Schoenfeld (2015) also describes the partnership of two national assessment bodies — the Smarter Balanced Assessment Consortium (SBAC) and the Partnership for Assessment of Readiness for College and Careers (PARCC) — in affecting change in how formative and summative assessments are viewed. Through a series of Formative Assessment Lessons (FAL) created by the Mathematics Assessment Project (Mathematics Assessment Project, 2014), Schoenfeld (2015) hopes to prepare students and teachers for a nationwide change in assessment. He nevertheless acknowledges that the challenge for assessment in mathematics will always be in the reliability and validity of the tools being used (Schoenfeld, 2015).

In conclusion, it is clear that an instructor’s pedagogical content knowledge plays an important role in the authentic assessment of student’s abilities. Clear thought and vision must accompany any action toward assessing the mathematical abilities of students engaged in the classroom. The instructor of ‘at-risk’ college mathematics students must be mindful of how assessment is considered.

2.6.2 Non-cognitive/Affective Interactions

Non-cognitive domains are critical in teaching and learning. In mathematics, beliefs and attitudes can be recognized as areas of affective domains that can have a major impact on instructing ‘at-risk’ students of college mathematics. In general terms, beliefs are believed to be the “meanings connected to psychological objects or phenomena and are an environmentally
contingent and culturally defined lens through which sense is made of events, people, and interactions” (Brown, 2004, p. 302).

It has been advocated by English et al. (2008) that there exists a connection between affective domains and helping students to think critically in mathematics:

When problem solvers describe or design things mathematically, they tend to do more than simply engage logical-mathematical systems; they also engage feelings, values, beliefs, and a variety of problem solving processes, facts, and skills. So, the development of processes, skills, attitudes, beliefs, is part of the development of specific models. Skills, attitudes, and beliefs are not developed separately in the abstract before they are connected to concepts or conceptual systems; skills, attitudes, and beliefs are engaged and developed when the relevant models are engaged. Thus, skills, attitudes, and beliefs are integral parts of relevant models. (p. 10)

Some researchers suggest that effective teaching of ‘at-risk’ students must include some understanding of students’ affective domains (McLeod & Ortega, 1993; van Uden et. al., 2014). McLeod and Ortega (1993) stated that “beliefs, attitudes, and emotions are terms that reflect the range of feelings and moods that make up our affective responses to mathematics” (p. 22). Van Uden et. al. (2014) linked student’s emotional engagement with a positive learning experience. More specifically, van Uden et. al. describe emotional engagement in the following way: “Students are emotionally engaged when they are enthusiastic about a class, are interested in going to the class, and demonstrate a positive learning attitude” (p. 22).

Ernest’s seminal work (1989) cited three categories of a psychological beliefs system that remain influential in understanding teacher beliefs about the nature of mathematics today (Beswick, 2012; Beswick & Callingham, 2014; Depaepe, De Corte & Verschaffel, 2016; Shilling-Traina & Stylianides, 2013): the instrumentalist view, the Platonist view and the problem-solving view. The instrumentalist view envisions mathematics as “an accumulation of facts, rules and skills to be used in the pursuance of some external end. Thus, mathematics is a set of unrelated but utilitarian rules and facts” (p. 250). The Platonist view, on the other hand, is
a “static but unified body of certain knowledge. Mathematics is discovered, not created.” (p. 250).

The final category is the problem-solving view in which mathematics is regarded as “a dynamic, continually expanding field of human creation and invention, a cultural product. Mathematics is a process of enquiry and coming to know, not a finished product, for its results remain open to revision” (p. 250). Ernest (1989) considers these three categories in terms of a hierarchy of a psychological system of beliefs and describes them in the following way:

Instrumentalism is at the lowest level, involving knowledge of mathematical facts, rules and methods as separate entities. At the next level is the Platonist view of mathematics, involving a global understanding of mathematics as a consistent, connected and objective structure. At the highest level, the problem solving view sees mathematics as a dynamically organised structure located in a social and cultural context. (p. 250)

In examining these categories, Ernest (1989) suggests that beliefs may have a more powerful influence on teachers’ actions than knowledge.

Beswick (2012) examines beliefs that influenced the practice of secondary teachers. She concludes that more consideration needs to be given to the beliefs about the nature of mathematics that the teachers had constructed as a result of the “cumulative experience of learning mathematics in primary and secondary school, and university, and for experienced teachers, from years of involvement in the profession” (p. 145). Hersh (1986) summarizes a unique way of describing the beliefs of educators about mathematics:

One's conception of what mathematics is affects one’s conception of how it should be presented. One’s manner of presenting it is an indication of what one believes to be most essential in it...The issue, then, is not, “What is the best way to teach?” but, “What is mathematics really all about?” (p. 13)

Pursuant to the last statement, an individual, whether they be a teacher or learner, comes to know “what mathematics is really all about” through the lens of what they may believe or feel to be true about the discipline. It is not surprising then, that some concede that the importance of
a belief system for the teacher may lie at the very heart of teaching (Kagan, 1992; van Uden, Ritzen & Pieters, 2014). What follows next is an investigation into the teacher’s role as well as the learner’s role in the affective domain of teaching and learning mathematics.

2.6.2.1 Teacher’s Role in Non-cognitive/Affective Interactions

An area of concern when teaching in a remedial program is a teacher’s attitudes toward mathematics. There have been numerous studies on the connection between teacher’s attitudes and beliefs about mathematics and the impact on teaching and learning (Beswick, 2012; Burton, 2002; Carney et al., 2014; Ernest, 1989; Karp, 1991; Kiemer et al., 2015; Pierce, Chick & Gordon, 2013; Polly et al., 2013; Rehak, 2015; Smith, 2015; Umbach, 2005; van Uden et al., 2014). Underpinning the study by Umbach (2005) is the notion that behavior and attitudes of faculty have a dramatic effect on student learning and engagement. Similarly, van Uden et al. (2014) conclude that a teacher’s beliefs about teaching and about being a teacher influences decisions about teaching and learning environments. Specifically, Carney et al. (2014), Karp (1991), Kiemer et al. (2015) examined teachers’ attitudes toward mathematics and the impact that the attitude had on their students.

In Karp’s (1991) study, the sample of teachers was purposefully selected so that the two opposite spectrums of attitude were clearly delineated. Teachers with positive attitude and those with negative attitudes regarding mathematics were specifically selected. The author describes two major themes emerging of teachers with negative attitudes regarding mathematics: teacher dependence and learned helplessness. It was found that teachers with negative attitudes were observed providing instruction which was based on rules and memorization (Karp, 1991). Kiemer et al. (2015) integrated:

student motivation research with research on productive classroom discourse supporting the theoretically derived assumptions about changes in students’ motivation to learn
mathematics and science because of specific TPD (Teacher Professional Development) activities of their teachers. (p. 101)

Keimer et al. (2015) suggest that their findings “further show positive changes in students’ experiences of autonomy, competence and social relatedness as well as intrinsic learning motivation” (p. 101), as teachers changed their “behavior towards more productive classroom discourse” (p. 101).

Beswick’s (2012) account relates how it is “possible for teachers to hold differing beliefs about mathematics” (p. 131). She furthers her argument by stating:

teachers can create clusters in their belief systems in order to preserve existing belief structures and thereby avoid the upheaval inherent in accommodating new and conflicting ideas. (Beswick, 2012, p. 132)

The idea of holding differing beliefs about mathematics was also investigated by Schuck (1999). Schuck (1999) observed that some pre-service mathematics teachers held:

The belief that being knowledgeable about mathematics was a disadvantage for teaching helped to justify their weakness in the subject and assured them that it would not prevent them from being the effective teachers they so strongly desired to be. (p. 120)

Schuck (1999) draws three major conclusions: Firstly, “if student teachers do not view knowledge of mathematics as a desirable and necessary component of their studies, little improvement in their mathematical knowledge will occur” (p. 120). Secondly, “if teachers develop activities which are entertaining and enjoyable but do not see the need to extract the mathematical principles underlying these activities, they will miss many opportunities to help their pupils gain in understanding” (p. 121). Finally:

those student teachers who feel marginalized in terms of their mathematical learning and power are unlikely to gain access to the power and beauty of mathematics if they devalue the mathematical knowledge to which they are exposed. (p. 121)
This idea is further pursued by Austin (2015) and Wheatley (2000), who have suggested that teacher’s efficacy beliefs can be poorly grounded because teachers may not be aware of their own lack of knowledge.

Pedagogy can be related to teacher beliefs (Beswick, 2012; Carney et al. 2014; Keimer et al., 2015; Smith, 2015; van Uden, Ritzen & Pieters, 2014). Teaching with a focus on rules and memorization reinforces the belief that the teacher is the only source of information and learning. The implication of a teacher-centred mode of instruction is that students may be unable to transfer the learned skills or apply higher level thinking to novel situations without the help of the teacher (Karp, 1991).

Karp (1991) investigates teacher’s negative and positive attitudes when using questioning techniques in teaching. Karp’s (1991) finding of teachers with negative attitudes suggests a theory of learned helplessness. By their behavior of limiting students’ active involvement and opportunities to respond to questions, spending extended periods of time with individual students, asking questions and immediately answering them, teachers affected a students’ ability to have control over a learning situation (Karp, 1991). It is evident that a teacher’s negative attitude can have a profound and detrimental effect on the learning and teaching of mathematics.

In contrast, teachers with positive attitudes used instructional methods that encouraged student independence. Some of the behaviours exhibited by these teachers included: focusing on the ‘why’ of algorithms working, less rule-based instruction, resources other than the teacher for self-instruction and requesting that students prove their answers (Karp, 1991). The above teacher behavior encouraged self-instruction, reflective thinking and self-correcting in their students (Karp, 1991). By encouraging reflective behavior, students are able to learn and think independently and are better prepared to deal with real-life problems. This finding is consistent
with the work of Beswick (2012), Carney et al. (2014), Keimer et al. (2015), Polly et al. (2013) van Uden, Ritzen and Pieters (2014) in connecting positive teacher beliefs and efficacy with that of student achievement.

The teacher must model “conversations by listening to students, following students’ arguments and encouraging students’ attempts to support (or challenge) assertions of knowledge” (Smith, 2003, p. 13). They must also provide the emotional and attitudinal support necessary to deepen their knowledge construction. Once these are met, the student will be empowered to build, adapt and construct their own relevant mathematical knowledge more positively in terms of their world (Carney et al., 2014; Clarke & Hollingsworth, 2002; Desimone, 2009; Desimone & Garet, 2015; Loewenberg Ball, Thames & Phelps, 2008; Smith, 2003). In doing so, the teacher can become a positive influence in the student’s learning of mathematics.

Van Uden, Ritzen and Pieters (2014) investigated teacher beliefs to determine “the extent to which student engagement can be seen to be related to specific teacher behavior and beliefs” (p. 22). The study aimed to identify “the influence on engagement of teachers’ motives for being a teacher, their beliefs about the specific teacher knowledge domains, and their self-efficacy for teaching” (p. 23). In the study, they identified eight types of teacher behavior that could affect a positive relationship between a teacher and student: “leading (DC), helping/friendly (CD), understanding (CS), freedom (SC), uncertain (SO), dissatisfied (OS), admonishing (OD) and strict (DO)” (p. 23). They surmised that “teachers’ beliefs influence their behavior in the classroom, and could affect the way they teach and the kinds of learning environments they create” (p. 22). They also asserted that “interested and caring teachers who try to establish positive relationships with their students could make the difference for students at risk” (p. 22).
Coincidentally, it was also suggested that student engagement could also explain teacher beliefs in that teacher and student beliefs could be considered as bi-directional:

But could student engagement explain teacher behavior or teacher beliefs as well? That is, do teachers change their beliefs based on perceived student engagement or do they alter their interpersonal teacher behavior? In other words, we assumed that teacher beliefs influenced their behavior and finally student engagement, but it could also be the other way around, or even be bi-directional. (p. 30)

In essence, they questioned the directional relationship between teacher and student beliefs with that of student engagement in the classroom.

Notwithstanding the last statement, the majority of examples from the literature suggest that, if the teacher conveys positive attitudes about the teaching and learning of mathematics, then this attitude is transferred to his or her students (Austin, 2015; Beswick, 2012; Carney et al., 2014; Karp, 1991; Keimer et al., 2015; Polly et al., 2013; van Uden, Ritzen & Pieters, 2014). I go a step further in suggesting that those instructors that choose for themselves to commit to teaching in such a way are more likely to have these positive attitudes and are therefore more likely to have a constructive impact in the students that they teach.

### 2.6.2.2 Understanding Student’s Non-cognitive/Affective Interactions

It is naïve to think that all students come prepared and focused to learn every day. There are many influences in a student’s daily life. One of these is the affective domain whereby attitudes, beliefs, emotions and self-efficacy of the student play an integral role in the learning of mathematics (Benken et al., 2015; Guy et al., 2015; Jameson & Fusco, 2014; Leong & Alexander, 2014; Martin, Goldwasser & Harris, 2017; McLeod & Ortega, 1993; Zientek et al., 2014). These affective components can be an underestimated domain that often goes unchallenged in the classroom (Farren, 2008; Stage & Kloosterman, 1995). This is more acute in the ‘at-risk’ mathematics college classroom, where students already come pre-packaged with
certain views in mind (Farren, 2008). In some cases, many years of negative experiences and self-evaluations have been built over the years to obstruct the learning of mathematics (Farren, 2008). If these experiences persist it can lead to self-esteem issues for the student. Horton (2015) contends that:

Continuous negative self-evaluation can create significant risks for students, such as fostering low self-esteem and depression because students have not met their own standard of performance. (p. 92)

Sometimes, these ‘affective factors’ must be teased, sifted out and negotiated before effective teaching can occur. McLeod and Ortega (1993) offer us a way to think about the effect that these set of factors have on the student:

Beliefs, attitudes, and emotions are terms that reflect the range of feelings and moods that make up our affective responses to mathematics. These terms vary from cold to hot in the level of intensity of the affect that they represent. They also vary in stability: Beliefs and attitudes are relatively stable and resistant to change, but emotional responses to mathematics may change rapidly. (p. 22)

These affective responses can be a key factor in the instruction of mathematics. It is important to understand that mathematical content is related to the attitudes, expectations, and feelings that students bring to their learning (Driscoll, 1987).

Benken et al. (2015) studied the affective characteristics of those students taking developmental college mathematics courses. More specifically, they considered “their previous mathematics coursework, perceptions of mathematical ability and confidence, and attitudes towards learning mathematics both generally and in their current developmental course” (p. 17). It was found that “most participants had taken more mathematics than was required for entrance” (p. 17) into the specific college in the study and it was reported that there was “a significant difference in participants’ self-perception of skill level” (p. 17). It was found that participants who completed the minimum requirement for college entrance with a grade of “C” or better in
Algebra II rated their skill level as low as compared to those students that passed a Statistics or Calculus course in high school (Benken et al., 2015). With respect to common characteristics, it was reported that:

Overall, participants reported positive changes in their self-perceptions regarding mathematics. Specifically, participants reported a positive change in their perceived skills, enjoyment, confidence, and comfort related to mathematics. (p. 18)

There was, however, an interesting finding with respect to confidence levels. When initially asked, 82% of participants reported they would achieve a passing mark despite 77.9% actually passing with a grade of C or better with some sections reporting a 60% passing rate (Benken et al., 2015, p. 18). This finding suggests that “participants had high confidence and believed that they knew more than what their assessment test and course grades showed” (p. 18).

With respect to enjoyment of mathematics, it was reported that:

Students requiring remediation in our study initially held positive views of their level of knowledge and skill and were highly confident that they would be successful in their developmental courses; however, many held inaccurate conceptions, and most also indicated throughout remediation that they did not enjoy mathematics, even after half or an entire year. (p. 20)

Ultimately, Benken et al. (2015) challenged educators to take a careful look at the “affective impact of allowing students to move to the next level without adequate skills” (p. 20).

Often, feelings or attitudes about mathematics have been linked to mathematics anxiety and performance (Ashcraft & Kirk, 2001; Ashcraft, 2002; Clute, 1984; Crosswhite, 1972; Guy et al., 2015; Hendy et al., 2014; Jameson & Fusco, 2014). Others would argue that there is confusion over understanding the affective domain and how it is linked to the meaning of mathematics anxiety (Baxter et al., 2016; Bessant, 1995; Fuller et al., 2016; Hart, 1989; Hembree, 1990; Hogan, 2016; Iossi, 2013; Josiah & Adejoke, 2014; Kulm, 1980; Mesa et al., 2014; Mcleod, 1988).
A general description of math anxiety includes a “feeling of tension, apprehension, or fear that interferes with math performance” (Ashcraft, 2002, p. 181). Others would claim that mathematics anxiety has its roots in a much larger construct of anxiety (Bessant, 1995; Fuller et al., 2016; Hembree, 1990; McAuliffe & Trueblood, 1986).

Rating scales were developed to measure the level of math anxiety by numerous researchers (Alexander & Martray, 1989; Fennema & Sherman, 1976, 1986; Richardson & Suin, 1972; Spielberger et al., 1980) and are named Abbreviated Mathematics Rating Scale (AMARS), Mathematics Anxiety Scale (MAS), Mathematics Anxiety Rating Scale (MARS) and Test Anxiety Inventory (TAI), respectively. Various studies using these scales were conducted to help understand the role that anxiety played in a student’s math performance and success (Ashcraft & Kirk, 2001; Baxter et al., 2016; Fuller et al., 2016; Hembree, 1990; Hendy et al., 2014; Hogan, 2016; Iossi, 2013; Josiah & Adejoke, 2014).

Ashcraft and Kirk (2001) studied lower level undergraduate students and identified that working memory capacity had a negative association with math anxiety. It was surmised that:

the possibility exists that the lower working-memory capacity that seems characteristic of high-math-anxiety individuals may be at least partially responsible for the performance decrements commonly found with math anxiety. It may be, further, that this reduced working-memory capacity is an on-line effect, one that disrupts information processing in arithmetic and math tasks. (p. 227)

Ashcraft and Kirk (2001) further found that math anxiety was connected to the actual doing of math involving mental processes that worked with numbers and reasoned that “because of their long-term avoidance of math, and their lesser mastery of the math that couldn’t be avoided, high-math-anxiety individuals are simply less competent at doing math” (p. 235).

Ashcraft and Kirk (2001) also suggested that “on-line math anxiety has an impact during original learning of difficult arithmetic and mathematics, probably beginning in the early years of
middle school” (p. 236) by disrupting and slowing down performance and degrading accuracy of
task completion. The implication of this study seems to suggest that math anxiety has early roots
in a student’s academic career and that those invested in teaching these students must endeavor
to understand the nature of that anxiety first so that appropriate teaching models may be utilized
effectively.

AMATYC (2005) suggest that:

Attitudes toward mathematics can create either a feeling of confidence or anxiety that
may have a positive or negative effect on mathematical behavior. “Math anxiety” is
described as a feeling of dread that is experienced when a person attempts to understand
and solve mathematics problems. Factors such as age or maturational level, relationship
between student and teacher, and the nature of the learning environment, including
instructional methods used and learning resources available, influence why mathematics
anxiety occurs. (p. 23)

Since my study is concerned with the experiences of instructors teaching ‘at-risk’ college
mathematics students, the treatment of ‘mathematics anxiety’ will be articulated within the
affective domain as it identifies with the case subjects. It should be noted, however, that
“Mathematics anxiety is not an isolated phenomenon; it originates and persists within a complex
learning process” (Bessant, 1995, p. 330).

Nevertheless, a successful college preparatory mathematics program must address these
non-cognitive issues such as beliefs, attitudes, self-efficacy and emotions as well as cognitive
needs (Astin, 1984; Baxter et. al., 2016; Hogan, 2016; Smittle, 2003). It is believed that a
developmental teacher must consider the whole student and, accordingly, be aware of his or her
affective domains when teaching (Smittle, 2003). Instruction may include helping to motivate
and initiating goal setting strategies. Some strategies recommended for motivating students
include: defining course goals and help students think about their own personal learning goals,
making use of students background knowledge, making connections to real life, teaching
independence skills, giving frequent feedback, developing and maintaining positive self-esteem and avoiding excessive negative feedback (McCombs, 1991; Presiosi, 1990; Tinto, 1993).

Often, if students fail to experience success, their negative belief about their own ability in mathematics may be hard to change. Instances where students can be successful so that they can feel empowered to do mathematics must be provided. These moments must be built upon so that strong belief in negative ability can be changed little by little. What is needed is for a teacher to negotiate honestly and sincerely by validating the attitudes, beliefs and emotions of students first (Farren, 2008). Perhaps, once student’s affective response is met with honesty and sincerity, the learning of mathematics can occur in a meaningful way.

2.6.3. College Content Delivery Methods

The delivery of content material can utilize a number of methods. Patterson and Sallee (1986) described three major teaching styles for learning environments specific to remedial college mathematics that are still considered today. These learning environments are described as lecture classes, independent learning classes and individualized classes without lecture (Patterson & Sallee, 1986). The first, lecture classes — or as some would term them, traditional Socratic style classes — are described as where “the instructor is viewed as the primary source of information, with the text and other sources serving supplementary roles” (p. 726). Of the three learning environments, Patterson and Sallee hone in on what makes a lecture-style environment successful.

The most successful lecture-style environments that Patterson and Sallee (1986) have investigated were the ones “which deal honestly with the ability of the remedial math student to handle abstraction” (p. 726). Patterson and Sallee (1986) provide examples of successful lecture-
style environment programs that take place in Ohio State University and Ramapo College, where according to the designer of one such program:

instruction proceeds from the concrete or intuitive, to the abstract, emphasizing process rather than specific rules…Students are continually asked: to look for patterns in examples; to explain any relationships they see; to test if the proposed relationship is maintained in other examples, if not to propose alternatives; and finally to make generalizations based on their observations…Since the abstract formalization is the result of the students' own experience, it is more easily assimilated…Consequently, students demonstrate significant gains at the end of instruction. (p. 727)

A further case for face-to-face instruction was made by Ashby et al. (2011). Ashby et al. (2011) compared student success in a development math course offered in three different learning environments (online, blended and face-to-face). It was found that “distance-based and blended students performed worse than the traditional face-to-face developmental math students” (p. 138). Further, it has been suggested by Bain (2004) that:

In the hands of the most effective instructors, the lecture then becomes a way to clarify and simplify complex material while engaging important and challenging questions, or to inspire attention to important matters, to provoke, to focus. (p. 107)

The second type of teaching style described by Patterson & Sallee (1986) is the independent learning courses where:

the students are generally given access to several means of learning the material and the responsibility for acquiring the necessary information is left to the students' initiative. Student/teacher interaction may be minimal or non-existent. The students progress at their own pace, and generally have a minimum amount of day-to-day structure imposed by the course. (p. 726)

Other research in this area has named this type of learning environment as PSI or Personal System of Instruction (Hassett & Thompson, 1978; Pascarella, 1977; Wambach et al., 2000).

One of the models of Independent learning or PSI is a Math Module System at Colorado State University (Patterson & Sallee, 1986). In this system, students choose modules that are appropriate to their learning goals and are given access to texts, lectures, video tapes and tutors
to aid in their learning. Patterson and Sallee (1986) conclude that, since tests are the recognized learning tool for students and “since there is no day-to-day structure imposed on the student, procrastination is reported to be a major problem for the less mature and less well-prepared student” (p. 727). On the other hand, Wambach et al. (2000) suggest that:

PSI is effective at developing self-regulating behavior in students because it encourages behaviors relevant to the self-regulation of learning. Active learning is central; students spend class time doing (taking quizzes, studying, relearning) rather than watching (the instructors lecture). (p. 10)

Finally, the third type of teaching style described by Patterson & Sallee (1986) is the individualized classes without lecture, which:

requires a prescribed number of hours per week in a class or a learning center. In a group setting individuals study work texts and supplementary sources, such as audio-visual and computer materials while an instructor and tutors are available for help with the material as needed. This arrangement provides high degrees of both structure and of interaction between the individual and the instructor for those students who need these. (p. 726)

Patterson and Sallee (1986) describe the individualized classes without lecture method as the format that “provides the structure and student-teacher interaction that these students so often need, while allowing for some elements of self-pacing” (p. 727).

More recently, there is growing support for collaboration in college content delivery methods (Bain, 2004; Barkley et al., 2014; Cafarella, 2013; Davidson & Major, 2014; Ku et al., 2013; Lahann & Lambdin, 2014). Collaborative learning as described by Barkley et al. (2014) has roots in social constructivism that is different from cooperative learning discourse. They state that collaborative learning “assumes that knowledge is socially produced by consensus among knowledgeable peers” (p. 6) and that students and teachers form a community in search of knowledge.

Further, Barkley et al. (2014) “use the term collaborative learning to refer to interactive learning groups in higher education, from structured to unstructured” (p. 7). Barkley et al. (2014)
discuss the advantages of collaborative learning in improving the quality of student learning and improving the effectiveness of teaching. They first and foremost acknowledge that:

Teachers can’t simply transfer knowledge to students. Students must build their own minds through a process of assimilating information into their own understandings. Meaningful and lasting learning occurs through personal, active engagement. The advantages of collaborative learning for actively engaging students are clear when compared with more traditional methods – such as lecture and large-group discussions – in which only a few students typically can, or do, participate. (p. xi)

Barkley et al. (2014) further the cause for collaborative learning in the college environment:

Collaborative learning offers students opportunities to learn valuable interpersonal and teamwork skills and dispositions by participating in task-oriented learning groups; thus, even beyond enhancing the learning of content and subject matter, collaborative groups develop important skills that prepares students for careers…Learning to listen carefully, think critically, participate constructively, and collaborate productively to solve common problems are vital components of an education for citizenship in the twenty-first century. (p. xii)

Finally, Barkley et al. (2014) view collaborative learning as a way for students to become lifelong learners that “engages students of all backgrounds personally and actively, calling individuals to contribute knowledge and perspectives to the education developed from their unique lives as well as academic and vocational experiences” (p. xii). Barkley et al. (2014) encourage faculty to experiment with collaborative learning methods and to be reflective in their experiences with its use in the classroom.

Bain’s (2004) study of exemplary college teachers offers yet another view of content delivery. His study revealed that regardless of the method of delivery of instruction (lecture style, case-studies, problem based, role playing, fieldwork, discussions, collaboration), there emerged seven unifying principles, which led to outstanding teaching (Bain, 2004). He believed that “the method of choice varies considerably depending on a variety of factors, including the learning
objectives, the personality and cultures of teachers and students, and the learning habits of both” (p. 100). The following are the seven principles uncovered by Bain (2004):

1. Create a natural critical learning environment;
2. Get their attention and keep it;
3. Start with the students rather than the discipline;
4. Seek commitments;
5. Help students learn outside of class;
6. Engage students in disciplinary thinking;
7. Create diverse learning experiences. (Bain, 2004)

With respect to a lecture style mode of instruction, Bain (2004) acknowledges that the most effective lecture style classroom experience has the following qualities:

lectures from highly effective teachers nearly always have the same five elements of natural critical learning noted above. They begin with a question (sometimes embedded in a story), continue with some attempt to help students understand the significance of the question (connecting it to larger questions, raising it in provocative ways, noting its implications), stimulate students to engage the question critically, make an argument about how to answer that question (complete with evidence, reasoning, and conclusion), and end with questions. (p. 107)

These five elements are central to lecture style delivery, and also apply to discussion led classes as well as case studies or problem based learning classes (Bain, 2004). Bain (2004) provides a positive conclusion of lecture-based instruction:

We found no great teachers who relied solely on lectures, not even highly gifted ones like Jeanette Norden, but we did find people whose lectures helped students learn deeply and extensively because they raised questions and won students’ attention to those issues. The students became engaged in thinking through the problems, in confronting them, in looking at evidence, and in reasoning rather than memorizing. Most important, the lecture was part of a larger quest, one element of a learning environment rather than the entire experience. (p. 107)

Central to the ideas outlined above, Bain (2004) observes that teachers must have the “ability to communicate orally in ways that stimulate thought” (p. 117). They must hone their craft of oral communication and realize that interaction with students should take the form of
“communication rather than performance” (p. 118). Bain (2004) concludes his study by reminding us that good instruction and good teachers put learners first:

Great teachers are not simply great speakers or discussion leaders; they are, more fundamentally, special kinds of scholars and thinkers, leading intellectual lives that focus on learning, both theirs and their students’. Their attention to the details of performance stems from a concern for the learners, and their focus is on the nature and processes of learning rather than on the performance of the instructor. (p. 134)

2.7 Summary

My study investigates the experiences of those instructing the ‘at-risk’ mathematics learner at the college level. The literature review began by defining the terms ‘experiencing’ and ‘at-risk’. Then, some of the principles for effective teaching were elucidated. Three bodies of work were used to enhance and justify this investigation: NCTM, the AMATYC and the body of research in the area of ‘remedial’ or ‘preparatory’ mathematics specifically applied to the college level. Each uniquely and collectively spoke to the instruction of the ‘at-risk’ learner of mathematics at the college level. In Chapter three, I describe and justify a qualitative research method for this study.
Chapter 3: Methodology

3.1 Introduction

This thesis utilizes a case study methodology (Creswell, 1998) with the goal of understanding how mathematics instructors experience the activity of teaching ‘at-risk’ learners at the college level. Interviews, classroom observations, field notes and teacher journals were used to provide a narrative of their experiences.

