STUDENT ACCOUNTABILITY AND FORMATIVE ASSESSMENT AND ITS EFFECTS ON MOTIVATION AND ACADEMIC ACHIEVEMENT IN DEVELOPMENTAL MATHEMATICS

A dissertation submitted by

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ABSTRACT

The purpose of this study was to investigate whether high student accountability and formative assessment affected student motivation, learning and resource management strategies, and achievement in developmental algebra I. The setting was a fifteen-week semester at a community college in suburban New York. Two sections of developmental algebra I were held highly accountable for online homework and received three formative assessments, while two other sections were held to low accountability for online homework and received three summative assessments. Study participants answered the Motivated Strategies for Learning Questionnaire (MSLQ) at the beginning and end of the semester. This quantitative study examined three constructs of motivation which were control of learning beliefs, self-efficacy for learning and performance, and test anxiety; one learning strategy construct, metacognitive self-regulation; four resource management strategies which were effort regulation, peer learning, help seeking, and time and study environment management; and online homework and final examination grades.

Developmental algebra I students did not rate their motivations, learning strategy, and resource-management strategies for developmental algebra I strongly. Students' response averages were within a somewhat not true to somewhat true range. An independent samples t-test revealed a significant difference in online-homework grades between the high- and low- accountability groups. A repeated measures two-way analysis of variances found (a) accountability was near a significant main effect for self-efficacy for learning and performance, (b) a significant difference in effort regulation within groups of low and high accountability, and (c) a significant interaction with test anxiety between low and high accountability groups. A correlation analysis revealed 21

significant relationships between dependent variables and a stepwise linear regression revealed a good model for high accountability with self-efficacy and help seeking as predictors of final examination grades. The collected data failed an assumption to calculate a discriminant analysis and gave invalid results to determine if student responses and grades can classify students into their accountability group.

Low accountability for online homework and summative assessments significantly increased students' test anxiety. High accountability for online homework and formative assessment kept students' effort consistent, significantly improved homework performance, and encouraged students to become intentional learners and acknowledge their true performances and ability.

Instructors should implement high accountability and formative assessment with students in their high school and college-preparation classes. These pedagogical practices would positively affect study skills and help students' college readiness.

Colleges should divide coursework into modules and implement high accountability and formative assessment within developmental mathematics. Modules offered during the summer or winter sessions should motivate students to remediate and confidently pursue college-level mathematics.

DEDICATION

I dedicate this research to my best friend and loving husband Teddy. May we always cherish our journey that began in differential equations and take time to remember and celebrate our milestones along the way.

I thank and love my sons Dean and Nick for all their patience and support. I am so proud of my young men as they understand the importance of learning and the lifetime of effort needed to self-progress.

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CHAPTER I

INTRODUCTION

Introduction

College remediation is known as the gatekeeper to postsecondary education. It controls quality and gives students a second chance to learn the standard or basic skills needed to enroll in college-level courses (Attewell, 2006; Bahr, 2008; Kowski, 2014). Federal and state policy makers viewed remediation as inefficient and costly (Berl, 2014). The Community College Research Center (CCRC) at Columbia University approximated the cost of college-level remediation at community colleges to be close to $4 billion per year (Scott-Clayton & Rodriguez, 2012). The State University of New York (SUNY) includes thirty public, community colleges and continues to spend over $70 million annually in remedial education. The majority of local community colleges' sections in mathematics were remedial, with over 40 percent of incoming freshmen in 2013-14 placed in a reading and or mathematics remedial course (Langstaff, 2013).

In January 2015, President Obama proposed tuition-free community college for all citizens of the United States. This proposal included a plan to divert 75 percent of the average student's tuition to federal funds, leaving the state to pay the remaining balance (American Federation of Teachers On Campus, 2015). New York State already had financial obligations in public higher education, and the New York Statewide Plan for Higher Education 2012-2020 predicted SUNY's more selective institutions will decrease remediation, causing an influx of enrollment and intended student financial aid for remediation at SUNY's community colleges (Boone, 2012). Policy makers looked for alternatives (Berl, 2014) to reduce the number of students in remediation and repeated courses and also to reserve government funds for students ready for (Mitchell, 2014) and performing well in college (American Federation of Teachers On Campus, 2015).

The National Education Longitudinal Study of 1988 compared two-year and non-selective, selective, and highly selective four-year institutions; the study reported that the percentage of students enrolled in a remedial course were 58, 31, 14, and two percent, respectively (Atwell, 2006). In the case of two-year colleges, low graduation rates predominantly reflected skill deficiencies students brought from high school, and did not result from students taking remedial courses (Atwell, 2006; Hagedorn, 1999). In 2011, 10.5 million students were enrolled in community colleges across the nation (Institute of Education Sciences, 2013) and the Nation's Report Card (2013) estimated that only 39 percent of twelfth graders were academically prepared for college-level mathematics. As a result, students lacked basic math skills to be confident to pursue and succeed in Science, Technology, Engineering, and Mathematics (STEM) coursework (Berl, 2014).

College students who remediated successfully in math were as effective in credential accomplishment and transfer as those who achieved college-level math without the need for remediation (Bettinger, 2005; Hagedorn, 1999). Bahr (2008) collected data pertaining to 85,894 freshmen students enrolled in 107 community colleges and Kowski (2014) collected data about 1,169 freshmen students in a community college; each found that the long-term academic outcomes of students who remediated successfully and achieved college-level math skill were similar with students who achieved college-level math skill without remediation. Bahr (2008) also found that 75 percent of community college freshmen in mathematics remediation failed to remediate. Berl (2014) found that among the 50 percent of community college students placed into remedial courses 30 percent remediated successfully and attempted a college-level math course. Repeatedly, evidence indicates that college remediation in mathematics is ineffective for students who had the greatest deficiencies and needed the greatest amount of support (Bahr, 2008; Kowski, 2014), making college remediation a possible contributor to high college-dropout rates (Mitchell, 2014).

Some college policies enforced seat-time to improve remediation but probably had the least effect on students' grades, and no formula was found to predict who in remediation would succeed or drop out (Berenson, 1992). When a standardized test score determined students' exit from remediation, many students did minimal work and did not complete assignments that *did not count* toward their final grades.

Instructors strove to reverse past failures and repair students' damaged perceptions of self-ability in mathematics (Hagedorn, 1999). Students' confidence to master concepts strengthens when students have successful experiences while learning mathematics. Also, greater confidence in learning mathematics encourages students to pursue career paths in which math is a fundamental skill (Hall, 2005).

Teaching strong study habits was an important part of successful remediation (Hagedorn, 1999) and students' beliefs and motivation were integral parts of mathematics achievement (Stevens, 2004). Bahr (2008) predicted that helping all students to remediate successfully in mathematics might reduce up to 65 percent of students who enroll in non-vocational math and do not complete a credential. Many instructors have suggested that student motivation is an important factor in successful mathematics remediation (George, 2010). George (2010) suggested implementing a grading policy that accounts for motivation, where required work would count towards greater effort and study for the exit examination.

For many years, community-college policy required all students, regardless of their major, to achieve at least intermediate algebra before graduation (Achieving the Dream, 2015; United States Department of Education, 1997). Colleges that stipulated remedial coursework were criticized by the public as lacking standards and wasting the time of students who did not remediate successfully towards a college education (Atwell, 2006). The Obama administration believed the biggest obstacle in higher education was remediation and hindered the number of Americans attaining postsecondary degrees (Mitchell, 2014).

A non-governmental reform movement for student success called Achieving the Dream (2015) advocated for community colleges and their student advisors to focus students on an alternative pathway with remediation in mathematics, designed to help students achieve goals, succeed in remediation, and earn their desired degree. This pathway allowed community college students to enroll in a college-level statistics course instead of the usually required one to two semesters of remediation in algebra (Fain, 2014). Proponents of pathways viewed this shift to college-level statistics coursework as a more practical and functional training in mathematics that could remove the obstacle of remediation, accelerate students' progress toward their degrees, or increase transfer rates of non-STEM majors. Therefore, reports of increased success rates in remediation most likely came from colleges that gave non-STEM majors this alternative remediation option (Achieving the Dream, 2015).

The comparison of scores from the Armed Services Vocational Aptitude Battery found that civilians who did not enroll in college and had high mathematical ability earned salaries that were 38 percent higher by the age of 30 and had extremely low unemployment rates than non-college-educated civilians with low mathematical ability (United States Department of Education, 1997). In 2010, the United States Department of Commerce reported that more than 66 percent of STEM workers had at least a college degree, STEM-worker salaries were 26 percent higher than those of non-STEM workers, and employees with STEM degrees had higher salaries whether or not they were employed in STEM careers. One in every18 workers in the United States had a STEM-related occupation, and STEM and non-STEM careers were projected to rise 17 and 9.8 percent, respectively, by 2018. Furthermore, successful and globally competitive non-STEM careers increasingly required more analytic-thinking and technological skills (Soergel, 2015).

College degrees do not guarantee a white-collar job, and the risk of underemployment is based on the student's chosen degree. During tough economic times, STEM fields, which require analytical thinking and technological savvy, were still in demand (Bardaro, 2013); in 2013, the 10 careers with the highest potential salaries among 103 different ones studied, were STEM-field careers (Pay Scale Human Capital, 2015). When researchers compared students' total cost of tuition with their annual salaries, institutions with a high number of STEM majors had the highest financial return of investment (ROI) whereas those with a high number of non-STEM majors had low or negative ROI (Pay Scale Human Capital, 2015).

A late-1990s report from the United States Department of Education found that a student's mathematical ability was a significant predictor of that student going on to a lucrative career (United States Department of Education, 1997). More recently, colleges have implemented web-based platforms into coursework to increase learning and resource management strategies in mathematics (Dragon, et al., 2013) in which teachers set student goals that increased mathematical achievement (Ruzek, Domina, Conley, Duncan, & Karabenick, 2015). Research suggests that teacher practices possibly alter students' motivation, learning strategies, and resource-management strategies and partially influenced student achievement. Although teachers differ in their ability to motivate students, they were found to be the primary contributors to their students' educational improvement (Ruzek et al., 2015). Similarly, investigations have shown that student support services and faculty-student interaction were needed most by non-traditional students in community colleges (American Federation of Teachers On Campus, 2015).

Therefore, the present study investigated how instructional processes in a blended learning environment affect community-college students' motivation, learning, resource-management strategies, and academic achievement. Findings of this study may enable students to successfully remediate in mathematics, continue onto college-level courses, earn a degree, and possibly pursue a STEM career.

Purpose of the Study

During a fifteen-week fall semester at a community college in New York, two sections of developmental algebra I students were highly accountable for online homework and received three formative assessments while two other sections of students had low accountability for online homework and received three summative assessments. This quantitative study examined: (a) three constructs of student motivation, which were control of learning beliefs, self-efficacy for learning and performance, and test anxiety, (b) a student learning-strategy construct, metacognitive self-regulation, (c) four student resource-management strategies, which were effort regulation, peer learning, help seeking, time and study environment management, and (d) academic achievement.

All participants answered the Motivated Strategies for Learning Questionnaire (MSLQ) at the beginning and end of the semester. The MSLQ measured participants': (a) control of learning beliefs, (b) self-efficacy for learning and performance, (c) test anxiety, (d) metacognitive self-regulation, (e) effort regulation, (f) peer learning, (g) help seeking, and (h) time and study environment management, while online homework and final examination grades measured participants' academic achievement.

This study reported MSLQ-scores at the beginning of the semester and, based on instructional process, compared final examination grades, analyzed relationships between variables, and how MSLQ-scores changed at the end of the semester. This study also examined how the variables predicted final examination grades and if they correctly classified students by their instructional experience.

Statement of the Problem

How did low and high student accountability in developmental algebra I affect student motivation and performance?

Research Questions

Research Question One

How did developmental algebra I students report their control of learning beliefs, self-efficacy for learning and performance, test anxiety, metacognitive self-regulation, effort regulation, peer learning, help seeking, and time and study environment management at the start of the semester?

Research Question Two

How did students' online homework and final examination grades in developmental algebra I differ based upon low and high accountability?

Research Question Three

How did students' control of learning beliefs, self-efficacy for learning and performance, test anxiety, metacognitive self-regulation, effort regulation, peer learning, help seeking, and time and study environment management change based on low and high accountability for developmental algebra I?

Research Question Four

What were the relationships between students' online homework, final examination and post-MSLQ scores for control of learning beliefs, self-efficacy for learning and performance, test anxiety, metacognitive self-regulation, effort regulation, peer learning, help seeking, and time and study environment management for developmental algebra I?

Research Question Five

How did students' control of learning beliefs, self-efficacy for learning and performance, test anxiety, metacognitive self-regulation, effort regulation, peer learning, help seeking, and time and study environment management scores at the end of the semester predict final examination grades for developmental algebra I and for the low- and high-accountability groups?

Research Question Six

Were developmental algebra I students correctly classified by low and high student accountability based upon their online, final examination, and post-MSLQ scores for control of learning beliefs, self-efficacy for learning and performance, test anxiety, metacognitive self-regulation, effort regulation, peer learning, help seeking, and time and study environment management?

Definition of Major Variables and Terms

For the purpose of this study, the following definitions of variables and terms were used.

Student Accountability

Student accountability is the student's responsibility to be aware of the learning standards, course criteria, and control the quality of their response to a given activity to produce an effective performance (Wiggins, 1983). As mentioned above, two sections of students had high accountability and two other sections had low accountability for online homework, for the purpose of this study. One class meeting in the computer lab and the average mean score for unit one homework counted as the first-unit examination grade. This ensured all students were online and acclimated to the online homework system. After the deadline for unit one, unit-one assignments and all future homework remained open for the remainder of the semester. Unit examination days were set semester target dates.

Low-accountability students received the second-, third-, and fourth-unit examinations on their scheduled day as a whole class regardless of their unit-one examination grades and online homework grades. High-accountability students had to achieve at least a 90 percent on each unit one and two homework assignment in order to receive the second unit examination. The same process applied for the third and fourth units. To inspire timeliness, instructors offered high-accountability students five extra unit examination points when each related assignment scored at least a 90 percent and ten extra unit examination points when each related assignment scored 100 percent by its target date. High-accountability students were not permitted to skip a unit examination. Instructors accounted improved unit one examination grades for the high accountability group. This study's data did not include unit one homework and unit examination grades.

Formative and Summative Assessment

In 2008, Popham defined formative assessment as "a planned process in which assessment elicited evidence of students' status is used by teachers to adjust their ongoing instructional procedures or by students to adjust their current learning tactics" (p. 6). For the purpose of this study, formative assessment determined future instructional steps to shrink learning gaps so students would be where they should be at the end of instruction. Hattie and Timperley (2007) detailed formative assessment as a three-question process concurrently posed and answered by teachers and students alike. Where am I going? establishes new goals as old goals are accomplished to promote uninterrupted learning; How am I going? investigates progress towards approaching the goal, and Where to next? determines strategies to facilitate better and deeper understandings.

Summative assessment is the evaluation of an instructional unit's outcome, at its conclusion, via comparison to a standard. For the purpose of this study, low-accountability students received summative assessments for three units and cumulative final examinations. High-accountability students received formative assessments for three unit examinations (Appendix A) as recommended by Stiggins (2007) and one summative assessment for the cumulative final examination. Instructional steps (Appendix B) and follow-up questions (Appendix C) provided instructors with guidelines for managing formative assessment in the classroom.

Homework

Instructors give students assignments to complete outside of the classroom. These assignments may review prior knowledge, practice new knowledge, or provide students with additional time to explore applications of knowledge to solve new problems. Homework enhances student learning and performance, enabling students to better comprehend concepts in a subject area (Astleitner, 2007; Cooper 2015). For the purpose of this study, homework was assigned to review prior knowledge and practice new knowledge. No applications of knowledge were used to solve new problems. All sections were given a similar number of questions per assignment. Based on the questions' level of difficulty, the online homework system estimated that students would need eight hours and 15 minutes to complete all homework assignments for the semester.

Motivation

Bandura (1988) defined motivation in an academic setting as follows:

> In cognitively-generated motivation, people motivate themselves and guide their actions anticipatorily through the exercise of forethought. They anticipate likely outcomes of prospective actions, they set goals for themselves and plan courses of action designed to realize valued futures.

> Future events cannot be causes of current motivation or action. However, by cognitive representation in the present, conceived future events are converted into current motivators and regulators of behavior. Forethought is translated into incentives and action through the aid of self-regulatory mechanisms (p. 37).

For the purpose of this study, motivation was defined by the following three variables.

Control of Learning Beliefs

As an expectancy component and measure of motivation from the MSLQ, this variable refers to a student's belief that he or she controls his or her own efforts and no external or unknown controls affect his or her performance or achievements. For the purpose of this study, students that held this belief would be more inclined to implement strategic and effective plans of study that produced wanted results (Pintrich, 1991).

Self-Efficacy for Learning and Performance

As an expectancy component and measure of motivation from the MSLQ, this variable concerns a student's appraisal of one's own cognitive capabilities to undertake and achieve a specific academic task or goal. For the purpose of this study, self-efficacy for learning and performance was the belief that a student's surroundings will respond to his or her actions and that the outcome is the result of his or her level of performance in the act, not the act itself (Bandura, 1986; Pintrich, Marx, & Boyle, 1993; Schunk & Hanson, 1985).