My study is exploratory and seeks to uncover the strategies and tools used by the teachers of ‘at-risk’ college mathematics students. Smittle’s (2003) work is used as a referent in building and extending a framework on which to observe, report and analyze my research. In particular, headings were derived from some of the key elements used by Smittle (2003) to support effective teaching for instructors of ‘at-risk’ college students. The data analysis highlights themes regarding teachers’ strategies, affective interactions and learning environments while experiencing the activity of instructing ‘at-risk’ college mathematics students.

A qualitative approach was chosen to gain a deeper, authentic and descriptive perspective of the issues being explored (Denzin & Lincoln, 2000). This design was chosen to allow for a more open-ended approach in which through data collection methods, the participants could choose how they would articulate their response (Creswell, 2012). I encouraged my participants to describe instances of teaching either verbally, via e-mail or through journals. My case study is also interpretive (Merriam, 1988) in its construction of categories and themes to describe experiences of the two instructors.

A constant comparative method (Glaser & Strauss, 1967; Strauss, 1987; Strauss & Corbin, 1994) along with observational case studies (Bogdan & Biklen, 1998) are also used since data was collected and analyzed over the span of three years. I expected that my field notes would help me keep track of any comparisons that may have resulted over time.
I chose the case study in particular because, as in Yin’s (2017) interpretation, I “wanted to cover contextual conditions-believing that they might be highly pertinent” (p. 13) to the phenomenon of my study. I expected that the participant’s actions and reactions to teaching moments would be dependent on the events taking place. As such, my field notes were recorded with the description and interpretation of events to help guide these contextual moments of understanding.

3.2 Research Design

A qualitative research design has been developed to investigate how mathematics instructors experience the activity of teaching ‘at-risk’ learners at the college level. Denzin and Lincoln (2005) define qualitative research “as a set of practices, embracing within its own multiple disciplinary histories constant tensions and contradictions over the project itself, including its methods and the forms its findings and interpretations take” (p. 7). I kept an open mind toward any tensions or contradictions in the field while observing the participants during their practice.

Creswell (1998) offers us another perspective as to what defines qualitative research:

Qualitative research is an inquiry process of understanding based on distinct methodological traditions of inquiry that explore a social or human problem. The researcher builds a complex, holistic picture, analyzes words, reports detailed views of informants, and conducts the study in a natural setting. (p. 15)

I position my work within Creswell’s field of qualitative research, because it brings to bear such practices. In particular, I endeavored to build a complex yet holistic picture that analyzes a social condition (teaching at-risk college math students) in a natural setting (a college classroom) using the experiences of people (my participants) through observation, interviews, field notes and journals. I expect that a ‘holistic picture’ will result.
Creswell (2013) believes that there are five assumptions that guide the design of any qualitative study. These include: the multiple nature of reality, the close relationship of the researcher to that being researched, the value-laden aspect of inquiry, the personal approach to writing the narrative and the emerging inductive methodology of the process of research. In particular, attention was paid to the personal approach to writing the narrative as this will involve personal moments and reflections of the observed. To this end, I use vignettes to paint a more personal account of my observations. I expect vignettes to add another dimension to the ‘reality’ that allows me to become that much closer to that being researched (the participants).

Since the teaching of mathematics is described as a profoundly human affair steeped in human interaction (Driscoll, 1987), a constructivist view is taken. My work lends itself to the constructivist paradigm presented by Denzin and Lincoln (2005):

The constructivist paradigm assumes a relativist ontology (there are multiple realities), a subjectivist epistemology (knower and respondent co-create understandings), and a naturalistic (in the natural world) set of methodological procedures. (p. 24)

It has been acknowledged, however, that constructivist principles are difficult to describe: “There is no simple function that maps teaching methodology onto constructivist principles. A constructivist epistemology does not determine the appropriateness or inappropriateness of teaching strategies” (Simon, 1995, p. 117). This idea is furthered by Bauersfeld (1995), who states:

The fundamentally constructive nature of human cognition and the processual emergence of themes, regularities, and norms form a thematizing across social interaction, to bring the [psychological] and the social together, make it impossible to end up with a simple prescriptive summary for teaching. There is no way towards an operationalization of the social constructivist perspective without destroying the perspective. (p. 137)

I acknowledge that the appropriateness or inappropriateness of teaching strategies will not be judged, but will be described within a given context. I have tried, wherever possible, to give
contextualization to the teaching events that have occurred when observing or describing the events.

Table 1 identifies the plan of action for each research question.

Table 1

<table>
<thead>
<tr>
<th>Research questions</th>
<th>Data Collection</th>
<th>Data source(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 What strategies are used by the instructors to teach their “at-risk” college mathematics students?</td>
<td>Observation Unstructured Interviews Structured Interviews Teachers Journal</td>
<td>Researchers notes Transcript of interview and researchers notes Transcript of interview and researchers notes Writings in journal</td>
</tr>
<tr>
<td>2. How does the instructor experience noncognitive issues that affect the teaching of the “at-risk” mathematics learner?</td>
<td>Observation Unstructured Interviews Structured Interviews Teachers Journal</td>
<td>Researchers notes Transcript of interview and researchers notes Transcript of interview and researchers notes Writings in journal</td>
</tr>
<tr>
<td>3. How does the college instructor create an open and responsive learning environment?</td>
<td>Observation Unstructured Interviews Structured Interviews Teachers Journal</td>
<td>Researchers notes Transcript of interview and researchers notes Transcript of interview and researchers notes Writings in journal</td>
</tr>
</tbody>
</table>

3.3 Case Study

A case study is “an exploration of a ‘bounded system’ or a case (or multiple cases) over time through detailed, in-depth data collection involving multiple sources of information rich in context” (Creswell, 1998, p. 61). Stake (1995) considers the ‘case’ as an object of study, while Merriam (1988) considers it a methodology. Lincoln and Guba’s (1985) case study structure involves the problem, the context, the issues and the lessons learned.
In particular, case study will be used as a qualitative tool in this study. Creswell (2013) sees case study as a research strategy beginning with “assumptions and the use of interpretive/theoretical frameworks that inform the study of research problems addressing the meaning of individual groups ascribe to a social or human problem” (p. 44). In order to study the problem, Creswell (2013) further ascribes to utilizing:

the collection of data in a natural setting sensitive to the people and places under study…that includes the voices of the participants, the reflexivity of the researcher, a complex description and interpretation, and its contribution to the literature or a call for change. (p. 44)

I observed my participants in their natural setting (their classrooms) and included their voices in the telling of their actions. I expect that their descriptions as well as mine will add to the complex activity that is teaching.

I investigated the everyday experiences in the ‘at-risk’ college mathematics classroom. What decisions of psychological tasks combined with ‘taken-as-shared knowledge’ (Cobb, Yackel, & Wood, 1989) and ‘classroom social norms’ (Yackel & Cobb, 1996) will guide their practice? Since I myself am an educator in an ‘at-risk’ college mathematics classroom, I was attentive of my own voice in the telling of this story. I was aware that the articulation is situated in the “multicultural, gendered components of the research act” itself (Denzin & Lincoln, 2011, p. 16). I have acknowledged that my case study investigates the ‘how’ and ‘why’ questions and that I have “little control over events…within some real life context” (Yin, 2017, p. 1). As such, my study lends itself to Yin’s (2017) notion of exploratory case study, “the goal being to develop pertinent hypotheses and propositions for further inquiry” (p. 5). I have tried to give a description of my observations as they unfold to help better understand the phenomenon that instructors experience in deciding how to teach ‘at-risk’ college mathematics students.
I have combined data collection methods such as interviews, field notes, journals and observations. These will be the main methods of data collection in this study and a further treatment of case study follows in the next section.

3.4 Data Collection

The decision to use case study to open up the space to investigate the ‘at-risk’ college mathematics classroom involves “visualizing data collection as a series of interrelated activities aimed at gathering good information to answer emerging research questions” (Creswell, 1998, p. 110). Data was collected by unstructured, open-ended interviews, as well as semi-structured interviews by audiotape and transcribed using appropriate software; field notes were gathered by conducting observations; physical artifacts such as journals of the participants and any correspondence such as e-mails was also collected.

As an observer in the classroom, I tried my best not to influence my participants in their daily teaching activities. This included locating myself in an inconspicuous area in relation to each specific teaching environment, as well as minimizing eye contact with the participant during instruction. In this way, I wanted to limit any teacher-student interaction based on any of my reactions to events as they were occurring. I have to acknowledge, however, that this was difficult in some occasions. For instance, Jill (pseudo name) observed me writing my field notes after a particular incident and wondered what I had reacted to. I had to acknowledge at that moment that my presence in the classroom (however inconspicuous I thought) may have had an effect on my data. I have made every effort to report all evidence fairly as suggested by Yin (2017) but acknowledge that the inability to control the effect of my presence of every instance may have compromised my data.

Data was collected and analyzed over the span of three years as commitment to this
project was undertaken between full-time work and part-time studies. This project has thus informed my thoughts and ideas over the span of time. In the beginning of my study, I was observing how instructors taught. Toward the end of my observations, I recognized that some teaching acts were similar and some were different. Later, when I interviewed my participants, I tried to tease out those similarities and differences. This became the lens through which I interpreted my results as certain themes and ideas emerged and developed over the course of the study.

Some ideas were revisited with a different lens. For instance, the participant’s notion of pedagogical content knowledge became sharper with each interview. The idea that they were struggling with articulating this concept was a revelation to me as I probed how they each interpreted this in their own practice. I therefore included PCK as an integral component that each participant identified with in their practice. My interpretation and understanding of how they enacted PCK in their practice evolved out of their actions and words.

Another concept that became evident was each participant’s perceived responsibility in their practice was different. I began to take notice of the particulars that made their practice different and designed exit questions to clarify these differences. For instance, Dan’s (pseudo name) role in his instruction was teacher-directed, while Jill’s teaching depended on individual instruction and the needs of her students. I had to determine what the various teaching practices looked like under each role, and the particulars are evident in the headings used to describe the data. I used NVivo, a coding software, as a means to sift out first what was described as teaching practices used by each participant through interviews. Then later, I mapped out my observations to connect with their practice. The vignettes are interpretations of my observations that support these differences.

Nevertheless, changes or influences of pre-existing and current research were considered
and explored as it related to the experiences of the instructors. Ideas and themes were revisited in subsequent communications with the participants over time in interviews or by email communication. This ensured stability of issues of validity and reliability over time.

3.4.1 Recruitment Phase

I identified the participants by first looking at the college programs that teach ‘at-risk’ mathematics students. I identified four possible participants and approached them in person to get a sense of their willingness to participate. Two participants agreed to participate. I set dates to meet with participants to provide them with the study background and to get consent forms signed. Two separate meetings took place (one at each participant’s office space) to establish the background of the participant and their environment. An unstructured interview was used to ascertain background and to add to the comfort level of the interview. Then a semi-structured questionnaire was given to establish a reference or starting point relating to the experiences of the participant. (See Pre-Observation Interview Questionnaire Phase I in Appendix).

At both meetings, audio as well as field notes were taken to be transcribed and used later in the analysis phase. The meetings concluded with agreeable dates for classroom observations. Participant 1 agreed on being observed on three occasions during the semester: within the first two weeks, during week seven, and finally during week twelve of a fifteen week semester. Participant 2 agreed on being observed on three occasions between the start of the school year and the end of the calendar year.

3.4.2 Observation, Journals and Field Notes

I observed each participant in their particular classroom. Their pseudonyms (Dan and Jill) are used for purposes of anonymity. Approximately five hours of observation for Dan was recorded to be transcribed at a later date and approximately seven hours of classroom observations of Jill was recorded to be transcribed later. For each observation, I arrived early and
set up a location at the back of the classroom (for Dan) or at the front of the classroom to the left of the instructor (for Jill).

The reason for choosing the front of the class for Jill was to observe teacher/student interactions more effectively. In this classroom, students worked independently and desks were situated facing the front and facing back walls. Often, students would seek help at the instructor’s front desk where a second chair was placed. The instructor would request a meeting with the student to consult on his/her status at the front desk. It was more advantageous to observe from the front as my task was to observe the instructor as participant, not the student. I limited the times that I would walk around the classroom in both locations, as I did not want to give students the idea that I was observing them.

Field notes were also taken, transcribed and used in the analysis phase. Field notes were used to write down “whatever impressions occur, that is, to react rather than to sift out what may seem important, because it is often difficult to know what will and will not be useful in the future” (Eisenhardt, 1987, p. 539). My field notes included quick sketches of the classroom layout, notes of teacher-student interactions and a quick running sequence of events for the observed day. Often, my own thoughts and reactions to the participant’s instruction were included as field notes and questions or ideas were recorded for a later time. In the case of Jill, I noted timed interactions with students at the instructor desk, as these interactions involved the majority of time spent observing in the classroom.

Participants were asked to keep a journal of any incidents that occurred within the observation dates. Participants were instructed to write down details, thoughts and feelings of events of the classroom teaching within a timely manner. On one occasion, participants were asked to record their experiences of a particular instance that occurred in the classroom in a
journal. Each participant was later asked to share their experiences of the incident. Jill wrote a detailed account of the incident that included a description of the incident and reaction, while Dan wrote about the reaction to the incident. Key events in the observation of classroom teacher were identified by the researcher to be discussed with the participants at a later date.

My observations were strictly exploratory and I allowed thoughts and ideas to emerge during this phase. No particular lens was used other than to record the events of the classroom and the interactions within. In this way, I was able “to retain the holistic and meaningful characteristics of real-life events — such as individual life cycles” (Yin, 2017, p. 3).

3.4.3 Exit Interviews

Two exit interviews were conducted with each participant. I first interviewed both participants separately at the conclusion of the observation phase of this study. Participant’s journals and researcher notes were used as reference points to discuss any critical incidences that occurred. A semi-structured interview was used in this phase (See Post-Observation Interview Questionnaire Phase III in the Appendix E). Perspectives from observer and observed were made in relation to events. Audio as well as field notes were taken at this interview to be used later in the analysis phase. Emails were also used to clarify any questions that might have resulted from the meetings with the participant.

I then conducted a post-exit interview (See Post-Exit Interview Questionnaire Phase III in the Appendix F) after I noticed further investigation was needed while coding the data. The post-exit interview was done to delve deeper into a number of subcategories that surfaced after some of the data was coded. Since questions were very specific, the participants were given the questionnaire prior to the meeting. This interview was structured with specific closed ended questions. The intent was to tease out more details in understanding the subcategories that
emerged. This interview was audio taped and field notes were also taken. Again, emails were also used to clarify any questions that might have resulted from the meetings with the participant.

3.5  Data Analysis

The qualitative data gathered from the audio and field notes of the interviews, teacher journals, observations and emails were transcribed electronically. All interviews were transcribed verbatim for three reasons: 1. To provide authentic documentation for data analysis; 2. To allow participants to review transcription for changes or clarification; and 3. To create a permanent record for documenting the trustworthiness and validity of the study. Transcription then emerged as transformed data. It was expected that the data would clarify, describe and explain possible interpretations and findings.

Each data set was entered to NVivo and the text was coded in NVivo. Each narrative was examined for relevant themes, similarities or differences. Specific moments or critical incidents that may have occurred during observations were explored to connect the experience of teaching ‘at-risk’ college mathematics students with emerging research.

Data was organized into three main headings for each participant: teaching strategies, affective interactions and learning environments. Data from meetings with participants, classroom observations, journals and field notes were coded into one of the three main headings. There emerged subcategories that in some cases were similar, and, in other cases, different for each participant. These subcategories were further explored for similarities and differences for each participant in the Findings section of this study.

3.6  Ethical Considerations

Any educational research inquiry “requires complex and careful ethical treatment” (Wallace & Louden, 2000, p. 155). Some would agree that the validity and reliability of a study
depends a great extent on the ethics of the researcher (Merriam, 2007; Patton, 2002). Merriam (2007) sees the ethics of the researcher as fundamental “because as in all research, we have to trust that the study was carried out with integrity and that it involves the ethical stance of the researcher” (p. 229). The rigor in this study demanded that I undergo ethical review of the University of Toronto’s ethical protocols, and also the ethical review of the host College where the study was conducted. Both institutions granted Ethics approval for completion of the study.

Another concern of ethics in case study has to do with biases that may result in the interpretation of the final product (Merriam, 2009). Merriam (2009) recognizes that the lack of rigour sometimes attributed to case study as linked to the problem of bias arising out of the subjectivity of the researcher. The subjectivity of the researcher, however, may not be entirely viewed as a negative consequence. As a teacher of ‘at-risk’ college mathematics students, I acknowledge my biases in all facets of this study but in doing so, I further acknowledge that this can also add to the strength of my study. Stake (2010) points out that: “It is quite appropriate for researchers to study their own places” (p. 163) but further cautions that to do so would require review and checking on the part of the researcher.

Case study offers a way to view the richness and complexities of the human experience. As Shields (2007) points out in a paper presented at the Annual Meeting of the American Educational Research Association:

The strength of qualitative approach is that they account for and include difference-ideologically, epistemologically, methodologically-and most importantly, humanly. They do not attempt to eliminate what cannot be discounted. They do not attempt to simplify what cannot be simplified. Thus, it is precisely because case study includes paradoxes and acknowledges that there are no simple answers that it can and should qualify as the gold standard. (p. 13)

In this study, participants were recommended by their program chairs and selected because they have a commitment in the education of ‘at-risk’ college mathematics learners and
voluntarily participated. This study included freedom to withdraw and participants signed a form to indicate informed consent. Information was stored in field notes, transcriptions and computer files and kept as per standards of the Ethics Review Board. Member checking was conducted to ensure transparency and accuracy of information.

It was made explicit at the onset that the information would be used in fulfillment of a thesis in the Department of Curriculum, Teaching and Learning at the Ontario Institute for Studies in Education. It was my intention to be forthright and I communicated with the participants at every stage of research. Member checking was conducted during the final writing stage of the thesis and in the end; the findings were shared with the participants. By attending to the “interrelated activities aimed at gathering good information” (Creswell, 1998, p. 110) as outlined above, an authentic understanding of the participants experiences thus emerged.
Chapter Four: Findings

4.1 Introduction

This chapter describes the teaching practices of two college instructors of at-risk students. Their pseudonyms (Dan and Jill) are used for purposes of anonymity. I begin by setting the teaching context of instruction, which includes describing the program type. I describe their personal histories and professional backgrounds. I then describe each instructor’s teaching practices as it relates to the three domains of this study, which include: a) instructor’s strategies; b) affective interactions; c) open and responsive learning environments. Findings for each participant are presented in headings derived from using Smittle (2003) as a referent. Each case study concludes with a summary of the important findings gathered from the college teacher.

4.2 Context

The Ontario Community College system, established in 1967, was originally designed to be occupation-oriented and designed in accordance with the specific needs and demands of the local community so students could feel prepared to meet the social and economic demands of society (Carruthers, 2017). At present, Dziwak (2014) contends that, “in the environment of growing postsecondary education participation rates and increasing diversity of students, the Ontario colleges, with their mission of access, have become the higher education pathway choice for many students with a lower level of academic preparedness” (p.1). While Dziwak’s (2014) treatise is concerned with the “efforts that the colleges undertake to support ‘at-risk' students in their journey to graduation and credential attainment” (p. 1), he nevertheless supports “the need for a funding system that drives a focus on quality, while maintaining access” (p. 1).

The Ontario College in this study is a public college located in a large urban area that offers approximately 300 full-time and part-time programs at the baccalaureate, diploma,
certificate and graduate levels. There are various satellite campuses across Ontario where enrolment of full-time students is approximated at 17,000 and part-time students at approximately 90,000. Academic programs in this college include: Applied Arts & Health Sciences, Applied Science and Engineering Technology, Business, Communications, Art & Design and Liberal Arts. This college also includes many training and employment services such as: Business Office Skills, Career Programs for Internationally Trained Persons, Career Change, College Preparation for Adults, Employment Training and Business Services, Services for Skilled Immigrants and Workforce Re-entry Programs for Employment Ontario Clients.

The discipline of mathematics is featured significantly across many programs of study in this college. I will focus on two major programs that involve the teaching of mathematics. The discipline of mathematics within each of the two programs of study will be situated as it relates to the experience of the instructors revealed in this research. For purposes of anonymity, the two programs of study will be referred to as Program A and Program B. Both participants are from the same college, but teach in different programs of study.

4.3 The Case of Dan

Dan’s teaching career began informally in Grade 12 when he replaced his teacher for the day. He recollects the incident:

My math teacher was absent on a day, and I asked if I could teach the class. So I dressed up and found a fake pair of glasses and a pocket protector, and came in and taught. I had a lot of fun. I was always pretty good at math anyway. So, usually I tried to help others in class. I always got something out of that. It was always fun to try to help others. (Dan, Interview, January 31, 2013)

Dan grew up in the city of Toronto and has an Undergraduate and Master’s degree in mathematics. After teaching in various colleges and universities in the United States, Dan has since settled in Toronto with his family of four and teaches at a large college in Toronto. He has
been teaching at this college since 2007. His experience in the classroom spans twenty-five years teaching mathematics at both the college and university level. One of the reasons he attributes to teaching over the years is “Because it is a lot of fun, and it is rewarding. You are helping others to learn things. So, when that happens, it is very rewarding. It is a fun lifestyle,” (Dan, Interview, January 31, 2013).

Mathematics has always been a part of Dan’s life. His father, also a life-long teacher of mathematics, has inspired Dan to be the educator of mathematics that he is today. He believes that one’s upbringing has much to do with the structure of thinking. He credits his passion for mathematics to the relationship he developed with his father: “I think it is something you develop. If you have somebody like your dad or my dad is, then they will-- it might not be sort of an overt thing but when they are helping you with stuff, they are helping your thinking structures as well” (Dan, Interview, January 31, 2013). It is evident to Dan that he has cultivated mathematical skill over the years, so it is not surprising that Dan has chosen mathematics as an integral part of his life and career.

4.3.1 Program at Dan’s College (Program A)

Program A is part of a Liberal Arts program in a large college in the province of Ontario. In general, a Liberal Arts program can be described as involving a variety of humanities and social science disciplines that may emphasize skills in literacy, numeracy and critical thinking. Program A is a four-semester diploma program that has transfer agreements and pathways to major Ontario universities. Students who maintain a 3.0 grade point average at the end of the second semester are given the option of applying to University Partnership Programs in Ontario. Program A entrance eligibility includes an Ontario Secondary School Diploma (OSSD) or equivalent with a grade 12 English course. Students can also be eligible as having Mature
Student Status. These are students who are 19 years or older and who still meet the requirements as the above prerequisite courses, their equivalents or appropriate Academic and Career Entrance Certificate program credits.

Regardless of which type of student is admitted, students must take an assessment post-admission to determine their skill level and placement in Math and English. Program A requirements include a four-hour-per-week Math course that is scheduled in the first semester. This particular program of study has three first semester Math options. If they score low on their Math assessment, they are placed in a course that offers the basic numeracy and algebraic skills.

This is the course that Dan teaches. He describes the course as:

An Introduction to Mathematics, or College Mathematics. I am not entirely certain which it is. But it's essentially a course that pretty much takes students to the beginning of math almost. So we start with whole numbers, and we do arithmetic with whole numbers and exponents, order of operations. And then we do the same with fractions, and we sprinkle in some applications. So it's almost like a refresher of K through 12 math for them, and maybe not even 12. (Dan, Interview, September 12, 2012)

Students must obtain one Math credit in order to graduate with an Ontario College Diploma in Program A.

4.3.2 Vignette 1: Dan’s Teaching Strategies

September 28, 2012

I met Dan outside his office and we both walked to the classroom he was to teach in. I noticed that some students were already waiting outside the room that was located on the first floor of the main building. I received some puzzled looks as I took a place at the back of the classroom and started to set up my recorder and note pad. Without too much fanfare, Dan reminded the students that I was the researcher who would be joining them periodically throughout the semester. I performed a quick scan of the room and noticed that there were approximately seventeen students dispersed around the room. There were three columns of tables
in four rows. Each table had room for three students. The right wall was covered by windows whose blinds were raised half-way to cast some natural light into the room.

As students trickled in, I sensed an air of ease and comfort between the students and Dan as the roll call was conducted. He invited students to sit at the front and joked about the space that was available to them. For the roll call, I noticed that Dan did not read from his class list. He made eye contact with the students as they were seated and then checked them off his list. It was five classes into the semester and he seemed to know all their names.

Dan reminded students that solutions to the test were posted online and quickly reviewed how to access the results. One student corrected Dan as to the location online to access the solutions to the test. This initial interruption of Dan’s speech did not disturb him. In fact, Dan thanked the student for bring it to his attention. I was to learn that the constant interjection of the lesson by students was encouraged. The entire lesson became more of a dialogue between teacher and student rather than a one-way lecture.

Dan spent the next ten minutes discussing the solutions to the test and he pointed out that students could download the test (as a Microsoft Word document) and remove the answers, so that they would always have a blank test to practice on. He encouraged students to use the blank tests to practice their skills and reminded them it was a good way to keep track of questions to prepare for the exam.

He used the document reader to display the test solutions and pointed out where common mistakes were made. He reminded students that if they had questions on how they were marked on a question, it was to be discussed after class individually. Dan allowed students to ask questions without raising their hands. I noticed that students did this in a respectful and organized manner. He dealt with student concerns regarding his comments on the test. In
particular, a student asked what ‘OK’ meant on the test. Dan explained that “it was not exactly what I was looking for but you will get the credit for it. It was in a reasonable ballpark and it is not going to get any deductions.” The same student asked what a “subtraction sign” meant. Dan responded that “if you have a negative, it means you lost points.” I noticed that as soon as Dan mentioned the words “lost points”, the student made an audible “ugh” sound. Dan recognized this and explained quickly that “instead of adding points, I subtract points. I know it is not as positive a feedback but there are fewer points that get deducted than get added. It is just quicker for me to do it that way.” The student seemed to accept the explanation from Dan without any further querying.

Dan then spent approximately twenty minutes reviewing the lesson from the previous class. He did this using a PowerPoint presentation as well by using the white board. In particular, he explained equivalent fractions as it related to multiplication of fractions using pictures of rectangles and different coloured markers. Dan reminded students of a particular example and put up the slide of the example while at the same time using the white board. By doing this, Dan was able to demonstrate the sequence of steps, explaining each stage in different colours. He used terms such as ‘matrix multiplication’ and ‘denominations’ readily in his explanations, which led me to believe that students were familiar with the terms. During this review, I noticed that students were focused on the screen and the white board. Initially, there were rhetorical questions being asked that students were not expected to answer. It was noticed, however, that students were nodding their heads as Dan took students through the example of ‘three-fifths times two-thirds’. From the solution of visual rectangular pieces, Dan finally led students to the algorithm of multiplying fractions. I noticed that he used one colour to show the numerator and another colour to show the denominator to link up the visual with the algorithm.
He explained whole numbers as ‘oneness’. He asked the questions: “Why can we rearrange the order any way we like when we are multiplying?” and “why is this important?” (with regards to cancelling out the threes in two-thirds times three-fifths). He showed how the “The threes were disappearing to oneness.” As Dan was coming to a conclusion of the example, I noticed a palpable increase of volume and excitement in his voice. At this point, I witnessed an eureka moment in the class. One student shouted out that “three thirds was just one whole”. I think Dan was surprised, as he was not expecting an answer to his rhetorical questions.

Dan then extended his example to include more than two fractions being multiplied together. He showed that simplifying (cancelling out) any two numerators and any two denominators would yield the same result. In the process of explaining this, one student interrupted and asked a clarifying question. Dan acknowledged the question and explained and validated how the student’s idea was the same as what he was demonstrating by using a separate example.

Dan stressed that, as the class performs the skill, work needs to be organized so that “you have lots of room on the left of your page while making notes on the right.” There seemed to be a concern with the physicalness of steps on paper. He used words such as “aesthetics of work”, “lining up work”, “layers” and “organization”. There was a record of the entire question on the two white boards complete with colours that linked up with the previous example.

Dan then used an example to extend his lesson to include division of fractions. It was evident to me that the review of the previous lesson was over, and a new skill was being taught. For the student, however, it was a seamless, smooth transition. He used algebra to transition into division and explained to students that division was just “multiplication in disguise.”
Dan then stopped his lesson and invited a student to ask a particular question regarding the homework. This seemed out of sequence until I realized that the student had posed the question before class started on division of fractions (two-thirds divided by four-twenty-sevenths). It became apparent that Dan wanted to review the work (multiplication) first to give the question context. Dan then spent time on leading students through the example two-thirds divided by four-twenty-sevenths using the white board and coloured markers.

As Dan worked on the division example, he stressed that work needed to be organized as there were many layers of steps being used. He acknowledged to students that some questions may require an entire page of work because questions may be part of a longer process. Dan reiterated to students that they will have to become better at working on being organized so that students can become better problem solvers. He reiterated that “when you solve something complex by doing simpler steps that can be managed; you do not have to think about how we arrived at it”. He invited students to practice the steps as he was working on the example. At various times, students asked questions regarding why certain steps were preformed first. Each time, Dan answered their questions first before moving on.

At one point, Dan addressed the issue of light talking in his class while the lesson was going on. He acknowledged to the class that, although it does not happen very often, students should consider that only one person speaks at a time. He invited anyone to speak and reminded them that, although they may be excited about something or that it is a Friday, they should raise their hands and say it to the entire class. Dan clarified that “The sharing does not have to be about math but I ask that only one person speak at one time so that, if someone wants to pay attention, you are not distracting them.” There was a noticeable change in the noise level of the classroom as Dan completed his lesson.
Fifty minutes had just come to an end and Dan allowed a break in his two-hour lecture. As this was my first observation, I found this an appropriate time to depart.

4.3.3 Dan’s Pedagogical Strategies

In this section, I describe Dan’s understanding and experiences as it relates to his pedagogical teaching strategies. The methods and strategies that he uses to teach together with the reasoning within an ‘at-risk’ classroom, commitment to teaching ‘at-risk’ students, communicating high standards, evaluation of students and perception of student abilities. As described earlier, there are some specific techniques to consider when teaching in an ‘at-risk’ classroom. These strategies will become evident when investigating Dan’s interpretation of why he teaches (Dan’s perceived ‘purpose’), what he teaches (Dan’s course ‘content’) and how he teaches (Dan’s ‘teaching strategies’).

4.3.4 Dan’s Purpose

Dan believes that understanding the ‘purpose’ in mathematics is fundamental to his teaching. In his experience, a student must understand why a rule is applicable and is tantamount to understanding how a rule works:

In a lot of the math that they took, that we are revisiting — in elementary school, in middle school or however far we are going, maybe even a little bit of high school — is they were — or at least, this was what? Is they are just the drills. They did not really explain the why. Why, when you are dividing fractions, you invert and you multiply, why it works. I try to tell them why division by zero is bad. What is it that makes it undefined, you know, not good. I try to explain that what's happening is just sort of logical thinking that these things are not magical things that we do. It is not just a game that people know the rules of and play, and they are very good at thinking. It is just an abstract way of thinking about quantitative things and getting to the bare essentials of these. (Dan, Interview, September 12, 2012)

In another instance, he said:

Explaining why multiplication is working or what is going on, as opposed to just showing them how long division works. Trying to explain what is going on with; you know why we are doing what we are doing, to try to make them feel a little bit more comfortable
about it. As opposed to just saying, this is what we do, without any kind of — because most people, if they understand why they're doing something, they might be more likely to say, oh yes, okay, it makes a little bit more sense to me. (Dan, Interview, September 12, 2012)

Dan believes that the usefulness of studying math is important in motivating students to be successful. He tries to articulate the value that our culture places on the studying of mathematics in the following way:

It is rarely the subject matter that is going to be important but just the thought process of math. [The process] of taking a complex problem and breaking it into smaller, more manageable steps. That particular way of thinking is something that is useful, not just in a math class, but anywhere. It is very helpful to get them to be better problem solvers. That is something that is valued in our culture and that is the motivation that I give them that that is the reason math is required everywhere, because that type of thinking is a useful tool in our society. (Dan, Interview, September 12, 2012)

Sometimes, students can become discouraged with the everyday routine of doing and practicing mathematics. In these times, Dan tries to refocus them on the usefulness of mathematics:

I think trying to work on ways to make them better students and not shy away from doing math. I try to motivate them by periodically giving them analogies that — and trying to motivate, why they are taking a math class. What it is that is useful about mathematics in general. Also, trying to make them a little bit better students because that is ultimately what will make them successful in these classes is just working at it. (Dan, Interview September 12, 2012)

4.3.5 Dan’s Content

The content of the course that Dan teaches is based on the needs and requirements of the program of study. As such, the mathematics of Dan’s course includes whole numbers, fractions, percents and operations in each area. Dan believes that algebra should be the focus. He stated: “What I think the course should be is just basic algebra, different levels of algebra, and that is what I consider as sort of the essential college mathematics. If they have those basic skills, then they would be ready to do other things, that they would be ready to relate it and apply it” (Dan, Interview, April 17, 2015). This is reiterated in another instance when Dan says, “I would think
that they would benefit most going all the way back to high school and not doing anything like probability or calculus, just focusing on basic skill building” (Dan, Interview, April 17, 2015).

Dan believes that basic skill building is crucial to the mathematical development of his students. Dan offers a glimpse of what his teaching includes and offers advice to anyone newly assigned to teach it:

Well, first I would tell them to not assume that they know anything because in this class, we start essentially from grade one. So you can go at a faster pace, but a lot of these students cannot do simple arithmetic. I am not talking with fractions or decimals. I am talking about with whole numbers, adding, multiplying. So, I think spending some time in that area and trying to get them to be a little bit better at simple arithmetic and knowing things like their multiplication table. That is one of the things that I tell the students is going to be a very important factor in terms of success and in struggling all semester, just knowing your multiplication table one through nine, but just, not assuming that they know anything, and if they ask a question, then just try to answer the question filling in all the details. (Dan, Interview, January 31, 2013)

He further elaborates:

And then as the semester goes, if it is something that you already talked about then you can go through it a little bit, quicker as supposed to going through all the details again, but it is pretty much starting from zero because there are some students that are really weak in this class and unfortunately, varies from class to class, there is more of them in one. (Dan, Interview, January 31, 2013)

While other content may be important, Dan believes that:

For these types of students, the skill-learning and the repetitive aspects of it, unrelated to actual problem-solving, because there's so many more layers when you try to actually apply these things. They need basic skill-learning, and that needs to be the focus. (Dan, Interview, January 31, 2013)

4.3.6 Dan’s Teaching Strategies

The predominant teaching strategy that Dan employs in his classroom is a lecture-style method with the aid of a white board, PowerPoint technology and an opaque projector. Many examples are used to demonstrate the rules and skills of the lesson. Dan understands the importance of presenting material in different ways:
I try to think of new ways to present materials. This semester, I am trying to use PowerPoint. I think trying to be a little bit more visual with them, trying to use different methods to help keep them engaged instead of just writing on the board, which is important in a math class. Just [using] paper and pencil or pen, or board and marker, blackboard and chalk. Just different ways to try to reach them, different medias or whatever — I will definitely use the whiteboard and write things out, because that is the essence of basic math, but trying to use things like PowerPoint. I am trying to show them things on the Internet that might be interesting. I try to present it in [different ways] because I know that, in class, if I am talking about something and I am getting glazed looks so I try to, especially for this class, try to dress it up a little bit. (Dan, Interview, September 12, 2012)

Whether using PowerPoint or the whiteboard, students are continually urged to ask questions and come to the board or to the front of the class to demonstrate or further articulate questions and ideas.

Visual cues are important in a lecture-style method, and Dan is constantly seeking eye contact to gauge his audience:

Just looking for those kinds of signs, where things are just kind of getting heavy for them and I am losing their focus. So if I have their focus and their concentration, then that is one way that I measure that I am kind of being successful, at least in my presentation. Not that they are going to go out and do their own work, but it might be more likely that they will. (Dan, Interview, September 12, 2012)

In another instance, Dan recognizes when students may have reached their listening saturation point:

Looking out there, you can figure that out when that is happening you have cues that you would look at to see that either they need some help. Visually, where you can sort of eyeball them, or that maybe they are not paying attention. (Dan, Interview, January 31, 2013)

In Dan’s experience, the importance of presenting material in different ways is crucial in helping students stay focused and helps keep them coming to class. In his words:

You have to kind of try to think of different ways of presenting material to them, and not only that, motivate them. Because of their weakness, they are easy to lose. They get discouraged quickly, and so they will just kind of stop doing anything. (Dan, Interview, September 12, 2012)

Dan believes that an informal lecture style delivery model best suits his class. In this way, he is
able to best meet the needs of his students.

4.3.6.1 The Use of Technology as a Teaching Strategy

Although Dan uses technology in his classroom, he is wary of the impact it may have on his learners. He maintains that technology is not useful when students are focused on the fundamental skills and rules of basic mathematics. He describes it in the following way:

Especially in a class like this, where it is basics, and regardless of how much technology you have, ultimately, what they are going to need are chalkboard and chalk, or paper and pencil. With this type of fundamental stuff, technology's not going to be very [helpful]. I mean technology is helpful when you have intricate things and you are trying to make connections and it is helpful to sort of visualize, but with this one, there is not really a lot of visualizing that is going on, it is just basic skill-building. (Dan, Interview, April 17, 2015)

Although Dan acknowledges that students use calculators at an early age, it is not necessarily a helpful advantage. In fact, he believes that calculators can be “detrimental to their learning and fundamentals” (Dan, Interview, April 17, 2015). He truly believes that working without a calculator is vital because, student’s basic skill foundations are so weak that students need to work on their innate math abilities first.

In his experience, he believes that students need to develop an instinct for math. In his words: “if they are given an application problem, their foundations are so weak that things just collapse, they are not able to do those things. They are not able to utilize things like calculator or software because they do not know when it is wrong. They need the math instinct more than anything else” (Dan, Interview, September 12, 2012).

Dan is somewhat conflicted with the idea of students using calculators in the classroom and admits that he is of two minds:

I do not mind it because I think it does help them work on their math instinct and developing that instinct a little bit. So when they look at numbers, they have a sense for what the answer should be, roughly. I think the course would have to be quite different. (Dan, Interview, January 31, 2013)
If calculators must be used, then Dan believes that the course itself would have to change.

Application of skills would have to be the focus. Dan believes that, if this was to happen, then students would be “lacking fundamental things, [students] would not do very well with applications, and they might punch stuff in on the calculator and not know whether it was the right answer or even a reasonable answer” (Dan, Interview, January 31, 2013).

Despite his views on using the calculator in the classroom, Dan has invested time and effort in utilizing software for online homework assignments. He describes it as:

an online interface with turning in their homework. The only problem with that is they do not get feedback, but a lot of them — because it only usually wants the answers — a lot of them will kind of work it out, submit the answer, but throw away their work as opposed to keeping [it]. I try to encourage them to do that — keeping paper and pencil, and writing everything out so that you have a record of what you did — so you can go back and look at it, and review for tests and finals. (Dan, Interview, September 12, 2012)

Dan also acknowledges the use of other technology in the classroom, but points out how it can be misused. He stated that:

For example, this semester I have been trying to use PowerPoint. I am not an expert with PowerPoint, but I think — and trying to minimize what I put on there, because if I put too much on the board at once, I think that can be overwhelming to them. There are times where you have to do that, but trying to figure out ways that I can present things to them — whether it is the actual lecture or a problem that we are working — so that they will feel comfortable. Not only will they be able to understand it, but they will feel comfortable enough to go and try it, and see if they can re-create it themselves. (Dan, Interview, September 12, 2012)

Dan offers another way of thinking about using PowerPoint technology in his classroom:

And the PowerPoint was just something that I thought I would try just to see how it would work; more bells and whistles and flashy things. I hope that, in some instances, it might help them visualize what I wanted to say in specific steps. On the board sometimes it is difficult if it is a process that takes more than two boards to write. So with the PowerPoint you can have ten slides to illustrate a single point and hopefully that helps a little bit. A different approach from writing, and I do not think it is necessary for this class, but just something else. I might put a picture in there, something amusing or something like that, something to distract them from an hour and forty-five minutes of math. (Dan, Interview, January 31, 2013)
In another instance, he refers to a document reader as another instrument he utilizes in the classroom:

At the University of Tennessee, somebody — a colleague — said, ‘Oh, there is this thing by the way, so that if you want to show something you do not have electronically or even if you have a calculator, you have an emulator for you. [You] can stick it on there and punch it.’ And I found it quite useful with math classes where you do need paper and pencil, or something to write on and something to write with. It helps if you have that. In that way — for some classes, what I did was I essentially, if I felt the students could handle it, I would just write my lectures there and I would have them. So if we did examples, I’d have the examples, if they wanted to see them. (Dan, Interview, January 31, 2013)

I noted that Dan used a document reader to take up tests and assignments (Field notes, September 28, 2012; October 5, 2012; November 23, 2012).

4.3.6.2 Motivation

In Dan’s experience, motivating students is the key to their overall success. He maintains that there are various ways in which this can be achieved. This section includes his thoughts and experience on such ideas as using analogies, offering encouragement, enhancing engagement, supporting student initiative, using entertainment to maintain consistent attendance, fostering confidence, creating positive attitudes, demonstrating patience and student rapport.

4.3.6.3 Using Analogies for Homework Completion

Dan believes that using analogies throughout the semester is important to his teaching. He believes that it gives students motivation in sustaining their effort while doing homework. He describes it:

Some of the things that I try, and it is mostly early on in the semester but I try to repeat myself throughout, are to try to give them analogies. The analogies, things that I used, are things like learning to drive. If you are not good at driving, and most of the people in these math classes are self-classified ‘Not good at math’ people, I tell them ‘Well if you are not good at math, then the way that you are going to get better is to do math.’ Because if you are not good at driving, how do you get better at driving? You practice driving, if you are not good at swimming, how do you get better at swimming? I try to tell them that the way that they are going to practice is by doing [the] homework. That is why it is so
important to [practice]. That's why everybody always drills to try to do the homework, to see if you really understand stuff. (Dan, Interview, September 12, 2012)

Putting the required time and effort to complete homework is the goal of Dan’s analogies and he judges if he is successful in this objective by constantly seeking dialogue and feedback from his students. He states frankly that:

Putting in an appropriate amount of time, and for the most part that means just sitting somewhere and working problems. It does not mean that that is all they have to do, but again, the way I try to communicate that is usually through analogy. So one of the things that I try to mention is, as students — I try to associate it to a full-time job. If they are taking a full load, then part of their life is that they are a full-time student and that is their job, which means they need to be spending 30 to 40 hours on that. So if they are going to class for 12 hours, [equates to] 20 to 30 hours outside of class. That means at least a few hours a week in math class, especially if it is their weakest discipline…If you are going to go and take a math test, if you don't practice any problems, chances are you are not going to be successful. Or hitting a baseball…or whatever else, just to try to get them to try some problems and then give me some feedback. (Dan, Interview, September 12, 2012)

If Dan can get students to practice their skills by completing homework or even attempting homework on a daily basis, this would further their success:

Specifically, trying to do the homework or anything for that matter outside of class. Trying to do math outside of class because their needs are that they need to work on math. They need to do a little bit of math every day to get more comfortable with it. I do not think that that varies a lot in terms the needs of these types of students. (Dan, Interview, September 12, 2012)

Dan believes that homework attempts and completion are key factors in his student’s success and, by using analogies in his teaching, he helps students stay focused and motivated to finish their work.

### 4.3.6.4 Offering Encouragement

Dan believes that another approach to increase motivation is to encourage his students. He does this by being open and inviting to questions during his lectures as well as validating student’s responses. This was evidenced when I observed him in the classroom (Field Notes, September 28, 2012; October 5, 2012; November 23, 2012). In his words:
I try to encourage [the students]. Some of the students feel intimidated to answer and so they do not feel like answering. I will say, ‘Take a shot, give it a try.’ But if they really do not feel like it then, just call somebody else. (Dan, Interview, January 31, 2013)

Dan admits to some uncertainty over time concerning encouraging his students. He states:

If you teach it for a long period of time, there is not anything really fresh. You start losing the ability to put a lot of effort into the encouragement and explaining things, and it starts to be — I mean I noticed that this semester’s a little bit — like I said, they have negative attitudes and sometimes that rubs off because I am teaching the other classes and the other classes go so much more smoothly, but this one, it takes a lot more effort. (Dan, Interview, April 17, 2015)

Nevertheless, Dan considers it is important to continue encouraging the students to keep striving to be better students of mathematics:

Well, so after every quiz or every test I try to encourage them to keep at it. Really, that is the only choice they have. If they give up now than they are not going to be successful with this and they are not going to be able to go forward with their program or whatever it is they are doing. (Dan, Interview, January 31, 2013)

Encouraging students to not give up and continue practicing the skills learned every day in class is a concept that Dan supports by his actions and words in the classroom.

4.3.6.5 Enhancing Engagement and Rapport

Dan believes that enhancing student engagement can be a strategic factor in motivating students to become interested in studying mathematics:

I think an ability to engage with these students, [is] a way to get them interested and keep them interested…So, even if it is not all the way through — because ultimately it will still be math — but at least the motivation, you know, get them a little bit excited about [math]. (Dan, Interview, September 12, 2012)

Dan believes that engaging his students on a daily basis is important and ultimately up to the individual instructor to forge:

Ultimately, it is sort of up to the teacher to get them to try to do the work. Try to do the work, keyword, try to do the work. And practice, because that is ultimately how they are going to get better. But I think the best way to do that - the best way to encourage them to come to class and to try to do the homework — is to try to engage them on a daily basis in class. And the smaller the class, the better chance of that happening, because if it is a
big class, they will just kind of sit there and they will not say anything. (Dan, Interview, September 12, 2012)

For Dan to cultivate a positive learning environment, he needs to be able to develop a rapport with his students. For his students to feel comfortable and confident in his class, he must also feel the same. According to Dan, “I think that I might have a reasonably decent rapport with students, and I think that that might be important for these types of students so that there is a comfort level, and that will aid in their motivations” (Dan, Interview, September 12, 2012).

At times, however, there are obstacles for Dan in developing student rapport. He states that “some other classes are a little bit more sort of ‘high school-ish’ and they see me more as an adversary rather than somebody who is trying to help them” (Dan, Interview, January 31, 2013). In those cases, Dan makes an effort to get to know the student personalities of his class. As evidenced in the field notes and classroom observations, during break time, Dan walks around and converses with his students about local events and happenings outside of the classroom. Although Dan is aware of teacher-student boundaries, he describes his rapport with his students:

It could be verbal, sometimes they send me emails, [and] sometimes they come and talk to me after class. I know that students are usually a little bit afraid to be critical, but they are certainly not afraid to be complimentary. I do not want to make it seem like I am their friend, because I am their teacher and a lot of times they mistake that for that we are buddies and they are going to get an easy mark. So I try to make sure that there is the teacher-student relationship. I try to do things that might seem sort of silly in class, so that they are not intimidated by me for whatever reason even though I am the teacher. So that they will come and talk to me, they will give me feedback positive or negative, because I know negative is a little bit harder. (Dan, Interview, September 12, 2012)

Developing student rapport affords Dan the gateway into helping motivate students to succeed. If Dan is consistent in his persistence of enhancing student engagement and rapport, he feels that his students will have a greater learning experience that might lead to a more successful outcome in their mathematical achievements.
4.3.6.6 Entertainment and Attendance

Dan concedes that there exists an entertainment factor in enhancing student motivation. As evidenced in his classroom, the informal atmosphere created allows for ease of communication between and among his students (Field notes, September 28, 2012; October 5, 2012; November 23, 2012). This openness is necessary to help students feel comfortable enough to communicate in the classroom and helps build trust between student and teacher. Once the comfort level is established, Dan must maintain student attention and motivation. He believes that, “You do not really have to be charismatic, but you have to find ways to entertain them. But, not only that, make the math at least somewhat entertaining or interesting” (Dan, Interview, September 12, 2012).

He has developed some unique ways to do this. One of the techniques he has tried “is to play a little bit of music, during the class. Stop, let somebody pick a song” (Dan, Interview, September 12, 2012). He believes that, by doing this, students get a mental break from intense thinking and then can re-focus on the lesson with renewed vigour. He also describes an alternate technique:

Something else that I try is stopping, letting somebody else come up and tell a joke or something like that, or I try to tell a joke just to break it up a little bit, get the blood flowing again somehow. But definitely [I try] somehow to make [learning] positive. I try to act silly and I exaggerate my body language. I try to be more animated, to try to make it more amusing, more enjoyable, [and] more positive. (Dan, Interview, September 12, 2012)

Identifying early signs of tediousness in the lesson signals to Dan when he needs to change gears:

I think in this class, in particular, if there is any moment at which it becomes overwhelming, there is a tendency for them to just shut down. But generally, my sort of enjoying the stuff and being sort of jovial and excited about it does reflect in their interest, because if I am seeing it as dry and uninteresting then it is not going to be [interesting]. (Dan, Interview, April 17, 2015)
Dan maintains that, if students see the benefits of attending class, then they are more likely to attend:

But just getting them to come to class because I do not think they realize the benefits of coming to class. And just continually encouraging them to try to do the homework. And as their motivation for doing homework is because that is the type of exercises that they will see on the tests. (Dan, Interview, January 31, 2013)

Dan believes that, if he makes his class more enjoyable and positive, student motivation will increase and his students will continue coming to class:

I try to think of ways to encourage them to come to class. If I feel like that that is not working, if there is a low turnout then I ask myself, "What can I do to get the turnout to be a little bit higher in class?" because I know that it will help them. Sometimes they do not realize it, that what we are doing in class is easy and there is no point of being there, but I know that it will benefit them to be there. (Dan, Interview, September 12, 2012)

Dan believes that linking student attendance to student success is inevitable. He says that, “if there is a good turnout then that is a pretty good indication that what I am doing is being helpful to them” (Dan, Interview, September 12, 2012). Dan believes that “if you can get students to attend class, participate or practice their work, spend time with materials, then the student is more likely to be successful” (Dan, Interview, April 17, 2015).

4.3.6.7 Fostering Confidence & Supporting Student Initiative

Dan maintains that fostering student confidence in their mathematical ability will support the student’s academic initiative. He believes that demonstrating initiative in the classroom can include seeking missed material when absent, doing extra questions, seeking instructor or tutor help, reading ahead, preparing for a test or assignment ahead of time and being proactive around personal events. Dan believes that, if he can foster this idea of self-confidence, then taking the initiative can even transcend the mathematics classroom for some students. He views the idea of taking the initiative in the following way:

It is very important for these kids to develop some sense of taking initiative and that will
go in other directions because if they [can] continue to remain anonymous, they are not really taking the initiative. It is important in life too — they need to be developing some things that are going to be helpful to them outside of the academic world. (Dan, Interview, April 17, 2015)

Dan admits to frustration at times, when it comes to students taking the initiative:

[Students] probably need people to chase them; not very many [students] take the initiative. I think that's probably true across the board for college and university people. There are not many [students] that take the initiative to come and seek out professors. (Dan, Interview, September 12, 2012)

As the semester progresses, Dan becomes optimistic. He acknowledges that he sees progression in the area of student’s level of self-confidence and it gives him a sense of satisfaction and fulfillment:

I think as the semester goes and it depends on sort of the characteristics of the class because some of the classes are a little bit different…[A] kind of [high-school behavior] which students in the class [may] like, that [confidence] does not seem to go as well. But if it [is] sort of a friendly class and they see others attempting then, yeah then usually, usually as the semester goes they become a little bit more [confident]. (Dan, Interview, January 31, 2013)

In another instance, he states:

Yeah, it is their [students] confidence level. So their level of confidence with dealing with math, just anything ‘math-y’ [math related] improves. Because they take other math classes or other classes that have math in it and they are more confident, more able. They attribute it to me but it is got nothing to do with me. It is just that they spent time and put the effort in and they developed a little bit of confidence and that is something that they can do if they just work at it. (Dan, Interview, January 31, 2013)

Dan believes that improving confidence in a student’s math ability and cultivating initiative are both positive signs in a student’s overall motivation to succeed.

4.3.6.8 Creating Positive Attitudes

Positive attitudes about doing and learning mathematics are crucial to a student’s success in the subject (Benken et al., 2015). Dan is aware of his student’s attitudes toward mathematics and initially senses negative tensions that can be present in his classroom. He admits that “their
attitudes are usually negative towards a math class, so I try to do what I can to make it positive. Of course I am not always successful because ultimately it is math” (Dan, Interview, September 12, 2012). Dan concedes that it can be frustrating when he encounters students with negative attitudes:

There is only very few, maybe like one every other class that just has absolutely no chance either because they do not want to put in any kind of effort or they just give up too quickly. There is a lot of that personality type in the class especially with math. You know, things start getting a little hard and they are like, ‘Math too hard. Not going to try.’ So, that is a little bit of a hurdle that is tough to navigate. (Dan, Interview, January 31, 2013)

Nevertheless, Dan is persistent in his quest to motivate students to practice mathematics by creating a positive atmosphere in his classroom:

That is why I think trying to make it something positive, trying to make it encouraging so that they will not get discouraged as quickly. Try to make it positive so that they will spend some time on it. I think that's how they are related to — generally they have negative attitudes and that means they probably will not spend time on their homework. (Dan, Interview, September 12, 2012)

Dan’s persistence to create a positive atmosphere is reflected when he says:

And so if there is something positive about it, that there is even a little bit of hope that it is something they can be successful at, then I think that that will probably motivate them to want to spend more time on it. Also, if I can get them to be better note-takers or process the information from class better, to where they can actually utilize what we are doing in class, then again, that will probably encourage them to sit down and try the stuff. (Dan, Interview, September 12, 2012)

It has been suggested earlier that, although beliefs and attitudes about mathematics may be hard to change, the opposite is true of emotional responses to mathematics (McLeod & Ortega, 1993). One of those emotions is fear and Dan is sensitive to those students that demonstrate a fear toward mathematics:

I think most of them have a little bit of a phobia — most of them — of math. They are afraid of it, so I think there's a little bit of a negative attitude. I think, as I mentioned before, they can be easily discouraged if things do not go well. I think that is part of the reason they are in this class is because the foundations are so fragile. If they try to climb up the steps, or the pyramid, they are a lot more likely to fall and that is why they get
discouraged. (Dan, Interview, September 12, 2012)

Dan’s use of encouragement, fostering of confidence, support of student initiatives and enhancement of student engagement and rapport all can evoke an emotional response to the learning of mathematics in his classroom. By doing so, he has strived to create a positive environment that helps to motivate learning and increase student success in his classroom.

4.3.6.9 Demonstrating Patience

Dan realized early in his career that patience in his classroom was important. He demonstrated this virtue many times in the classroom. He was patient when waiting for students to articulate their questions and concerns during lessons and was patient when demonstrating examples, taking up homework and test solutions (Field notes, September 28, 2012; October 5, 2012; November 23, 2012). He summarizes his thoughts on having patience during the course of the semester:

It helped me to be a little bit more patient. It helped me develop some more patience. And just try to instead of having one certain way that I know was sort of the right way to think about it, I try to think about it in different ways and maybe one of those would shed some light on [the] why. (Dan, Interview, January 31, 2013)

An added bonus to developing patience in his teaching environment was the ability to extend it outside the classroom. In his words:

Being able to teach the ‘at-risk’ people helped me sort of learn to reach smaller children. Not necessarily that — in terms of their math ability they were like high school kids, or middle school kids. And so it helped me to — because I did a little bit of tutoring. (Dan, Interview, January 31, 2013)

He further states:

I think it does take somebody who has got a little bit more patience, so maybe somebody who has got experience with children, having children, or having worked with younger people because their level of maturity is not quite the same as students in other math classes. (Dan, Interview, April 17, 2015)

Dan believes that patience was the glue to fostering encouragement, engagement and confidence
in his students.

4.3.6.10 Problem Solving

AMATYC (2005) and NCTM (2000) suggest that problem-solving should be utilized in the teaching of mathematics. Dan acknowledges that the use of problem-solving as a primary strategy may not always be the best technique for the ‘at-risk’ student:

Problem solving. I do not think they should do that until they have a solid foundation in all the basic areas, most especially in algebra, just the solid foundation in algebra, then they can start adding the layers with respect to whatever particular area they are interested in and then do applications in those areas. But I think that is part of the reason that a lot of them struggle because they understand the basic ideas, but it is just the details that they have and math is details, and that is true in all the classes. (Dan, Interview, April 17, 2015)

Dan believes that the culmination of learning and practicing basic mathematics skills is to problem solve. He believes that, only when students have attained the basic skill should they attempt problem solving. Dan maintains that problem solving is a ‘layering’ of learned skills. An instance of Dan’s belief in ‘layering’ in problem-solving is captured in the actual classroom moment with relation to percents:

So we have to ask the question. This is the layer that it adds here. Because it helps if we could ask the type of question that we are translating. So we have to ask sort of the right type of question. What is six percent of 850, because that is how much the tax will be. The tax is 6 percent of 850 so we need to know what that is. And if we can get it here, if we can do this one layer, then we can get it into an equation…So when you get comfortable solving these types of equations, then the only other layer you have to add is sort of reading through an application and seeing if you can ask the right question that sets up the equations and so, that layer is not necessarily straightforward, you have to ask sort of the right version of it. (Dan observation #3, transcripts, November 23, 2012)

Dan believes that, along with the ‘layering’, the structural nature of problem-solving is the key to understanding how to problem-solve. He states that:

It is just the logical structure of math that is beneficial, the learning to be a better problem solver, to organize your thoughts, and to take complex scenarios and break them down into smaller more manageable steps. That is the essence of what is useful in math. I try to point that — when we are doing certain things that, see it is the structure of the way that
we are thinking about this, taking something complex and breaking it into smaller more manageable steps that we at any one we can do, and then just putting it in a sequence to arrive at the answer. (Dan, Interview, September 12, 2012)

In summary, Dan maintains that once basic skills and structural form are acquired, problem solving as a teaching tool can finally be utilized in the classroom.