Test Anxiety

For the purpose of this study and as an affective component and measure of motivation from the MSLQ, "test anxiety is seen as the affective-cognitive experience during activity engagement that mediates the link between performance-avoidance goals and realistic and achievable outcomes" (Elliot & McGregor, 1999, p. 642).

Learning Strategies

Learning strategies refer to the activities students use to achieve learning. Examples of learning strategies are reading to others, transferring notes, consulting with peers, and requesting clarification from the instructor. The utilization of learning strategies permits students to progress actively through information and to affect their mastery of material and future academic achievement (Pintrich, Marx, & Boyle, 1993).

For the purpose of this study, learning strategies was defined by the following variable.

Metacognitive Self-Regulation

As a scale of learning strategies, metacognitive self-regulation is a cyclical process where students oversee the effectiveness of their learning strategies and react to this feedback with altered thoughts of self and self-behaviors (Zimmerman & Schunk, 1989). The MSLQ focuses on the awareness and control of cognition, whereby students actively plan, monitor, and regulate their learning by setting goals. For the purpose of this study, metacognitive self-regulation was the process students used to continuously analyze their tasks and constraints to alter and fine-tune their practices to reach their anticipated goal (Pintrich, 1991).

Resource Management Strategies

Students may modify their own time, effort, and study environment, with the help of their teachers and peers, to acclimate and alter their learning environment. When students practiced these strategies in an effective manner, they managed and controlled their learning environment to fit their needs and goals (Pintrich, 1999).

For the purpose of this study, resource management strategies was defined by the following four variables.

Effort Regulation

For the purpose of this study, effort regulation measured a student's continued use of learning strategies and commitment to completing goals even through difficulties, disinterest, and distractions (Pintrich, 1991).

Peer Learning

For the purpose of this study, peer learning measured a student's clarification of learning content through dialogue with classmates (Pintrich, 1991). As Topping (2005) explained:

> Peer learning can be defined as the acquisition of knowledge and skill through active helping and supporting among status equals or matched companions. It involves people from similar social groupings who are not professional teachers helping each other to learn and learning themselves by so doing (pg. 631).

Help Seeking

For the purpose of this study, help seeking measured a student's ability to identify either an instructor or peers to facilitate one's achievement when course content was incomprehensible (Pintrich, 1991).

Time and Study Environment Management

For the purpose of this study, time and study environment management measured a student's ability to outline and program one's own effective study time within a setting that is organized, quiet, and free of distractions (Pintrich, 1991).

Academic Achievement

Achievement is a task-oriented behavior that permits a student's performance to be assessed according to some internal or external source. The behavior may be a competition with others or some standard of excellence (Spence, 1983). For the purpose of this study, online homework and final examination grades at the end of the semester defined academic achievement.

Remediation in Developmental Mathematics

Coursework in developmental mathematics is a prerequisite for students who want to enroll in a college-level course but have deficiencies in mathematics. Remediation is the process of correcting a student's mathematical misunderstandings and enhancing his or her mathematical performance through non-credit-bearing college classes.

Blended Learning Environment

A blended learning environment is a hybrid of electronic and traditional educational models of teaching and learning. Students in this study interacted face-to-face with their peers and instructor, and received instructional websites, instructor-student email, and an online account for electronically-delivered help and homework.

Online Homework Management System

For this study, Pearson's My Math Lab was the internet platform used to deliver online homework. Online homework was an instructional tool that provided students with help, practice, and synchronous feedback. Students used this tool to reinforce and enhance their knowledge of course content. The management system allowed the instructor to view individual performances, set deadlines, and email students individually or as a class.

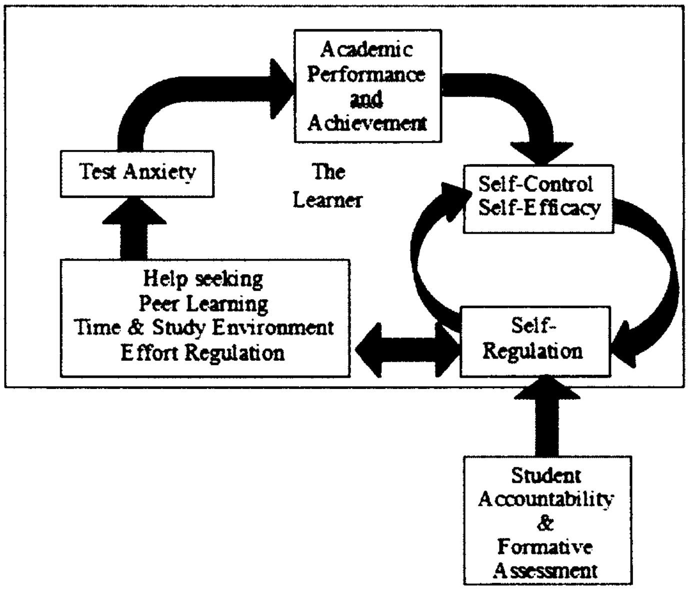
Conceptual Rationale

A thorough review of related literature set up the conceptual rationale for this study. The following paragraphs are a synthesis of research findings that describe the connections between this study's variables. Figure 1 provides an illustration of those connections.

Student self-efficacy and self-regulation are essential for academic success (Pintrich & De Groot, 1990) and students' control of learning beliefs intensifies effective plans for wanted results (Pintrich, 1991). Goals coupled with these motivational beliefs affected reactions and influenced regulation of effort, peer learning, help seeking, time and study environment management, and helped maintain students' self-regulation (Bandura, 1997; Butler, 1995; Schunk & Hanson, 1985).

Students' social goals and competence relate positively to students' self-regulatory strategies, academic scores, and acclimation to the learning environment (Ryan & Pintrich, 1997). Self-efficacy is dependent on past success and failure and is swayed by social influence and skill. Students' perceptions of self-efficacy predicted academic performance better than their amount of skill (Bandura, 1997) and those with high self-

Figure 1. Conceptual Rationale



efficacy were readily engaged and consistently applied more effort into tasks (Brophy, 1998). The social demands of peer learning increased the amount of effort and cognitive growth necessary for self-regulation, as students developed and experimented with a variety of behaviors and strategies to attain goals (Bandura, 1986, Brophy 1998). Research also indicated a possible cyclical influence between self-efficacy and self-regulation (Clancy, 2004).

Self-regulating skills improved goal-setting abilities, performance, and academic success (Clancy, 2004). When held accountable, students claimed ownership of and were responsible for their learning process (Clancy, 2004). Also, online-learning environments with tailored feedback offered a scaffold to learning and monitored students' self-regulation (Boekaerts & Corno, 2005).

Feedback on effort and ability facilitated rapid problem solving, self-efficacy, and achievement in children (Schunk, 1983) but teachers paid little attention to the effect of assessment scores on the students' current and future motivations (Wiggins, 1998). Although evidence indicated no relationship between levels of test anxiety and motivation (Hancock, 2001) formative feedback was shown to reduce test anxiety, enhanced learning, and increased scores on cumulative final examinations (Khanna, 2015).

When students used feedback well, they established specific goals and created suitable learning strategies that favorably influenced their performance and efficacy (Pintrich, 2003). Student cultures, demographics, personality traits, and classroom environments were not the only factors of academic achievement. Researchers suggested that teachers incorporate more non-traditional activities that support student volitional control (Pintrich, 2004) and attention towards goal setting, feedback use, and attributional responses (Boekaerts, 2005). Goldrick-Rab (2010) stated past findings were not conclusive enough to write a definitive guide to best pedagogical practices and recommended more intense and intentional research in community colleges to advance pedagogy and assess future instructional performance.

Significance of the Study

This study examined if student accountability and formative assessment enhanced student motivation, learning and resource-management strategies, and achievement in developmental mathematics in a suburban New York community college. This study was designed to identify a new combination of pedagogical practices that would help all students, regardless of their level of skill or ability, in pursuance of successful remediation in mathematics. The findings of this study might influence professional development within remedial mathematics and improve student retention rates.

Limitations and Delimitations

The study was limited to one fall semester with 111 participants from one community college. Since participants experienced student accountability and formative assessment simultaneously, results did not pinpoint if one instructional strategy had more impact than the other, nor if results were simply a reflection of the simultaneous use of both strategies. This investigation possibly formulated a practice of instruction that strengthened the motivation, learning strategies, and resource-management strategies of college freshmen who need remediation to master mathematical concepts, pursue college-level courses, and earn a college degree.

CHAPTER II

REVIEW OF RESEARCH LITERATURE

Introduction

This study investigated if student accountability and formative assessment effectively shaped a learning community enabled any student, regardless of their level of skill and ability, to remediate successfully in a developmental algebra I class at a community college. This study examined student responses from the pre- and post-Motivated Strategies for Learning Questionnaire (MSLQ), as well as student online-homework and final-examination grades. This chapter reviews the literature on: (a) student accountability, (b) formative assessment, (c) homework, (d) online homework, (e) control of learning of beliefs, (f) self-efficacy for learning and performance, (g) test anxiety, (h) metacognitive self-regulation, (i) effort regulation, (j) peer learning, (k) help seeking, and (l) time and study environment management.

Student Accountability

Clancy's (2004) two-year study included 54 sixth graders and 40 teachers from five different schools in a rural area of Indiana. Students were asked to enter and keep track of their own academic progress in individualized student data binders. Clancy measured student-accountability strategies with the most relatable variables from the MSLQ: task value, control of learning beliefs, self-regulation, effort regulation, and organization. Students who scored mid-range for accountability had the greatest gain and highest level in academic achievement when compared to those who scored high for accountability. Students who monitored their progress had greater self-efficacy, and (a) understood the need for or importance of a task, (b) had the commitment to complete the task, (c) believed their efforts resulted in positive outcomes, and (d) participated in the activity for the purpose of a challenge, interest, or mastery. Teacher surveys indicated that 47 percent of students monitored their own progress. Teachers noted that students who were accountable exerted more effort in difficult tasks and appeared more mindful of their own learning and academic progress. This study may have placed more emphasis on grades and positively influenced academic achievement.

Clancy (2004) incorporated an instructional method that emphasized student accountability and participation that is similar to Gillespie's (2009) business-oriented method called performance management (PM). Gillespie suggested instructors use his PM or "student as employee" method to develop productive learning environments. As he stated:

> The instructor and student collaborate to produce learning that will benefit customers (e.g., society, future employers). Although the instructor relies on the student to participate in learning outcomes and produce high-quality work, the student depends on the instructor for providing structure and creating a learning environment. The student is an active participant in the learning process as a means for his or her own development rather than simply producing learning. (p.555)

Gillespie went on to discuss how instructors consistently had course objectives and college upperclassmen applied just enough effort to pass the class and graduate. This lack of mastery stunted students' development in their major and possibly put limitations on future opportunities and potential employment. Students with the philosophy "Cs get degrees" set easy performance goals and were unresponsive to instructors' demands for higher quality work. The PM model required instructors to implement new styles of management that prompt students to focus on becoming active developers of their own goals, competence, and mastery. One method, learning portfolios, possibly prepared students for self-management in academia and future employment in performance-oriented organizations. A second method also used in the workforce, teacher-student appraisal interviews, guided students to regulate their effort and alter performance realistically to attain their set goals (Gillespie, 2009).

The philosophy of viewing college students as employees offered new insights into classroom learning. Leaders of college programming recommended degree goals that treat each course as fulfilling a segment of the major's overall goals. Quality programs identified any deficient student-support systems, while tasks and standards in student coursework were formulated to meet the needs of future employers (Gillespie, 2009).

Many college students perceived themselves as customers of the institution. Instructors viewed students as passive receivers of information and management instructions (Brady, 2013; Gillespie, 2009). Brady (2013) noted that, in reality, instructors and students each take on different roles at various points within the classroom setting. Brady viewed instructors as the actors of content and customers of assessment. Students who are cognizant of the variety of their roles were active learners. Brady considered students to be customers of course materials, classroom processes, and instructor feedback, actors in their classwork, projects, and assessment processes, and owners of the study process. Students did not have to be satisfied with their grades, but the instructor’s timely and fair feedback on their work was part of students’ customer satisfaction. The performance management model labeled its participants in public education as follows: the government and taxpayers were the owners, society was the customer, parents and future employers were the suppliers, faculty members were the actors who carried out the transformation, and students were the output or product produced (Brady, 2013).

Jones, Crandall, Vogler, and Robinson (2013) incorporated mobile ongoing course assessment (MOCA) as an instructional tool for an undergraduate educational psychology course. Participants who answered pre-lecture questions through MOCA increased their readiness and performance on unit exams. Results found MOCA increased student accountability and teacher efficiency with its paperless, instant student feedback.

Students who hold themselves accountable appear to have greater self-efficacy, effort, help seeking, time management, and academic achievement (Clancy, 2004). Gillespie's (2009) performance management model of instruction (incorporating student portfolios) helped students self-manage and possibly provided them with performance-related skills they would need as a future employee. As internet-based technology became more reliable, researchers incorporated more efficient instructional tools in the classroom and found increased student accountability and teacher-student performance (Jones, et al., 2013).

Formative Assessment

Assessments proven to be valid and reliable did not always hold a standard or empower a vision towards future success (Wiggins, 1998). Feedback without the setting of goals was ineffective and a performance without feedback hindered goals. These two factors, when acted together, altered levels of student motivation (Bandura & Cervone, 1983; Locke, Shaw, Saari, and Latham, 1981). When assessments were formative, they did not determine accountability, ranking, or competence, though they promoted learning, monitored and audited achievements, and improved performance (Black &Wiliam, 2004; Wiggins, 1998). The primary purpose of formative assessment was not to eliminate failure but rather to remedy continuing or habitual failure (Stiggins, 2007) and effectively reduce differences between a student's present comprehension and course objectives or goals. Effective feedback was information received, understood, and processed correctly by students and teachers jointly to promote learning. Student and teacher performance was reflected in student and teacher feedback (Hattie & Timperley, 2007). Formative assessment was not an instrument but a planned process that used evidence from an assessment to bring present levels of student achievement to reach possible mastery and curricular goals. Used this way, formative assessment determined whether teachers should alter upcoming instruction and whether students should alter current learning tactics (Popham, 2009).

Students who were secure in their capabilities were more likely to view their level of effort or lack of strategy as the cause of a situation, and would take steps to improve their strategy in order to attain success in the future (Bandura, 1986). However, poorly defined or undefined criteria made it difficult for students to self-assess their performance, which in turn led to poor student judgment. Deficiencies in instructor feedback likely caused students to inaccurately interpret the reasons for their performance. In effect, such deficiencies may have caused students' spending inappropriate levels of effort and time on inessential work (Rachal, 2007). Individual student and classroom formative assessment, such as peer- and self-assessment, has been integrated into the instructional process in order to clarify standards of learning and compare student work to those standards (Popham, 2009). Success criteria were defined by the Visible Learning Model as challenging, appropriate, and highly transparent goals that distinguished the current level of skill from desired learning outcomes; this method of feedback was most productive when undertaken jointly by both teacher and student (Hattie & Gan, 2011).

When an instructor's feedback acknowledged quality in a student's work, the student's perceived self-efficacy increased and the quality of their future performances improved. In contrast, feedback that only commented on the amount of work completed, without mention of its quality, had no effect on a student's performance or efficacy (Bandura, 1997). An effective assessor scored student progress longitudinally and did not base achievement from the total points earned on a simple examination, which itself mandated low expectations. Ideal instructor feedback reflected what was already known about a student's progress effectively provided guidance, and identified correct answers. Wiggins (1998) found that many methods of scoring and reporting scores did not consider their effects on student motivation and did not provide guidance on how students could improve their performance. Instructors who did not want to be perceived as insensitive avoided stating specific standards on student papers, fearing that negative feedback would suggest to students that they had an inability to learn (Black & Wiliam, 2004; Wiggins, 1998). As a result, students did not receive critiques that would help them to strategize and develop appropriate action plans for future performances. Students who did exceptionally well did not receive supplemental instruction, which could have heightened their performances and led to subsequent gains (Wiggins, 1998).

Those "who failed fell into losing streaks and hopelessness, [and] stopped trying" but proper assessment was able to turn their failure into success (Stiggins, 2007, p. 23). Hattie and Timperley (2007) stated that effective assessment-feeds are posed and answered concurrently by students and teachers alike, using three questions. The feed up question "Where am I going?" establishes new, applicable, and transparent goals, as previous goals are accomplished, in order to promote uninterrupted learning. The feedback question "How am I going?" investigates one's progress in approaching the goal. This progress is rated by a comparison to a standard that includes an examination grade. The feed forward question "Where to next?" empowers learning the most and helps determine strategies that facilitate better or more challenging learning processes, deeper understandings, and self-regulation. Feed up and feedback questions identify learning gaps, while the feed forward question provides learning remediation. Students unable to self-regulate paused their learning until they were instructed appropriate strategies (Hattie & Timperley, 2007).

Instructor feedback validated student self-efficacy and perceptions of progress, while students without feedback questioned how efficacious they were despite their progress (Schunk, 1983). If students believed that their increased level of effort or altered strategies would lead to better performance, then feedback indicating poor performance may not have decreased levels of self-efficacy (Bandura, 1997; Schunk, 1983). Performance feedback informed students of their progress towards goals, heightened their self-efficacy, and sustained their motivation (Hattie & Timperley, 2007; Schunk, 1983). When learners experienced failure, instructors who formatively assessed were most likely to get students back on track and restore student confidence for success (Stiggins, 2007).

Effective feedback was circular between teachers and students and most productive when students shared challenging goals of learning, learned how to self-assess, detected errors, sought help, and developed evaluation strategies for understanding lessons and mastering concepts (Hattie & Timperley, 2007). The nature and timing, as well as, how the student received, actively sought, and interpreted feedback were crucial to promoting student self-efficacy for learning and performance (Hattie & Timperley, 2007). Instructor motivation coupled with students' self-beliefs let students use negative feedback as a challenge and positive feedback as a means of enhancing their motivation (Black & Wiliam, 2009).

Popham (2009) described formative assessment as (a) being effective between disciplines when used via different approaches, (b) beneficial to the learning process, and (c) comprising four levels. In level one, the instructor collects evidence from student assessments and determines whether alterations are needed for current and future instruction. In level two, the instructor gives students their assessment-elicited evidence that will enable them to alter their learning strategies to suit the course materials. Level three changes the classroom environment to one where students and the instructor concurrently use assessment-based evidence to promote better learning. Level four involves increasing formative assessment on a broader scale: in schools, districts, regions, and the nation.

Students achieved less under conditions of high evaluative threat (Hancock, 2001). Appropriate instructional feedback benefited student learning; students who self-assessed and actively sought out feedback had the most learning opportunities (Hattie & Timperley, 2007). Research suggests scores or grades inhibited or had a damaging effect on task-orientation, as they suppressed formative feedback, and students self-regulated learning behaviors (Black & Wiliam, 2009; Hattie & Gan, 2011). Instruction on subject matter was paramount to feedback, as the latter, scaffolds acquired knowledge and performance. Instructional feedback was most progressive when errors or misconceptions were immediately addressed by instructors, students, and peers in a trusting classroom environment (Hattie & Gan, 2011). Khanna (2015) researched the effects of test-based learning on 140 college students in three sections of an introductory psychology course. Each section was randomly given a quiz condition. There were 44 students who received graded quizzes, 48 who received ungraded quizzes, and 48 who received no quizzes. She found that instructional feedback on ungraded quizzes decreased student anxiety and increased memory recall, attention to test questions, and cumulative, final-examination grades. Students learned and performed more effectively from instructional feedback on ungraded quizzes than students who received instructional feedback on graded quizzes or received no quizzes.

Black and Wiliam (2004) found that assessment methods used by teachers in secondary schools in the United Kingdom were ineffective for promoting learning. Grading practices, particularly in mathematics and science, emphasized competition and enhanced egos. Students focused on comparing their image and status to others rather than their own personal improvement. Quality and effective comments without a score had a significant effect on students' motivation and self-esteem. This communication was successful if students took acted on the feedback and instructors provided appropriate support. Black and Wiliam (2004) also stated that a model of good formative assessment should not be imposed, but rather supported in a way that allowed teachers to work smarter, not harder.

Adequate scoring systems allow students to use their assessment as a learning opportunity, comfortably self-assess, and alter their learning strategies. When students had the opportunity to improve test scores, they worked harder and learned more with adequate feedback. Teachers and students, alike, needed a system that measured empathetically but allowed instructors to gave adequate performance feedback in a timely manner (Wiggins, 1998). Inefficient students performed better when teachers elaborated concepts through instruction than when given feedback on concepts they understood poorly or misunderstood (Hattie & Timperley, 2007).

Formative assessment took place only when instructors used performance information to adapt their teaching methods to meet learners' needs. Students became more active and receptive when teachers were more active and attentive to the selection of questions, prompts, or activities for upcoming student work. This change in pedagogy invited all students to explore and develop ideas and take ownership of their learning to eliminate their own deficiencies (Black & Wiliam, 2004). Continuous and manageable amounts of descriptive feedback in a student-friendly language clarified achievements. Also, instructor remarks on goals still to be achieved were vital to heighten standards and student motivation (Stiggins, 2007; Wiggins, 1998). Feedback on their own performance, with explicit targets for achievement and examples of high-quality student work, helped students become self-assessors, increase their effort, and produce improved work (Hattie & Timperley, 2007; Stiggins, 2007).

Students often perceive feedback as the teacher's responsibility to provide information that helps students to evaluate how their performance is and has been and to decide what they should do next to achieve mastery of concepts. Teachers often assume that students are responsible only for receiving feedback and therefore overlook ways that they could learn from student questions or comments about instructor feedback (Hattie & Timperley, 2007). If comments on or scores of an assessment do not lead to an instructional learning plan then the assessment is summative (Black & Wiliam, 2004) and "cannot be regarded as high quality if it causes a student to give up" (Stiggins, 2007, p. 25). Not all students were successful during a formative process, but this high-quality assessment did help all students improve their learning and approach the set standards (Stiggins, 2007). Formative assessment was more effective with coursework that involved a sequential set of objectives designed to acquire mastery of the curriculum or goals (Popham, 2009). Formative assessment affected learning and performance more than summative assessment, but if a student lacked confidence or commitment, he or she did not implement an action plan from any form of feedback (Black & Wiliam, 2009).

Homework

Cooper (1989) examined nearly 120 empirical studies of effects and successful components of homework assignments. These studies revealed that 69 percent of high-school and 35 percent of junior-high-school students who were assigned homework outperformed students in non-homework classes on standardized tests and grades. Among elementary-school students, homework had no relation to achievement gains. Fifty studies found correlations between the amount of time students spent on homework and achievement data from statewide surveys or national assessments. Within these 50 studies, 43 positive and seven negative relations were reported between homework time and achievement. Correlation coefficients reported nearly no relationship for elementary-school students, a weak-positive relationship for middle-school students, and a moderate-positive relationship for high-school students between homework time and achievement.

The length of time a middle-school student spent on mathematics homework did not relate to the amount of student effort for the assignment (Trautwein & Köller, 2003). Two studies on the relation between homework and achievement were conducted in Germany. The first study included 2,216 seventh graders from 91 different classrooms in low-, moderate-, and advanced-tracked schools. Researchers found that lengthy times spent on homework did not predict greater achievement within classrooms. The second study included 483 eighth graders from 20 classes in advanced academic schools. This study reported a low to no relationship between student time spent on homework and achievement within and between classrooms. No positive correlation was found between homework time and effort; moreover, students with high achievement scores in mathematics were predicted to spend less time on assignments. Student cognitive ability was closely related to math achievement and high-achieving students needed less time for homework. Homework effort was positively related to achievement gains in test scores and grades for mathematics (Trautwein, 2007).

In 2003, the Program for International Student Assessment (PISA) had 5,200 students in the ninth, tenth, and eleventh grades from 221 schools throughout the United States complete a student and school questionnaire. This program assessed mathematics literacy and was administered by the National Center for Educational Statistics (NCES). Within this, nearly 81 percent of students reported they spent more than zero but less than or equal to five hours on homework for mathematics per week, with a mean of 3.69 hours (Kitsantas, Cheema, & Ware, 2011). Cooper (2015) reviewed research that studied relationships between time spent on homework and test scores for high-school students. He found that homework time was positively related to test scores when students spent at least one hour on homework per week. Test scores increased when students spent between one and ten hours per week on homework. In particular, twelfth grade students who spent seven to 12 hours on homework per week reported the most positive relationship between homework time and test scores. Students who spent 13 to 20 hours per week on homework reported a homework-time and test-score relationship more positive than students who reported 20 or more hours per week. One to six hours and 20 or more hours per week spent on homework showed the same relationship to test scores.

Fifty-eight freshmen enrolled in a college introductory mathematics course in New York City participated in the Self-Regulation of Learning Project (SRLP). The SRLP supported at-risk students in developing self-regulation. This project found that the number of hours per week spent on homework was positively related to mathematics homework completion. Of the students sampled, 64 percent reported studying for their mathematics course at home, 88 percent studied alone, and 11 percent studied with a friend. Students who spent the full amount of time, as intended, on homework were categorized as highly accurate. Highly accurate time goals related to student motivational beliefs, self-regulation, and performance. Actual time that students spent studying had a moderately positive correlation with math homework completion and self-regulation (Bembenutty, 2009).

Quality homework includes interesting, non-overwhelming activities that reinforce and cognitively challenge students beyond simple recall (Trautwein, 2007). In Germany, a study of 3,483 high school students in 155 classes documented homework quality in mathematics. Homework selection positively related with homework motivation and effort at student- and class-levels. Homework motivation positively predicted homework effort. Students' perceptions of homework challenge were mainly affected by the students' prior knowledge and cognitive abilities, and negatively related to beliefs in homework expectancy and effort. Students who perceived homework as cognitively demanding showed less effort in homework completion and lower achievement gains than students who were confident in their mathematical ability to complete the homework. Classes with high-quality selections of homework had increased mathematics achievement (Trautwein, 2007), and students in such classes learned more than their peers in other classes (Dettmers, Trautwein, Lüdtke, Kunter & Baumert, 2010).

Another study (Weems, 1998) was conducted with 108 freshmen, attending a four-year university in western Tennessee, enrolled in a developmental intermediate algebra course. In this study, all students received the same homework assignments. The students were divided into groups; homework was collected and graded from one group, but not from the other. Homework was organized in notebooks, collected on examination day, and counted as part of the final semester grade. There were more "A" grades in the collected group, while a higher percentage of withdrawals were recorded for the non-collected group. This study observed that many of the collected notebooks were unorganized, contained wrong content, and incomprehensible to grade. Collecting homework fostered instructor-student conversations, student participation and questions, and possibly increased student-instructor interactions. Checking homework completion had no positive relation with mathematics achievement (Weems, 1998) and did not significantly influence academic achievement (Trautwein, Köller, Schmitz, & Baumert, 2002).

Homework frequency has been shown to play a role in mathematics achievement. Frequency of homework was a positive predictor of mathematics achievement within middle-school classrooms (Trautwein et al., 2002; Trautwein, 2007). Frequency of students studying alone had moderate, positive relationships with homework completion and interest in course material. Frequency of setting homework completion goals positively related to a student's self-efficacy beliefs but did not enhance student performance in mathematics (Bembenutty, 2009).

Lengthy assignments in mathematics for seventh-grade students showed no significant effect on achievement gains (Cooper, 2015; Trautwein et al., 2002). A study reviewed by Cooper (2015) revealed no differences in mathematics achievement between assigning students a short, two, or three times as long version of a homework assignment.

Cates and Skinner (2000) found that interspersing brief and easy tasks with target problems may have improved academic skills and students' perceptions of independent work in mathematics. Five high-school remedial mathematics classes were simultaneously given three versions of assignments to complete. One assignment was shortest in length and provided only target problems. The second assignment added 20 percent and the third, 40 percent more problems. The two longer versions provided the same amount of target problems as the shortest version while adding easier or reinforcement tasks. Students did not reveal a notable difference among the three versions in target problem accuracy or fluency; they used more effort and time to complete the longer versions, and most likely preferred the longer versions for the way these reinforced prior knowledge.

Research has suggested that most students are cognitively challenged and inspired by personalized homework and that personalization widened differences in achievement in a class (Trautwein & Köller, 2003). Struggling students required additional time to complete non-individualized homework. On the class level, classes that incorporated personalized homework showed no differences in achievement from those in which all students received the same assignments (Cooper, 2015).

Researchers have noted that when used properly, homework is a tool that inspires independent learning (Singh, Granville, & Dika, 2002), self-regulatory skills, and self-efficacy (Bembenutty, 2009) in secondary-school students in mathematics. Homework has been associated with gains in achievement, but the amount of time spent on homework was not the decisive factor. Excessive time spent on homework may reflect problems in comprehension that may lead to unproductive effort (Trautwein, 2007) and decreased motivation (Dettmers et al., 2010; Trautwein, 2007). It may also reflect inefficient focus and study habits, or low cognitive ability (Dettmers et al., 2010).

Online Homework

In 2008, Kodippili and Senaratne investigated homework-delivery effects in a college algebra course. Two classes received traditional, paper-based instructor-graded homework while two other classes received interactive, online homework. Although there was no significant difference between the semester grades for paper-based and online semester grades for homework, the online (M=73.7, SD=17.4) mean was slightly greater than the paper-based (M=67.4, SD=17.6) mean for homework semester grade.

In 2010, Brewer and Becker investigated homework-delivery effects between students with low- and high-incoming mathematical skills. The study included 145 participants enrolled in college-level algebra at a large community college. Students who received online homework spent roughly the same amount of time on homework as those who received textbook homework, with each group spending 3.22 and 3.08 hours per week, respectively. Students with low-incoming mathematical skills were more likely to succeed in college algebra with online homework. Among students with low-incoming skills, those who were assigned online homework achieved a final examination score mean 10 points higher than those who were assigned textbook homework.

Burch and Kuo (2010) also investigated homework delivery in a college algebra course. In their study, three sections received traditional paper homework and two sections received online homework. The retention rate for sections that received online homework (86%) was much higher than the rate for sections that received traditional paper homework (58%). At the conclusion, of the study, 65 students received paper homework and 61 students received online homework. Students preferred online homework because of the quick interaction it allowed. Online homework provided immediate, graded solutions, multiple attempts, and tutorials that corrected misconceptions and offered a review of concepts. Students who received paper homework had one attempt to answer questions and waited long periods of time before receiving comments and grades from teachers. On unit examinations, students who received online homework performed significantly better than those who received paper homework. No significant difference was reported between the two groups' final examination score means.

According to these three studies (Kodippili & Senaratne, 2008; Brewer & Becker, 2010; Burch & Kuo, 2010), the use of online homework in a college algebra course had positive effects on achievement. Semester grades for homework were slightly higher (Kodippili & Senaratne, 2008); retention rates and unit examination scores were significantly greater (Burch & Kuo, 2010); students with low-incoming skills performed better on final examinations (Brewer & Becker, 2010).

Control of Learning Beliefs

Broadly defined, control beliefs are expected relations between an agent and its outcome (Skinner & Wellborn, 1990). In the theory of planned behavior, control beliefs are the basis for perceptions of behavioral control and determine an individual's motivation and goals. They may be based on past experiences and influenced by peers or other factors that increased or decreased the perceived difficulty of performing the behavior at hand (Ajzen & Driver, 1991).

Previous experiences of uncontrollability caused learned helplessness and a person's perception of future uncontrollability diminished one's future performances (Brown Jr. & Inouye, 1978). In contrast to control beliefs of learning, helplessness involves a perception of agents and outcomes as two mutually exclusive events. In the case of helplessness, students believed that positive behaviors would not produce favorable outcomes with regard to a perceived unfavorable or unreachable goal (Schunk, 1991).

Drawing on previous studies (Connell, 1985; Skinner, 1990), Pintrich (1991) described control of learning beliefs as a type of internal control with means-ends beliefs. In other words, control of learning beliefs resulted from performances that were perceived to have been achieved through a student's own efforts (Connell, 1985; Rotter, 1966). These efforts typed students as those who can identify and utilize suitable behaviors for a task that delivered the wanted result (Skinner & Wellborn, 1990). A reoccurrence of a particular behavior was an indication of the behavior's stability or reliability (Ajzen & Driver, 1991).

Research has found that, as they grow older, students are less likely to perceive their own success or failure as being due to other individuals (i.e. teachers and parents) or unknown factors (i.e. luck or by chance). Older or more mature students perceived themselves as the locus of the cause (Connell, 1985), and college students who believed they had internal control over their own learning performed better academically and processed and effectively used metacognitive strategies (Pintrich, 1989). Although few students illustrated learning as function of active, goal-seeking (Rossum, 1984), internal control beliefs were positively related to college students' performance on assignments and final grades (Pintrich, 1989).

Pintrich, Marx, and Boyle (1993a) reported that control beliefs increased if instructors spent more time on concepts that reviewed students' prior knowledge. Although this had a positive effect on control beliefs, it may have hindered a students' conceptual changes and taken control of course content. On the other hand, project-based learning possibly led to deeper levels of cognitive engagement, exercised a student's control over how to work, and determined what products they create.

Bereiter (1990) labeled students who perceived their learning as under their control as intentional learners. These students employed prior knowledge to assimilate new information and were more willing to tackle difficult tasks. They also put more effort into learning the underlying concept or intention of a task, rather than simply completing the task by rote memorization. The practices of intentional learners may lead to higher levels of cognitive thinking.

The more resources and opportunities students believed they possessed, the greater possibility of their perceived control over their own behavior. Students in this position anticipated fewer obstacles, while researchers viewed it as an underlying perceived behavioral control (Ajzen & Driver, 1991). In addition, a student's perception that the teacher cares, combined with persuasive communication from the teacher, positively related with academic effort and internal control beliefs (Ajzen & Driver, 1991; Wentzel, 1997). As described by students, a caring teacher demonstrated democratic interaction styles and was considerate towards student work, developed expectations for student behavior, and provided constructive feedback (Wentzel, 1997).

Furthermore, control beliefs were the most powerful predictors supporting behaviors that reduced personal health risks of patients (Kals & Montada, 2001) and instilled happiness and trust in the belief that goals may be accomplished. Haase, Poulin, and Heckhausen (2012) conducted a longitudinal study with 752 students from four high schools in California and 464 students from two high schools in Germany. Results were consistent among the six cohorts. They found that happiness motivated and predicted the time and effort an individual invested in overcoming difficulties when pursuing one's career and educational goals.