4.3.6.11 Visual Organization of Work

Dan believes that crucial to problem solving is the layering of basic skill and the organization of work itself. This was clearly evident in a captured segment of teaching when observing him in the classroom. Dan thought it was important to keep a visual record of the lesson on the board:

Now remember you have got your paper and writing utensil out and you are giving yourself lots of room going down the left making notes on the right….So there are many layers at this point. We have now started to work through problems where we really need to be able to be organized when we are working through them. Right that is going to be important….Alright, that should be on the right of the work over there which was kind of going down and to the left. So we have many things. We were working on steps one and four on the last test. And they were just single questions. Now they might be part of a longer process. So we have to make sure that we might even have to devote a whole page or half a page to one problem at this point. We have to get better at working on that particular part of our math….That is what we are working on. And it’s a longer process. With the Chapter 1 stuff, we were able to do things in one or two steps. But we are going to get a chance to work on organization and I want you to try to work on it when we are working through problems. I am limited with my space on the board so I cannot keep going down the left, but you keep going down the left and the extra stuff goes on the right. (Dan observation #1, transcripts, September 28, 2012)

Dan’s use of pace in his class is important to him. He believes that, if he goes too fast, he may lose his class, and if he goes too slowly, many can get bored and ‘check out’ of the lesson. He understands the need for a balance and sees the need for organized presentation of work. Dan later articulated the need to demonstrate the organization of math work in the following way:

Well, I guess trying to go slowly, trying to be very organized with what I write, and articulating that to them, so that when they take notes to sort of do it the same way, a focus on problem solving rather than just lecturing. This class in particular, I have treated it as more of a tutorial rather than a lecture, just because I find that they are more likely to
sort of shut down if I am talking in general as opposed to just starting to work specific problems and then mentioning the generalities as we go through. (Dan, Interview, April 17, 2015)

Dan asserts that, if a student is organized in their math work, it leads to stronger analytic skills:

I think what is most important for these kids is just to be able to take their thoughts by writing things down on paper and just trying to be neat and organized so that sort of transfers back up here, and I think if they could do that then they'll be able to cope with doing things analytically. (Dan, Interview, April 17, 2015)

Whenever Dan presented his material on the board, he was always neat, organized and structured in his work. In this way, it demonstrated the importance of the attention he paid to the structural organization of math work and its importance in student understanding and learning. This was evidenced in both interviews with Dan and classroom observations of Dan.

4.3.7 Commitment to Teaching At-Risk Students

Dan’s commitment to teaching ‘at-risk’ college math students began early in his career. At the University of Tennessee, he began teaching non-credit courses in mathematics:

I consider them remedial math classes, because at the University of Tennessee, you did not get credit for them but they — again, it was an assessment test that students took and they rated low enough to need a pre-math before actually starting at the lowest university level, so they did this. (Dan, Interview, September 12, 2012)

Dan was assigned these types of non-credit courses because there was a need to address this group of unique students, and at the time, not many instructors seemed to show commitment to the cause. He describes his experience in the following way: “I was just assigned these courses. I think that a lot of professors shy away from teaching these types of students” (Dan, Interview, September 12, 2012). When questioned further as to why “professors shy away from teaching these types of students”, Dan offers a possible reason for this: “Because I think it takes more
effort to teach these types of students than students who have better aptitude for math because you have to spend more time” (Dan, Interview, September 12, 2012).

Dan describes his journey and mindset of teaching ‘at-risk’ college math students from the beginning in the following way:

I sort of saw it as a challenge and at first, I do not think I had the right mindset because these are the really weak people and that was just going to be more of a chore but I found it more so to put a positive spin on it. I found it more of a challenge to try to reach these people because you try to. These [basic math skills] are some of the most basic things and usually they should be the easiest to explain for us. Rather than the more complex things where there is sometimes a little, a few more gaps you know when you're teaching it at the introductory level but with this, I mean it just boils down to just basic whole numbers. (Dan, Interview, April 17, 2015)

Although Dan stated earlier that he can sometimes get in a rut during the course of the semester, he later concedes just the opposite. When committed to teaching ‘at-risk’ mathematics students, he describes his thinking:

I want to try to keep them and try to get them to get better at it, and so I have to try to think of ways to do that. I do not think with this type of a class you can get in a rut. Like when you are teaching other classes, if you have notes and you have been doing it for years, it just becomes sort of second nature. But I think with this type of a class, you almost always have to try to think of something new, some better way of trying to present the material so that you get more student participation in class, you get better attendance, you get more people working on their homework, and you get a better success rate on tests. (Dan, Interview, September 12, 2012)

Dan believes that ‘at-risk’ math class sizes should be smaller. If classes are treated more as a tutorial, then he would be able to reach more students. However, Dan understands the reality of economics:

Ideal, of course would be a significant amount of time one-on-one with every student, because these students do need a quasi-tutor. I think ideally small classes so that that is more likely, versus the reality of 30 to 40 students in a class, where you really do not have the time. If they do not take the initiative and come see you during office hours, and even if they did, you would not be able to give everybody half an hour every week otherwise you are spending 20 hours a week just with office hours. But, if there were 10 to 15 students, 5 hours a week, you could do it. And, you could spend 15 [minutes] and, as you did it they might need less and less time, and not everybody might need a half an hour every week. They might get more comfortable that way. I think that is the
unfortunate reality of economics, and you cannot do that. You cannot have classes that small and make a profit. (Dan, Interview, September 12, 2012)

The reality of large class sizes is that students will often feel centred out and embarrassed should they need to ask in-class questions. In Dan’s words:

The reality is in this kind of class they actually have to take some kind of initiative and either speak up in class or speak up outside of class, and with so many students there are not very many that do that. In class, they just kind of fade away if they are not getting it. They do not want to be embarrassed. They do not want to ask anything stupid. (Dan, Interview, September 12, 2012)

Dan suspects that the reason he is assigned to teach the ‘at-risk’ math students is that he has “a reasonably decent rapport with students”, and he maintains that having that rapport “might be important for these types of students” (Dan, Interview, September 12, 2012). The fact that Dan has been teaching ‘at-risk’ mathematics students since 2007 is a testament to his commitment and success in this endeavor.

4.3.8 Communicating High Standards

The critical goal in communicating high standards is to get the students to become more responsible for their education and for students to become more self-regulatory (Wambach et al., 2000). Dan believes that a high standard in this particular type of class is not “necessarily to be getting an A in class, but just being a good student and getting better at whatever it is that you're studying”, (Dan, Interview, September 12, 2012). He continually imparts to his students that they need to treat their schooling as a full time job:

I try to tell them that as students, their full time job is to be a student, so that they need to be spending 30 hours a week on being a student. So if you are only in class 10 hours, then you should be spending 20 hours outside of class, even if you have a part time job that takes 20 hours. Somebody could perform well in terms of having a high standard, but still end up with a C grade. When they started they were maybe an F student, but at the end there is an improvement. Sometimes I get people in there that seem like the stuff is easy to them and they should probably be in a higher-level class. They seem like A grade students but they do not really put in the effort and they end up with B grades or something like that, where they could have easily made A grades. To me that is not a high standard, even
though they made a B grade. (Dan, Interview, September 12, 2012)

Dan thinks self-regulation on the part of students involves attending class and doing their homework. As he describes it:

I think that I can probably generalize in saying that most of them probably just need work at being good students. So being able to take good notes in class, being able to go afterwards and spend time doing their homework. I do not think that beyond that there is very much, case-by-case maybe, but I think for the most part those two things are the places that they need to work on. And those students that have one of those two things down usually are more successful than the ones that do not. The ones that already know how to organize their time and then spend time on the class. It is kind of treating it as a job, not just coming to class and then showing up for tests. (Dan, Interview, September 12, 2012)

There are moments that Dan sometimes feels helpless. He describes these moments when students cannot self-regulate themselves and who get easily distracted in a classroom:

Oh, yes. There are some students unfortunately, that are beyond reach. If they happen to be on their laptop and they are not paying attention, there is really not much I can do. I think the students at the head of the class, I can do things for. Primarily, I like to try to reach the middle of the class, and maybe the lower end of the middle; students who are putting in some kind of effort but struggling a little bit. I like to get feedback from them because usually when I ask questions, it is the students that are at the head of the class that are volunteering. (Dan, Interview, January 31, 2013)

It is apparent, then, that putting in the time and effort in their studies, is the standard by which Dan measures how successful a student may become. In his words: “Yes, just putting in time working. Putting in time, practicing. Absolutely, that's really the most important thing for post-secondary education is just putting in quality time” (Dan, Interview, September 12, 2012).

4.3.9 Professional Development

The Ontario college system affords instructors multiple opportunities to develop in their profession. Some departments within the college structure are dedicated to professional development and may be served by a leadership and employee development branch. However, unless there is a demand or necessity for a particular interest, most professional development is
generic in nature. Some of the programs offered by Dan’s college consist of the following: tuition assistance for ministry approved courses outside the college, conference/workshop funding, tuition subsidy for all courses taken within the college and professional development leaves. While these programs are generous, most are available to full, part-time or contract employees.

Dan is aware of these programs but has not availed himself of these opportunities as of yet. When asked what, if any, professional development he has experienced, Dan acknowledged the following:

I have not done anything to sort of work on being able to deal with this type of class other than just the experience with dealing with the class. I have not done anything outside of the class, not personally. It might benefit a person to not necessarily to get any kind of professional certification or accreditation but just to work with younger people to develop more patience, and be able to explain things at really sort of a base level. (Dan, Interview, April 17, 2015)

Nevertheless, Dan is continually evaluating and assessing his own practice on a daily basis. This is evident in the sharing of his introspective moments of his teaching from the interviews and classroom observations.

4.3.10 Evaluation of Students

Research has suggested that “classroom assessment can have a positive impact on student behavior and performance when it focuses on improving the learning experience, not on identifying individual student weakness” (AMATYC, 2005, p. 32). Dan’s rapport in the classroom helps to create a sense of openness for his students. When the two-way communication is established, it helps improve the learning experience of his students. Dan believes that evaluation of learning can occur once students are comfortable so they can actually focus on learning and not just passing the class:

[Focusing] on actually learning something and getting better, as opposed to just focusing on trying to learn stuff to pass, and then not really learning it, [is better than] just sort of
remembering stuff to pass the class. (Dan, Interview, April 17, 2015)

Dan is mindful yet skeptical of evaluations that would make it easy just so students can pass the course without too much effort. He describes the evaluation and breakdown of marks currently in practice:

What they are doing for 30 points, it is online, and all they have to do for — it is either five points or ten points — is just sit through online lessons, which would parallel what we are doing in class, and then the other 20-25% would be taking an online quiz, but it is not a timed quiz and they can repeat it as many times to get 100%. It is really easy to get 30 points, so in order to pass the class; you only need another 20 out of the 70, which is not even 30%. It has become a lot easier to pass the class even for students who are very, very weak, which is unfortunate because that is not ideal. It used to be that for the weaker students, regardless of what they did, they were not able to make it through, but now it is possible as long as you take the time to go through the lessons. It is not necessarily reflected in that they are learning the material but they are just getting these points because you can do the quizzes and all they do is scramble the numbers so if you get the hang of what they are doing with the numbers and punch it in, and in class, we are supposed to be working without a calculator, but outside of class they do not have to. (Dan, Interview, April 17, 2015)

Even though a sense of frustration is evident from the above quote, Dan believes that measuring a student’s success in the course can be achieved in other ways. He describes one way this can be accomplished:

In order to measure success in these types of basic fundamental skill-building classes, what might be helpful is to have a beginning exam that is similar to a final exam and measuring if there is any significant change between how they do at the start of the class versus how they do at the end of the class. Not just their score but how long it takes them as well — as a tool for measuring success. (Dan, Interview, April 17, 2015)

This insight of Dan’s thoughts on assessment was given at the end of the semester, at a stage when he had time to reflect on his cumulative teaching experience. Research suggests that listening to students, asking them appropriate questions, and giving them the opportunity to show what they know in a variety of ways are effective strategies that increase student learning (AMATYC, 2005, p. 32). It is evident from the interviews and classroom observations that Dan strives to meet these goals.
4.3.11 Understanding Student’s Noncognitive/Affective Interactions

Instructors of ‘at-risk’ students must consider the whole student and, accordingly, be aware of the student’s affective domains when teaching (Smittle, 2003). Dan is acutely aware of his student’s emotional responses to learning mathematics. He acknowledges that student “attitudes are fairly negative, so the phobic attitudes, a dislike of math, a disassociation, they don't see any actual applications in the real world, but generally, negative [attitudes]” (Dan, Interview, April 17, 2015).

Dan says:

I think they have negative attitudes, and I try to impart on them not only that they have to spend time but they also need to focus on other important characteristics that will help them with not just math classes, but with the ‘math-way’ of thinking. (Dan, Interview, September 12, 2012)

In another instance, he stated that:

There are very few students that have positive attitudes because generally, they have had poor experiences or they have done poorly, or they have been away from it for a while, so generally, the negative attitudes. Sometimes, there are more mature students who have just been away from it for a while that they are not as negative about it. (Dan, Interview, April 17, 2015)

Dan understands that his students come from varied cultural and academic backgrounds and uses a variety of strategies such as offering encouragement, enhancing engagement, supporting student initiative, entertainment, fostering confidence, creating positive attitudes, demonstrating patience and student rapport to motivate his students to learn and practice mathematics. He recognizes his student’s needs, even if sometimes students themselves do not:

I think that it is pretty uniform for most of the students that their needs are just doing something, other than just coming to class, is just doing something. Specifically, trying to do the homework or anything for that matter outside of class, trying to do math outside of class because their needs are that they need to work on math, they need to do a little bit of math every day to get more comfortable with it. I do not think that that varies a lot in terms the needs of these types of students; I think that they are pretty much the same. Some of them are a little bit more motivated, and some of them maybe do not get discouraged as quickly. I think they are all, or a lot of them are fairly fragile, and they will get discouraged. I think the need is keeping them doing the homework, and, even if they
are not doing well, if they are not being successful not to get discouraged. (Dan, Interview, September 12, 2012)

Dan acknowledges that he must continually encourage and support students so that, eventually, students themselves can take ownership of their learning:

I do not know that we necessarily need to change anything at the college level; I just think we need to think of ways to encourage them to work and not get discouraged. I think encouraging students to work together. I think that sometimes gets them motivated, if it is something they have to do on their own, it might not be as interesting. I think if we change it too much to where we are really trying to help them, I do not think it benefits them, because I think they do need to learn to take the initiative to learn something on their own without somebody pulling them along the whole way. (Dan, Interview, September 12, 2012)

Dan’s understanding and awareness of his students’ affective state in the classroom helps him better enhance the learning experience of his students. He constantly challenges his students to persevere through their frustrations and anxiety with words of encouragement and support throughout the semester.

4.3.12 Learning Environments

AMATYC (2005) suggested that educators in the college community should work together to create a positive learning environment that would maximize student learning in mathematics, both inside and outside of the classroom for all students. While Dan teaches in a program that requires daytime student contact, he does provide outreach in other ways. A platform is readily available for students to dialogue with Dan outside the classroom. Students have course information regarding outlines, course addenda, class updates and homework links on a specific site that is made accessible to students via the Internet. While Dan encourages his students to use the tools necessary to be successful, the online component of the course is described differently:

Well, just with respect to this online [component]; so it is not just homework that they are submitting, but we have got it so that they have online lessons. So there is a redundancy
there in class and online, and they have the online labs which…is not necessarily more beneficial for these kids because I think these kids really need sort of the [personal contact]. I do not know that any kind of technological enhanced learning would benefit these guys. I think the best way for these guys to learn is to sit down with paper and pencil, and write stuff out, and get better at being sort of neat and organized so that it translates from the paper to their brain to be able to sort of organize their thoughts, to be analytical and break things down. (Dan, Interview, April 17, 2015)

Dan sometimes questions the ability of his students to interact face to face when remote learning is emphasized. In his words:

It is important in life too. They need to be developing some things that are going to be helpful to them outside of the academic world, and what I have noticed with a lot of them — because they do not have a lot of face-to-face interaction. It is remote interaction — and so they do not have the ability to interact with other human beings as well. (Dan, Interview, April 17, 2015)

Dan maintains that, for most ‘at-risk’ students in his class, face-to-face interaction is crucial to their success in which students are compelled to communicate with peers and learn to take initiative. He states:

[Online homework and online assignments] might be beneficial but I do not think in the long term, it would be beneficial because as I mentioned before, it is very important for these kids to develop some sense of taking initiative and…if they [can] continue to remain anonymous, they are not really taking the initiative. (Dan, Interview, April 17, 2015)

Dan suggests that, although not much change and innovation is needed, he nevertheless acknowledges that technology will play a part in his classroom instruction:

I do not think we need any radical changes. I mean the only changes that we might need are just technological, that is the direction that the world is going in. So incorporating technology, but not necessarily revamping it, [not] starting from scratch. (Dan, Interview, April 17, 2015)

While majority of Dan’s efforts have been directed to inside classroom teaching and instruction, he has been open to reaching students beyond the classroom via technology to enhance the learning environment for his students.
4.3.13 Summary of the Case of Dan

Dan believes that the ‘purpose’, ‘content’ and ‘teaching strategies’ of teaching are all connected. Students must understand the ‘purpose’ before the ‘content’ can be taught. Dan describes his views on motivating students using various techniques such using analogies, offering encouragement, enhancing engagement, supporting student initiative, providing entertainment, fostering confidence, creating positive attitudes, demonstrating patience and developing student rapport. In addition to motivating students, Dan maintains that student attendance and skill practicing are key to overall student success. He strives to provide the positive space in which the teaching and learning of mathematics can occur. Through Dan’s eyes, we can begin to get a glimpse into the teaching experiences of ‘at-risk’ college mathematics instructors.

4.4 The Case of Jill

Jill knew she wanted to be a teacher at a young age. She candidly recalls a memory of when she was a young girl:

Since I was young, I wanted to be a teacher and I spent all my time playing school. That was something that I was good at. I was good at teaching. When I was in elementary school and high school, I was picked out by teachers to help other students. I think I had that ability, that if it is something I know, I can impart that well to somebody else. If I do not know it, then that is — I don’t know a lot of things, but what I do know, I can break down into small parts and teach other people. (Jill, Interview, January 24, 2013)

However, Jill began a teaching profession as a second career. She initially started out in a nursing program, but decided upon the completion of her degree that she should follow her true calling and pursue a teaching profession. She describes her change of profession:

Surprisingly though, when I was going through high school, I decided I did not want [to teach] at the end, when it was time to apply, so I applied to nursing. I went to U of T for nursing for two years. Hated it [chuckles], and decided, what am I doing here? I really wanted to be a teacher. So left and finished my degree and went to teachers college. Even though it was something I had always wanted to do, there was a little blip where I thought
there was something better for me to do or different. I got interested in that. (Jill, Interview, January 24, 2013)

Jill considers that her ability to make steps comprehensible for others is a trait that propelled her into teaching. In her words:

Yeah, I break things down well. I am good at showing people how to do things step-by-step and I think that is another important — and I had teachers in high school that were good at that, laying a math problem out and doing it step by step by step. I think that that is — not everybody needs to do all those steps. But I think remedial students do, they need to see it. In fact, if they look at the textbook and the textbook has sort of skipped over a step. For example, if they have come up with an answer and fractions like 11 and 25 over 18, their next step is 12 and 7 over 18. But they did not break down the changing, the 25 over 18 to the one in 7 over 18. And then adding the 11 and 1. (Jill, Interview, January 24, 2013)

Early in Jill’s teaching career, she was introduced to individualized teaching programs.

Her experience in special education classrooms served her well in her current teaching position.

She describes her evolution from whole classroom teaching to individualized classroom teaching:

I started out as an elementary school teacher and taught in a regular primary classroom, grade one, two and three, for just two years. Then I taught the regular math program at that level. Then, I spent the next 13 years teaching in a special education class, so kind of what I am doing now. I had all students from maybe grade three, by the time they were identified — kids from grade three to eight in the school who needed help. I had them all in my class for half day at a time and [I would] teach language and mathematics to them. So that is where I got into more the individualized program, because you had somebody in grade eight and somebody in grade two and everybody was doing their own things. They would each be on wherever they were working on and whatever they were working on and they would-- I would give them exercises. I would work with them individually. If we had two kids doing the same thing, I would work with them, but that is where my background was. (Jill, Interview, January 24, 2013)

Even though Jill is presently teaching adults, she acknowledges the impact of her earlier experience in the elementary classroom. Jill says, “I think my special ed. background certainly influenced how I do things in the classroom and my experiences with remedial students. Yes, they are adults, so it is a little different, so that background is certainly helped me a lot” (Jill,
Interview, January 24, 2013). She further describes her experience of how she came to be in her current program:

I really actually only taught in the stand-up teaching style for two years. Then I was home for a while and then I started out supply teaching in the program because I had a friend in the program. From there was offered jobs and then, in 2001, was hired full-time. (Jill, Interview, September 27, 2012)

In the following passage, Jill describes the makeup of her classroom:

We have people from all different backgrounds, not just school backgrounds where they did their schooling, but abilities and where they are coming into the program. Some people are coming in just to do the algebra. They have mastered all the other skills. Some are coming in just to get a Canadian credential, and then some are coming in because they went through our system, did poorly, and they still need to improve their math skills, so that is my math teaching. (Jill, Interview, January 24, 2013)

It is not surprising then, given Jill’s background and experience, that she came to be where she is: teaching remedial mathematics at the college. Her previous experiences in the elementary classroom have afforded her the opportunity to teach in a highly individualized program of study at the college level. As her story unfolds, the reader will become aware of how Jill navigates the journey and experiences of teaching ‘at-risk’ college mathematics students.

4.4.1 Program At Jill’s College (Program B)

Program B is also part of a program of study in the same college as Program A. Unlike Program A, it leads to a certificate. It is a program funded by the Ontario Ministry of Training, Colleges, and Universities that prepares students to meet college entry requirements that are accepted within the college organization as an academic upgrading resource. Admission requirements include being at least nineteen years of age or being categorized as a mature early school leaver. All applicants are tested and interviewed in order to determine program suitability and student entry-level.

Depending on how the students perform on the assessment, some students may need to
complete specific pre-requisites for some courses. If students do not have English as their first language, then they must provide proof of ESL Assessment at Level Six or above. Once the student has completed four advanced level courses, including an English course and a series of math courses (approximately six hours per week), they are eligible for an Academic and Career Entrance (A.C.E.) Certificate.

The A.C.E. Certificate is important to students as it is deemed equivalent to Grade 12, and is generally accepted by colleges across Ontario for admission to post-secondary college level programs. Program B is funded by the Ontario Ministry of Training, Colleges and Universities and as such, has added responsibilities for its requirements. Jill has described this relationship in the following way:

We have to satisfy two bodies of people, I guess. The Ministry of Colleges, Training and University has appointed a group called the College Sector Committee, which revises our program according to the needs of the community in terms of apprenticeship programs and workplace programs. Then we also have to satisfy the requirements of the college that our programs match the high school programs as much as possible so that our students have the entrance requirements to get into the college programs, and that they will have the background they need to be successful once they are in those programs. (Jill, Interview, October 3, 2012)

Apart from the requirements by the Ministry, there is also an added level of reporting that is demanded of the instructor of Program B. In Jill’s words, she provides us with an example of this level of reporting:

This is an example: this is a new directive from Employment Ontario, which our program is now a part of. Where each client or learner — we call them learners — who is in our program has to be entered in a Government of Ontario program. It is called CAMS and it is our Employee Ontario Information Systems, so that they are getting actually service from us and we have to enter each student into the program that they register, plus we have to enter the courses they're taking and there are goals that they have to meet and they are evaluated by something called milestones that have been set out by the government. In each of our courses, the students, besides doing our required tests and evaluations, also have to do a government milestone. (Jill, Interview, October 3, 2012)

Given the uniqueness of Program B, it is not surprising that instruction in this program — and in
particular, mathematics — is highly individualized. Jill did not have a choice in the method of delivery in her classroom. A student-centered approach using a sequenced set of workbooks, practice tests, chapter tests, exam and cumulative testing called Milestones was already in place. Jill found, however, working one-to-one with her students played to her strengths as an educator.

4.4.2 Vignette 2: Jill’s Teaching Strategies

October 9, 2012

I arrived at eight-fifty A.M. for a nine A.M. class and set up a place at the front and to the left of Jill’s main desk. I noticed that some students were already there. Some students were working on their math and had calculators and workbooks out, while others were reading the newspaper. Desks were arranged in rows and columns of three by three. Each desk had room for two students. I noticed that there were computers on desks around the left and half of the back wall. These desks had chairs, and as the class was filling up, students took these places as work desks. The computers had huge monitors and some had keyboards attached. As I found out later, none of the computers were set up to work, and the space was temporarily used to store these items.

Filing cabinets took up the right corner of the back wall. A portion of the back wall contained a television, an easel and an overhead projector. I also observed an old push button phone and printer piled on a desk. The latter two items were not connected to any outlets or other technology. The right side of the classroom contained big windows, which were covered by faded white blinds. When the curtains were open, the sunlight illuminated the wooden cupboard at the front right of the room.

As I set up my place of observation, there were some low inaudible whispers and the room was almost full by the time Jill entered. Jill greeted some late students as they arrived and
attendance was taken quietly before re-introducing me to the class. Jill then asked for a verbal confirmation that all students had signed the consent to participate form. Some students responded out loud in the affirmative while others students quietly started their work without any prompting from Jill.

It was observed that some students were conversing in pairs, but most students were focused on their own workbooks silently. The classroom noise level was observed to be low and the only observable sounds were chairs moving and papers rustling. Jill then consulted her notes/binder and then called upon a student to review their training plan. This interruption did not seem to disturb anyone as the student approached Jill’s desk. The student sat in a chair beside Jill’s desk and a file was produced. Jill spent approximately three to four minutes with the student, but their discussion was inaudible and even though my recorder was no more than five feet from the consultation, I, along with my recorder, could not pick up any audible communication. It was observed that the file was used to communicate information to the student, but this observer was not privy to the discussion.

As this student was leaving, another student approached Jill’s desk. The student initiated help by asking a specific question regarding BEDMAS and then sat down in the chair beside Jill. Jill viewed the student’s work and suggested that underlining parts of the mathematical expression would help in visually recognizing the next operations to complete. Jill helped the student with completing the question by using prompts in specific areas. The student answered verbally and then completed the next step in her book as Jill watched. There seemed to be, however, issues with integer operation.

More specifically, the student was having difficulty with multiplying by a negative integer and subtracting a negative integer. There was a short break in the explanation, as there
was an audible gasp from the student and making eye contact, Jill recognized some concern on the part of the student. Jill then took some time to remind the student of the rules of multiplying and dividing integers as well as adding and subtracting integers. A number line was used to help visualize adding and subtracting integers. Jill stressed that the sign of the bigger number is kept when adding integers. The student then went on to ask a question regarding multiplying fractions. Jill explained that common denominators are not needed when multiplying fractions. Jill checked the student’s workbook and pointed out areas that the rules of integers were followed well and areas where the rules were not followed. The student was sent back to correct the work and practice more questions. Upon leaving, the student thanked Jill for her help. This exchange lasted approximately 10 minutes.

The next student that approached Jill asked her to verify that the work on simplifying radical expressions was done correctly. Jill verbalized what she was looking for when checking the work and suggested that steps should not be skipped. Jill then did an example with the student and prompted where certain steps should be added. This was done in the student’s notebook in a different colour of pen. Jill reminded the student “not to skip steps.” The student acknowledged that she was trying to do too many steps at once. This student-teacher exchange lasted approximately ten minutes.

It was observed that the normal classroom vibe included moments of individual student-teacher interaction. The ensuing noise of regular conversations in their discussions was not viewed as distracting to other students. I did, however, observe that students in the front row directly in front of Jill’s desk did from time to time raise their heads when conversations became louder than normal.
Next, a student approached Jill asking to take the final chapter test. Jill asked if the student was happy with the results of the practice test and the student answered that she was ready for the test. Jill then went to the locked cupboard at the front of the class and found the appropriate test, and before administering the test reminded the student to write one question per line. Jill also recorded the date the student was taking the test on a separate student file. The student went back to her seat to write the test. I noticed that all books and paper were put away on the student’s desk. They chose to write the test in pencil and had an eraser and calculator on the desk.