Self-efficacy for Learning and Performance

Self-efficacy has been shown to predict motivation and achievement for students at all levels of ability (Collins, 1982) and it has predicted performance better than expected outcomes (Bandura, 1986). Self-efficacy was defined as an agent belief within the group of perceived control beliefs (Pintrich et al., 1993a; Skinner, 1990) or, more precisely, as a person's "judgment of their capabilities to organize and execute courses of action required to attain designated types of performances" (Bandura, 1986, p. 391). Findings suggested that self-efficacy played a supportive role in relation to student cognitive engagement (Pintrich & De Groot, 1990) and positively influenced expectations regarding performance (Bandura, 1977; Brown Jr. & Inouye, 1978; Pintrich & De Groot, 1990).

Students appraised their own efficacy based upon past performances, experiences with or persuasions from others, and instincts (Bandura, 1997; Schunk, 1983). Levels of efficacy have changed between different domains and situations (Pintrich, Marx, & Boyle, 1993), and appraisals have affected a student's level of involvement and motivation (Bandura, 1986), and influenced persistence and achievement (Bandura, 1997; Schunk1983). Although past performances did not simply echo judgments of one's personal capabilities, research has found that past performance influenced self-efficacy for future achievements (Schunk, 1983; Schunk & Hanson, 1985) and mediated attempts to learn new and potentially difficult material (Pintrich et al., 1993a).

Goals set too low made students' capabilities indistinct (Schunk & Hanson, 1985). Performing difficult tasks built stronger self-efficacy than simpler ones (Bandura, 1986), and students seemed to lower their sense of efficacy for learning when they judged material as difficult or as exceeding their capabilities (Schunk & Hanson, 1985, 1989). In such cases, students were quick to lower their standards, level of effort, and attempts at skill acquisition (Bandura & Cervone, 1983; Schunk, 1983) or avoided the task in its entirety (Bandura, 1977, 1986).

Brown, Jr. and Inouye (1978) showed that students' judgments about their own self-efficacy established their regulation of effort. Self-doubters hesitated to use known skills and abandoned tasks if initial efforts were deemed unsuccessful (Bandura & Cervone,1983). Even if self-doubters believed that a particular course of action would produce certain outcomes, they would not act on that outcome belief because of apprehension about how to execute the necessary course of action. For example, students knew that a medical degree typically led to a high-paying job but avoided the prospect of a career in medicine because they doubted their ability to complete or pass necessary requirements. Self-doubters anticipated mediocrity in their performances and predicted negative outcomes (Bandura, 1986).

Research has shown that a student's belief of comprehending content or a task previously modeled by an instructor may have raised self-efficacy and task motivation and led to increased skill acquisition (Schunk, 1982, 1983, 1984; Schunk & Hanson, 1989). Regardless of the level of difficulty or expected outcome, participants with higher judgments of self-efficacy (a) coped, (b) persisted, (c) selected challenging and unsolvable tasks (Brown Jr. & Inouye, 1978), (d) showed skillful test performance (Schunk, 1985) and (e) had strong beliefs in their own ability. Additionally, students with high self-efficacy who were pleased with their prior accomplishments raised their ambitions for future goals. When information on performance was compared to an academic standard, higher student dissatisfaction students with their subpar performance caused students to increase their self-efficacy and effort for future goals. High levels of self-efficacy enabled students to withstand failures, push forward, and experience minimal stress in order to promote self-development (Bandura, 1986). Most diligent students held slightly overestimated their ability, were continuously motivated to develop and improve these capabilities, and took on sensible but challenging tasks (Bandura, 1986; Bandura & Cervone, 1983).

Schunk (1982) found that hard work toward success did not increase self-efficacy and was not the preferred process for achieving among children. His results showed that persistence negatively related to self-efficacy and skill (Schunk, 1983) even though children developed self-efficacy as they persisted longer and performed more skillfully at tasks (Schunk & Hanson, 1985).

Repeated success with a given behavior minimally affected students' judgments of their capabilities, and students eventually performed the behavior unconsciously and without the need for prior self-efficacy appraisal (Bandura, 1986). Students that held exceedingly high estimations of their actual ability were overly confident and resisted change in old concepts or acceptance of new concepts and ideas (Pintrich et al., 1993a). Students also portrayed higher perceptions of self-efficacy as they progressed in school (Zimmerman & Martinez-Pons, 1990). As students increased persistence and coping techniques they enhanced their beliefs of self-efficacy and achieved occasional success rather than constant failure (Bandura, 1997).

Children who perceived themselves as efficacious in mathematics were given difficult math problems to solve and were able to: (a) quickly discard faculty strategies,

(b) be more accurate, (c) rework prior failures, (d) solve more problems, and (e) display more positive attitudes towards mathematics than those who perceived themselves as having low self-efficacy in mathematics (Collins, 1982). In general, people with perceptions of high self-efficacy expected positive outcomes (Bandura, 1986) and increased their perseverance; improved self-efficacy increased the utilization of cognitive strategies in learning (Pintrich & De Groot, 1990). Gifted students, in particular, portrayed high mathematical efficacy and extremely high academic motivation and self-confidence (Zimmerman & Martinez-Pons, 1990). When research used tasks ordered by level of difficulty to measure the degree of student perseverance, results showed that some students persisted and completed all the tasks while others abandoned the list at varied points (Bandura, 1997).

Effects to efficacy varied when students met new sources of efficacy-altering information (Bandura, 1977). Schunk (1982) found that students' perceptions of efficacy could potentially be undermined in the presence of an instructor whom they perceived to have low credibility. Additionally, direct persuasion or pleads for improvement from the instructors only improved student effort and performance for brief durations (Schunk, 1982). Zimmerman and Martinez-Pons (1990) found that constructive feedback promoted student task involvement, skill development, and perceived self-efficacy. As students matured, peer feedback predominantly controlled their self-perceptions of competence, often causing a sharp drop during the junior high-school years. As students compared themselves to peers, they gained independence from their parents and increased their perceptions of academic self-efficacy, use of learning strategies, and task mastery.

Hall (2005) observed 185 college freshmen at a four-year institution. He administered the Mathematics Self-Efficacy Scale (MSES) to four sections of Calculus I and four sections of Intermediate Algebra students. Of the 185 participants, 80 were enrolled in Calculus I and 105 were enrolled in Intermediate Algebra. Hall found that Calculus I students had significantly higher levels of mathematics self-efficacy than Intermediate Algebra students. Mathematics self-efficacy increased as students successfully advanced through higher levels of mathematical coursework (Hall, 2005), and mathematics self-efficacy strongly related to mathematics achievement (Kitsantas et al., 2011).

Test Anxiety

Test anxiety has a cognitive and emotionality components. The cognitive component, labeled as worry, is a student's reaction of self-criticism or concern about the outcomes of the failure caused by their performance (Deffenbacher, 1980). Worry places doubt in one's capabilities, interferes with recall, diverts focus from task demands, and undermines performance on examinations (Deffenbacher, 1980; Pintrich & De Groot, 1990). The second component, emotionality, is a student's physiological reaction to the test situation, including increased heart rate, nausea, sweating, or feelings of panic (Cassady, 2002; Hembree, 1988).

Heightened emotionality has been shown to lead to physiological distractions that prevented students from keeping on task (Geen, 1980), cognitively obstructed recall in a testing situation (Pintrich & De Groot, 1990), and related negatively to performance (Cassady, 2002). Although emotionality may seem more harmful, emotionality affected test performance less negatively than worry and researchers have agreed that worry played a constant role and had the most negative effect in test performance (Cassady, 2002; Elliot & McGregor, 1999; Hembree, 1988).

Students with higher test anxiety: (a) possessed low self-esteem (Hembree, 1988), (b) made more serious errors on examinations (Birenbaum & Gutvirtz, 1993) (c) were significantly less motivated in classrooms they perceived as highly evaluative and authoritative (Hancock, 2001), (d) were "disadvantaged during high stakes testing" (Cassady, 2002, p. 288), (e) significantly underperformed those with lower levels of test anxiety on SAT and college-course examinations, and (f) earned lower final grades, in the range of C to D (Cassady, 2002).

Test anxiety negatively related to self-efficacy, effective study skills, and performance on exams and directly related to fears of negative evaluation and dislike of tests (Cassady, 2002; Hembree, 1988; Pintrich & De Groot, 1990). The negative relationship was found to be stronger for average students than those with low and high abilities (Hembree, 1988).

Researchers found differences in test anxiety depending upon students' years in school. Hembree (1988) found an absence or low levels of test anxiety in early grades but firm signs of test anxiety by the fifth grade. Rachal, Daigle, & Rachal (2007) reported that college freshmen, sophomores, and juniors shared the same level of test anxiety, and this level was significantly higher than that of seniors. Lynch (2006) found test anxiety in undergraduates who studied upper-level coursework negatively correlated to performance. Lynch (2006), Rachal, et al. (2007), and Schwarzer (1986) indicated that many college freshmen who considered themselves as having low-level test anxiety underestimated challenging evaluations, learned passively, reduced their study time, and performed poorly. It was recommended that these students, in particular, be given more challenging tasks, adequate feedback on their cognitive skills and abilities, and strategies to cope with their test anxiety (Rachal et al., 2007).

Test anxiety has been seen as a progression of failure, in that it either caused or was the result of poor examination performance (Covington, 1985). Depending on its level, test anxiety either debilitated or facilitated student performance. Poor performance caused test anxiety, while better performance reduced test anxiety (Elliot & McGregor, 1999; Hembree, 1988).

Despite the level of test anxiety, students were motivated to learn in classrooms they felt were less evaluative (Hancock, 2001). Khanna (2015) found that college students who received ungraded pop quizzes with feedback had less test anxiety and achieved more than students who did not receive pop quizzes, or who received graded quizzes.

Certain research has found atypical strategies within high- and low-test-anxiety students. Some students set low aspirations, were defensively prepared for potential failure, and managed their anxiety to motivate themselves. These *defensive pessimists* were not confident and relaxed but nervous and anxious, and their strategies used their anxiety productively. Known as a cognitive hoax, this type of strategy entails students denying responsibility for their failure and setting low expectations with high anxiety, and has been shown to significantly correlate with student performance. Although these students performed no differently than optimists, positive reinforcement by instructors obstructed the cognitive hoax strategy and significantly decreased performance (Norem, 1986).

Test anxiety is most likely a behavioral construct, since emotionality incites worry and only behavioral treatments have reduced both the cognitive and emotionality components. Performance incentives benefited children with all levels of test anxiety, while teacher instruction that boosted egos and tests that ordered items by difficulty helped the performance of low-test-anxiety students. Furthermore, tests given with low-stress instructions and few distractions helped the performance of high-test anxiety college students. When used in conjunction with a behavioral treatment, interventions such as study-skill management or training improved test anxiety, performance, and grade-point averages (Hembree, 1988).

Baghurst and Kelly (2014) had 531 university students participate in three different stress treatments. The treatments were stress management (n=124), cardiovascular fitness (n=131), and team-related physical activity (n=144), with a control group (n=132). Students who participated in the cardiovascular fitness segment of the study showed neutral or comparably adverse outcomes. Unlike team-related physical activity and stress-management courses, cardiovascular fitness presented no effect on test anxiety; moreover, levels of burn-out at the end of the semester significantly increased. This research may have ruled out cardiovascular fitness programs as an option for relieving stress and anxiety among college students, but it found that stress-management and team-related physical activity programs were beneficial to students. Those programs significantly decreased stress and test anxiety throughout the semester, and personal burn out at the end of the semester.

Liebert and Morris (1967), Birenbaum and Gutvirtz (1993), and Cassady (2002) have noted other possible causes of test anxiety. Lower ability has been identified as a possible third component, in addition to worry and emotionality, of test anxiety (Liebert & Morris, 1967). Students' egos appeared to be less threatened if the students blamed poor performance on test anxiety rather than low ability (Birenbaum & Gutvirtz, 1993); students cited test anxiety as a plausible excuse for poor performance (Cassady, 2002). Cassady (2002) also observed that worry possibly interfered with a student's preparation or completion of an exam, and noted that most test-anxiety research focuses only on the testing session. Intelligence, preparation, test-taking skills, and luck were other possible influences on a student's test performance.

Cassady (2002) eliminated procrastination as a variable of the test anxiety students experienced during and at the end of a semester. It was determined that the multitude of exams, pulling all-nighters, and cramming during finals week were most likely the causes of a decline in student performance at the end of a semester (Cassady, 2002).

A recent pilot study conducted with 1,133 high school students developed three different student profiles for test anxiety with high-stakes performance assessments. In this study, students with low test-anxiety scored the lowest on social derogation, physiological tenseness, and cognitive obstruction variables. The students with mid test anxiety scored between the low and high test anxiety students in all three variables and the third profile, high test-anxiety, scored the highest in all three variables. Furthermore, low-, mid-, and high-test anxiety students reported their highest component to be cognitive obstruction, physiological tenseness, and physiological tenseness, respectively, where physiological tenseness was significantly higher for students with high test-anxiety (von der Embse, Mata, Segool, & Scott, 2014).

Metacognitive Self-Regulation

Self-regulation, defined as the active participation of students in their own learning, turns motivation into a purpose to act with a process and an action plan. It was the school psychology of self-management that taught self-questioning and replaced negative with positive thoughts e.g., I can't do… becomes How can I do….? (Boekaerts & Corno, 2005; Pintrich, 2004; Zimmerman & Schunk, 1989). Information, provided by others and themselves, constructed meanings and established goals, expectations, strategies, self-encouragement, and awareness about outcomes (Boekaerts & Corno, 2005; Pintrich, 2004). Students who self-regulated "adapted regulatory behaviors such as seeking out help when confused, motivating oneself when struggling to learn, and being organized and prepared for class" (Cleary & Callan, 2014, p. 301).

Theorists of self-regulation learning assumed there was a certain goal, measure, or standard present for students to compare themselves to and determine continuance or alterations to their learning processes and goals. Students were capable of using standards to guide their learning and make decisions about their own goals (Boekaerts & Corno, 2005).

Increased self-regulation has been shown to cause persistence in academic work and was the best predictor of academic performance. Students who believed they were competent were more likely to self-regulate and exercise metacognitive strategies when tackling difficult or uninteresting academic tasks. The majority of effective learners self-regulated through greater organization and transformation (Butler, 1995; Zimmerman & Martinez-Pons, 1990) and knew when, why, and from whom to seek help (Pintrich, 2004; Zimmerman & Martinez-Pons, 1990). Self-regulators were motivated, engaged, interested in learning, and comprehended course content; they valued learning as something more than a means to a grade (Pintrich & De Groot, 1990). Moreover, sophisticated self-regulated learners aimed to minimize bad habits, such as avoiding help from others, self-handicapping, or procrastinating (Flowers, Bridges, & Moore, 2012).

Students do not self-regulate during all learning experiences (Zimmerman & Schunk, 1989), yet regulatory strategies are important and have most likely improved student performance on academic tasks (Pintrich & De Groot, 1990). Zimmerman & Martinez-Pons (1990) conducted a study in four public schools in New York City in which they observed 30 students each from the fifth, eighth, and eleventh grades in a gifted school and 30 students each from the fifth, eighth, eleventh grades in three non-selective schools. Their study found that high-achieving fifth-grade students significantly sought more teacher and parent assistance than their peers. Between fifth and eighth grades, high-achieving students significantly increased their record keeping, monitoring, goal setting, and planning significantly increased, and as they matured study habits relied more on self-recorded notes than on published text. Through high school, while their level of record keeping and monitoring remained constant, students' goal setting and planning declined. The authors also reported that as adolescents aged they relied significantly less on parental guidance and increasingly sought academic assistance (Zimmerman & Martinez-Pons, 1990).

A 2003 study found that, in mathematics, there was a strong positive relationship between self-regulated learning and achievement (Pape, Bell, & Yetkin, 2003). Similarly, Flowers, Bridges, and Moore (2012) found that teachers identified self-regulators as highly strategic and reported them as highly interested in activities and motivated during mathematics class.

In theory, self-regulation recognized the learner's biological, developmental, contextual, and individual difference constraints that may have stopped or interfered with an their efforts in regulation (Pintrich, 2004), and how they coped with failure. Some students focused on negative emotions and lacked the skills to integrate academic and non-academic goals when they were challenged with an overload of tasks, while others self-regulated and sought help with finding a solution. (Boekaerts & Corno, 2005).

Zimmerman and Schunk (1989) found that when students questioned their ability to learn, they became anxious, avoided learning situations, and developed convoluted rationalizations for possible failures; they were naturally defensive. Teachers saw defensiveness as the prime factor hindering or distorting self-perceptions and reduced it by encouraging students to become practical and know their self (Zimmerman & Schunk, 1989). Cognitive strategies without continued self-regulation had adverse effects on performance. Students used these cognitive strategies successfully when they understood the *what* and properly knew the *how* and *when* of the strategies (Pintrich & De Groot, 1990). Self-regulation possibly gave students volitional strategies that initiated learners to shift their focus from themselves to task involvement (Perry, 2002). Learners gained volitional control by regulating their cognition and motivation. The self-regulation process caused students to reflect on the qualities of attributes and emotions they experienced during their performance, with the intention of protecting their egos and cultivating motivation for future tasks (Pintrich, 2004).

Co-regulation was shown to be difficult between a teacher and 20 or more students, all with different learning needs and styles, during whole-class instruction (Meyer & Turner, 2002). Co-regulation helped lower-achieving students to observe the explanations and work habits of their higher-achieving peers. Teachers who modeled learning behaviors by thinking aloud and asking the why, when, where, and what questions, so that students could assimilate the strategies (Boekaerts & Corno, 2005).

Self-regulation had a variety of lurking variables (co-regulation, instructional strategies, work habits, and classroom-reward procedures) that made it impossible to formalize how self-regulation could be developed individually or in a classroom. The complex cognitive- and social-skill environment of a classroom which constantly and publicly demands learning performance, caused students to juggle their personal goals in cognitive growth with their emotional well-being. When students experienced difficulty, disinterest, or stress they alienated their cognitive-growth goals and focused on their well-being in order to appear smart, protect their egos, and avoid social harm. These coping strategies alleviated students' immediate concerns and restored positive feelings, but did not address the long-term consequences or influences they had on performance. When environmental cues gave warnings, students redirected their resources to stabilize their emotional well-being, rather than work on their firmly established goals (Boekaerts & Corno, 2005).

Bottom-up self-regulation is triggered by cues from the environment or task feedback and classroom reward structure; it helps establish work orientations and generate changes in work styles. In contrast, top-down self-regulation describes students who adopted goals that steered their learning process and mastery, and who strived from personal interest, value, expected satisfaction, and rewards (Boekaerts & Corno, 2005).

Effort Regulation

Low efficacy leads to low effort and skill attainment (Bandura, 1977), and studies have shown that the regulation of effort varied depending on students' judgments of self-efficacy (Bandura, 1997; Brown Jr. & Inouye, 1978; Schunk & Hanson, 1985). Students regulated effort effectively when they demonstrated concern about *how* to reach their goals. Accurate self-appraisals weighed facts from a variety of sources and informed courses of action, leading to significant improvement in personal results (Bandura, 1986; Schunk, 1983). Through these appraisals, students determined if difficult tasks were worth the amount of their time, effort, and resources (Bandura, 1986). Effort has been viewed as a measure of how active students are in their own learning. Most research has utilized effort as an outcome rather than a predictor and observed that effort levels varied among subject areas and tasks within each subject area (Rosen, Glennie, Dalton, Lennon, & Bozick, 2010).

Schunk (1982) found that although children preferred to attribute their achievement to high ability rather than high effort, a mixture of effort and ability was necessary for success. When discontentment blended with self-efficacy, a student heightened their effort to complete a challenge (Bandura & Cervone, 1983). Tasks of increasing difficulty led to a greater need for perseverant effort to produce and test altered forms of behavior (Bandura, 1986). Coping models credited effort, defined as terms of increased attention and hard work, for improved performance, whereas, mastery models highlighted high ability and low task difficulty. Remedial students considered the coping model to be more reliable than mastery (Schunk, 1987).

Schunk (1983) found that in the primary grades instructors' feedback on effort was a reliable measure of a student's hard work. However as students built skills, effort feedback most likely did not help if topics that instructors portrayed as easy were considered difficult by students, and vice versa. Therefore, as students' skills improved, feedback on their ability was more reliable in recognizing mastery and had a stronger impact on self-efficacy than feedback on effort.

Lynch (2006) administered the MSLQ to 264 freshmen and 237 upperclassmen enrolled in a mid-Atlantic, private university. Students' MSLQ scores revealed that self-efficacy and extrinsic goal orientation predicted freshmen course grades while scores for self-efficacy and effort predicted junior and senior course grades. Effort regulation was one of the three largest correlations for upper classmen. Upperclassmen most likely changed their behaviors, became more independent learners as their internal controls strengthened, adjusted intrinsic goals, and found that effort improved performance and achievement in more challenging, advanced coursework.

Rakes and Dunn (2010) found that effort regulation and motivation had a significant influence on procrastination. Motivation to learn, effort regulation, and student performance had negative relationships with procrastination. They noted that a supportive instructional style used (a) peer modeling, (b) created strict deadlines, (c) sequenced tasks appropriately, (d) encouraged autonomy and a perception of competence, (d) presented challenges that minimized distractions, (e) encouraged student effort regulation, and (f) reduced procrastination.

Peer Learning

Modeling, defined as an imitative behavior and characterized as a form of social comparison, informed children about their own capabilities and beliefs in achieving success. When children of the same faction observed others perform and master an activity, their self-efficacy and cognitive skill attainment were positively influenced more than those who observed only teacher models (Bandura, 1986, 1997; Schunk & Hanson, 1985; Schunk, Hanson, & Cox, 1987). Perceived similarity in ability and skill gave students a good source to judge their own self-efficacy (Schunk et al., 1987). The perception of similar ability also engaged children's reasoning skills, leading to deep conceptual change (Phelps & Damon, 1989). Modeled displays relayed to learners that they, too, were capable of learning and fostered the belief that if they followed the same sequence of steps they would also be successful (Schunk 1995). Peer learning involved the acquisition of knowledge and skill through active help and support among equals or matched companions (Topping, 2005).

Schunk (1989) found that students who observed themselves on videotape successfully solving mathematical problems had heightened levels of self-efficacy; they also increased achievement behaviors to attain cognitive skills. Whether it was a recording of themselves or peers, videotaped model treatments were beneficial to self-efficacy for learning and performance in problem solving with fractions. Moreover, no differences in self-efficacy were found between children who were videotaped but did not view their tapes, and those who were not taped.

Students who particularly doubted their capabilities may have seen the coping model's performance as similar to their own when they learn a new task (Schunk &

Hanson, 1985). Both mastery and coping models were shown to support self-efficacy (Schunk, 1995; Schunk et al., 1987). Coping models dealt with difficult tasks and gradually improved performances through diligent work and strategy application, while mastery models performed flawlessly from the outset (Schunk et al., 1987).

Phelps and Damon (1989) discussed how peer learning "positioned children toward discovery and reflection rather than practice and implementation" (p.644). This technique facilitated deep learning and insight of basic concepts that were frequently resisted when presented by teacher-modeled instruction. Peer learning was helpful for tasks that dealt with ratio, proportion, and spatial perspectives, but had less or no effect on rote activities or copying skills that relied on formulas and procedures such as addition and multiplication. Although the efficacy of peer collaboration varied by task, children involved in peer learning showed greater gains in learning tasks that required problem-solving skills than those who did not experience peer learning. Peer collaboration helped students grasp and bring new ideas to consciousness and had a significantly improved, long-term effect on a child's future capacity to attempt and solve math and science problems (Phelps & Damon, 1989).

Peer learning is learning by teaching. Students partnered with others of similar capabilities and cognitive skill were appropriately stimulated and challenged cognitively in classroom activities. This method of pairing in peer learning aims for one partner to have equal levels of ability, or for one to have slightly superior mastery; the pair therefore works collectively on activities toward a shared and deeper understanding of the curriculum. Peer learning increased self-esteem when same-ability participants switched roles, allowing students the opportunity to become the "helper". Peer learning was more effective when organized with (a) problems within the local context, (b) clarified objectives, (c) helping techniques, (d) assigned helpers, (e) given material or resources, (f) a monitored process, (g) student self- or peer-assessments, and (h) student feedback on the peer-learning experience (Topping, 2005).

Peer assessments demanded more cognitive effort from learners to assess the product and provide their peers with formative and qualitative feedback. Peer learning built trusting, non-authoritative relationships that promoted the admission of errors or inaccuracies in thought or activity. This process increased the amount and immediacy of feedback that motivated students to keep on task. It also encouraged personal and social development, used individuals' strengths, and encouraged students to be active participants in learning. Peer learning fostered a cultural norm of helping and caring, and contributed to a sense of cohesiveness within the classroom community. It demanded that students possess or develop the communication skills to explain, question, and summarize thoughts into language. Peer learning was a skilled routine in which partners added and extended each other's capabilities with increased opportunities to (a) modify and restructure new perceptions, (b) think through and craft their own arguments, (c) observe others' problem-solving practices, (d) listen and respond to ideas that challenge their own, (e) coach and receive help from more advanced peers, and (f) improve skills and knowledge through teaching others (Micari & Drane, 2011; Topping, 2005).

College students participated in and enjoyed the peer-learning process when they felt confident and comfortable in their group roles. Although student academic preparation in higher education had no effect on how intimidated students were by peers, some students may have perceived peer learning as a threat or an unhealthy function that caused academic anxiety, due to the requirement to perform publicly in front of others with similar abilities (Micari & Pazos, 2014; Micari & Drane, 2011). However, when instructors shared experiences of student academic struggles and errors of thinking, feedback about the self as a person and levels of concern for social comparison lessened (Hattie & Timperley, 2007; Micari & Pazos, 2014).

Phelps and Damon (1989) studied instances of the tutor-tutee experience where an older child acted as the tutor and expert on the content. They compared this experience to peer learning and found that the latter engaged a higher order of reasoning skills, which led to developmental shifts in conceptual insight. Peer learning was not classified as mentoring or tutoring, but cooperative learning with a mutual pursuit of a specific, shared goal or outcome (Topping, 2005).

Daneshamooz & Alamolhodaei (2012) administered the Mathematics Anxiety Rating Scale (MARS), Academic Hardiness Scale (AHS), and two mathematics examinations to 263 college participants from nine classes in three different universities in Khorasan Razavi, Iran. They reported that students with high math anxiety performed better when they worked cooperatively on a mathematical task (Daneshamooz & Alamolhodaei 2012).. Even though less-confident or less-prepared students opposed social-comparison, small-grouped settings with peer learning techniques most likely reduced academic anxiety (Micari & Pazos, 2014).

Help Seeking

Research has shown that a child's attitude and levels of belief and motivation were affected by his or her classroom structure, as well as by the communication skills of the teacher and classmates. The classroom rules and climate regulated (a) how approachable or friendly student-teacher and student-classmates interactions were (Newman, 1990), (b) students' questions on content, and (c) students' level of engagement in mathematical tasks (Ryan & Pintrich, 1997). Research suggested teaching practices that encouraged students to use self-referenced standards possibly fostered positive feelings about seeking help (Ryan & Pintrich, 1997). Help seeking, as a social interaction, influenced academic achievement in adolescents (Ryan & Pintrich, 1997) and was considered an important strategy and social aspect of a child's learning (Pintrich, 2004), even though most students do not seek help (Black & Wiliam, 2009).

Two different situations described instrumental and non-instrumental help seeking. Instrumental help seeking has been defined as a student's adequate effort to work independently to solve problems and use the help-seeking process for adaptive and mastery learning (Ames & Archer, 1988; Nelson, 1985). Non-instrumental help-seeking students worked dependently and were guided by simple task completion (Newman, 1990). Bereiter (1990) labeled non-instrumental students as non-intentional learners who perceived an activity as a job, not as a learning opportunity. Non-intentional learners would also ask for assignment modifications for difficult tasks.

Students who believed they were competent were more likely to seek academic help if needed and perceived seeking help as less taxing to their self-esteem (Newman, 1990). It appeared that effective students knew when, why, and whom to seek help from (Pintrich & De Groot, 1990), and students' perceptions of cognitive competence were positively related to help seeking. Students with a greater desire to gain understanding, insight, or skill, understood the benefits of help seeking and effectively asked for hints or clarification from either an example or similar problem. Those who felt academic assistance was beneficial were more likely to seek and less likely to avoid help (Ryan & Pintrich, 1997). Additionally, high-performance expectations or interest in mastery learning were possible causes of frequent and appropriate support from computer-assisted instructional software (Beal, Qu, & Lee, 2008) and the teacher (Karabenick & Berger, 2013).

Motivational factors, such as perceived competence and intrinsic orientation, possibly caused chain reaction and influenced attitudes that, in turn, affected help seeking behaviors. It was found that attitudes had the greatest direct influence on a child's likelihood to seek academic assistance during the third, fifth, and seventh grades. Only positive attitudes were influential to younger children, while positive and negative attitudes were highly influential and of greatest importance in the seventh grade. Attitudes about self-image did not inhibit a younger child's willingness to seek help as the way they did with an adolescent. When students foresaw that help seeking was beneficial, they were not concerned about how seeking help affected their self-image. Findings showed no differentiation in children's purpose to seek help according to grade (Newman, 1990).

Children in grades three, five, and seven were motivated to seek help but only seventh graders seemed to be motivated to solve problems on their own; they sought help only when needed for purposes of long-term learning and independent mastery. A grade-related difference in the correlations between independent mastery and help-seeking intentions supported the conjecture that children, as they mature, progressed toward autonomy and self-reliance (Newman, 1990). Furthermore, Newman (1990) purports that seventh graders who displayed greater preferences for challenge exhibited a greater likelihood to strive as independent learners.

If students experienced decreased cognitive competence, they perceived an increased threat from others regarding help seeking. Students who did their math work to simply comply saw themselves as incompetent at math, doubted their cognitive and social skills, and were more likely to (a) avoid seeking help, (b) feel threatened when asking their peers for help, and (c) feel susceptible to worries and concerns about others' negative judgments and reactions if they asked for help. A lack of help seeking most likely inhibited long-term learning and performance (Ryan & Pintrich, 1997).

Therefore, adolescents who were at ease and competent in relating to others were less likely to feel threatened when asking for help from peers and less likely to avoid seeking help for their math work. Also, students experienced their perceptions between peer- and teacher-influenced threats differently. The connection between threats from peers and perceptions of social competence provided evidence to support that help seeking was a learning strategy and social interaction. As a result, students' perceptions of their ability to relate to others influenced their feeling about how their peers would perceive them when they asked for help. Adolescents who were susceptible to perceptions of threat were inhibited to seek help with their studies when needed. Students, who perceived help seeking as a threatening resource, felt vulnerable and questioned their cognitive and social competence (Ryan & Pintrich, 1997). Ruzek, Domina, Conley, Duncan, and Karabenick (2015) agreed with the earlier finding and observed that student motivation in mathematics steeply declined in secondary school. They attributed this result to the possibly heightened awareness of social comparison as adolescents potentially alter their focus from academic achievement to performance for their peers.

Beal et al. (2008) observed 90 participants in four geometry classes from three different urban high schools in California. His study utilized software that identified inappropriate guessing and appropriate student use of multimedia resources to solve problems in high school geometry. Low-, average-, and high-achieving students engaged in appropriate help seeking behavior 27 percent, 15 percent, and 21 percent of the time, respectively. These percentages showed low-achieving students were possibly more willing to seek academic assistance from a computer than a teacher. Data analysis revealed that math achievement was not related to guessing rates but was related significantly to students' appropriate use of help-seeking resources. Additionally, Beal et al. (2008) found a negative relation between self-concept in mathematics and inappropriate guessing.

Some students did not seek help at all, either because they lacked metacognitive skills or were unaware of their need for help (Ryan, Pintrich , & Midgley , 2001), or may not have perceived the feedback as valuable. Students with high-mastery avoidance goals often requested more specific help to avoid any misunderstandings, and did not effectively apply anticipative reasoning—a strategy in which a student tries to anticipate the next step of the example before looking it up (Renkl & Atkinson, 2003).

Variations of help seeking and their relationships to academic achievement were also studied using an online tutoring system that provided help with problems at a college student's request. Results found that students with mastery goals may have invested the necessary mental effort and utilized the system more appropriately to learn than students with performance goals (Vaessen, 2014).

Classroom structure and interactions, attitudes, motivation, perceived competence, intrinsic orientation, levels of belief, communication skills (Newman, 1990), awareness (Ryan, Pintrich, & Midgley, 2001), student goals, and adequate teacher feedback (Renkl & Atkinson, 2003) all directly affected students' feelings about seeking help and their engagement in mathematical tasks (Ryan & Pintrich, 1997). As a social and influential part of learning (Pintrich, 2004) and achievement, adolescents who are susceptible to perceptions of threat negatively affected their help seeking behaviors (Ryan & Pintrich, 1997) and motivation in mathematics (Ruzek et al, 2015).

Independent learners were instrumental help seekers (Ames & Archer, 1988; Nelson, 1985), while those who were dependent were either non-instrumental help seekers (Newman, 1990) or labeled as non-intentional learners (Bereiter, 1990). Students with beliefs in self-competence, high-performance expectations, or interest in mastery learning were not worried about their self-esteem (Newman, 1990), had effective help seeking strategies (Pintrich & De Groot, 1990), knew the benefits of help, were more likely to seek help (Ryan & Pintrich, 1997) and used computer (Beal et al., 2008; Vassen, 2014) and teacher (Karabenick & Berger, 2013) resources appropriately. Appropriate help-seeking behaviors significantly related to achievement in mathematics, and low-achieving students were possibly more willing to seek academic assistance from a computer than a teacher (Beal, Qu, & Lee, 2008).

Time and Study Environment Management

Hoeksema (1995) defined two different causes that affect a student's strategy of learning. When students were interested in the meaning of a task and wanted to satisfy their curiosity, a deep-learning strategy benefited their performance. This strategy included longer and more continuous study hours to produce detailed notes from the textbook or class website. Cramming was not part of deep learning. Conversely, a surface-learning strategy described a method of students who were only interested in making the grade and not concerned with making connections to other concepts or with mastering content. These students, therefore, spent time memorizing facts and only understood disjointed pieces of information. Purdie and Hattie (1999) found students who implemented surface-oriented learning strategies direly needed a study skills program.

Vermunt (1998) described the differences in student ability and how they affected learning strategies. Students who were unable to process and cope with the volume of material had undirected learning strategies or difficulties separating the essential from the inessential in course content. Purdie and Hattie (1999) claimed more time devoted to studying did not increase student achievement. Rather, putting effort into appropriate learning strategies that elaborated and yielded deeper understandings of concepts increased achievement.