Jill then calls a student to go over the results of the last test as well as the individual training plan. The entire test was discussed with the student and specific test questions were chosen by Jill to examine further. These were questions that had given the student difficulty. The marking scheme was also addressed and Jill conceded that she had given the student part marks in some instances “because you set up the solution correctly.” Jill verbalized with the student occasions where the student was correct and questioned times where the student was incorrect. She challenged the student to explain his thinking and asked the student to verbalize what should have been done when a question was incorrect. Jill asked clarifying questions to check if the student fully understood particular questions even if the question was correctly completed. This student-teacher interaction of test analysis lasted approximately ten minutes with Jill declaring to the student “very good”. I did not observe if the student’s individual plan was discussed.

During this time, there were two students who walked in late. One of the students apologized for being late. Jill greeted both students politely with a “hi” and asked the two students if they had filled out a consent form. Both students indicated in the affirmative and Jill carried on with her walk about the classroom toward another student.
Jill approached a student at his desk and asked if he was ready to complete a Milestone. The student said “yes” and Jill went to the locked cupboard again and produced a set of pages. She explained to the student that the question related to purchasing a car and that a series of five questions would be asked in reference to the purchase agreement. Jill spent some time getting the student acquainted with the language surrounding purchase agreements such as “options”, “sale price”, “base price”, “promotions”, “license fees”, “taxes”. She then left the student to complete the Milestone.

Another student was waiting for Jill by her desk. This student had questions about division and prime factorization. Jill went over the question with the student asking leading questions to help the student complete the question and showed her how to check her work. She demonstrated how to break down a number into its smallest divisor. All this was done in the student’s notes. The student acknowledged that she had challenges with the skill and very politely thanked Jill for the help.

Just as Jill was completing her example, another student asked for a chapter test. Jill confirmed with the student that a practice test was complete. The student answered in the affirmative and again Jill went to the cupboard to find the appropriate test to give to the student. Jill again reminded the student to “put one question per line”, that “the whole booklet could be used to answer the questions” and that “work could be spread out to show what you are doing”. The student took the test and went back to her desk to begin.

The student who was working on simplifying radical expressions came back to Jill to ask for help with a specific question. The student asked a question regarding operation with roots. The example I heard was: \(\sqrt{18} - 3 + 2\sqrt{2} - \sqrt{32}\). Jill took the student through the stages in order to simplify the expression. Jill stressed the signs of the expression and pointed out to the student
that she had forgotten to keep the negative sign. Jill acknowledged to the student that “It’s hard to keep all these things straight.” The student was asked to review this area with more examples, and then the practice test would be given.

At this point, a colleague of Jill’s came into the classroom and Jill introduced me to her. Jill explained that her colleague had come to take over the remainder of the class as Jill had an appointment scheduled. Since I was observing only Jill, I left at this point as well. The observation time lasted approximately forty-five minutes.

4.4.3 Jill’s Pedagogical Strategies

In this section, I describe Jill’s understanding and experiences as it relates to pedagogical strategies. The methods and strategies that she uses to teach together, along with the reasoning behind the choices she makes will be further investigated. These strategies will become evident when investigating Jill’s interpretation of why she teaches (Jill’s perceived ‘purpose’), what she teaches (Jill’s course ‘content’) and how she teaches (Jill’s ‘teaching strategies’). Areas of focus will include: pedagogical strategies within an ‘at-risk’ classroom, commitment to teaching ‘at-risk’ students, communicating high standards, evaluation of students and perception of student abilities.

4.4.4 Jill’s Purpose

The question of why Jill came to teach mathematics at the college level is a progression of her experiences in the education field. She began in the elementary school system teaching younger grades and then moved on to the special education classrooms that comprised an array of student abilities. Jill is candid of her teaching background. At no point does she profess to be a specialized instructor with university-level training in mathematics. She is cognizant of her limitations:
Why mathematics? It is something that I did fairly well, although I am not a mathematician at all. I never even took math at university. I only took it in high school. I did really well in it, but then went on to the nursing program for two years, so I did not do any math. I did sciences, but not math. Then, by the time I was switching out, I was doing a B.A. and I did not choose mathematics, or whatever. I just chose the arts things, but it is something that I find I never had any problem doing it, but as I say, I am not a mathematician because I do not have the higher-level training at university. (Jill, Interview, January 24, 2013)

Jill believes she has the ability to break and communicate mathematical knowledge into small manageable pieces of instruction. Jill describes her role:

I think it really has made me really think about how to do everything step by step, to break things down into the smallest bits. I can do something intuitively, but you know when you are teaching someone, you have got to break it down into step by step. There is lots of little things that I have come up with — I am trying to think of an example — lots of things where I know it is going to make it easier for the student to do it, to do a question. You come up with little strategies that the students can use. (Jill, Interview, January 24, 2013)

Jill teaches mathematics because she believes she is good at it and truly believes in the process of mathematics. In her words, she says, “I do not want somebody just to be able to add a column of figures but not know how that relates to the real world, in a worldly situation” (Jill, Interview, April 23, 2015). Jill’s ability to see the bigger picture and then teach mathematical ideas into smaller fragments, has dominated her experiences in her teaching of ‘at-risk’ college-level mathematics. Her experiences have translated into why Jill teaches mathematics today.

4.4.5 Jill’s Content

The content of Jill’s course is heavily based on essential mathematical skills and is dependent on how much mathematical knowledge students have at the beginning. Students are tested to determine at what level they should begin. Jill states that the students are “all tested, and they are placed at-- we have basically three levels of courses, and they are placed in one of those levels depending on how they do on the assessment. Now having said that, probably 90% to 95%
of them end up in the first level,” (Jill, Interview, September 27, 2012). Jill describes the process of evaluating students for the program:

We assess them before they come in. It is a paper and pencil test, which is not timed. They can take as much time as they — well, within a reasonable amount of time to do that. We also interview each student before they come into the program to see what their goals are, what their background is, that kind of thing. That gives us a better idea, too. (Jill, Interview, September 27, 2012)

Once the student is in the program, Jill works with them to determine the best starting point of basic mathematics skills. She may have up to forty students working on different areas within a classroom. Jill’s has six classroom hours per week, which are broken down into two three-hour sessions. A student may begin at one of three levels of mathematics. Within each level, there are up to eight units of work. A student is tested after each unit of work. There is an exam at the end of all the units, which tests everything in the level. Students must obtain a minimum of 70% to move to the next level. The tests count for 70% of the mark, the exam counts for 25% and the milestone 5%.

A milestone is described as a standardized question given at the end of a number of units of work (See Appendix G for an example of a milestone question). Students must score a minimum of 80% on the milestone to be deemed successful (Jill observation #4, field notes, December 11, 2012). The tests and exams are administered individually or as a group depending on the needs of students. Finishing three levels gives students a Grade 12 equivalency (Jill, Interview, September 27, 2012; Jill email, November 20, 2015).

First and foremost, Jill sees the program as “trying to prepare people in a practical manner. We want them to do the first level of our math so that they can use these in daily living” (Jill, Interview, April 23, 2015). Jill describes the first program level:

We have three levels of math and I try to convince all of them to take the first level. Which is essentially up to about a grade eight level, because I feel it's necessary for daily
living, figuring out your mortgage rate or buying things, it is taxes and mark-up. Just decimals and adding money up. That kind of thing. Sometimes they don't want to do it. But, for the most part, they do. We get about 80% that probably will do it. (Jill, Interview, September 27, 2012)

Jill recognizes the critical advantage for all students knowing the basic skills of mathematics, even though it may not be essential to their program of study. Jill describes the math skills taught in the program along with an example of her thinking as it applies to the importance of these skills in daily living:

The first level is basically the skills up to a grade-eight level. Then, after that, it is introductory algebra and trigonometry. If they are going into a program, for example Early Childhood Education that does not require any mathematics, we do not make them go on beyond that first level. That is the kind of person that we have to convince to take math in the first place because they do not need it for their program, but they need it for everyday living. But, if they want to continue, they are free to continue. If they just want to for their own sake, they can continue. (Jill, Interview, September 27, 2012)

Jill is candid about the outcome of course completion for her students:

What I am thinking is that this course is the means to get into college. And sometimes they are impatient with that process, they want to get into college as fast as they can. They are sometimes reluctant to put in that year, they want to hurry up the process. But we find that generally those that actually complete the process fully are the most successful once they get into college. (Jill, Interview, September 27, 2012)

The importance of teaching math life skills is an integral part of Jill’s course. Essential math skills must be incorporated and evaluated as part of her course. She describes it:

That is something that was developed out West and they are skills that any person needs in performing a job, and they are broken down into different areas. We are asked to incorporate these essential skills into our math programs. For example, if we were doing a chapter on decimals, they would go through the exercises, have the test. And at the end of that, we would give them three exercises involving daily living tasks that involved decimals. For example, giving them a menu at a restaurant and people ordered this, this, and this and adding up the bill at the end. You would be a restaurant worker or whatever. There were different tasks like that, and these have all been created by different organizations in the country. (Jill, Interview, September 27, 2012)

The essential math skills are also incorporated as milestones and are mandated by the government. Jill describes the milestones:
We do the first one after the chapter on percent, which is actually the fifth chapter that they have to do, because that milestone is an exercise where you have to know percent to do it. We give it to them right after they have done the work on that so that it is fresh in their minds and hopefully they will do well on the milestone — as opposed to waiting until the end of the course and giving it to them then, which they still should know the percent, but the reality is they might have forgotten some of the things. (Jill, Interview, January 24, 2013)

Teaching essential mathematics skills is a large portion of what Jill experiences in her classroom.

She validates the importance of teaching life skills in conjunction with teaching essential math skills by weaving life skills within the content of her course.

Jill recognizes that proper study habits must also be an integral component of her course.

She acknowledges that sometimes the difficulty in teaching her students is not necessarily because of their ability, but because of their lack of study habits. In her words:

“...It does not really have anything to do with their math ability. It has to do with their school habits, their work habits, a lot of ingrained work habits that you are trying to break, or they had an attitude in high school that they were not really that interested and they did not develop a lot of study habits. A lot of what we do is even developing those study habits that go along with the math skills because I do not think you can do one without the other. (Jill, Interview, September 27, 2012)

Jill reveals that, along with students’ weak study habits, students tend to exhibit a lack of confidence in their ability to do math. Thus, Jill believes that addressing a student’s lack of confidence is a necessary component in her teaching. She describes how her belief about changing a student’s confidence in mathematics is related to a student’s study habits, and ultimately, to their understanding of mathematics:

“...Yes, I think for those who first of all lack confidence, we need to try to increase their confidence level by giving them skills, which I think will then help their confidence level. We need to change the attitude about showing up on time, showing up regularly, doing the work in a timely manner, learning about deadlines. These are the skills that we feel will help them when they get to college, because they need those skills. (Jill, Interview, September 27, 2012)

In summary, Jill feels that the content of her course must include the teaching of essential mathematics skills, and also an instruction of study skills as well as confidence in one’s ability to
perform mathematically.

4.4.6 Jill’s Teaching Strategies

In this section, Jill articulates her experience in the classroom as it relates to the ‘how’ of mathematics teaching. She outlines her thinking and reasoning as it relates to how she teaches the content she is mandated to teach.

4.4.6.1 Stand-Up Instruction

Jill had previous experience teaching in elementary school. She thought about how best to teach ‘at-risk’ students:

Standing at the front of class, I would say: ‘We are all going to learn subtraction today’. I think for the students, who really are not good math students, this is not the best system. But it is the most expedient, and honestly, the people that are going to go on to college and use math, they usually do fine with it. Those who are not really good math students and are not probably going to go on in mathematics, this probably is not the best method to teach them. (Jill, Interview, January 24, 2013)

Jill shares her experiences of a colleague teaching in the same college program, but in a different satellite campus:

Their students were not as disciplined, did not work outside — or they have more with young families. In other words, they were not [practicing math] outside the classroom and they were not getting through. So they decided, ‘Well, if we do the stand-up teaching, then they will get through at a pace that we set’. The problem is, many of them do not have the skills to get through at that pace, so they are running into problems. (Jill, Interview, April 23, 2015)

However, Jill does acknowledge the merits of such a method of teaching:

I guess my other experience was teaching children as opposed to adults. It is a little bit different. You are introducing things. When I was doing the teaching, you were introducing things for the first time that the students had not been exposed to. I like the idea that in that there is a lot more give and take, in that you teach, you ask the students up to the board to do things — that kind of thing. I think, in some ways, you can have a better handle on what each student knows. (Jill, Interview, January 24, 2013)

Jill admits that an advantage of standing at the front of the class is the ability to impart the same piece of information to a larger audience, especially when zeroing in on potential
hazards and difficulties of a particular question or concept: “With each type of question or each concept you would, if I were teaching upfront, you would zero in on the pitfalls, things to remember, whatever” (Jill, Interview, January 24, 2013). Jill acknowledges that her students are all individual learners.

4.4.6.2 Individualized Instruction

Jill employs an individualized method of instruction in her classroom. In her experience, her ‘at-risk’ mathematics students benefit from an individualized instruction rather than a whole-class teaching approach. Jill’s classroom is made up of students with various mathematics backgrounds and Jill considers the starting abilities of each student. Jill believes that individualized instruction can meet the needs of her students:

I think that this is the best for — there is some students who do not need to spend two weeks on fractions. If you are in a classroom situation, you have so much content. In this situation, it is different in the college where you are assuming people — you are giving everybody new information. This is not new information for a lot of people, so it would be really boring if somebody had to start at a certain level and go through everything just because that is the way the class was structured. (Jill, Interview, January 24, 2013)

Jill believes that the program is very individualistic:

I believe that a lot of what we do has to be individualized because each student is different, and that’s the way our program works. I feel there has to be a fair amount of structure in the program, a lot of demonstrating, one-on-one. (Jill, Interview, September 27, 2012)

Jill wants to reconsider the structure of the program:

I think the structure is important. Ideally, you would be doing more teaching as a group, but the way that our program is structured with everybody in the same class working on all different levels; it does not work that way. So, I try to do individualized teaching. I think that making [it] as individualized as structured as you can, within the structure, the format that you are given. (Jill, Interview, January 24, 2013)

Within the classroom structure, Jill finds it useful to instruct her students one-on-one. She describes this one-on-one teaching in the following way:
I tend to do a lot of one-on-one teaching, and try to break things down in the simplest way possible. So if they are showing in a text book a more complicated way to do things, I try to break it down to an easier way, try to give them strategies, and how to approach a problem. For example, if they are doing word problems, setting up charts, to take the information, put it into a chart, and then you can see the equation from the chart. That kind of thing is what I try to do. (Jill, Interview, April 23, 2015)

Jill believes that the major barrier to individualized instruction is the maturity level of the student. Jill acknowledges that some students exhibit the same tendencies that made them unsuccessful earlier in their lives. She is candid about describing her students in the following way: “They have not grown up. They do not get it, that they have got to be here regularly and they have got to be doing the work regularly” (Jill, Interview, January 24, 2013). Jill believes that an individualized approach of instruction best suits the needs and abilities of her students.

**4.4.6.3 The Workbook**

When a student is accepted into Program B, the student is then interviewed and tested to determine a beginning level of study. Once an ability level is determined in mathematics, students are given an appropriate workbook that systematically builds basic mathematics skills.

Jill describes the first workbook:

Oh, here it is - Basic Mathematics Skills. We use this with those students, but it is not very many and so in that booklet would be a lot of chapters on addition - whole thing on addition. It would take them from adding one digit to two digits and to three digits. Then subtraction would start with one digit and then borrowing and so forth. So you can see it is much more detailed. Half the book is just on adding, subtracting, multiplying, dividing, and then fractions. (Jill, Interview, January 24, 2013)

As students weave their way through the workbooks, they work through examples, ask questions and complete the exercises. When Jill and the student both determine that a unit of work has been completed successfully, one or two practice tests are then taken.
Once a student’s knowledge and understanding is confirmed with the practice test, a test is administered as a formal evaluation. A student needs to pass with a mark of 70% or greater to be deemed successful in order to move on to the next unit.

If a student gets less than 60%, s/he can review again and rewrite a different version of the test. We then average the two marks but the highest they can get is 70%. To pass from the first level to the second level, a student has to get 70% to move on. (Jill email, November 20, 2015)

At times, Jill finds that her students feel the need to rush into writing tests before they are ready. During these moments, Jill must communicate to the students the need to practice the skills carefully in the workbook:

A lot of them get ready to start a new chapter and they'll say, ‘Could I have the practice test?’ and I'll say, ‘No, you have to do the exercises first and you have to do the practice in the book.’ I really feel that practice makes perfect, in that I feel the structure is important. (Jill, Interview, January 24, 2013)

Much of what a student is able to accomplish hinges on a student’s ability to work independently and ask questions as they work through the workbooks. First and foremost, however, a student must be able to read independently. Jill states that:

They are supposed to able to read at about a grade-nine level before they come in, which is why we assess them for English, as well. So anybody who comes in, even if they just want do math, they have an English assessment as well. (Jill, Interview, January 24, 2013)

Jill surmises that part of the ability to work independently involves knowing when to seek help. As students experience difficulty understanding instructions or lessons in the workbook, Jill encourages them to seek support from her. This was evidenced in the many observations of Jill:

Student 1: Jill worked with student for approximately ten minutes until all questions were addressed. Jill checked her work for procedure. (Jill observation #1, field notes, October 9, 2012)

Student 2: The student came to verify that she was doing work correctly. Jill’s advice after she checked her work was to take steps slowly, and not to skip steps. The student was working on simplifying roots. Jill spent approximately ten minutes with the student. (Jill observation #1, field notes, October 9, 2012)
Student 3: Jill went over the last test and a training plan. Specific questions from the test were looked at more carefully. The marking scheme was addressed and Jill explained that marks were given for work structure. Then Jill handed the student the next practice test. Jill spent approximately ten minutes. (Jill observation #1, field notes, October 9, 2012)

Student 4: A short two-minute discussion of the language regarding ‘borrowing’. (Jill observation #2, field notes, October 23, 2012)

Student 5: Jill discusses rounding to the nearest tenth. Demonstrates with an example and directs student to more examples in the text. Jill reaffirms the rules and procedure of rounding, then, asks student to demonstrate a question. Student is correct and goes back to desk to do more examples on his own. Jill spent approximately seven minutes. (Jill observation #2, field notes, October 23, 2012)

Jill acknowledges that students need to have some level of knowledge before they can ask a question. She states that students would:

Have to know enough to ask questions. You have to know something to ask a question. Like if you are just looking at it and you do not get any of it, then there is no question to ask because you do not know enough to ask. You have to have some knowledge in order to ask a question. (Jill, Interview, January 24, 2013)

It is at these moments that Jill questions the individualized workbook method of instruction:

This way it is dependent on them coming up to me to ask questions. I do go around a little bit, but not that much, to see how they are doing. The students that are really struggling, I would say this is not the best approach for them. (Jill, Interview, January 24, 2013)

Jill acknowledges that students struggle in various ways while using the workbook as an instruction tool. One such struggle involves retaining information. Jill recalls students’ individual struggle for retention:

There are a few students who seem to have great difficulty retaining the series of steps in order to solve a problem. For those [students] we have to try to make it a little more mechanical but even if they learn it, they have difficulties. (Jill, Interview, January 24, 2013)
Another area of concern for Jill is getting students to see the big picture. Often, while students are using their workbooks, and performing mechanical tasks, they can forget to make sense of their solution. Jill describes this situation:

They can do things mechanically, but they have a lot of trouble understanding. They will mechanically do something and then you will say, "Well, does that make sense that if you only make $15 an hour that the raise you are going to get is $8?" [chuckles]. This is a question yesterday that comes to mind. Then they will say, "Well, no. It does not make sense." But they did not see that themselves when they mechanically did the thing. Some people have that understanding and some do not, I think. (Jill, Interview, January 24, 2013)

Jill also recognizes the issue of time limits that can cause difficulties for some students. She describes the delicate balance between the time it takes to learn a skill and progression toward completion of the program. Jill acknowledges that her program is unlike most colleges that are sequenced in fourteen-week blocks of instruction: “They cannot do things in a fourteen-week block. [But] There has to be some time restraints, because they have to progress, but they need to be given the time to digest things and practice” (Jill, Interview, September 27, 2012).

Jill later concedes that time restraints must also be considered when she states that:

Yes, we do have time frames, but they are quite generous and, again, the student has to be working at a steady pace. They cannot just take all the time in the world. They have to be working at it. But they are given the time to do that. (Jill, Interview, September 27, 2012)

The workbook has been a successful tool that enhances individualized instruction of mathematics in her classroom. In her opinion, the workbook is successful because “most of our students get over 70% on the tests, so that is pretty good” (Jill, Interview, January 24, 2013).

**4.4.6.4 Conferencing with Students**

Individualized instruction includes conferencing with students one-on-one. For each student, conferencing takes place at various times. It could be as informal as a student initiating a dialogue by asking a clarifying question, seeking an explanation of method, or seeking an
explanation of marking scheme. It can be more formal, where Jill initiates the dialogue to discuss overall career objectives. Students must meet with her before and after any informal or formal evaluations. Evaluations include practice tests, chapter tests, milestones, and unit tests. Most students also meet with her as needed, during the course of making sense of their understanding of the self-taught lessons.

A conference is where most of her math instruction is imparted and where Jill gets to know her students as individuals. Often, students will conference with Jill more than once in a class, depending on what interactions have taken place initially. In any given three-hour class, approximately thirteen students conference with Jill ranging from three to fifteen minutes. What follows are the experiences of Jill in three particular conferences with students. All conferences are done individually.

i. Interaction 1

Jill believes that “most students can learn math if they are given the right support, and in the right environment, and given the time to learn” (Jill, Interview, September 27, 2012). However, in some cases, Jill admits that a few students still have difficulty retaining a series of steps in order to solve particular problems. In one particular scenario, Jill describes her interaction with a student:

I have a student, for example, who has just done this whole chapter on fractions. She has been on it for about two months. We have done a lot of one-on-one work, and she gets to the end of the chapter and she says, ‘I really cannot remember anything from the beginning.’ Even though she has kept doing the things all along, she does not seem to be able to have retained what she is doing. (Jill, Interview, September 27, 2012)

At these moments, Jill finds that she must address other issues of student concerns such as anxiousness and confidence first. Jill had reviewed the practice test with the student and realized that the student was still anxious about taking the test. Jill explains her decision to go onto a different topic in the following way:
I have gone through the review with her, and I just said, she was so anxious about this that I had said, ‘Let us put it on hold, we will not do the test right now. Let us go on to decimals,’ and I want her to have some success at that and then we will go back. (Jill, Interview, September 27, 2012)

In most mathematics classrooms, when a unit of work is completed, some type of test or evaluation is given. Jill’s knowledge about her student, along with the flexibility of the program, allow for adjustments and accommodations for the student.

After many interactions with the student, Jill concedes that there could be other barriers involved in preventing the student’s success in learning mathematics:

I am pretty sure there is a learning disability there. She seems to have a lot of anxiety issues as well. The unfortunate part is that she has chosen what she wants to go into is dental hygiene, which does require a grade 12 credit for math. We will have to revisit that goal as she goes along, if things do not change. (Jill, Interview, September 27, 2012)

The opportunity to conference frequently with the student allows for flexibility in Jill’s program and is an integral component of Jill’s teaching.

ii. Interaction 2

A second conference example describes the interaction of Jill with a particular student in relation to fragments within a particular classroom observation. Bob, a pseudonym, was the student in this example. Jill recalls the day as a bit unusual as there were two students in particular who monopolized Jill’s time in different ways:

That was one day that was a little bit unusual. Although those kinds of things do happen, but they do not usually happen with two people on the same day. I didn't have a whole lot of time for other people, although it might have discouraged other people from coming up because they were spending so much time there. (Jill, Interview, January 24, 2013)

There were approximately eight other students that conferenced with Jill that day (Field notes, December 11, 2012). The interactions with the other students involved quick clarification of questions, going over individual training plans, addressing minor calculation errors, administering practice tests and formal unit tests (Field notes, December 11, 2012). These types
of interactions were characteristic of any given classroom day as evidenced by other field notes
(Field notes: October 9, 2012; October 23, 2012; November 20, 2012).

In particular, Jill describes the interaction with Bob that day:

[He] was a student who had done poorly on a test, and so I was having him try to make
the corrections for the test on his own and doing a few at a time, coming up and checking
those, rather than doing ten at a time, getting them all wrong — just doing two and then
come back for a check. (Jill, Interview, January 24, 2013)

Bob was the fourth student to conference with Jill that day. He was asked to bring his individual
training plan along with his test. Jill emphasized the importance of organization when answering
questions and reinforced the skill of reducing (with respect to fractions). Bob was sent back to
his seat to reconsider some of his solutions while keeping in mind the overall organization of his
work. On looking back, Jill provides an explanation of why she focused some of her class time
on Bob:

He did not do well because he does not do the work and does not do the practice and
whatever. So, I could have said to him, ‘Okay, you need to go and practice.’ or whatever,
but that would just be more of the same of what he is doing so I felt I wanted to spend the
time with him that day. (Jill, Interview, January 24, 2013)

When Bob returned for further clarification, Jill was able to spend time explaining to Bob
the marking scheme of the test in relation to how work ought to be organized when answering
questions (Field notes, December 11, 2012). Even though Bob was progressing slowly in the
program, Jill had “been reluctant to let him go,” because Jill thought that “this is one thing in his
life that he is doing” (Jill, Interview, January 24, 2013). Jill offers another reason for her decision
to allow Bob to continue in his studies:

He has been here two years, which is not typical. We like them to finish within a year,
but there are a few that take longer. If they are coming regularly and putting some work
into it, we let them stay. If they are not finishing in a year because they are not here and
they are not doing the work, then we do not let them stay. (Jill, Interview, January 24, 2013)
Jill’s back and forth communication with Bob was one example of how Jill experienced individualized instruction in her math class. She was able to focus units of instruction based on the needs of the student at a particular moment in time.

iii. Interaction 3

Mike was another student that monopolized Jill’s classroom time, but in different ways. It was observed that this student was the second student conferencing with Jill that day and did not leave Jill’s desk even though another student asked for clarification with a particular question (Field notes, December 11, 2012). Jill describes her reasoning for focusing her time and energy with Mike as “a student who really has a disability and needs constant assurance, so it is the kind of student that after he does one or two questions, [he] needs to come up for constant reassurance,” (Jill, Interview, January 24, 2013).

Jill felt the need to reinforce Mike’s mathematical thinking by asking him to practice by her desk. In this way, he was held accountable for his efforts. Mike was working on questions that involved solving a system of equations by graphing. At each step, Jill was observed asking leading questions such as: “where do they cross?” and “how would I label that?” (Field notes, December 11, 2012). After each answer, Jill was seen as affirming Mike’s response. Jill’s constant reinforcing and strategic questioning helped Mike build structure and organization into his thinking.

It was observed that scaffolding prompts were necessary to help Mike build his understanding of the skill needed to graph, then solve, linear systems. After approximately ten minutes by Jill’s side, Mike was asked by Jill to return to his desk to try some questions on his own (Field notes, December 11, 2012).

Mike returned after five more students had conferenced with Jill. He needed further
clarification, and Jill constructed another graph with him. Jill watched as Mike graphed a horizontal line and she offered words of encouragement as he performed this task. Jill then gave Mike another example to solve to see if there was a true understanding of the skill just taught. After Jill confirmed that Mike could solve the linear systems by graphing on his own, Jill sent Mike back to his seat to reinforce what he had just learned (Field notes, December 11, 2012).

In the course of the remaining class time, Mike came back to conference with Jill two additional times. Each time, Jill reminded Mike of specific details that were missed and encouraged him to keep working on performing the task correctly (Field notes, December 11, 2012). This back and forth conversation over the course of three hours seemed to have no resolution and it was observed that Jill became a little frustrated with the interaction (Field notes, December 11, 2012). Jill offers us a reason for her frustration and summarizes her interaction with Mike:

The problem is he is not a consistently attending student. To make any progress with that kind of student, they have to change their behavior in that they have to come on time and they have to do their 50%. It cannot be just when you are in the classroom with me doing it. He has to do something on his own. He, subsequently, left the program…He never finished because he just did not have those study skills, did not bring the skills to the program and he had been with us since last May. He had been with us, basically, for six months. There were slight improvements, but you cannot go to the people's house and get them out of bed and get them here on time. (Jill, Interview, January 24, 2013)

Jill’s use of individual conferencing with her students was an integral mode of instruction. The conference helped Jill better understand the individual needs and concerns of her students. It also afforded Jill unique and authentic experiences in her classroom.