Sankaran (2001) observed 116 undergraduates in an accelerated, four-week business computer course that gave students a choice of instructional delivery. Seventy participants selected lectures and 46 participants selected web-based instruction, and all responded to the Learning Strategy and Motivation Survey. Results stated that deep-, surface-, and undirected-learning strategies had the same effects in lecture and web-based settings. Students who used the deep-learning strategies performed equivalently to those who used surface-learning strategies, while students who used undirected-learning strategies negatively affected their performance. High motivation associated with deep-learning strategies and better performance in web-based and lectured instruction methods. Low motivation associated with undirected-learning strategies.

When Lynch (2006) administered the MSLQ to students enrolled in a mid-Atlantic, private university, the time and study environment scale was one of the three largest correlations for upperclassmen taking upper-level college courses.

Bembenutty (2009) found that effective time management for college freshmen in an introductory mathematics course related to the degree of learning and achievement. High levels of satisfaction with homework completion related to final exam performance and high self-efficacy beliefs, and students remained motivated and continued their efforts to learn.

Summary

Studies indicated that self-efficacy, effort, and self-regulation were better predictors of academic performance than the actual skills and abilities of students. Moreover, students with high levels of control of learning beliefs, self-efficacy, metacognitive self-regulation, and low-level test anxiety exhibited higher levels of motivation and achievement in mathematics. Supportive styles of instruction encouraged student self-efficacy and effort regulation, and reduced procrastination. Proper mathematics homework, assigned frequently, increased achievement, effective effort, and study time.

The literature reveals that student accountability and formative assessment individually promoted active learning environments, student motivation, and learning and resource-management strategies. Management models for performance defined many roles the instructor and student take on during the learning process. Students who were cognizant of their multiple roles in the classroom held themselves accountable and took active roles in their own education. They also exhibited greater self-efficacy, self-regulation, effort, help seeking, time-management skills, and academic achievement. Instructors who utilized formative assessment promoted student motivation and self-esteem. This process of assessment helped students learn how to self-assess, regulate their effort, and it improved collaborative work with peers.

CHAPTER III

RESEARCH DESIGN AND METHODOLOGY

Introduction

This quantitative study examined how student accountability and formative assessment affected students' control of learning beliefs, self-efficacy for learning and performance, test anxiety, metacognitive self-regulation, effort regulation, peer learning, help seeking, time and study environment management, and achievement in developmental algebra I in a community college in suburban New York.

During a fifteen-week developmental algebra I course, two sections with 30 students each were held highly accountable for online homework and received three formative assessments (see Appendix A), while two other sections with 30 students each were held to low accountability for online homework and received three summative assessments. A researcher and volunteer instructor individually conducted one section with high accountability and formative assessment and the other with low accountability and summative assessment. Instructional steps (Appendix B) and follow-up questions (Appendix C) provided instructors with guidance on how to manage formative assessment in the classroom.

Instructors sequenced topics differently and had similar quantities of problems assigned for the four units of homework. All students received the same course content, classroom time, online homework system, and cumulative final examination.

One class meeting was conducted in the computer lab and the average mean score for unit-one homework counted as the first-unit examination grade. This ensured that all students were online and acclimated to the online homework system. After the deadline for unit one, unit-one assignments and all future homework remained open for the remainder of the semester. Unit examination days were set semester target dates. Low-accountability students received the second-, third, and fourth-unit examinations on their scheduled dates as a whole class, regardless of their unit-one examination grade and online-homework grades.

High-accountability students had to achieve a score of at least 90 percent on each unit-one and -two homework assignment in order to receive the second-unit examination. Students had to score at least 90 percent on each unit-three homework assignment to receive the third-unit examination. The same process applied for the fourth unit. To inspire timeliness, instructors offered high-accountability students five extra unit-examination points when they scored at least 90 percent on each related assignment, and ten extra unit-examination points when they scored 100 percent on each related assignment and completed it by its target date. Instructors also accounted for improved unit-one examination grades and did not allow students to skip a unit examination. A student received a formative assessment from their instructor after he or she completed a unit's assignments and examination. This study's data did not include unit-one homework and unit-examination grades.

All participants answered the Motivated Strategies for Learning Questionnaire (MSLQ) at the beginning and end of the semester. The constructs (a) control of learning beliefs, (b) self-efficacy for learning and performance, and (c) test anxiety measured motivation; (d) metacognitive self-regulation measured learning strategy; (e) effort regulation, (f) peer learning, (g) help seeking, and (h) time and study environment management measured resource-management strategies; final-examination grades measured achievement. Student responses and grades were investigated to find any differences within and between groups of low and high student accountability.

This chapter describes the MSLQ, how data were collected, and how participants were selected for this study to answer the following research questions.

Research Questions

Research Question One

How did developmental algebra I students report their control of learning beliefs, self-efficacy for learning and performance, test anxiety, metacognitive self-regulation, effort regulation, peer learning, help seeking, and time and study environment management at the start of the semester?

Research Question Two

How did students' online homework and final examination grades in developmental algebra I differ based upon low and high accountability?

Research Question Three

How did students' control of learning beliefs, self-efficacy for learning and performance, test anxiety, metacognitive self-regulation, effort regulation, peer learning, help seeking, and time and study environment management change based on low and high accountability for developmental algebra I?

Research Question Four

What were the relationships between students' online-homework, final-examination and post-MSLQ scores for control of learning beliefs, self-efficacy for learning and performance, test anxiety, metacognitive self-regulation, effort regulation, peer learning, help seeking, and time and study environment management for developmental algebra I?

Research Question Five

How did students' control of learning beliefs, self-efficacy for learning and performance, test anxiety, metacognitive self-regulation, effort regulation, peer learning, help seeking, and time and study environment management scores at the end of the semester predict final-examination grades for developmental algebra I and for the low- and high-accountability groups?

Research Question Six

Were developmental algebra I students correctly classified by low and high student accountability based upon their online-homework, final-examination, and post-MSLQ scores which were: control of learning beliefs, self-efficacy for learning and performance, test anxiety, metacognitive self-regulation, effort regulation, peer learning, help seeking, and time and study environment management?

Selection of Participants

Developmental algebra I is a requirement for students who scored within a certain range of points on the college mathematics placement examination. Scores below this range place students into a Basics Mathematics course and scores above this range place students into college-level mathematics.

Students registered into one these four sections of developmental algebra I, based upon their need for remediation and schedule availability. The sample included students from these four sections who agreed to participate and complete the MSLQ.

Setting of Participants

The study was conducted in a suburban, New York community college staffed with 22 percent full-time faculty. College student enrollment included 60 percent full-time, 54 percent female, and 75 percent were between 18 and 24 years old. Sixty-three percent were White, seven percent were Black, and 13 percent were Hispanic.

Instrumentation

This study's survey instrument was designed for college students to self-report their motivational orientations and utilization of various learning strategies in a college course. The 1991 version of the MSLQ has 81 items for 15 scales that may be used individually or as a whole (Pintrich, 1991). The present study adapted 48 items for the domain of mathematics to analyze three variables in motivation, one variable in learning strategies, and four variables in resource-management strategies.

The survey instrument (Appendix D) consisted of two parts. Part one collected participants' demographic data, such as gender, high school graduation date, and number of courses attended during the study. Part two contained four questions to measure control of learning beliefs, eight questions to measure self-efficacy for learning and performance, five questions to measure test anxiety, 12 questions to measure metacognitive self-regulation, four questions to measure effort regulation, three questions to measure peer learning, four questions to measure help seeking, and eight questions to measure time and study environment management. Participants answered each question based on a seven-point Likert scale, where (1) = not at all true of me and (7) = very true of me.

Validity

A study of 380 Midwestern college students, of whom 356 were enrolled at a four-year university concluded that the survey items had predictive validity. The variables correlated with the final course grades of college students in 14 subject areas and five disciplines (see Table 3.1). Control of learning beliefs (r=.13) and self-efficacy for learning and performance (r=.41) had significant correlations with final course grades. Students who exhibited metacognitive self-regulation (r=.30), managed their effort (r=.32), and tended to their own time and study environment (r=.28) were likely to receive higher final grades. Peer learning (r=-.06) and help seeking (r=.02) were not

Table 3.1
Items included in survey

Variables	Items	Number of Items	Raw Score Range	Alpha Coefficient	r with final course grades
Control of Learning Beliefs	1, 6, 10, 14	4	4-28	.68	.13
Self-Efficacy for Learning and Performance	3, 4, 7, 9, 12, 13, 16, 17	8	8-56	.93	.41
Test Anxiety	2, 5, 8, 11, 15	5	5-35	.80	-.27
Metacognitive Self- Regulation	18, 21, 24, 26, 31, 32, 33, 34, 37, 44, 46, 47	12	12-84	.79	.30
Effort Regulation	22, 28, 36, 42	4	4-28	.69	.32
Peer Learning	19, 27, 29	3	3-21	.76	-.06
Help Seeking	23, 35, 39, 43	4	4-28	.52	.02
Time and Study Environment Management	20, 25, 30, 38, 40, 41, 45, 48	8	8-56	.76	.28

significantly related to final grades, and students with test anxiety (r=-.27) were more likely to receive a lower final grade. In all, these eight scales were typically related to academic performance (Pintrich, Smith, Garcia, & McKeachie, 1993b).

Reliability

The variables control of learning beliefs, self-efficacy for learning and performance, test anxiety, metacognitive self-regulation, effort regulation, peer learning, help seeking, time and study environment management were tested for reliability. The Cronbach alpha coefficients were .68, .93, .80, .79, .69, .76, .52, and .76, respectively (Table 3.2). Self-efficacy's alpha coefficient had the greatest internal consistency, while test anxiety, self-regulation, peer learning, and time and study environment management displayed good internal consistency. Control of learning, effort regulation, and help seeking showed the most variability in students' responses. Control of learning beliefs and effort regulation were considered reasonable for reliability while help seeking seemed very low yet reasonable, since help-seeking items asked about help from both peers and instructor. Students may have sought help from only one source. Research suggested that this alpha coefficient, along with the goodness-of-fit and Pearson product-moment correlations test results, supported the items and scales of the MSLQ as a reliable instrument to assess college students' motivation and use of learning strategies (Pintrich et al., 1993b).

A Cronbach alpha analysis of the collected data measured the reliability of the eight MSLQ scales used in this study. Items used in this study were based on a comparison of Cronbach's Alpha results from pre-MSLQ student responses in this study to Pintrich et al.'s (1993b) research (See Table 3.2). This analysis reported increased internal consistency with items removed from the metacognitive self-regulation and help seeking scales. In comparison to Pintrich et al. (1993b), seven out of eight alpha test results from this study differed between zero to five percentage points. Self-efficacy for learning and performance items had the greatest internal consistency (α =.93) and reported the same alpha score. Metacognitive self-regulation (α =.84) was second in highest internal consistency and presented a 10 percentage point increase in reliability

Table 3.2
Cronbach's Alpha-Reliability Results

Variable	Koukounas (2016)		Pintrich, et al. (1993b)	
	Number of items	*α*	Number of items	*α*
Control of Learning Beliefs	4	.71	4	.68
Self-Efficacy for Learning and Performance	8	.93	8	.93
Test Anxiety	5	.77	5	.80
Metacognitive Self- Regulation	10	.84	12	.79
Effort Regulation	4	.73	4	.69
Peer Learning	3	.73	3	.76
Help Seeking	3	.71	4	.52
Time and Study Environment Management	8	.71	8	.76

after items 18 and 34 were removed. Test anxiety (α =.77) peer learning (α =.73), and time and study environment management (α =.71) item responses scored slightly lower and displayed good internal consistency. Control of learning beliefs (α =.71) and effort regulation (α =.73) scored slightly higher and displayed good internal consistency. Both studies reported the most variability in students' responses for items in help seeking. In this study, help seeking (α =.61) with four items displayed more internal consistency and presented another 10 percentage point increase in reliability with item 23 removed. Cronbach alpha coefficients confirmed items used in this study as reliable.

Upon further review of the metacognitive self-regulation and help seeking scales' items, items 18, 23, and 34 were discussed differently than the remaining items. Item 18 of metacognitive self-regulation discussed a classroom behavior while the remaining scale's items examined study habits outside of the classroom. Item 34 of metacognitive self-regulation examined a student's reading habits for class. Students most likely do not associate reading assignments with studying algebra. Item 23 of help seeking measured a learner's lack of help seeking while the remaining three items measured a learner's help seeking from an instructor or peer. Items 18 and 23 were not consistent with the remaining scales' items and item 34 did not relate to learners studying mathematics. Therefore, items 18, 23, and 34 were excluded to increase reliability of the metacognitive self-regulation and help seeking scales.

Data Collection

The researcher secured approval from Dowling College Internal Review Board (IRB) for the Protection of Human Subjects. The researcher asked for volunteers and collected letters of consent (Appendix E) from four sections of students enrolled in developmental algebra I to participate in the study. The researcher compiled participants' pre- and post-MSLQ (Appendix D) responses via internet-based software (Google Forms) and documented their online homework and final examination grades. Randomly generated numbers identified and kept participants' responses anonymous. The MSLQ acquired student demographics and responses to control of learning beliefs, self-efficacy for learning and performance, test anxiety, metacognitive self-regulation, effort regulation, peer learning, help seeking, time and study environment management at the start and end of the semester. Online homework and final examination grades documented student academic performance and achievement. MSLQ responses did not compromise student grades and were sealed until final grades were posted. All participants remained anonymous, and their responses and grades remained confidential.

Data Analysis

Research Question One

How did developmental algebra I students report their control of learning beliefs, self-efficacy for learning and performance, test anxiety, metacognitive self-regulation, effort regulation, peer learning, help seeking, and time and study environment management at the start of the semester?

Descriptive statistics reported means and standard deviations for each variable.

Research Question Two

How did students' online homework and final examination grades in developmental algebra I differ based upon low and high accountability?

Independent samples t-tests compared students who had high accountability and formative assessment with those who had low accountability and summative assessment in regard to online homework and final examination grades.

Research Question Three

How did students' control of learning beliefs, self-efficacy for learning and performance, test anxiety, metacognitive self-regulation, effort regulation, peer learning, help seeking, and time and study environment management change based on low and high accountability for developmental algebra I?

A repeated measures two-way analysis of variance (ANOVA) examined what effects and influence student accountability and formative assessment had on control of learning beliefs, self-efficacy for learning and performance, test anxiety, metacognitive self-regulation, effort regulation, peer learning, help seeking, and time and study environment management.

Research Question Four

What were the relationships between students' online homework, final examination, and post-MSLQ scores for control of learning beliefs, self-efficacy for learning and performance, test anxiety, metacognitive self-regulation, effort regulation, peer learning, help seeking, and time and study environment management for developmental algebra I?

Pearson's product moment correlations determined relationships between and among all of the variables.

Research Question Five

How did students' control of learning beliefs, self-efficacy for learning and performance, test anxiety, metacognitive self-regulation, effort regulation, peer learning, help seeking, and time and study environment management scores at the end of the semester predict final examination grades for developmental algebra I and for the low- and high-accountability groups?

Stepwise multiple linear regressions analyzed if scores from control of learning beliefs, self-efficacy for learning and performance, test anxiety, metacognitive self-regulation, effort regulation, peer learning, help seeking, and time and study environment management from the post-MSLQ predicted final examination grades.

Research Question Six

Were developmental algebra I students correctly classified by low and high student accountability based upon their online homework, final examination, and post-MSLQ scores that were: control of learning beliefs, self-efficacy for learning and performance, test anxiety, metacognitive self-regulation, effort regulation, peer learning, help seeking, and time and study environment management?

A discriminant analysis determined if a student could be correctly classified as low or high accountability on the basis of his or her scores for control of learning beliefs, self-efficacy for learning and performance, test anxiety, metacognitive self-regulation, effort regulation, peer learning, help seeking, time and study environment management, and online-homework and final-examination grades.

Limitations

The study was limited to one fall semester, with 111 participants from one community college. Since participants experienced student accountability and formative assessment at the same time, results did not pinpoint if one instructional strategy had more impact than the other, or if results were only the reflection of both strategies used simultaneously.

CHAPTER IV

DATA ANALYSIS AND FINDINGS

Introduction

This chapter explains the analysis and findings of data collected for this study. Student responses to the Motivated Strategies for Learning Questionnaires (MSLQ) at the beginning and end of the semester, online homework, and final examinations were collected from developmental algebra I students in a community college from suburban New York. The Statistical Package for the Social Sciences (SPSS) conducted a statistical analysis to answer six research questions posed for the purpose of this study, to examine how student accountability and formative assessment affect students' control of learning beliefs, self-efficacy for learning and performance, test anxiety, metacognitive self-regulation, effort regulation, peer learning, help seeking, time and study environment management and achievement in developmental algebra I.

Data Collected

Data were collected at separate times during a fifteen-week semester with an 88.7 percent and 77.6 percent retention rate for low and high accountability groups, respectively (see Table 4.1). One hundred eleven and 77 student participants from four sections of developmental algebra I responded to the MSLQ at the beginning and at the end of the semester, respectively. Ninety-five online homework grades were downloaded and 92 final examinations were administered. Final examination grades were recorded and participants who did not log on to or attempt any online homework received a data entry of zero for online homework.

Table 4.1
Amount and Description of Data Collected

Accountability	Pre-MSLQ	Post-MSLQ	Online Homework Grades	Final Examination Grades	Retention Rate
Low	53	39	47	47	88.7%
High	58	38	48	45	77.6%
N	111	77	95	92	

Demographic Analysis

One hundred eleven participants responded to the survey administered at the beginning of the semester. Of these, 50 percent were female, 86.48 percent were enrolled in four or more classes and attended the college full-time, and 54.95 percent had graduated from high school in the previous nine months (see Table 4.2).

Table 4.2
Participant Demographics

	Category	Frequency	Percent	Valid Percent
Gender	Female	55	49.55	49.55
	Male	56	50.45	50.45
# of Classes Attending	5	61	54.95	54.95
	4	35	31.53	31.53
	3	6	5.41	5.4
	2	6	5.41	5.4
	1	2	1.8	1.8
	Missing	1	0.9	0.9
Year Graduated High School	2015	61	54.95	54.95
	2014	24	21.62	21.62
	2013	7	6.31	6.31
	2012 or prior	13	11.71	11.7
	Missing	6	5.41	5.4
Total Participants	N	111	100.0	100.0

Research Findings

Research Question One

How did developmental algebra I students report their control of learning beliefs, self-efficacy for learning and performance, test anxiety, metacognitive self-regulation, effort regulation, peer learning, help seeking, and time and study environment management at the start of the semester?

Research question one was answered with descriptive statistics. One hundred eleven participants responded with a seven-point Likert scale to 45 items provided by the pre-MSLQ. The Likert scale scored (1) = not at all true, (2) = less true, (3) = somewhat not true, (4) = neutral, (5) = somewhat true, (6) = more true, and (7) = very true. Participants' raw scores for each MSLQ variable were the sum of the responses of each

Table 4.3
Descriptive Statistics for Pre-MSLQ Responses

Variables	Raw Score Range	AVG. Response	M	SD
Motivation				
Control of Learning Beliefs	4-28	5.28	21.13	4.49
Self-Efficacy for Learning and Performance	8-56	5.19	41.52	9.51
Test Anxiety	5-35	4.08	20.41	6.99
Learning Strategy				
Metacognitive Self-Regulation	10-70	4.55	45.49	11.02
Resource Management Strategies				
Effort Regulation	4-28	4.94	19.77	5.14
Peer Learning	3-21	3.3	9.90	4.91
Help Seeking	3-21	4.18	12.55	4.87
Time and Study Environment Management	8-56	4.69	37.48	8.03

Note. N=111.

item related to that variable. Means, standard deviations, and item means of control of learning beliefs, self-efficacy for learning and performance, test anxiety, metacognitive self-regulation, effort regulation, peer learning, help seeking, and time and study environment management were calculated by participants' raw scores (see Table 4.3). Scores for control of learning beliefs (M=21.13, SD=4.49) and self-efficacy for learning and performance (M=41.52, SD=9.51) and averaged slightly above somewhat true. Effort regulation (M=19.77, SD=5.14) averaged slightly below somewhat true. Metacognitive self-regulation (M=45.49, SD=11.02) and time and study environment management (M=37.48, SD=8.03) averaged in between neutral and somewhat true. Test anxiety (M=20.41, SD=6.99) and help seeking (M=12.55, SD=4.87) averaged slightly above neutral. Only peer learning (M=9.90, SD=4.91) averaged below neutral and slightly above somewhat not true.

Research Question Two

How did students' online homework and final examination grades in developmental algebra I differ based upon low and high accountability?

Table 4.4
Independent Samples t-Test Based on Accountability

Grades	Accountability	N	M	SD	t	df	*p*
Final Examination	Low	47	68.21	19.32	.51	90	.611
	High	45	66.11	20.22			
Online Homework	Low	47	58.89	33.48	-5.713	71.087	.000*
	High	48	90.65	18.38			

Note. Variances for online homework are not assumed equal. Variances for final examination scores are assumed equal. *=p<.05 (two-tailed).

Independent samples t-test compared students with high accountability and formative assessment to those with low accountability and summative assessment in regard to online homework and final examination grades. No significant difference was found in final examination grades $(t(90)=.51, p>.05)$ between low-accountability (M=68.21, SD=29.32) and high-accountability (M=66.11, SD=20.22) groups (see Table 4.4). Online-homework grades reported a large mean difference of -31.75 between low- and high-accountability groups. A significant difference between online-homework grades for low-accountability (M=58.89, SD=33.48) and high-accountability (M=90.65, SD=18.38) groups was found, $t(71.087)=-5.713, p<.001$.

Research Question Three

How did students' control of learning beliefs, self-efficacy for learning and performance, test anxiety, metacognitive self-regulation, effort regulation, peer learning, help seeking, and time and study environment management change based on low and high accountability for developmental algebra I?

Research question three was answered with a repeated measures two-way analysis of variance (ANOVA), also known as, a mixed-design ANOVA. This examined any significant effects and influence student accountability and formative assessment had between pre-and post-MSLQ student responses.

Box's Test of equality of covariance matrices (Table 4.5) determined that control of learning beliefs (p=.867), self-efficacy for learning and performance (p=1.94), test anxiety (p=.549), peer learning (p=.147), help seeking (p=.202), and time and study environment management (p=.613) had homogeneity of variance-covariance matrices. Metacognitive self-regulation (p=.008) and effort regulation (p=.038) had significant Box's Test of equality of covariance matrices. Heterogeneity of variance-covariance matrices of metacognitive self-regulation and effort regulation failed an assumption of mixed-design ANOVA analysis and limited their analyses.

Table 4.5
Box's Test of Equality of Covariance Matrices

Variable	*p*
Control of Learning Beliefs	.867
Self-Efficacy for Learning and Performance	.194
Test Anxiety	.549
Metacognitive Self-Regulation	.008
Effort Regulation	.038
Peer Learning	.147
Help Seeking	.202
Time and Study Environment Management	.613

Mixed design ANOVA results (Table 4.7) for control of learning beliefs (p=.833), self-efficacy for learning and performance (p=.437), peer learning (p=.859), help seeking (p=.579), and time and study environment management (p=.096) were insignificant. Accountability had no main effect. None of the mean scores between groups of low and

Table 4.6
Means of Variables based on Accountability and Pre- and Post- MSLQ

Variable	Accountability	Pre-MSLQ		Post-MSLQ	
		M	SD	M	SD
Control of Learning Beliefs	Low	21.39	4.14	22.26	4.00
	High	21.21	4.55	21.84	4.28
Self-Efficacy for Learning and Performance	Low	44.13	7.02	44.26	8.75
	High	41.63	9.10	40.16	10.14
Test Anxiety	Low	18.42	6.89	20.84	7.52
	High	21.0	6.32	20.76	6.27
Metacognitive Self-Regulation	Low	44.74	11.08	47.55	12.02
	High	45.26	12.46	45.5	8.07
Effort Regulation	Low	21.58	4.06	19.97	4.63
	High	19.34	5.40	18.74	5.24
Peer Learning	Low	9.58	5.17	9.74	5.35
	High	9.76	4.6	9.68	4.77
Help Seeking	Low	13.03	5.25	11.95	4.68
	High	12.45	4.76	12.05	4.92
Time and Study Environment Management	Low	37.84	8.72	39.42	8.16
	High	37.24	7.62	36.03	8.52

Note. N=38 for low and high accountability groups.

high accountability differed significantly. Self-efficacy for learning and performance displayed a slight increase in means (Table 4.6) between pre- (M=44.13, SD=7.02) and post-MSLQ (M=44.26, SD=8.75) for low accountability, and a slight decrease in means between pre- (M=41.63, SD=9.1) and post-MSLQ (M=40.16, SD=10.14) for high accountability. Self-efficacy for learning and performance was the only variable near a

Table 4.7
Mixed Design ANOVA- Main Effects and Interactions

Variable	Source	F	η^2	p
Control of Learning Beliefs	Accountability	.143	.002	.706
	Pre-Post-MSLQ	1.802	.024	.184
	Pre-Post-MSLQ*Accountability	.045	.001	.833
Self-Efficacy for Learning and Performance	Accountability	3.585	.046	.062
	Pre- and Post-MSLQ	.427	.006	.516
	Pre-Post-MSLQ*Accountability	.611	.008	.437
Test Anxiety	Accountability	.756	.010	.387
	Pre- and Post-MSLQ	3.454	.045	.067
	Pre-Post-MSLQ*Accountability	5.114	.065	.027
Metacognitive Self-Regulation	Accountability	.108	.001	.744
	Pre- and Post-MSLQ	1.889	.025	.173
	Pre-Post-MSLQ*Accountability	1.348	.018	.249
Effort Regulation	Accountability	3.019	.039	.086
	Pre- and Post-MSLQ	4.992	.063	.028
	Pre-Post-MSLQ*Accountability	1.022	.014	.315
Peer Learning	Accountability	.005	.000	.944
	Pre- and Post-MSLQ	.004	.000	.953
	Pre-Post-MSLQ*Accountability	.032	.000	.859
Help Seeking	Accountability	.063	.001	.802
	Pre- and Post-MSLQ	1.439	.019	.234
	Pre-Post-MSLQ*Accountability	.310	.004	.579
Time and Study Environment Management	Accountability	1.373	.018	.245
	Pre- and Post-MSLQ	.049	.001	.825
	Pre-Post-MSLQ*Accountability	2.836	.037	.096

Note. df=(1,74)

significant difference for mean scores between low- and high-accountability groups, $F(1,74)=3.585, p=.062, \eta^2=.046$.

There was one significant main effect within groups of low and high accountability. Effort regulation displayed decreases in means between pre- (M=21.58, SD=4.06) and post-MSLQ (M= 19.97, SD=4.63) for low accountability, and pre- (M=19.34, SD=5.4) and post-MSLQ (M=18.74, SD=5.24) for high accountability. Mean scores for pre- and post-MSLQ in effort regulation differed significantly within low- and high-accountability groups, $F(1,74) = 4.992, p < .05, \eta^2 = .063$.

Test anxiety had the only significant interaction between factors. Test anxiety reported an increase in means between pre- (M=18.42, SD=6.89) and post-MSLQ (M=20.84, SD=7.52) for low accountability, and a slight decrease in means between pre- (M=21.0, SD=6.32) and post-MSLQ (M=20.76, SD=6.27) for high accountability. Pre- and post-MSLQ mean scores for test anxiety significantly interacted between low and high accountability groups, $F(1,74) = 5.114, p = .027, \eta^2 = .065$.

Research Question Four

What were the relationships between students' online-homework, final-examination and post-MSLQ scores for control of learning beliefs, self-efficacy for learning and performance, test anxiety, metacognitive self-regulation, effort regulation, peer learning, help seeking, and time and study environment management for developmental algebra I?

Pearson product moment correlations investigated the fourth question of this study. Correlation coefficients determined statistically significant relationships among control of learning beliefs, self-efficacy for learning and performance, test anxiety, metacognitive self-regulation, effort regulation, peer learning, help seeking, time and

Table 4.8

Pearson Correlations on Post-MSLQ and Final Examination Grades

		CL	SE	TA	MSR	ER	PL	HS	TS	FE
SE	r	.441**								
	r^2	.194								
	N	77								
TA	r	.088	-.288*							
	r^2	.008	.083							
	N	77	77							
MSR	r	.359**	.468**	.134						
	r^2	.129	.219	.018						
	N	77	77	77						
ER	r	.172	.473**	-.306**	.285*					
	r^2	.03	.224	.094	.081					
	N	77	77	77	77					
PL	r	.259*	.242*	.246*	.402**	-.104				
	r^2	.067	.059	.061	.162	.011				
	N	77	77	77	77	77				
HS	r	.171	.118	.104	.455**	-.122	.741**			
	r^2	.029	.014	.011	.207	.015	.549			
	N	77	77	77	77	77	77			
TS	r	.184	.460**	-.193	.411**	.543**	.230*	.214		
	r^2	.034	.212	.037	.169	.295	.053	.046		
	N	77	77	77	77	77	77	77		
FE	r	.186	.490**	-.282*	.126	.243*	.062	-.100	.219	
	r^2	.035	.24	.08	.016	.059	.004	.01	.048	
	N	76	76	76	76	76	76	76	76	
HW	r	.135	.136	-.008	.323**	.028	.092	.167	.224	.112
	r^2	.018	.018	.000	.104	.001	.008	.028	.05	.013
	N	77	77	77	77	77	77	77	77	84

Note. CL = control of learning beliefs, SE = self-efficacy for learning and performance, TA = test anxiety, MSR = metacognitive self-regulation, ER = effort regulation, PL = peer learning, HS = help seeking, TS = time and study environment management, FE = final examination grades, HW= online homework grades, *=p<.05, **= p< .01 level (2-tailed).

study environment management, and online homework and final examination grades. Twenty-one of 45 correlations (Table 4.8) were significant.

The greatest positive, and very strong ($r = .741$, $p < .01$), correlation between help seeking and peer learning accounted for 54.9 percent of the variance. The second-highest relation ($r = .543$, $p < .01$) was between time and study environment management and effort regulation, in which time and study environment management accounted for 29.5 percent of the variance in effort regulation.

Results indicated five strong positive relationships for self-efficacy for learning and performance and three strong positive relationships for metacognitive self-regulation. Self-efficacy for learning and performance related with final examination grades ($r = .49$, $p < .01$) accounted for 24 percent of the variance; effort regulation ($r = .473$, $p < .01$) accounted for 22.4 percent of the variance; metacognitive self-regulation ($r = .468$, $p < .01$) accounted for 21.9 percent of the variance; time and study environment management ($r = .46$, $p < .01$) accounted for 21.2 percent of the variance; and control of learning beliefs ($r = .441$, $p < .01$) accounted for 19.4 percent of the variance. Metacognitive self-regulation related with help seeking ($r = .455$, $p < .01$) accounted for 20.7 percent of the variance; time and study environment management ($r = .411$, $p < .01$) accounted for 16.9 percent of the variance; and peer learning ($r = .402$, $p < .01$) accounted for 16.2 percent of the variance.

Positive coefficients indicated two moderate relationships for metacognitive self-regulation and effort regulation, and four moderate relationships for peer learning. Metacognitive self-regulation related with control of learning beliefs ($r = .359$, $p < .01$) accounted for 12.9 percent of the variance, and online homework grades ($r = .323$, $p < .01$)

accounted 10.4 percent of the variance. Effort regulation related with metacognitive self-regulation ($r = .285$, $p < .05$) accounted for 8.1 percent, and final examination grades ($r = .243$, $p < .05$) accounted for 5.9 percent of the variance. Peer learning related with control of learning beliefs ($r = .259$, $p < .05$) accounted for 6.7 percent of the variance; self-efficacy for learning and performance ($r = .242$, $p < .05$) accounted for 5.9 percent of the variance; test anxiety ($r = .246$, $p < .05$) accounted for 6.1 percent of the variance; and time and study environment management ($r = .23$, $p < .05$) accounted for 5.3 percent of the variance.

Test anxiety's coefficients indicated three moderate negative relationships. Test anxiety negatively correlated with effort regulation ($r = -.306$, $p < .01$) accounted for 9.4 percent of the variance; self-efficacy for learning and performance ($r = -.288$, $p < .05$) accounted for 8.3 percent of the variance; and final examination grades ($r = -.282$, $p < .05$) accounted for eight percent of the variance.

Three out of the eight variables correlated to final examination grades. Final-examination grades correlated with self-efficacy for learning and performance ($r = .49$), effort regulation ($r = .243$), and test anxiety ($r = -.282$).

Research Question Five

How did students' control of learning beliefs, self-efficacy for learning and performance, test anxiety, metacognitive self-regulation, effort regulation, peer learning, help seeking, and time and study environment management scores at the end of the semester predict final-examination grades for developmental algebra I and for the low- and high-accountability groups?

Stepwise multiple regressions analyzed if scores from control of learning beliefs, self-efficacy for learning and performance, test anxiety, metacognitive self-regulation, effort regulation, peer learning, help seeking, and time and study environment management from the post-MSLQ predicted final examination grades for developmental algebra I and for the low- and high-accountability groups. Only one model with one dependent variable, self-efficacy for learning and performance, was found to predict final examination grades for developmental algebra I students (see Table 4.9). Self-efficacy for learning and

Table 4.9
Stepwise Multiple Regression- Final Examination Grades for Developmental Algebra I

					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.490[a]	.240	.229	16.51642	.240	23.322	1	74	.000

a. Predictors: (Constant), self-efficacy for learning and performance

Table 4.10
Stepwise Multiple Regression Coefficients for Developmental Algebra I

Model	B	SE	β	t	p
Constant	29.377	8.386		3.503	.001
Self-efficacy for learning and performance	.939	.194	.490	4.829	.000

Note. dependent variable=final examination grade.

performance predicted 24 percent of the variance in final examination grades. When raw score measured self-efficacy for learning and performance (Table 4.10), participants' predicted final examination grades were equal to 29.377 + .939 (self-efficacy for learning and performance) points. Participants' final examination grades increased .939 points for each raw-score point in self-efficacy for learning and performance. A weak model with one dependent variable, self-efficacy for learning and performance, predicted 14 percent of the variance in final examination grades for low accountability (see Table 4.11). When

Table 4.11
Stepwise Multiple Regression- Final Examination Grades for Low Accountability

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics: R Square Change	F Change	df1	df2	Sig. F Change
1	.380[a]	.144	.121	16.42352	.144	6.241	1	37	.017

a. Predictors: (Constant), self-efficacy for learning and performance

raw score measured self-efficacy for learning and performance, participants' predicted final examination grade was equal to 38.274 + .73 (self-efficacy for learning and performance) points. Participants' final examination grades increased .73 points for each raw-score point in self-efficacy for learning and performance (see Table 4.12).