4.4.6.5 Motivating Students

Jill finds that motivating students is an ongoing activity. Since each student is starting at a different point and is progressing at a different pace, motivation is dependent on each student. Jill finds that some students are self-motivated, but other students are not:
For the most part they are very enthusiastic. There is always a group that are quite young, not necessarily in age but attitude, where I have to say that sometimes some of the reasons why they did not get through the first time is the same reason they are not going to get through the second time…But generally, they are trying, they want to succeed. (Jill, Interview, September 27, 2012)

Jill strongly believes that students must first be motivated to learn. In Jill’s opinion, if students do not have this initial motivation, they may struggle. Jill explains how the willingness to learn is connected to being motivated to do the work:

I think that if you don't have the attitude of first of all, wanting to learn, you are not going to learn. Being open to listen to how someone else does something; being willing to do the work and to do the practice. For me, I think in math a lot of it is practice and if you're only willing to do two questions and go on to the next one, and that's fine if you are skilled at something, but if you are not doing the ten questions makes a difference so it is doing the work. (Jill, Interview, September 27, 2012)

Jill finds that keeping students aware of their end goal is what keeps them motivated. She often goes over a student’s training plan to show how far they have come and reviews the next steps to achieve success. Jill would meet with at least one student per class to go over training plans individually (Field notes: October 9, 2012; October 23, 2012; November 20, 2012; December 11, 2012). A training plan is an individualized academic plan for each student that is completed during an interview prior to being enrolled in the program. In mathematics, it sets approximate dates for completing units of work toward the student’s end goals.

By providing continuous feedback and keeping students on task over the year, Jill is able to keep students motivated in completing the program:

Even though everybody is doing the same course content, you have to work individually with the students because everybody has different needs. I try to stay on top of them. (Jill, Interview, January 24, 2013)

In another instance, Jill tries to help students meet deadlines to keep them motivated:

I am trying to get people to do tests by deadlines and things, as opposed to when they feel they are ready. We were always doing this informally anyways and saying to somebody, ‘You have been on chapter two for two months now. You have got to get moving.’ (Jill,
Interview, April 23, 2015)

Jill’s monitoring of student progress is continuous over the semester. Her open
demeanour suggests to students that she is approachable. The open dialogue and constant
feedback between Jill and her students is how she sustains student motivation.

4.4.6.6 Commitment to Teaching ‘At-Risk’ Students

According to Patterson and Sallee, “Developing and coordinating effective remedial
programs requires a great deal of time and energy from a dedicated, creative faculty member”
(Patterson & Sallee, 1986, p. 724). In Jill’s experience, she believes that instructors must be
organized and be committed to teaching ‘at-risk’ students. Jill expresses her thoughts:

I think that first of all, you have people who are highly organized, who are — first of all,
also I should say committed and interested in teaching that level, do not consider
themselves so far bothered that it’s boring, that they are stuck with this group or whatever.
People, who are willing to break things down and do extra things with the students, like
meet with them individually, do a lot of marking, a lot of monitoring them on a daily
basis; as opposed to just marking the test at the end of the six weeks or something like
that. (Jill, Interview, April 23, 2015)

Further, Jill believes that commitment to teaching ‘at-risk’ students is dependent on the
ability to recognize the needs of these students. In her opinion, the ability to get to their basic
level does not depend on knowing a higher level of mathematics. It involves knowing a student’s
strength and weaknesses. Her conviction is stated:

But they have to be able to look at a student and access what their skills are and what their
weaknesses, what their strengths are. Perhaps provide something a little more
individualized for somebody who needs extra work on a certain thing. I guess they just
cannot be too academic. I do not know if that is the right word, but especially in
mathematics. If you have someone who's really into higher levels of mathematics, they
have to be able to get down to the basic level. (Jill, Interview, April 23, 2015)

Jill acknowledges that there can be factors affecting her commitment to teach her students
and concedes that sometimes she has no control of these factors. One such factor involves the
inability to reach some students. Jill describes these students that “have the best of intentions,
and you think, ‘Oh, this kid is really going to go somewhere.’ And then they just stop. They do not show up and they do not get the work done” (Jill, Interview, April 23, 2015).

Another reality that Jill has stated is that “the reality is, is that you are given a class with a certain number of students and you have to teach however many is in front of you. You are given time limits. The ideal is to be able to have control over those things and reality is you do not always, you often do not,” (Jill, Interview, September 27, 2012). Regardless, Jill is able to accept these limitations and move forward in her commitment to teaching her students.

Jill feels that her reward for teaching is recognizing the success of her students. Success for Jill involves seeing her students move on to their desired college program and being successful, and involves the feeling of appreciation. She describes her feelings in the following way:

“The great thing about being here is getting to see them go on to college. We track them, and we go to their graduations, and that is very rewarding, very rewarding. The difference between teaching in this level, for me, and this program, as opposed to elementary school is people are very appreciative of what you do for them. They are very appreciative. They do not all finish and they do not all succeed, but they all are appreciative for having someone pay attention to them. So that is very rewarding. It is not like they are here because they have to be here, or whatever. I mean they have chosen to come back. It is not like when they are ten and somebody's saying, ‘You have got to sit in school from nine to three whether you like it or not.’” (Jill, Interview, April 23, 2015)

Commitment to teaching ‘at-risk’ students can be a very rewarding and yet challenging experience. Jill’s commitment to teaching her students is evident through her openness in sharing her thoughts and experiences in her classroom.

**4.4.6.7 Communicating High Standards**

One of the goals in communicating high standards is to get the students to become more responsible for their education (Wambach et al., 2000). In Jill’s case, most students are in her program because they need help to get to their own educational goals. Through student
conferences, Jill continuously dialogues with students to make them aware of the standards necessary to reach their end goals. The individual workbooks, personal training plans and individualized conferences are used to keep students on track toward their goals. Jill is responsible for monitoring student success, however, if students become vested in their goals, they can be led to become more responsible for their education.

At times, students need to be reminded of deadlines and standards. In these occasions, Jill must direct students with respect to the timing of their goals. In her words:

Now we have to kind of — for some people — enforce that, set a date that you have got to write the test by and that kind of thing…It is just that there is not quite as much freedom on the student’s part to direct the timing of their learning. (Jill, Interview, April 23, 2015)

In some instances, Jill acknowledges that there may be standards imposed with respect to time needed to complete the program. She concedes the pressures are imposed on her students and on her to relay and convey these standards. Jill describes the imposed standard of time:

It is now a year they want them in and out by; and we want that too. A lot of people do get that, but then there are always people that they have had a baby in between or other things come up or whatever, or they are just slower learners; they get through but they have been plodding along. I have taken the view that if we have 100 learners and ten of them are here more than a year, which is okay. I am going to try to defend that, but we cannot have 50% of our learners be here more than a year, because they are getting very excited about the numbers of learners and how fast they get through and all that sort of thing. (Jill, Interview, April 23, 2015)

Earlier, the nature and scope of Program B (Jill’s program) was described as fulfilling the requirements of the Ontario Ministry of Colleges, Training and University as well as the requirements of the College. It then follows that Jill has to insure that both sets of standards are met. At times, when new governments come into power, some standards are revised. Jill describes government standard revisions:

We have much more demand being made on us by the government. We are now part of Employment Ontario, and we were then as well, but they were just beginning to roll out their requirements and whatever, and we are going into a different phase now. So we have
to be much more accountable to them, in terms of what we are doing, in terms of numbers of students and the time they are allowed to be in the program and having to demonstrate progress. So we are not just now answering to the College and preparing them for college. We now have to have a set of things we have to do from Employment Ontario. Some of them do not really make that much sense for an academic program. They more apply it in an employment situation, but it does not matter, because they are funders. So we still have to meet their demands. (Jill, Interview, April 23, 2015)

When standards are met, students have completed the program and move into their desired field. Jill describes what occurs when students have met the standards:

Several have finished. We had four people start college in January because they had finished the math they needed, to get into — one went into accounting. I'm trying to remember what the others went into. One went into law clerks, so she just finished the first level of math which is all she really needed. Another one finished all the levels because she was going to accounting. We did have some finish and the rest are carrying on. So we actually have quite a few math students still here, but a lot are making progress, and there are three levels, so it takes them a long time. (Jill, Interview, January 24, 2013)

When circumstances are ideal, Jill finds in herself successful in imparting high standards of practice.

4.4.6.8 Professional Development

There are few occasions for Jill to receive professional development in mathematics at the College. Most opportunities are available on her own time and require commitment outside working hours. She describes professional development activities: “I go to workshops that the college offers, some technology things we do, we are having mental health workshops. So that kind of thing but not in terms of mathematics” (Jill, Interview, April 23, 2015). On another occasion, she describes attending college workshops: “I attend professional development workshops at the college. We have workshops that the College Sector Committee puts on” (Jill, Interview, September 27, 2012).

Jill also speaks of collaborative efforts with other sectors of the college. In one particular case, she describes being included in collaborative efforts within the Faculty of Applied Science
and Engineering:

We collaborated when (-----) was the dean of the faculty of Applied Science and Engineering. She included us in their meetings because they were finding that high school students, who came in, even if they had the credit, were not doing well in their first semester math course. What they devised was they decided they were going to test all students coming in, even if they had the credit or not…Then she knew that we were doing upgrading math skills, so she included us in our meetings and together we told her what we were doing and it was a collaborative, more for information than anything else on what should be in the course. We understood from her what our students would need to be successful in the courses in their school, and we gave them advice on what we were doing. (Jill, Interview, September 27, 2012)

Although opportunities to participate in professional development were few, when afforded the time and opportunity to do so, Jill enjoyed participating.

4.4.6.9 Evaluation of Students

According to AMATYC, “Assessment of student learning is a process of helping mathematics faculty adapt instruction to the needs of students” (AMATYC, 2005, p. 29). Adapting instruction to individual needs is clearly evidenced in Jill’s classroom practices. In Jill’s words, “I believe that a lot of what we do has to be individualized because each student is different, and that is the way our program works (Jill, Interview, September 27, 2012)”. Students are pre-tested in basic mathematics skills prior to entering the program. Jill then interviews the student to determine their placement of an initial level of mathematics and meets to determine each student’s individual future career goals in relation to their mathematics background. Jill states that, “Once they are in the program then I work with them individually. I feel like I know what they are doing” (Jill, Interview, September 27, 2012).

As previously stated, the method of student assessment and evaluation in Jill’s program included chapter tests, milestones, and an exam. Once a student has completed a chapter of work, Jill gives a practice test. If a student is comfortable with the practice test, they can then write the real test. A student can elect to complete a second practice test if necessary. Jill spends time
going over the practice test until students are comfortable and successful in understanding the material before the actual test is given. Jill then gives the student the actual test.

A student must score a minimum of 70% to be successful before moving to the next level. If a student gets less than 60% the student can review again and rewrite a different version of the test. Jill then averages the two marks but the highest they can get is 70%. Once a student is successful in a chapter, they are administered a standardized milestone question that encompasses the skills obtained in the chapter. This standardized question may have more than one part and a student must score a minimum of 80% to be deemed successful. This system of skill mastery is the pedagogy behind Program B. Jill finds that students who complete this program are often successful in their college path.

It has been suggested by AMATYC (2005) that authentic assessment includes providing constant feedback. In Program B, teachers use a pedagogy that relies heavily on mastery of skill, along with one-on-one teaching and constant feedback. Jill’s method of individualized instruction, which includes frequent student conferences, more than fulfills AMATYC’s recommendations for faculty action in the area of student evaluation and ongoing assessment.

4.4.7 Understanding Student’s Non-cognitive/Affective Interactions

Jill acknowledges that sometimes a student’s previous experiences, particularly of failure, can cause anxiety and have a negative impact on their learning. Jill states that “they basically have experienced failure, so they do not have a lot of confidence in themselves and they usually do not have very good basic skills. So you have to work on those with them in order to get to the process” (Jill, Interview, April 23, 2015). Jill also recognizes that her students can experience internal and external pressures that lead to a level of stress and anxiety. Jill states that there is “a lot of anxiety about going back to school and the anxiety around finances, how they are going to
pay for this and will they be successful, et cetera” (Jill, Interview, September 27, 2012).

An alarming trend that Jill has recognized in the classroom is the growing number of students who experience anxiety with respect to mental health issues. At times, Jill is frustrated with the lack of support she receives in dealing with her student’s struggles. Jill explains the nature of her concern:

One of the things that has changed — well, this is a difficult thing to talk about — but we are no longer getting support from counselling services. Now, they will see students who are having mental health issues — anxiety or depression or something — but they will not provide accommodations letters for us anymore. So it is up to us now to take this on. We do have that available, but we are not social workers or psychologists, we are just teachers. So we have some experience just from teaching all these years and working with young people, but we are not professionals. (Jill, Interview, April 23, 2015)

Jill also expresses disappointment with the support she receives:

But that to me is a real disappointment for us that this is the way they have gone. At first, they were going to give us no services and then we fought back, and thought, ‘There are [college] students here. Give them a student number.’ If there is a student who is in anxiety or they are suicidal, they need to be provided with services here. Anyway, they did back down on that. (Jill, Interview, April 23, 2015)

Jill’s ability to recognize that her students experience anxiety is one way in which Jill better understands her student’s affective domains. Jill is still able to provide a level of support and caring to the students in her classroom who experience anxiety issues. In one particular instance, it was observed that Jill identified and addressed a student’s anxiety. The student became anxious when going over material for the upcoming test. Jill decided that the student would do another practice test first. This alleviated the pressure felt by the student to take the test that day (Jill field notes, October 23, 2012).

Jill encourages her students to demonstrate, clarify and verify their thinking as soon as and as often as needed. In another instance, Jill spent time with a student demonstrating a conversion example relating to fractions. She then asked the student to demonstrate
understanding by performing an example at her desk. The student was asked to go back to his
desk and try another example. The student, however, came back to get further clarification a
number of times. Each time, Jill showed patience and understanding. Although the issue was not
resolved that day, it was observed that the anxiety of the student was reduced each time he came
back to Jill. Jill was able to use affirming tone and language to alleviate the anxiety of the
student (Jill field notes, November 20, 2012).

4.4.7.1 Perception of Student’s Attitude

Jill acknowledges that the attitudes of her students play an integral part in their learning.
At times, positive attitude can be reduced to ‘showing up’ and ‘doing the work’. Jill explains her
thinking regarding her student’s attitude in the following way:

For the most part, they are very enthusiastic. There is always a group that are quite young,
not necessarily in age but attitude, where I would have to say that sometimes some of the
reasons why they did not get through the first time is the same reason they are not going
to get through the second time. Because they have to know they have to show up, and they
have to do the work and those are the two things that lead to success and sometimes they
cannot meet one of those two criteria. (Jill, Interview, September 27, 2012)

Discipline in Jill’s classroom has never been an issue. For her, the major issue has been
attendance. Understanding this attitude and changing this behavior in her students is a concern
for Jill:

No, discipline is not usually an issue at all. The major issue is getting people to come on
time, or getting them to come at all. You get a whole range of people. Some are
extremely mature and are always there on time and really are goal-orientated, and then
you have those who did not finish the high school system. They have been out for a few
years. They come back and some of the reason they do not succeed is because their
behaviours really has not changed. (Jill, Interview, January 24, 2013)

Jill summarizes the above idea in another way: “I think your work ethic is extremely important,
arriving on time. I keep saying this, arriving on time, coming every day, doing some work
outside the classroom as well” (Jill, Interview, September 27, 2012).
One group of students in particular is a concern for Jill. She observes that young males in her classroom have attendance issues. She acknowledges that it is an attitude that needs to be addressed and changed. Jill provides an insight relating to the young males in her classroom with respect to attendance:

I think this is a systemic problem in education in Ontario — the young male. They are the ones that have so much potential, but have not reached their potential, so if we can get them to show up and stick with the course, they do very well. But the problem is, those are two issues for these people. They either cannot get out of bed still, or they just cannot get the work done. (Jill, Interview, April 23, 2015)

Jill believes that the education system is not in tune with the young male mathematics learner. In her words, she states that, “I find that is a group that somehow our system is not serving,” (Jill, Interview, April 23, 2015).

In general, Jill believes that most of her students are motivated to succeed in spite of their complicated lives. She acknowledges this:

But generally, they are trying, they want to succeed. But the other thing is, they are also at a stage where life gets in the way too. Often they have children; they have financial needs at this point. Their lives are a little more complicated than they were when they were 16. (Jill, Interview, September 27, 2012)

Jill’s understanding and mindfulness of her students’ affective domains in the classroom helps her enhance better the learning experience of her students.

4.4.8 Learning Environments

Learning environments are an integral component of teaching and learning. The following is a description of Jill’s experience as it relates to flexibility in delivery, use of technology and discussion of any barriers in the learning environment.

4.4.8.1 Flexibility in Delivery: Issues of Access

In Jill’s experience, offering a flexible programming is a key to some student’s success. She understands that students need consideration in some circumstances. Jill offers some
examples of how she provides flexible programming for her students:

Well, I guess one of the things is a bit of flexible programming. If class starts at 9:00, they are probably not going to get there at 9:00, so they get there at 10:00. I am just sort of happy they got there, so I do not get after them or whatever. Things like that: allowing them to come in later if they miss, having discussions with them, ‘What can you change in your life so that you can get here at that time and do what you need to do?’ So providing counselling I think, for them. (Jill, Interview, April 23, 2015)

Another way to offer some flexibility is to adjust a student’s schedule to accommodate for the necessity of a job or unexpected life events. In Jill’s words: “If they need to get a job, which means they do not have as much time for school, we try to adjust their schedule, try to adjust the number of courses they are taking, that kind of thing,” (Jill, Interview, April 23, 2015).

Jill believes that all of her students should have equal access and any special circumstances are on a case-by-case basis. Jill describes a special case:

They all have equal access; that, I can say for sure. Accommodation is on a case-by-case basis. They talk to me only because, not only am I the math teacher, I am a student adviser and the coordinator. If we had different people, we would send them to different places or whatever. But yes, if they come to me and say — these are simple examples of two students' parents were from China, their parent died, they had to go home for a couple weeks, so we let them go and try to accommodate them when they come back. (Jill, Interview, April 23, 2015)

Jill describes an additional method for increasing access for students. This involves opening up evening programs for students. The following is Jill’s account of how student access is increased:

Well, we do have an evening program now. We do have evening classes, not at this campus, at our campus. How else can we accommodate? So that is a big thing. Our other campus, we actually have a couple classes on Saturdays. Other than time change — this is a big thing with Employment Ontario, too. They want everybody to be what the student needs. (Jill, Interview, April 23, 2015)

An area that Jill believes that students could be better served is in distance learning. Although her program does not offer distance learning, Jill believes that it could provide opportunities for students to access the program in multiple ways:
Distance learning is available, not through this college, but that is another thing that I would say is a criticism. Our college has not gotten into the distance learning for this, but our students can access it through another College. So, there is distance learning. (Jill, Interview, April 23, 2015)

Access to programming is a key issue for Jill. She has offered up many ways that she thinks about and experiences student access in her program.

4.4.8.2 Use of Technology

Jill’s initial response when asked about the use of technology in her classroom is favourable, although she admits to not having the funds to acquire it:

Yes, I think it would be useful. Logistically, we have four computers in the classroom, and then we have 25 students. They would have to just access them whenever. We do not have money to buy technology. We are not funded for that, so it would just be using online resources that are out there already. (Jill, Interview, April 23, 2015)

Although, Jill admits to the initial expense yet usefulness of technology, she confesses to not really giving it enough consideration:

Yes, it is a very expensive thing to get into, but I could if I — there again, I think if I were doing stand-up teaching I would have been forced into it, because then you would — if everybody is doing the same thing one day, then you could put together a presentation or download stuff and do it all. But to do it for everything from adding, subtracting to trigonometry, I am less inclined to do it. I think for the lower-level things it would be particularly useful, but it is just finding the right program. I have not really gotten into it that much. (Jill, Interview, January 24, 2013)

Finding the right software program for Jill is costly and requires a time commitment on her part. Jill relies on her students to search out what is necessary for their needs. She describes her experience in the following way:

I would have to spend more time getting into programs and things. It could be, and that is probably something I should be doing more of. A lot of the students — I do not know if you saw it — the ones that have iPads and things — they are doing it themselves, too. They are going online and going to YouTube and they will tell me, "I looked at this on YouTube last night, how to do this." (Jill, Interview, January 24, 2013)

In Jill’s experience, finding capable software necessary for the level of her adult learners is a key
concern for her:

Now, the other problem is a lot of these things sometimes are a little too juvenile for our students, too. A lot of them are elementary school or high school math, but then they are not appropriate to adult education. But there are some — it is just not particularly a strength of mine, I have to say. It could be something we could bring in more, too. There again it would have to be individualized, and maybe give the people so many hours on the computers or things like that. (Jill, Interview, January 24, 2013)

Jill concedes that, although “we have not built it into our program yet”, the use of some technology sites “just gives them another, maybe a visual way. I would have to say that we are lax in not implementing some of these things” (Jill, Interview, April 23, 2015). Jill’s confession is one way in which she acknowledges that the experiences of her students could be enriched by the use of technology in her classroom.

**4.4.8.3 Barriers**

Jill admits to many barriers that exist in her program. Firstly, she describes the quality of education that her students initially come in with as a potential obstacle. Jill describes her experience:

Barriers? In our program, the quality of the education that they have had coming in with, greatly influences how they do in the end. So if you have students coming in from a country where it was a pretty poor education system, they come in, they have huge gaps. It is very difficult to make up all those years. (Jill, Interview, April 23, 2015)

A second issue for Jill is a change in time restraints for program completion:

That is sort of a big change for us. For example, in time, we cannot give students as much time in the program as we used to, because they are now counting when the people started and when they finished and they do not necessarily take into account that these peoples' lives do not run in a straight line. (Jill, Interview, April 23, 2015)

The need to satisfy both the government and college is a major concern for Jill. She notices the disconnect between academia and real world employability:

Oh, we have to prepare students for college. We are trying to do that, cover certain courses and things like that, and then sometimes what the government is wanting us to do has nothing to do with curriculum. It has to do with other things. I mean, this whole placing us under Employment Ontario, the rationale is that then we are preparing people
for the world of work. Then a way to improve their skills is then to get into college and to improve their life, but we have — there is academia and then there is employment. (Jill, Interview, April 23, 2015)

Jill has become increasingly frustrated with meeting some government obligations. One in particular has directed her to service a specific client group. The change in focus provides a major obstacle in providing services for all potential deserving students in her program. Jill provides some lengthy insight into her frustrations:

So I guess some of the frustrations are things — this is a good example: the government wants us to focus on people who are 45 to 64. That is not the demographic of people that are going to college, so that is a frustration. That is one of their — there are 12 criteria, so that is a big one. People are on Ontario Works (OW), so that is fine. They want us to focus on those people. Again, these people are non-employable and they have lost — they are 45 to 64, and if they have lost their jobs, how do they get another job? So that is why they want us to focus on that. They want us to focus on people who are on welfare, and all of that is good, but these are not necessarily the people that have the skills or even want to go to college. So, that is a frustration for us. They are telling us, "You don't have enough people 45 to 64." And we say, "Well, those people do not want to go to college. So how are we supposed to get them in here? It is not really the best use of our time because we can upgrade their skills, but they do not want to go to college and change their careers." So that is the kind of thing, when I am saying we are trying to — we want to be a college preparation program. So typically, the people that we are going to get are young people. Well, not necessarily young, up to 30, 35 or whatever, want to go and take another course or whatever. But you do not get a lot of people 45 to 64. (Jill, Interview, April 23, 2015)

There is evidence to suggest that barriers to learning environments do exist. Jill’s frank admissions of the barriers are ways in which she experiences the teaching and learning of mathematics in her program.

4.4.9 Summary of the Case of Jill

Individualized instruction is the way in which Jill experiences the act of teaching ‘at-risk’ math students at the college level. In her opinion, individualized instruction better meets the specific needs of her students and her commitment to instructing these students is evidenced in her daily interactions with her students. Jill teaches mathematics because she believes she is good at it and truly believes in the process of mathematics. Jill’s ability to see the bigger picture
and then teach mathematical ideas in smaller fragments has dictated her teaching experiences. The many obstacles Jill faces only strengthens her resolve in her commitment to teach the ‘at-risk’ college level mathematics learner.
Chapter Five: Discussion and Interpretation of Findings

5.1 Introduction

In this chapter, I revisit the research questions posed in Chapter One and explore how the two case studies of Dan and Jill answer these questions and describe common themes that emerge across the two cases. These themes are reflected in the headings used to organize the discussion and interpretation of the findings.

5.2 Question 1: What strategies are used by the instructors to teach their ‘at-risk’ college mathematics students?

There were number of ways in which the instructor’s used strategies to teach ‘at-risk’ college mathematics students. Knowing what and how to teach are two considerations when teaching mathematics. With respect to pedagogy, AMATYC (2005) challenges faculty to “recognize their own teaching style(s), reflect on the implications of their style on their students’ learning styles, and use that knowledge and other research to make informed decisions about the selection of multiple instructional designs and their classroom management” (p. 51).

I chose to investigate the ‘purpose’, ‘content’ and ‘teaching strategies’ of Dan’s and Jill’s experience to tease out their understanding of pedagogical content knowledge. In doing so, Dan’s and Jill’s understanding of pedagogical content knowledge became contextualized and influenced by their experiences in the field. Over the course of the semester, Dan and Jill reflected on their experiences in the classroom. They were asked to think about how they taught their specific course given the program of study.

Growth in their profession was observed, in that, they began thinking about the particulars of what and how they taught. Questions relating to pedagogy at the beginning of this study were not answered as in-depth in comparison to the end of this study. This is consistent with the work of Jang (2011) who focused on ‘college teachers’ pedagogical content knowledge
as the key to promoting the professional growth of teachers” and described “pedagogical content knowledge base as necessary for effective teaching” (p. 664). Further, Jang (2011) acknowledged that “these types of knowledge are, however, integrated and developed as a result of teaching experiences” (p. 664).

The reflections of Dan’s and Jill’s teaching became more insightful as the semester progressed. Dan and Jill shared their ideas about their experience teaching ‘at-risk’ mathematics students more readily, with more detail and frankness with me throughout the course of this study. It could be noted that my presence may have been a contributing factor in this self-reflection about their experience in the classroom. As their stories unfolded, a clearer picture into the experiences of teaching ‘at-risk’ college mathematics began to unravel.

5.2.1 The Purpose

The investigation into the ‘purpose’ of teaching mathematics was undertaken to explore ways in which the instructor’s teaching style was impacted by their educational and life philosophy (AMATYC, 2005). Knowing the reasons why Dan and Jill came to teach is important in understanding their decisions about how they teach mathematics. This, AMATYC (2005) tells us, is the difference between just simply teaching and becoming a professional educator.

Both Dan and Jill stated that mathematics has been an integral part of their lives. Dan had a natural affinity for mathematics and his inspiration to teach mathematics was borne out of his father’s devotion to the teaching profession. While Jill experienced success in mathematics throughout high school, the ability to break mathematical information into manageable bits provided impetus in the direction of teaching. Ball and Bass (2000) articulated that teachers’ own knowledge of the subject matter affects what
and how they teach.

Dan’s and Jill’s further knowledge of the subject matter was pursued throughout their post-university degree education. Dan completed a Master’s degree in Mathematics and Jill completed a Bachelor degree in Education. Both of them demonstrate knowledge, confidence and qualifications in the subject matter in ways outlined by Smittle (2003) and Ball (2000).

Their experience in the field of teaching for many years has cultivated and constructed their own beliefs about teaching mathematics. For example, Dan’s experience in this semester has led him to believe that the same pre-test should be given to students at the end of the semester to evaluate what and if students have actually learned. In this way, he believes, both teacher and student can visualize the progression of learned material. This is consistent with the work of Jang (2011) who speaks to the validity of teacher experience in constructing knowledge. Jang (2011) sees the roles of teaching experience and reflection as ways to better understanding what constitutes a knowledge base for teaching, and further acknowledges that teachers’ pedagogical content knowledge is developed over time.

Dan and Jill have demonstrated a belief in the relational need for mathematics to apply to real-life situations. In particular, Dan uses analogies and real life examples in his lessons to connect mathematics to the real world. These findings are also consistent with Jang (2011) who suggested that using appropriate analogies to explain abstract concepts gives students a better understanding of concepts. This is also consistent with the findings of NCTM (2000), AMATYC (2005) and Cafarella (2014) about the importance of real-world applicability of mathematics education. In particular, Carfarella (2014) stressed that
“the use of real-world situations improved student learning” (p. 41) with respect to developmental mathematics.

Jill is constantly focusing students on daily practice as a way to keep them connected with real life end goals. In this way, she also helped prepare students for life as asserted by Thomas & Higbee (2000):

Many freshmen are ignorant of the real purpose of higher education, which is to prepare students for life, not just for a job…so that students are prepared to fulfill their function as members of an educated citizenry. (p. 229)

Ultimately, Dan and Jill teach mathematics because they first and foremost enjoy teaching, they both appreciate and are successful in their understanding of the subject matter and they get a sense of fulfillment in helping others understand mathematics.

5.2.2 The Content

The content of both Dan’s and Jill’s program are similar in some ways. Both programs start at basic skill building operations of whole numbers, fractions, decimals and percent, and both programs pre-test students into a particular level of ability. While Dan’s content is a set pathway based on the needs and requirements of the program, Jill’s content is based on the needs and requirements of the student.

Dan’s course content never exceeds a grade 8 level and the pace of his class is dependent on the visual and auditory feedback cues he receives from his students during the lesson. Dan spends four hours a week for fifteen weeks delivering the content with chapter tests, online assignments and a final exam as evaluations. Ultimately, he feels that there should be more applicability to the real world reflected in the content. This real world applicability is consistent with the suggestions of NCTM (2000) and AMATYC (2003).

While Jill’s program content may start out at a very basic grade eight level, it progresses
to a grade twelve equivalency within approximately a year, encompassing introductory algebra and trigonometry. Jill recognizes the critical advantage for all students to understand basic math life skills even though it may not be essential to their program of study. Essential math skills, which are mandated by the government, are incorporated as milestones into the content. The milestones are questions based on real life situations and as such are consistent with NCTM (2000) and AMATYC (2003) guidelines.

Jill spends six hours per week in the classroom. These hours are broken down into two three-hour sessions. A student begins at one of three levels of mathematics and works independently toward chapter tests, unit tests and the final exam. The pace of the content is dependent on the individual’s learning and understanding. This is consistent with the work of Kwan (2016), who advocates for a student-centred approach to teaching mathematics where students become meaning-makers and teachers become facilitators and guides in the co-construction of knowledge. While most students complete three levels in one year, it is not uncommon for some students to take longer. Jill’s program content must meet both college and government requirements.

In conclusion, the content of Dan’s and Jill’s courses reflect the changing needs of society and the workforce. They both continuously examine their course content to reflect the mathematics content that is most appropriate for student learning. For both Dan and Jill, this occurs informally at the end of the semester when meeting with colleagues during promotion meetings. At times, Dan and Jill look beyond course content for what they teach. They both look for opportunities to teach students about ‘real life’ through daily classroom activities.

This is consistent with AMATYC (2006) where it is articulated that courses should be continually evaluated that provide opportunities to develop the quantitative skills students will
need to empower them to become confident and competent problem solvers in their academic work, in society, and in the workplace. Waycaster (2001) also points to the importance of continually examining and evaluating remedial programs in college mathematics to this end.

5.2.3 The Teaching Strategies

Both Dan and Jill are keenly aware of their student’s conceptions and preconceptions of learning mathematics. This is consistent of Shulman’s (1986) understanding of what makes the learning of specific topics easy or difficult in how instruction occurs. In the sections that follow, I will discuss some of the similarities and differences of Dan’s and Jill’s experiences as it relates to the instruction of ‘at-risk’ learners of college mathematics.

5.2.3.1 Teaching Methods

Dan adopts a predominant lecture style method. Dan’s lectures, which emphasized process and the constant search for patterns in his examples to explain relationships, are in keeping with Waycaster (2001) and Shepherd (2016) reporting on course delivery format in remedial college mathematics. Shepherd (2016) reported that “overall best practices are used by instructors regardless of course delivery format” (p. 130) while Waycaster (2001) concludes that “one mode of instruction is not a panacea for all students” and suggests that “colleges offer at least two modes of instruction for developmental mathematics courses” (p. 413).

Dan’s use of concrete visual examples to explain formalized rules is one way that students are helped to handle abstraction. By helping students recognize patterns using strategic examples, Dan was able to help students make meaning in their understanding. This is in keeping with the works of Moreno et al. (2011). Moreno et al. (2011) study indicated “that problem solving is fostered when learners experience concrete visual
representations that connect to their prior knowledge and are enabled to use abstract visual representations” (p. 32).

Cafarella (2014) articulated the importance of organization in helping developmental mathematics students. He concluded that, for students to be successful, “it is imperative that developmental math students are able to rely on some sort of solid algorithm when completing a math problem” (p. 56). This is also consistent with AMATYC (2005), NCTM (2000) and Boylan & Bonham’s (2011) work that stressed the importance of modelling appropriate methods of organizing information to compensate for student’s weaknesses. Dan’s use of modelling to problem-solve specific processes in mathematics was an important feature in his teaching methods.

Dan’s use of visual cues to gauge his student’s interest and understanding is consistent with Chickering and Gamson’s (1987) notion of student-faculty contact in motivating student involvement in the classroom as well as Engelbrecht and Harding (2005) idea that eye contact and body language of the instructor are considered intimate experiences of a learning transaction in a classroom setting.

Jill’s students are from diverse educational backgrounds, entering the learning of mathematics at various stages of understanding. Jill believes that each student’s starting ability should be considered. Jill acknowledges that her students are all individual learners, and as such, adopts an individual teaching style. She instructs students by breaking down mathematical information in manageable chunks based on feedback from the student. This is similar to the findings of Rosenshine (2012) who suggested that new material be delivered in small but rapid steps along with feedback on daily work, and Hagedorn et al. (2000) who confirmed that comprehension monitoring and immediate feedback could be
achieved by the use of daily quizzes and frequent teacher-prepared tests.

Jill’s uses of scaffolding and procedural prompts were consistent with the findings of Rosenshine (2012). Jill modelled mathematical procedures, completed some of the steps for her students, anticipated errors and provided feedback. These are all examples of scaffolding that Rosenshine (2012) describes.

The use of milestones for Jill to check for cumulative mathematical understanding is in keeping with Wiliam (2010) who reported higher levels of learning when cumulative testing was used. There is consensus in the work of Wiliam (2010) who believed that “frequent testing soon after instruction, cumulative demand with feedback soon after testing” (p. 140) are conditions in effective testing.

Siadat et al. (2008) identified ways that the dynamic testing of student learning occurred. It was reported that: “cumulative testing motivates students to constantly review the earlier topics and concepts, and plays an important role in consolidating student learning” (p. 338). Jill’s use of an appropriate workbook to build mathematical progression of skill, combined with individual conferences helps keep students on track toward mastery of content, is consistent with the findings of Smittle (2003) on providing the foundation for more advanced learning. This was also consistent with Siadat et al. (2008), who state that “students enter into a continuous dialogue with the teacher” (p. 339).

Both Dan and Jill utilized the technique of guided practice to help students understand concepts and examples. They were observed working out problems aloud at the board (in Dan’s case) or individually at the desk (in Jill’s case). This guided practice helped model a skill or technique in a particular mathematics lesson. This was consistent with Rosenshine’s (2012) findings that suggested that “when teachers provided sufficient
instruction during guided practice, the students were better prepared for the independent practice” (p. 16). Both Dan’s and Jill’s use of guided practice was another way in which they experienced the activity of teaching ‘at-risk’ college mathematics students.

5.2.3.2 Motivating Students

Dan believes that motivating students is the key to their overall success. Dan’s strategies of using analogies for homework completion, offering encouragement, enhancing engagement and rapport, using entertainment, fostering confidence and supporting student initiative, creating positive attitudes and demonstrating patience are ways Dan finds appropriate in motivating his students to be successful. These techniques are consistent with AMATYC (2006), Rosenshine (2012) and Smittle (2003), who state that student success can be achieved by reinforcing positive teacher-student engagement and active learning. Dan’s use of analogies is consistent with the work of Richland et al. (2007), who report that analogies are useful in that they “allow students to use commonalities between mathematical representations to help understand new problems or concepts, thereby contributing to integral components of mathematical proficiency” (p. 1128).

Dan’s use of open and engaging classroom questioning that lead to conversations about math were in keeping with Baumfield’s (2006) reflections on engaging and motivating learners, and on gaining insight into the thinking of students. Baumfield (2006) believed that, when understanding is negotiated by students openly articulating their ideas, the teacher understands new insight into student’s thinking and this helps to adjust the teacher’s perceptions and expectations of the students. Dan’s open classroom encouraged questioning by his students and thus provided him with further insight into the thinking of
his students. This was necessary in building motivational strategies in his classroom.

The objective in Dan’s motivational strategies was to get students to practice their mathematical skills and complete their homework on a daily basis. Dan equates practice with success. This is consistent with the work of Siadat et al. (2008), who suggest that homework and time-on-task increases student achievement and success.

Jill meets with students on an on-going basis to help develop their educational and career learning goals. This is consistent with the overall tenets of Smittle’s (2003) work regarding ‘at-risk’ mathematics instruction, where it is articulated that teachers need to help students develop specific plans of study. Jill believes that having a specific career goal keeps the students motivated to achieve success.

By meeting students on an individual basis, and by providing feedback continuously over the year, Jill helps to maintain student motivation throughout the course. This is uniform with the findings of Hagedorn et al. (2000) and Rosenshine (2012), regarding the contribution of providing feedback on a daily basis and on eliminating failure through practice. This is also consistent with the work of Siadat et al. (2008) on the importance of continuous monitoring of learning outcomes, as well as the work of Wiliam (2010) that reports closely monitoring student progress in linking overall student success.

Both Dan and Jill believe that attendance is an important factor in students’ success. Thomas and Higbee (2000) reported that “regardless of gender, race, or learning environment, two factors were consistently associated with achievement: attendance and academic autonomy, which reflects students’ interest in learning for learning's sake” (p. 229). While Dan relies on his motivational techniques to maintain good attendance, Jill relies on the student’s strong sense of self-motivation toward a career goal as a key
component. Tracking and reporting attendance is problematic at the college level. Instructors can take attendance, but there is no direct link to marks.

Dan and Jill keep an informal record of attendance, and based on their experience in the classroom, have determined a causal relationship between student attendance and student achievement. Some studies have been conducted regarding the causal effects of attendance and student achievement (Cafarella (2014); Goldrick-Rab, 2010; White, et al., 2011). Goldrick-Rab (2010) reported that success in post-secondary studies is linked to attendance patterns and chances for further college success. Cafarella (2014), on the other hand, concluded that most students that miss several classes are generally unsuccessful. The aforementioned works have suggested that, if student attendance is steady, then student achievement and performance will lead to greater student success. Both Dan and Jill acknowledge that, although barriers of work and family demands can get in the way of student attendance, they believe that strong student motivation leads to strong and steady student attendance. This ultimately leads to greater student achievement.

5.2.4 Summary of Teaching Strategies

There were many strategies utilized by Dan and Jill in their commitment to teach their ‘at-risk’ college mathematics students. Their consideration of pedagogical content knowledge influenced what strategies were used. Their reflections on ‘purpose’, ‘content’ and ‘teaching strategies’ led to the very nature and essence of who they are as teachers. Some of the key factors contributing to their understanding of pedagogical content knowledge included how they experienced motivating students, how they experienced communicating high standards, how they experienced evaluating students using a pedagogical basis, how they developed professionally and how they experienced commitment to teaching ‘at-risk’ college mathematics students. Communicating self-reflection in their teaching was observed in this study. These
experiences parallel much of the works cited earlier (AMATYC, 2005; Ball, 2000; Hagedorn et al., 2000; NCTM, 2000; Rysz, 1999; Smittle, 2003) regarding nature of pedagogical content knowledge and commitment to teaching ‘at-risk’ college mathematics students.

5.3 Question 2: How does the instructor experience non-cognitive issues that affect the teaching of the “at-risk” mathematics learner?

There were a number of ways in which Dan and Jill experienced non-cognitive issues that affected the teaching of the ‘at-risk’ college mathematics learner. In recognizing that mathematical content and instructional method are related to non-cognitive issues, such as attitudes, beliefs and emotions, Dan and Jill were able to negotiate their understanding with the realities of the classroom. A summary of the findings of Dan’s and Jill’s experience of non-cognitive issues that affect the teaching of the ‘at-risk’ college mathematics learner will be discussed.

5.3.1 Understanding Teacher’s Role in Non-cognitive/Affective Interactions

Both Dan and Jill shared their personal beliefs about mathematics, about teaching and about being a teacher. Both indicated a genuine love for teaching and concern for student understanding. Dan spent time addressing student concerns during lessons and allowed students to ask and answer questions as needed throughout his lecture. This alleviated student anxiety over waiting until the end of teaching before their needs were addressed. Dan prioritized his student’s needs first before considering the amount of content delivered. He was always polite and positive in his interactions with students.

In Jill’s case, she preferred to spend large amounts of time on one-on-one time with her students. She was positive in her contact with her students and demonstrated a concern for helping them achieve their end goals. This is in keeping with the qualities of
positive teacher attitudes of modeling positive behavior that Karp (1991) and Smith (2003) imply in their research.

Both Dan and Jill exhibited positive attitudes: Dan exhibited positivity with his tactical questioning during lectures, and Jill by her constant individualized attention. Both Dan and Jill also provided emotional support to students during the semester. Providing emotional support for students is considered a positive quality for caring teachers. This is consistent with the various works cited earlier of Karp (1991), Smith (2003) and van Uden et al. (2014).

By exhibiting positive attitudes about the teaching and learning of mathematics, both Dan and Jill were able to produce positive student-teacher relationships that better fostered student engagement. This is consistent with the findings of van Uden, Ritzen and Pieters (2014) that linked positive student-teacher relationships and engagement with achievement.

5.3.2 Understanding Student’s Non-cognitive/Affective Interactions

Both Dan and Jill are acutely aware of the attitudes, beliefs and emotions of their students. In particular, Dan is cognizant of the negative attitudes that students may bring to the classroom and utilizes motivation strategies such as offering encouragement, enhancing engagement, supporting student initiative, fostering confidence, demonstrating patience and promoting rapport with students to encourage positive attitudes. This is consistent with the work of Smittle (2003) and Astin (1984), who concede that instructors of developmental mathematics students must address and be aware of non-cognitive issues such as beliefs, attitudes and emotions in addition to the cognitive needs of the student.

Dan’s positive engagement with students support the findings of van Uden et al. (2014),
who suggest that a teacher’s intrinsic self-efficacy for teaching can create more engaged students. Dan’s own admission of a shift away from extrinsic motivation to a more intrinsic motivation to teach is evidence of this engagement. Jill is acutely aware of her student’s emotional responses to learning mathematics. Jill shared her ideas of how a student’s anxiety and attitudes shape their emotional response to learning mathematics.

Dan’s candid and open teaching style is a way he makes students comfortable in the classroom. This is consistent with the work of Bonham & Boylan (2011), who state that “An effective way to reduce math anxiety is to create a safe learning environment in which students feel comfortable expressing themselves without fear or ridicule” (p. 4). Dan also tells jokes in class and encourages students to ask, answer and demonstrate without fear of ridicule or embarrassment. This supports Bain (2004) suggestion that humour helps to diffuse anxiety.

Making connections to real life is another way that Dan attempts to change the negative attitudes of his students. In his class, he constantly draws comparisons to practicing mathematics with practicing driving, or practicing a certain skill in a sport in order to become more proficient. He also uses problem solving to make real-life connections. Jill used milestone questions to help students connect mathematics to the real world. Students were able to practice their acquired skills on the mathematics of car purchasing and restaurant bills. This is in keeping with the work of Tinto (1993), who along with many mathematics educators, advocate for the applicability and connectedness of mathematics to real life.

Findings in Clute’s study (1984) suggest that there is a significant relationship between instructional methods and the level of anxiety of students. It was found that
“students with low mathematics anxiety tended to do better under the discovery method, whereas the students with high mathematics anxiety tended to do better under the expository treatment” (p. 56). Both Dan and Jill practiced a methodical breakdown of mathematics information. It was not surprising, then, that both Dan and Jill chose a demonstrative, expository method of instruction in their classroom. Their experience in the field dictated such a method, given the level of anxiety they may have sensed in their ‘at-risk’ college mathematics classrooms. This is keeping with the work of Rosenshine (2012), who advocates for teaching in small steps and “more time in guided practice, more time asking questions, more time checking for understanding and more time correcting errors” (p. 17).

When there was an onset of student confusion and frustration during instruction, Dan and Jill were both able to promote the strategy of patience and supportive behavior. Both Dan and Jill paid significant attention to the confidence level of their students. At various times, Dan and Jill were able to point out instances of confidence instability in specific students. Their ability to do so indicates their level of awareness and sensitivity to students’ affective learning. By being attentive to students’ affective domains, Dan and Jill “help alleviate mathematics anxiety, build self-confidence, and maximize student learning in mathematics” (Bonham & Boylan, 2011, p. 4).

Building self-confidence involves creating an environment where students feel safe to make mistakes. Both Dan and Jill have created environments in their classrooms that allow for this to occur. Dan’s lectures resemble an informal dialogue between teacher and students. He is able to teach mathematic skills while allowing students to interject at any point during his teaching. Students feel comfortable and confident to interrupt either to ask
or answer questions at any time. This was observed multiple times during the study.

Jill encourages her students to seek help during class time and allows her students to determine when they are ready to take a test. This fosters student control over learning, which Jill believes can lead to confidence in students’ ability to be successful in mathematics. If a student is not successful on a pre-test or chapter test, Jill provides constant feedback until the student feels prepared. Her conversations are thoughtful and there is an aura of genuine concern on Jill’s part to help the student. This is consistent with the work of Bain (2004), who advocates for natural critical learning environments where:

students encounter safe, yet challenging conditions in which they can try, fail, receive feedback, and try again without facing a summative evaluation. They learn by doing and even by failing. They gain specific reasoning skills while the experience itself tells them and their teacher if they have learned to reason in the discipline. (p. 108)

The level of confidence to perform mathematical skills, concludes both Clute (1984) and Fennema and Sherman (1976), is strongly related to mathematics anxiety. Dan and Jill acknowledge that their students’ past failures in mathematics contribute directly to their negative attitudes and anxiety about learning and doing mathematics. They both acknowledged that external pressures added an additional level of stress and anxiety for their students. External pressures such as financing and going back to school were trends that Dan and Jill experienced in their classrooms.

This is consistent with the findings of Goldrick-Rab (2010) who reported that “undergraduates, students attending the nation’s two-year public colleges come from a wider range of family backgrounds” (p. 451). Similarly, Brock (2010) stated “non-traditional students are also much more likely to be enrolled in community colleges” (p. 114). In particular, Brock (2010) notes that the various forms of financial aid is “not always successful in directing federal aid to the neediest students and families” (p. 123).
This supports the trends that both Dan and Jill encountered regarding the financial strain experienced by some of their students.

Jill pointed out the alarming trend of mental health issues of her students and perceived lack of support from other stakeholders. She voiced concern and frustration in dealing with the college’s resources to help address her student’s mental health needs. Jill’s ability to recognize her student’s struggles and anxiety makes her a caring teacher. Once again, this affirms the positive attitude and her role in understanding her student’s affective domain. Jill’s recognition echoes the findings of Hunt & Eisenberg (2009) who point out the increase of mental health issues at the college and higher education levels and its negative impact on student retention, performance and graduation rates.

5.3.3 Summary of Experiencing Non-cognitive/Affective Interactions

Dan and Jill experienced multiple instances of non-cognitive/affective interactions when teaching ‘at-risk’ college mathematics students. They had to understand their role in non-cognitive/affective domains before perceiving the students’ non-cognitive/affective issues. Combatting their students’ perceived negativity and anxiety towards learning mathematics was balanced with encouragement and support in many occasions. Dan and Jill were better able to understand themselves and their students in the learning environment.

5.4 Question 3: How does the instructor create open and responsive learning environments?

Dan and Jill created open and responsive learning environments. It was clear that both Dan and Jill experienced very different teaching and learning settings. There are seven aspects of this theme: college learning environments, commitment to teaching ‘at-risk’ students, communicating high standards, professional development, evaluation of students, technology and
barriers. The following is a discussion and interpretation of these findings.

5.4.1 College Learning Environments

In Dan’s class, the lecture-style environment is where he is able to deal honestly with students’ capacity to handle abstraction (Patterson & Sallee, 1986). This was demonstrated by Dan in many instances when he used concrete examples to negotiate the rules of mathematics. He did so in an open and inviting manner that challenged students through an environment conducive to learning. This is in keeping with the research of AMATYC (2006), Bain (2004), Boylan and Bonham (1998), Chickering and Gamson (1987), Goldrick-Rab (2010), Patterson and Sallee (1986), and Smittle (2003) who all advocate for creative, supportive environments and positive student-faculty relationships.

Jill experiences the learning environment in a different way. Jill instructs in an individualized setting that is specific to the needs and abilities of each student. She allows for instruction to be student-initiated, and students can often decide when they are ready for a pre-test or chapter test. Jill’s use of conferences kept students focused toward meeting an end goal, and ultimately toward the goal of self-regulation. This is consistent with the work of Smittle (2003), who advocates for the conscious development of self-regulation for students as the key goal for developmental educators. Within this construction of student-initiated learning, Jill meets many components of the teachings of AMATYC (2006), Boylan et al., (2017), Chickering and Gamson (1987), and Smittle (2003) who advocate for supportive, positive environments for ‘at-risk’ college mathematics students that include goal-setting as well as constant and immediate feedback for students.

Despite the different college learning platforms used by Dan and Jill, it is interesting to note that they were both consistent in creating positive learning spaces. That is, they provided
strategies of feedback, self-regulation and spaces to grow that promoted strong and positive student-teacher contact. This is in keeping with the work of Rosenshine (2010), who continually advocates for systematic feedback.

Finally, regardless of lecture-style or an individualized setting, both Dan and Jill recognized students as individuals. Smittle (2003) asserts in her work that students needed to know that teachers recognized them as individuals throughout the learning process. For Dan and Jill, creating a positive environment was dependent on first and foremost creating a respectful teacher-student relationship.

5.4.2 Commitment to Teaching At-Risk Students

Both Dan and Jill have shared their experiences as it relates to being committed to teaching the ‘at-risk’ college mathematics student. Dan admitted that his commitment to teach the ‘at-risk’ students began as a ‘continuance commitment’ due to finance and need. He further admitted that he was assigned these courses because no one else seemed willing enough to invest the time to develop and teach remedial math courses.

Later, he describes his experience as a shift in mindset to address a challenge to reach and care about the students. This is consistent with the findings of Matinez and Martinez (1988) that “studies of teacher effects and teacher quality confirm the skilled, caring teacher as a key ingredient in student achievement” (Martinez & Martinez, 1988, p. 19). Austin-Hickey (2013) reported that “commitment among developmental math faculty members is needed to ensure the best possible allocation of faculty resources that ultimately facilitate administrative leadership effectiveness” (p. 14). Dan’s continued course assignments in developmental math can be attributed to what he describes as the “reasonably decent rapport” he has with his students.

Jill’s experience with respect to commitment involves organization and dedication to the
task. The ability to communicate mathematical knowledge, in Jill’s opinion, does not depend on knowing a higher level of mathematics. It involves a conviction and willingness to acknowledge and recognize a student’s strengths, weaknesses and needs. This is in keeping with the work of Wambach et al. (2000), who have suggested that caring and dedicated faculty are the backbone in the creation of effective educational environments for developmental education. Jill does acknowledge that her inability to control factors such as attendance, time restraints and class size can hinder her commitment to teach some students. This is consistent with the findings of Cafarella (2014), who reported that even when instructors employ various best practices, there are still students who display behaviours that thwart success, such as paltry attendance, poor attitude and external issues.

Dan and Jill state that student success in course attainment and graduation is both rewarding and challenging and has solidified their commitment to teaching the ‘at-risk’ college mathematics student. Likewise, Shepherd (2016) concluded that:

No matter the institution’s location or financial health or the faculty’s experience or tenure, remedial mathematics instructors employ best practices for the benefit of student success, testimony to the tenacity, creativity, and values of community college remedial mathematics instructors to ensure successful outcomes. (p. 157)

5.4.3 Communicating High Standards

Both Dan and Jill see self-regulation and self-efficacy as an integral component to student success. Dan states that self-regulation on the part of students involves attending class, putting in quality time and doing homework consistently. He communicates self-regulation throughout the semester by reminding students at every opportunity that it takes effort, consistent attendance and homework to be successful students. He has spoken candidly to his students on many occasions of the importance of organizing time effectively and treating school as a full time job. This is consistent with Smittle (2003), who suggests that teachers need to communicate
to students the importance of pacing and organizing their time toward their studies.

Jill’s constant focus on goal setting and conversations regarding corrections on tasks and after tests is one way in which she communicates high standards to students. In this way, she helps create a supportive environment for students to become confident to seek assistance. This is consistent with the work of Wambach et al. (2000) who suggested that “students who are self-regulated will adequately identify areas where their skills must improve and seek the means to improve them” (p. 3).

Jill further believes that students who are self-regulated and self-monitored will stay focused, have better attendance and ultimately become successful students. This is consistent with the research of Wambach et al. (2000), who present findings based on the principle that self-monitoring and chronicling progresses increase pressure to change learning behavior for the better.

Throughout the semester, Jill feels the need to constantly mediate between government standards and college standards. These are translated to the student in the form of imposing set time restrictions needed to complete the program. This is in keeping with the findings of Smittle (2003) who suggests that self-regulation is developed through demanding situations and Shepherd (2016) who suggests that “Self-regulated students will be able to monitor their academic progress and advance through developmental coursework to attain their academic goals” (p. 32). Holding her students accountable to time restraints in meeting test deadlines and course completion are ways in which Jill teaches her students to be self-regulated.

Both Dan and Jill are consistent and clear with communicating to students what is expected of them. This is in keeping with the work by Smittle (2003), who suggests that “developmental students need to know exactly what is expected of them and when it is due” (p.
In the ways outlined above, both Dan and Jill have demonstrated how they experience communicating high standards in their college mathematics ‘at-risk’ classroom.

5.4.4 Professional Development

Dan and Jill have had varied experiences when it comes to engaging students throughout on-going evaluation and professional development. Dan informally evaluates and assesses his own practice on a daily basis. He often reflects on what worked and what did not work in a particular lesson, and adjusts his plans for the future. Dan’s fluid classroom interaction and constant mediating of student responses and understanding of lessons reflect how he is willing to change within the classroom environment. This can be acknowledged as “reflection-in-action”, which Ross and Bruce (2007) describe in their study as a mechanism for facilitating professional growth and development.

By incorporating technology in the classroom, Dan has modified how he delivers his teaching. This is in keeping with the work of Boylan and Bonham (1998), as well as Roueche and Roueche (1993), who identify that program evaluation as one of the key elements in professional development.

Jill’s participation on collaborative efforts, both within and outside of the college, is an indicator of how she experiences ongoing evaluation and professional development. Spann (2000) recognizes that collaborative efforts between community college remedial educators and other stakeholders such as high school educators and community organizations are important in helping to “redefine what it means to possess the basic skills necessary to live and work in a global economy” (p. 6). Jill continually reflects on program change, at times as a necessity, in order to meet government mandates.

Although Dan’s and Jill’s responses to challenges to professional development have been
ambivalent, they nevertheless see the need to be in tune with the needs of their students in relation to the changing global economy. In doing so, Dan and Jill continue to move forward in growing in their profession. This is similar to the findings of Baiocco and DeWaters (1998), which see embracing change and quest for improvement as important for instructors to develop professionally in the 21st century. This sentiment is echoed by Spann (2000), who states that:

In an increasingly pluralistic society, remedial educators require not only specialized training in the content and processes of effective teaching, but also preparation in the understanding and appreciation of cultural and ethnic differences. (p. 6)

5.4.5 Evaluation of Students

Although Dan and Jill utilize formal evaluation to assess their students, both use some form of informal, ongoing evaluations. This is in keeping with McMillan’s (2012) advice on classroom assessment that describes how a teacher’s judgment of student achievement should be based on reasoned evidence in a variety of forms gathered at different times.

Dan gathers information from student responses and questions during lessons to evaluate evidence of students’ learning. In communicating with his students during lectures, Dan is also able to diagnose any strengths or weaknesses in their understanding of the material as teaching is happening. This dynamic process (of actions informing decisions on teaching) is one way in which Dan is able to experience his pedagogical thinking as it relates to his decision-making on student evaluation at specific times of instruction. This is in keeping with the recommendations of AMATYC (2005), who advocate adjusting classroom activities in response to assessment information.

Dan also believes in measuring student progress before and after instruction. In his thinking, administering the same test before and after instruction provides students with a
measure of how much learning has occurred. This was his experience on reflecting back at the end of the semester.

Constant and ongoing feedback as well as adapting to students’ needs is the key to Jill’s pedagogical response to student evaluation. During conferences with students, Jill is able to monitor, evaluate and diagnose student progress toward meeting levels of proficiency in specific areas. Jill informally evaluates students during conferences and avoids subjecting students to formal evaluation if she feels a student is not ready.

Instead, information is provided to the student on their weaknesses and further practice is encouraged. This is evidence of ongoing and meaningful evaluation that AMATYC (2005) recommends. Jill’s continual dialogue with students is a dynamic process that evolves with the needs of her students. In this way, student learning and motivation is maintained and enriched. This is keeping with the work of McMillan (2013) on classroom assessment, which depicts classroom evaluation as a vehicle through which student learning and motivation is enhanced.

5.4.6 Technology

Dan and Jill have varied experiences with technology. While AMATYC (2005) has set a standard of practice relating to technology, technology has been absent in Jill’s classroom. Although she is open to using technology in her classroom, budget restraints makes it difficult to invest in any structured use of technology. This is consistent with the work of Goldrick-Rab (2010), who reported that a survey of community colleges revealed that the most pressing facility needs are instructional-based and include the need for general classroom and computer lab space. While Jill does not use technology to instruct, her students are allowed to use technology. Since Jill’s instruction is individualized, she does allow for the use of smart phones, tablets, iPads and
laptops in the classroom, as long as it does not infringe on anyone else’s learning environment.

Jill confesses that her program is lax in implementing technology and acknowledges that the experiences of her students could be enriched by the use of technology in her classroom. This ambivalent feeling toward technology is echoed in the work of Li (2007). Li (2007) has suggested that teachers’ perceived obstacles to integrating technology in the classroom include “material conditions (including an insufficient number of computers and insufficient technology expertise among teachers)” (p. 379) as well as “difficulty integrating technology into the regular curriculum and instruction” (p. 379).

While Dan understood the merits of utilizing technology and made an effort to implement it by using PowerPoint, document cameras and online assignment tools, he nevertheless had strong feelings against the use of technology in the ‘at-risk’ classroom. Dan maintained that face-to-face interaction for his ‘at-risk’ students is crucial to their learning, while online tools give rise to anonymity and decrease experience in taking the initiative. This is in contrast to a study by Li and Edmonds (2005), whose participants involved ‘at-risk’ adult learners and their experiences with online mathematics tools. They concluded that “students’ knowledge, skill, and ability reflected in face-to-face settings were easily transferable to online environments” (p. 158).

5.4.7 Barriers: Issues of Equity and Access

Both Dan and Jill experienced issues of equity and access within the context of their teaching. Both have opened up outreach and communication to students beyond classroom hours via online tools such as Blackboard and emails. Dan sets his course information, provides class updates, homework links and test solutions on a college-wide platform called Blackboard. This provides access to students as needed throughout the entire semester regarding all aspects of coursework. Jill uses Blackboard as a means to set individualized meetings among particular
students or to notify the class of general information concerning the college.

Although issues of access were beyond the control of Dan and Jill, they nevertheless had to encounter students at various ability levels and teach them. Both Dan and Jill have experience with specific cases of students who have a wide range of abilities. They indicated that the quality of education that the students initially come in with as a potential barrier to their success. This is a strong connection with the works cited earlier (Bailey & Karp, 2003; Brock, 2010; Boylan & Bonham, 1998; Boylan & Saxon, 1999; Goldrick-Rab, 2010; Jenkins & Rodriguez, 2013).

Some positive gains to access were reported by Jill. These included flexible programming, accommodation on a case-by-case basis and the consideration of offering evening classes. These ideas are confirmed in the work of Cejda and Hoover (2010), who suggest creating supportive learning communities to underscore student retention.

Jill also acknowledges that incorporating distance learning is another way that could create opportunities for students to access the program in multiple ways. This is keeping with the work of many researchers who prescribe to the duality of the learning environment and connectivity of students with the physicality of the institution itself (Aspden & Helm, 2004; Bliuc et al., 2007; Crawford et al., 2014; Olapiriyakul & Scher, 2006;).

Another factor explored by some researchers to contribute to student access and equity was the presence of a counselling component for students. Jill met with her students throughout the semester to go over training plans and keep them focused on end goals. While Jill counselled her students on a regular basis with regards to career outcomes, she felt a disconnect with the college counselling services, who could be offering tandem services to help bridge issues of equity. In particular, she was frustrated with the inability of college services in addressing the mental health issues of her students.
This frustration is also a focus of research that questioned the commitment of Colleges to provide counselling services (Brock, 2010; Boylan et al., 2017; Boylan & Bonham, 1998; Boylan & Saxon, 1999; Goldrick-Rab, 2010). The counselling component can help keep students focused toward an end goal, provide for “contextualized instruction” (Brock, 2010), help students through hurdles they may encounter through program completion and ultimately contribute to student access and equity for ‘at-risk’ learners at the college level (Brock, 2010).

5.4.8 Summary of Open and Responsive Learning Environments

This area of the study focused on the experiences of Dan and Jill as they negotiated open and responsive learning environments of the ‘at-risk’ college mathematics learner. Dan and Jill differed in their experience of learning environments. Dan experienced a more structured lecture style, while Jill experienced a more individualized model of instruction. Dan was able to deal honestly and openly with student’s capacity to handle abstraction by using concrete examples in an inviting and encouraging manner that was conducive to learning.

Jill’s experience included an individualized setting specific to the needs and abilities of each student, where goal setting and immediate feedback was a constant theme. In each case, both instructors strived for the ultimate goal of self-regulation of their students and promoted strong and positive student-teacher contact.

The participant’s experience with technology was different in both cases. Dan utilized some forms of technology (PowerPoint, document scanner, online homework/assignment tools) but was wary of the consequences of its use. Jill, on the other hand, was ambivalent about the use of technology. She felt it might be useful for her students, but did not implement technology in her teaching because of the cost and her lack of familiarity with specific software.

Although some issues of access and equity were on an institutional level, and were
beyond the control of Dan and Jill, they nevertheless experienced these issues in their environment. They both strived to provide access through office hours, emails and online tools such as Blackboard. Dan and Jill experienced specific cases of students’ range of abilities and identified that the quality of education that the students initially came in with as a potential barrier to their success. This speaks to the tension between the ‘open-door’ policy and completion/success rates of ‘at-risk’ students in college.

Although Jill supported the idea of distance learning, it was not part of the program. However, counselling students before, during and after the program was an integral component of her experience. Integrating a counselling component within supportive learning communities is a strong contributor to student access and equity for ‘at-risk’ learners at the college (Brock, 2010; Goldrick-Rab, 2010).

5.5 Major Findings

This study investigated the experiences of two instructors teaching ‘at-risk’ college mathematics students. My intention was to glean insight into teaching this unique group of students by using the participants’ experiences and narratives as they negotiated teaching the ‘at-risk’ college mathematics student. There are a number of findings that were influential in the participants negotiation of teaching ‘at-risk’ college mathematics students as it related to the following areas: strategies of teaching, experience of non-cognitive/affective interactions and experience of open and responsive learning environments.

1. Conferences are a good way to provide individual attention to ‘at-risk’ college mathematics students.

2. Both individualized or lecture style delivery methods could be used.

3. These College instructors of ‘at-risk’ mathematics students believe that they could create
positive attitudes about mathematics by using humor, using praise, being caring, being patient, engaging in personal life stories, recognizing confusion and frustration in their students and being sensitive to outside pressures experienced by students.

4. The positive learning environment created by these College instructors of ‘at-risk’ mathematics students lead to self-regulation by the student. Providing conferences for personal attention, providing individualized educational plans and providing constant teacher feedback kept students focused on their end goals.

5. These College instructors of ‘at-risk’ mathematics students believe that the emotional state of their students is important to their overall learning and that more could be done to access emotional support for students.

6. These College instructors of ‘at-risk’ mathematics students used minimal technology and did not believe that the use of technology would enhance their instruction.

7. These College instructors of ‘at-risk’ mathematics students were mindful and responsive to the individual differences among their students.

8. By encouraging students to articulate their lack of understanding, these college instructors were able to identify areas of individual needs and assist their ‘at-risk’ students.

5.6 Recommendations for College Instructors and Colleges

1. College instructors of ‘at-risk’ mathematics students could consider individual meetings with students, providing constant and immediate feedback and supporting student initiative to help create positive attitudes about doing math.

2. College instructors of ‘at-risk’ mathematics students could consider breaking down mathematical content into smaller and more manageable pieces, and utilize scaffolding
techniques when instructing.

3. College instructors of ‘at-risk’ mathematics students could consider providing equity and access in the learning environment.

4. Colleges could help dedicated faculty working with ‘at-risk’ math students to provide appropriate and positive learning environment for these students.

5. Colleges may want to consider providing support to faculty in helping deal with students’ emotional health.

6. Colleges may want to consider improving communication platforms between departments, professors and counseling services to help coordinate issues of equity.

7. Colleges may want to consider providing faculty with professional development opportunities, regardless of status (full-time, contract or part-time).

5.7 Suggestions for Further Research

I have identified a number of areas that could lead to additional research ideas. One place to start is to investigate the backgrounds of instructors to determine, which characteristics might lead them to become college instructors. What underlying attributes predisposes one to become a college mathematics teacher of ‘at-risk’ students?

I wanted to use the narrative of instructors to offer some insight into what experiences they may have. One teacher believed that motivating students in various ways was the key to changing behavior about mathematics and would lead to overall success of these students. The other teacher demonstrated, in multiple ways, that promoting self-regulation is the key to student success. Although their experiences were rich in instances of supporting these types of actions, I was never able to measure how successful they were in their endeavor to do so. I relied on their perceptions of how successful they thought they were during the course of teaching their ‘at-risk’
college math students. Additionally, it might be useful to offer some quantitative measures to investigate this area in the future so that it could include insight into student perspectives.

My case study involved two cases. It may be useful to study the experiences of more instructors. It may be useful to gauge the perspectives of different instructors in different college contexts. For example, investigating a full-time college instructor’s experiences versus that of a contract or part-time instructor may be useful. It may be useful to investigate other college programs where ‘at-risk’ mathematics students are taught. It may also be useful to investigate all colleges in Ontario or across Canada and beyond with regards to their treatment of ‘at-risk’ mathematics programs.

Although, research has suggested that technology can have an impact when teaching ‘at-risk’ mathematics students, this was not evident in the two cases studied. It may be useful to more rigorously investigate why technology was not helpful for these case studies. It may also be useful to provide more cases that include technology in the instruction so that comparisons can be drawn.

5.8 Limitations

This study used the experiences of two teachers to shed some insight into the teaching of ‘at-risk’ college mathematics students. Although there were some expected results, there are some limitations to consider. The findings of this study are based on specific programs of study in the area of mathematics at college. We may not be able to generalize to every ‘at-risk’ college math course; however, as argued earlier, these findings may inform other teacher educators in similar situations. What worked for one instructor may not have worked well for another. The reasons for this are many. For instance, a person’s history and past mathematical background has much to do with who they are as teachers and what decisions they make about teaching.
5.9 Concluding Thoughts

During my thirty years as an educator, I have noticed that the landscape for teaching and learning mathematics has changed and continues to change. The ‘at-risk’ college mathematics classroom is no exception. Students come from varied backgrounds and experiences and are encouraged to think critically in a global economy. Colleges and faculties are concerned with the overriding urgency to retain students and provide positive engaging environments. Nevertheless, there are still students failing miserably in mathematics, even with the technological tools at our disposal. Students in some mathematics classrooms still lack the necessary skills to be successful.

The question in my practice remains, how can I help students to be successful in mathematics? What has become apparent to me is that the everyday real and authentic teaching practices of faculty can make a difference. As an instructor of an ‘at-risk’ college mathematics classroom, I must understand the nature of the student and engage with them in multiple ways, sometimes addressing their affective behavior and attitudes first. In my experience, it is the intangibles that may have to be addressed before any math can take place. These ‘intangibles’ include confidence building, decreasing anxiety and fear, and are important to address.

This study has informed me that individual teachers can make that happen, by using humor, using praise, being caring, being patient, engaging in personal life stories, recognizing confusion and frustration in their students and being sensitive to outside pressures experienced by students. Conferencing and providing timely feedback are also imperative to this undertaking. The challenge for me is to strike a balance between the affective needs of my students along with the pedagogical practices that lead to a positive learning environment. I remain optimistic in this endeavor.
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APPENDIX A: Information Letter to Participate in the Research (Instructor)

DEPARTMENT OF CURRICULUM, TEACHING AND LEARNING

E-mail: ctl@aise.utoronto.ca  Telephone: (416) 923-6541 ext. 2601  Fax: (416) 926-4744

Dear Potential Participant,

You are invited to take part in the research study on “Experiencing the Activity of Teaching ‘At-Risk’ College Mathematics Students” which is being conducted by Vanessa Farren, a fifth-year doctoral student from the Ontario Institute for Studies in Education at the University of Toronto. The research study is under the supervision of Professor Douglas McDougall to fulfill the thesis component of my degree requirements.

The purpose of this research is to understand the ways in which college teachers experience the instruction of the ‘at-risk’ mathematics learner. Your participation in this study will involve an interview, keeping a journal and being observed in the classroom. Your voice in this study is important and every effort will be made to insure that its integrity remains intact.

There are several significances this research can offer. Firstly, this study is designed to offer insight into the experience of those teaching and instructing ‘at-risk’ college mathematics students. It may be important to understand the stories, efforts, struggles and frustrations experienced by teachers as it relates to a prescribed set of strategies that are currently proposed. These insights may also be useful in general terms for those in the field of teaching and programming curriculum for ‘preparatory’ or ‘remedial’ education across broad areas of study at the college level. This study may even be useful for those teaching ‘at-risk’ mathematics at other levels other than college. The same mindset used to discover teaching practices and experiences of those instructing ‘at-risk’ college mathematics students could apply to all levels of educating the ‘at-risk’ learner. Any theoretical framework that may emerge to support or underline other research and inquiry efforts into the instruction of these students could add another level of significance to this study.

All data collected during the study will remain confidential. You have no obligation to participate in this study. You will be free to ask questions or concerns throughout the study, and may withdraw at any time if you choose. If you withdraw from this study, the data pertaining to you would be destroyed immediately. All survey responses will be identified with an ID code number and your name will not be linked to the research data. Only I and my supervisor, Professor Douglas McDougall, will have access to the raw data. All raw data will be secured in a locked facility and will be destroyed within two years of completion of the study.

Who can participate in the research?
Teachers of “at-risk”, “preparatory” or “remedial” mathematics at the college level.

What choice do I have?
Participation is entirely voluntary. If you decide to participate, you may withdraw from the project at any time without giving a reason. The researcher may also withdraw a participant if it is considered in the participant’s best interest or it is appropriate to do so for another reason. If this happens, the research will explain why and advise you about any follow-up procedures or alternative arrangements as appropriate.

All information collected will be confidential. All information collected will be stored securely with the researcher and kept for a period of two years in a locked facility. At no time will any individual be identified in any reports resulting from this study.

What will I be asked to do?
You will be asked to participate in an interview, keep a journal, be observed and audio taped in the classroom.
What are the risks and benefits of participating?

There is no risk for participating in this study. There is no direct benefit for the participants. You will receive a copy of the summary of findings from the study.

How will the information collected be used?

I will submit the research analysis to an examining committee, which is chaired by Professor Douglas McDougall at the Ontario Institute for Studies in Education at the University of Toronto. The results of the study will be reported.

What do I need to do to participate?

Please read this Information Letter and be sure you understand its contents before you consent to participate. If there is anything you do not understand, or you have any questions, please contact the Principal Investigator.

If you would like to participate, please sign the consent form, and attend an interview.

Thank you for considering this invitation,

Vanessa Farren

__________________________  ________________________
Researcher Signature        Date

__________________________  ________________________
Participant Signature        Date

CONTACT INFORMATION:
Principal Investigator:
Vanessa Farren
Ph.D. Candidate

Supervisor:
Dr. Douglas McDougall, Chair
Department of Curriculum, Teaching & Learning
Ontario Institute for Studies in Education/UT,
APPENDIX B: Consent Form to Participate in the Research (Instructor)

Title of Study: Experiencing the Activity of Teaching ‘At-Risk’ College Mathematics Students

Researcher: Vanessa Farren

Name of Participant: ______________________________ (please print)

I understand the purpose of this research study is to examine the ways in which college teachers experience the instruction of the ‘at-risk’ mathematics learner.

I understand that participation in this research study is completely voluntary and that I may withdraw from the study at any time and for any reason(s) without explanation or penalty of any kind. I am free to not answer any question(s) that I do not wish to answer. There is no anticipated risk for participating in this study. There is no direct benefit for me, the participant. I will receive a copy of this consent form for me to keep, before the start of the study. I will receive a copy of the summary of findings from the study within six months of completion of the study. Information about my rights as a research participant can be obtained from the Office of Research Ethics (ethics.review@utoronto.ca, 416-946-3273).

I agree to be observed and audio taped in my classroom, participate in an interview and keep a journal. I understand that eight, fifty minute classes will be observed for a two hours per week course having a fifteen week semester. I understand that all data collected during the study will remain confidential. I have no obligation to participate in this study. I will be free to ask questions or concerns throughout the study, and may withdraw at any time if I choose. If I withdraw from this study, the data pertaining to me would be destroyed immediately. All data collected will be identified with an ID code number and my name will not be linked to the research data. All digital data including audio-tapes will be encrypted and will be consistent with the standards of UT:
http://www.utoronto.ca/security/UTORprotect/encryption_guidelines.htm

Only the researcher, and the supervisor, Professor Douglas McDougall, will have access to the raw data. All raw data will be secured in a locked facility and will be destroyed within two years of completion of the study.

Further, at no time will value judgments be placed on my responses/comments nor will any evaluation be made of my participation in the class discussion or interviews.

I understand that the findings may be presented or published in appropriate professional publications and conferences but no participant will be identifiable in any reporting of the data or findings.
Participant’s Signature ______________________________ Date: ___________

If you have any questions or concerns about this study please contact:

CONTACT INFORMATION:

Principal Investigator: Vanessa Farren
Ph.D. Candidate

Supervisor: Dr. Douglas McDougall, Chair
Department of Curriculum, Teaching & Learning
Ontario Institute for Studies in Education/UT,

Researcher’s signature ____________________________ Date: ___________
APPENDIX C: Consent Form to Participate in the Research (Student)

Title of Study: Experiencing the Activity of Teaching ‘At-Risk’ College Mathematics Students
Researcher: Vanessa Farren

Name of Student Participant: ________________________________ (please print)

I understand the purpose of this research study is to examine the ways in which college teachers experience the instruction of the ‘at-risk’ mathematics learner. I understand that this study is NOT part of the requirements for the course that I am in and that participation in the research study is completely voluntary and that I may withdraw from the study at any time and for any reason(s) without explanation or penalty of any kind. I am free to not answer any question(s) that I do not wish to answer. I understand that my decision to participate or not participate in this study will in no way affect my course grade or academic standing. There is no anticipated risk for participating in this study. There is no direct benefit for me, the participant. I will receive a copy of this consent form for me to keep, before the start of the study. I will receive a copy of the summary of findings from the study within six months of completion of the study. Information about my rights as a research participant can be obtained from the Office of Research Ethics (ethics.review@utoronto.ca, 416-946-3273).

I agree to be observed and audio taped in my classroom. I understand that eight, fifty-minute classes will be observed for a two hours per week course having a fifteen week semester. I understand that all data collected during the study will remain confidential. I have no obligation to participate in this study. I will be free to ask questions or concerns throughout the study, and may withdraw at any time if I choose. If I withdraw from this study, the data pertaining to me would be destroyed immediately. Further, neither participation nor non-participation in this study will impact my status in the course/program now or in the future. All data collected will be identified with an ID code number and my name will not be linked to the research data. All digital data including audio-tapes will be encrypted and will be consistent with the standards of UT:

http://www.utoronto.ca/security/UTORprotect/encryption_guidelines.htm

Only the researcher, and the supervisor, Professor Douglas McDougall, will have access to the raw data. All raw data will be secured in a locked facility and will be destroyed within two years of completion of the study.

Further, at no time will value judgments be placed on my responses/comments nor will any evaluation be made of my participation in class discussion.

I understand that the findings may be presented or published in appropriate professional publications and conferences but no participant will be identifiable in any reporting of the data or findings.

Participant’s Signature ____________________________ Date: __________
If you have any questions or concerns about this study please contact:

CONTACT INFORMATION:

Principal Investigator: Vanessa Farren
Ph.D. Candidate

Supervisor: Dr. Douglas McDougall, Chair
Department of Curriculum, Teaching & Learning
Ontario Institute for Studies in Education/UT,

Researcher’s signature ___________________________ Date: ______________
APPENDIX D: Pre-Observation Interview Questionnaire

Questionnaire

What course(s) do you currently teach?
How long have you been teaching these courses?
How have you come to teach ‘at-risk’ college mathematics students?

How would you describe your beliefs and attitude in teaching ‘at-risk’ college mathematics students?

What skills are unique to teaching ‘at-risk’ college mathematics students?

Is there a need to change the learning environments of an ‘at-risk’ college mathematics classroom? If so, how do you do this?

How do you engage in on-going evaluation and professional development?

How do you communicate high standards to your students?

How do you measure your own success in your practice?

How would you describe the beliefs and attitudes of the students in your class regarding the learning and instruction of mathematics?

Is there a need to try and change their beliefs and attitudes throughout the course of this class?

How do you determine the learning needs of students in your developmental mathematics classes?

How are learning needs and attitude related?

What do understand as ideal teaching practices versus the real teaching practices of ‘at-risk’ mathematics instruction in the college classroom?
APPENDIX E: Post-Observation Interview Questionnaire

Questionnaire

Were there any moments or incidences that you have recorded in your journal relating to any of the observed days?

If not, were there any thoughts that have been recorded in your journal?

Please describe, reflect or share them.

In practice, can you reflect on the ideal teaching practices versus the real teaching practices of ‘at-risk’ mathematics instruction in your classroom?

Have your experiences changed since the beginning of this study? If so, how?

Do you have any final comments on anything pertaining to this study?

Thank you for sharing both your time and thoughts.
APPENDIX F: Post-Exit Interview Questionnaire

1. Given the lapse of time since we last spoke, **is there any changes that may have occurred during this time**. I.e., The main conclusion was that if you could get students to attended class, practice their work, spend time with material then they would be successful. Is there anything to add to this?

2. Beliefs about mathematics can be categorized in the following 3 ways:
   
   a) Instrumentalist view — an accumulation of facts, skills and rules to be used in the pursuance of some external end
      
      - those who believe in this view see various topics that comprise mathematics as unrelated
   
   b) Platonist view — mathematics is seen as a static body of unified, pre-existing knowledge awaiting discovery
      
      - structure of mathematical knowledge and the interconnections between various topics are of fundamental importance
   
   c) Problem-solving view — mathematics is regarded as a dynamic and creative human invention; a process, rather than a product
      
      - best reflects relatively recent changes in the way mathematicians view their discipline NCTM, AMATYC

What view do you think you have about Mathematics and why?

3. **Affective Domains**

   a) Teacher’s Role in Affective Domains — **How do you think that your attitude about the subject math affects your students?**

   b) Understanding Student’s Affective Domains — **what type of attitudes and beliefs do your students bring to the class? How does it affect their math success/learning in this class?**

4. Thoughts on:

   a) Pedagogical Content Knowledge — Knowing how to teach (pedagogy) together with what to teach (subject/content matter) were then seen as activities that contributed to successful teaching practices — **What specific strategies might you use that are unique to these learners? That you have found to be successful.**
b) Commitment to Teaching Underprepared Students — **Do you believe that there should be specific type of instructors teaching in this program?** What qualities should they have?

c) Communicating High Standards — **Are there any different standards that are communicated to the students?** Are they any different from a regular program?

d) Evaluation and Professional Development — **Have you undergone any further professional development?**

e) Evaluation of Students Using A Pedagogical Basis/Lens/View — **How have you evaluated (weighting, exams, tests) these students?** Is it any different than other evaluations in a regular setting?

5. **Open and Responsive Learning Environments**

   a) College Learning Environments — **Have you experienced any changes to the learning environment/platforms?**

   b) Technology — **Has your use of technology changed?**

   c) Issues of Equity and Access — teacher-student contact can be enhanced include formal and informal office hours, e-mail reminders about upcoming tests and assignments, acknowledging student absences by replying via e-mail or telephone when contacted — **Are there any strategies that you use to ensure that all students have equal access (to course material, sick, personal conflicts) in order to be successful?** How do you accommodate students with diverse needs?

The changing nature of Ontario’s economy, together with the emergence of an older student clientele, seeking more flexible and more accessible educational and training opportunities, will require the colleges to make radical changes if they are to maintain their reputation for being responsive to community needs. (Dennison, 1995, p. 44)

   **Any thoughts?**

   d) Blended or Hybrid Learning Environments — **what do you know about hybrid learning environments?** Do you see it as useful? Do you see yourself ever using it?
APPENDIX G: AN EXAMPLE OF A MILESTONE QUESTION

Task A

Review the receipt below to answer questions 1 to 5 on the Response Sheet.

Thank you for dining at
BBQ HUT EATERY
18 Linton Street (555) 282-9778

THU MARCH 26
CHECK 718949000-5
TABLE #5
CUSTOMERS: 5
SERVER: ALENA

For groups of 5 or more, we recommend a gratuity of 18%

3 Coffee 5.05
1 Diet Bev. - lg. 3.38
1 Sparkling Water 2.50
3 Ranch Chicken Sandwich 44.97
1 Classic Burger 12.95
1 Thai Stir-fry Special 11.50
2 Club Sandwich 22.98

Subtotal 104.13
Tax (13%) 13.54
Total 117.67

Follow our blog at www.blog.bbhut.ca
For special events and dining coupons.
Task A: Response Sheet

Learner name: ____________________________ Date: ______________

Answer the questions below by referring to the receipt. You do not need to write your answers in complete sentences.

1. The receipt is for lunch for five students. Each student will pay \( \frac{1}{5} \) of the bill. What will each student pay, excluding taxes and tip?

2. Calculate the cost of each ranch chicken sandwich before tax.

3. The restaurant recommends that groups of five or more tip 18% of the amount before tax. Which of the following amounts is closest to 18%?
   a) $15    b) $20    c) $25    d) $22

4. College students receive a 10% discount on the amount before tax. Calculate the amount of the discount on this bill.

5. The students should not have been charged for the two club sandwiches that appear on the bill. How much should be subtracted from the bill, including taxes?
Task B

Review the book order below to answer questions 6 to 10 on the Response Sheet.

http://www.textbook.com/newtextbook/12847779287/sales

**Textbook Hub Online Sales**  
Search Textbooks

Your Account > Order Summary  
*Free Shipping for July Orders*

Order Placed: June 18  
Order Number: 67817287-0076

<table>
<thead>
<tr>
<th>QTY</th>
<th>Title</th>
<th>Price ( CDN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Communicating in the Workplace</td>
<td>31.19</td>
</tr>
<tr>
<td>1</td>
<td>Grammar and English Usage Guide</td>
<td>18.95</td>
</tr>
<tr>
<td>18</td>
<td>Fundamentals of Marketing</td>
<td>756.00</td>
</tr>
<tr>
<td>1</td>
<td>Bart’s Dictionary</td>
<td>12.95</td>
</tr>
<tr>
<td>18</td>
<td>Ellis Guide to Test Writing</td>
<td>597.60</td>
</tr>
</tbody>
</table>

Item(s) Subtotal: 1,416.69  
Minus Bulk Discount: 203.04  
Subtotal (after discount): 1,213.65  
Tax (5%): 60.68  
Total CDN$: 1,274.33

| ➤ CHANGE ITEM?  
| ➤ CONFIRM ORDER? |

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Task B: Response Sheet

Learner name: ___________________________ Date: ______________

Answer the questions below by referring to the book order. You do not need to write your answers in complete sentences.


7. The student who placed this order agrees to put ¼ of the total on his credit card. How much will be charged to his credit card?

8. Shipping and handling costs are $1.50 per textbook. Calculate the shipping and handling costs on this order.

9. The student returns *Grammar and English Usage Guide* a week after receiving the order. How much money should be returned to the student, including taxes?

10. Used textbooks typically cost 25% less than new textbooks. Approximately how much would *Communicating in the Workplace* cost, before taxes, if purchased used?
   a) $19  b) $21  c) $23  d) $25

| Total: /10 | Successful: Y N |

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Getting Ready:

1. Make a single-sided copy of the milestone task(s) for the learner.

Administering:

2. Give a copy of the milestone task(s) to the learner.

3. Provide a non-programmable calculator to the learner.

4. Tell the learner:
   - The reason for the assessment (e.g., You are completing this milestone to help us monitor your progress towards your goal).
   - The number of pages he or she has in the milestone.
   - That there is no time limit.
   - To write his or her name and date in the space(s) provided.
   - To read the instructions before beginning.

5. Once the learner has completed the milestone, collect all sheets and staple them together.

Scoring:

6. Use the scoring instructions on the next page to evaluate the learner’s work.

7. Count the correct responses and record the total on the learner’s response sheet.

8. Use the total score to decide whether the learner has successfully completed the milestone. Successful completion of this milestone demonstrates the learner’s ability to make low-level inferences to calculate costs and expenses that may include rates such as taxes and discounts (Indicator C1.2).

9. If the learner successfully completes the milestone, update the service plan in EOIS-CaMS.
Scoring Instructions:

Score the milestone according to the responses provided below. There may be some acceptable alternative answers; the assessor must use his or her judgement to decide whether the learner's response is acceptable.

Answers:

Task A
Scoring notes: Answers do not need to be written in complete sentences.
1. $20.83
2. $14.99
3. b) $20
4. $10.41
5. $25.97

Task B
Scoring notes: Answers do not need to be written in complete sentences.
6. $33.20
7. $318.56
8. $58.50
9. $19.90
10. c) $23

Interpretation:

Success = at least 8 / 10