Table 4.12
Stepwise Multiple Regression Coefficients for Low Accountability

Model	B	SE	β	t	p
Constant	38.274	13.070		2.928	.006
Self-efficacy for learning and performance	.730	.292	.380	2.498	.017

Note. dependent variable=final examination grade.

A good model was revealed for high accountability (Table 4.13). Self-efficacy for learning and performance and help seeking predicted 33 percent and 10 percent of the variance in final-examination grades for the high-accountability group, respectively.

Table 4.13
Stepwise Multiple Regression- Final Examination Grades for High Accountability

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics: R Square Change	F Change	df1	df2	Sig. F Change
1	.570[a]	.325	.306	16.85023	.325	16.851	1	35	.000
2	.653[b]	.426	.393	15.75943	.101	6.013	1	34	.019

a. Predictors: (Constant), self-efficacy for learning and performance
b. Predictors: (Constant), self-efficacy for learning and performance, help seeking

When raw score measured self-efficacy for learning and performance and help seeking, participants' predicted final-examination grades (Table 4.14) were equal to 38.897 + 1.096 (self-efficacy for learning and performance) – 1.296 (help seeking) points. Participants' final examination grades increased 1.096 points for each raw-score point in self-efficacy for learning and performance, and decreased 1.296 points for each raw-score point in help seeking.

Table 4.14
Stepwise Multiple Regression Coefficients for High Accountability

Model	B	SE	β	t	p
Constant	38.897	12.554		3.098	.004
Self-efficacy for learning and performance	1.096	.256	.557	4.286	.000
Help seeking	-1.296	.529	-.319	-2.452	.019

Note. dependent variable=final examination grade.

Research Question Six

Were developmental algebra I students correctly classified by low and high student accountability, based upon their online homework, final examination, and post-MSLQ scores that were: control of learning beliefs, self-efficacy for learning and performance, test anxiety, metacognitive self-regulation, effort regulation, peer learning, help seeking, and time and study environment management?

Research question six was answered by discriminant analysis. Discriminant analysis determined if a student can be correctly classified as low or high accountability on the basis of their scores for control of learning beliefs, self-efficacy for learning and performance, test anxiety, metacognitive self-regulation, effort regulation, peer learning, help seeking, time and study environment management, and online and final examination grades.

The test of equality of group means (Table 4.16) found significant differences, with a high F value of 29.239 and $p<.001$, between means (Table 4.15) for online homework grades among low ($M=65.08$, $SD=29.95$) and high ($M=94.05$, $SD=13.2$)

Table 4.15
Group Statistics

Predictors	Low Accountability		High Accountability	
	M	SD	M	SD
Control of Learning Beliefs	22.18	3.99	21.86	4.34
Self-Efficacy for Learning and Performance	43.79	9.11	40.14	10.28
Test Anxiety	20.82	7.43	20.59	6.26
Metacognitive Self- Regulation	47.26	12.01	45.38	8.15
Effort Regulation	19.87	4.61	18.81	5.29
Peer Learning	9.74	5.28	9.54	4.75
Help Seeking	12.00	4.63	12.00	4.97
Time and Study Environment Management	39.31	8.09	36.19	8.58
Online Homework Grades	65.08	29.95	94.05	13.20
Final Examination Grades	70.26	17.52	67.32	20.22

Note. low accountability (n=39). high accountability (n=37).

groups of accountability. Box's M test was significant ($p<.001$) and group variance-covariance matrices were heterogeneous. Log determinants (Table 4.17) were determined

Table 4.16
Tests of Equality of Group Means

Predictors	Wilk's Lambda	F	p
Control of Learning Beliefs	.999	.108	.743
Self-Efficacy for Learning and Performance	.965	2.704	.104
Test Anxiety	1.000	.020	.887
Metacognitive Self- Regulation	.992	.630	.430
Effort Regulation	.988	.871	.354
Peer Learning	1.000	.031	.861
Help Seeking	1.000	.000	1.000
Time and Study Environment Management	.965	2.660	.107
Online Homework Grades	.717	29.239	.000
Final Examination Grades	.994	.458	.501

Note. df1=1. df2=74.

unequal. Discriminant analysis to classify low- and high-accountability groups by control of learning beliefs, self-efficacy for learning and performance, test anxiety, metacognitive self-regulation, effort regulation, peer learning, help seeking, time and study environment management, online-homework grades, and final-examination grades failed an assumption to analyze and gave invalid results. To further investigate, control of learning beliefs, self-efficacy for learning and performance, test anxiety, metacognitive self-regulation, effort regulation, peer learning, help seeking, time and study environment

Table 4.17
Box's Test of Equality of Covariance Matrices
Log Determinants

Accountability	Rank	Log Determinant
Low	10	36.392
High	10	37.030
Pooled within-groups	10	38.279

Note. The ranks and natural logarithms of determinants printed are those of the group covariance matrices.

management, and final-examination grades were removed as predictors to determine if online-homework grades classified low and high accountability groups. Box's M test was significant ($p<.001$) and group variance-covariance matrices were heterogeneous. Log determinants (Table 4.18) were determined unequal. Participants' data failed an assumption to calculate and discriminant analysis results were determined to be invalid.

Table 4.18

Box's Test of Equality of Covariance Matrices
Log Determinants

Accountability	Rank	Log Determinant
Low	1	7.022
High	1	5.822
Pooled within-groups	1	6.586

Note. The ranks and natural logarithms of determinants printed are those of the group covariance matrices.

Summary

This study examined how low student accountability and high student accountability with formative assessment affect students' control of learning beliefs, self-efficacy for learning and performance, test anxiety, metacognitive self-regulation, effort regulation, peer learning, help seeking, time and study environment management and achievement in developmental algebra I at a community college in suburban New York. Variables were measured by pre- and post-MSLQ survey responses and online-homework and final-examination grades. Participants' scores for self-efficacy for learning and performance, test anxiety, and online homework grades displayed significant findings.

The pre-MSLQ responses revealed demographics, motivation, and learning and resource management strategies of 111 developmental algebra I students at the beginning of the semester. Through descriptive statistics analysis, 50 percent of the participants were female; the majority attended the college full-time (86.5%) and graduated high school less than nine months before (54.95%). The highest pre-MSLQ item means reported were control of learning beliefs (5.28) and self-efficacy for learning and performance (5.19). Peer learning was the lowest and only item mean (3.3) below neutral.

Independent t-tests determined if online-homework and final-examination grades between low- and high-accountability groups differed significantly. Online homework grades reported a significant difference $t(71.087) = -5.713, p < .001$ with a large mean difference of -31.75 between low- and (M=58.89, SD=33.48) high-accountability (M=90.65, SD=18.38) groups.

A mixed-design ANOVA determined if there were any significant effects and interactions between groups. Self-efficacy for learning and performance's score means displayed differences between post- and pre-MSLQ, with 0.13 and -1.47 for low- and high-accountability groups, respectively. Accountability was near a significant main effect for self-efficacy for learning and performance (p=.062). Results for self-efficacy for learning and performance's difference of score means between low and high accountability groups was $F(1,74)=3.585, p=.062, \eta^2=.046$. Effort regulation reported differences between post- and pre-MSLQ score means with -1.61 and -0.6 for low- and high-accountability groups, respectively. Effort regulation had a significant main effect, $F(1,74)=4.992, p<.05, \eta^2=.063$, within groups of low- and high-accountability. Test anxiety's pre-MSLQ score means were 18.42 and 21 for low- and high-accountability, respectively. Test anxiety for low- and high-accountability groups revealed differences of 2.42 and -.24 between post- and pre-MSLQ score means, respectively. Test anxiety significantly interacted between low- and high-accountability groups, $F(1,74)=5.114, p=.027, \eta^2=.065$.

A Pearson Product Moment correlation determined any relationships between control of learning beliefs, self-efficacy for learning and performance, test anxiety, metacognitive self-regulation, effort regulation, peer learning, help seeking, time and study environment management, and final-examination grades at the end of the semester. Twenty-one of 45 correlations were significant. Help seeking and peer learning had the strongest correlation (r =.741, p<.01) and accounted for 54.9 percent of the variance. Self-efficacy for learning and performance tallied the highest number of significant relationships. Self-efficacy for learning and performance correlated strongly with final-examination grades ($r = .49$, $p<.01$) and accounted for 24 percent of the variance; effort regulation ($r =.473$, $p<.01$) accounted for 22.4 percent of the variance; metacognitive self-regulation ($r = .468$, $p<.01$) accounted for 21.9 percent of the variance; time and study environment management ($r = .46$, $p<.01$) accounted for 21.2 percent of the variance; and control of learning beliefs ($r =.441$, $p<.01$) accounted for 19.4 percent of the variance. Only three negative relationships were found and related moderately to test anxiety. Test anxiety correlated with effort regulation ($r = -.306$, $p<.01$) and accounted for 9.4 percent of the variance; self-efficacy for learning and performance ($r =-.288$, $p<.05$) accounted for 8.3 percent of the variance; and final-examination grades ($r = -.282$, $p<.05$) accounted for eight percent of the variance.

Stepwise multiple regressions produced models to predict final examination grades. The only good model produced to predict final-examination grades was for the high-accountability group, accounted for 43 percent of the variance, and determined self-efficacy for learning and performance and help seeking as significant predictors.

Collected data could not determine if a student can be correctly classified as low- or high-accountability on the basis of his or her scores for control of learning beliefs, self-efficacy for learning and performance, test anxiety, metacognitive self-regulation, effort regulation, peer learning, help seeking, time and study environment management, and online-homework and final-examination grades. This study's data failed an assumption to calculate a discriminant analysis and it results were determined invalid.

CHAPTER V

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

Summary

This study investigated whether student accountability and formative assessment affected student motivations, learning and resource-management strategies, and final examination grades in a developmental algebra I course at a community college in suburban New York. Data included student responses from the pre- and post-Motivated Strategies for Learning Questionnaire (MSLQ) and student online-homework and final-examination grades.

During a fifteen-week developmental algebra I course, two sections with 30 students each were held highly accountable for online homework and received three formative assessments, while two other sections with 30 students each had low accountability for online homework and received three summative assessments. The MSLQ was administered before the implementation of student accountability and formative assessment for the high-accountability group.

The survey instrument consisted of two parts. Part one collected demographic data and reported participants' gender, high-school graduation date, and the number of courses they took during the study. Part two examined: (a) three constructs of student motivation, which were control of learning beliefs, self-efficacy for learning and performance, and test anxiety, (b) a student learning-strategy construct, metacognitive self-regulation, (c) four student resource-management strategies, which were effort regulation, peer learning, help seeking, time and study environment management. Four questions measured control of learning beliefs, eight questions measured self-efficacy for learning and performance, five questions measured test anxiety, 12 questions measured metacognitive self-regulation, four questions measured effort regulation, three questions measured peer learning, four questions measured help seeking, and eight questions measured time and study environment management. Participants answered each question via a seven-point Likert scale, where (1) = not at all true of me and (7) = very true of me. Developmental algebra I student-response means and their standard deviations for control of learning beliefs, self-efficacy for learning and performance, test anxiety, metacognitive self-regulation, effort regulation, peer learning, help seeking, and time and study environment management were reported.

A researcher and volunteer instructor individually conducted one section with high accountability and formative assessment and the other with low accountability and summative assessment. Instructional steps and follow-up questions provided instructors with guidance on how to manage formative assessment in the classroom. Low-accountability students received unit examinations on their scheduled date as a whole class regardless of their online-homework grades. High-accountability students had to score at least a 90 percent on each previous homework assignment and those related to a given unit in order to receive that unit's examination. High-accountability students could not skip over a unit examination and received a formative assessment of their performance after they completed a unit examination. Out of 58 students, 43 received a formative assessment for unit two, 25 students received a formative assessment for unit three, and three students received a formative assessment for unit four.

One week prior to the final examination, student participants responded to the post-MSLQ. The post-MSLQ consisted of the same 48 items that were posed on the pre-MSLQ, measuring control of learning beliefs, self-efficacy for learning and performance, test anxiety, metacognitive self-regulation, effort regulation, peer learning, help seeking, and time and study environment management. Online-homework grades were recorded and cumulative final-examination grades measured achievement.

A quantitative analysis with 45 MSLQ items answered this study's research questions, since Cronbach's analysis determined increased reliability when items from the metacognitive self-regulation and help seeking variables were removed. Developmental algebra I students did not rate their motivations, learning strategy, and resource-management strategies for developmental algebra I strongly. Students' response averages were within a somewhat not true to somewhat true range. An independent samples t-test revealed a significant difference in online-homework grades between the high- and low- accountability groups. A repeated measures two-way analysis of variances found (a) accountability was near a significant main effect for self-efficacy for learning and performance, (b) a significant difference in effort regulation within groups of low and high accountability, and (c) a significant interaction with test anxiety between low and high accountability groups. A correlation analysis revealed 21 significant relationships between dependent variables and a stepwise linear regression revealed a good model for high accountability with self-efficacy and help seeking as predictors of final examination grades. The collected data failed an assumption to calculate a discriminant analysis and gave invalid results to determine if student responses and grades can classify students into low and high accountability.

Conclusions

Developmental algebra I students had misconceptions of or did not comprehend algebraic concepts, which caused failing performances on college-placement examinations or in previously taken developmental algebra I courses. The majority of participants in this study recently graduated high school and attended college full-time.

Research on college algebra has reported higher student-retention rates when using online homework (Burch & Kuo, 2010) and that paper- and online-based homework do not result in differences in grades (Kodippili & Senaratne, 2008). In this study, low accountability had a greater student-retention rate than high accountability for online homework (Table 4.1), yet high-accountability students significantly increased homework performance and grades. This may be an indicator that high-accountability students who were unwilling to devote adequate time and effort to actively participate in learning developmental algebra I withdrew from the course.

Studies have shown that high accountability and formative assessment are performance management tools that encouraged students to become cognizant of their role as a learners (Brady, 2013), focus on study skills, actively develop learning capacity (Gillespie, 2009), and set highly transparent goals that recognized a student's current status and the desired goal (Hattie & Gan, 2011). While Jones et al. (2013) found that implementing online student accountability increased student performance on examinations and Khanna (2015) found similar increases when implementing formative feedback, the present study found no difference in final-examination grades with high accountability for online homework and formative assessment in developmental algebra I.

Online homework may have increased student readiness and accountability (Jones et al., 2013), but developmental algebra I students were identified as passive receivers of course content and instructions (Brady, 2013; Gillespie, 2009). Developmental algebra I students' online homework grades did not relate to final examination grades. During this study, passive learning contributed to the rapid decline of formative assessments conducted in the high accountability group. Also, time management did not relate to or predict final examination grades. At the end of the semester, some students may have crammed in time and effort to boost their online homework semester grade but cramming is not a effective or deep-learning strategy. With this study tactic, students are usually interested in making the grade and not concerned with mastering content (Hoeksema, 1995). Inadequate amounts of student effort or time to complete homework most likely caused the insignificant difference in final examination grades between the low- and high-accountability groups.

In contrast to those exhibiting passive learning behaviors, students who held themselves accountable devoted more effort and time to difficult tasks and appeared more mindful of their own learning and academic progress (Clancy, 2005). Homework reinforces the instruction of new concepts. As noted by Cooper (2015), the strongest relationship between homework time and test score was shown by twelfth graders who spent seven to 12 hours per week on math homework. Also, high levels of satisfaction with homework completion related to final examination performance (Bembenutty, 2009). High accountability and formative assessment are most productive if students perform and acquire knowledge and become receptive to teacher feedback (Hattie & Gan, 2011). Formative assessment has been used to remedy continuing or habitual failure (Stiggins, 2007) and to lessen the gap between student comprehension and course objectives (Hattie & Timperley, 2007). Instructors have used formative assessment to monitor progress in the course, audit achievements, and note improved performance (Black &Wiliam, 2004; Wiggins, 1998). If students want to learn effectively, student accountability and formative assessment could guide students to tend to topics of weak comprehension, in order to successfully scaffold through the sequential topics of developmental algebra I.

Time management and effort regulation was this study's second highest correlation. Developmental algebra I students poorly managed their time management and effort regulation, and rated their time management and effort regulation as somewhat true or weak resources for learning algebra. Effort regulation is a measure of how active students were in their own learning (Rosen, Glennie, Dalton, Lennon, & Bozick, 2010). Interestingly, students' effort regulation in developmental algebra I related to final-examination grades but not to online-homework grades. Also, time management and effort regulation did not predict final-examination grades. These results most likely indicate that developmental algebra I students used undirected and surface-learning behaviors to learn algebra.

Students with low motivation tend to have undirected learning strategies (Sankaran, 2001). As in developmental algebra I, such students most likely could not cope with the volume of material, understood information in a disjointed manner, were only interested in making the grade, crammed, and spent time memorizing steps (Hoeksema, 1995).

Algebraic concepts are taught sequentially. Algebra instructors advance students through the course's content with discussions of simpler concepts with the intention that students will scaffold from previous knowledge to comprehend more complex techniques. Students who do not spend the time and effort to acquire and reinforce their knowledge of previously taught concepts most likely feel overwhelmed, and try to skim through material unsuccessfully or direct their effort entirely elsewhere.

During the course of this study, developmental algebra I students decreased their effort regulation. Significant differences between the decreases within the low- and high-accountability groups' effort regulation were found. Students in the low-accountability group significantly lessened their effort but displayed a slight increase in study time. Low-accountability students, with their poor homework performance, most likely misused time with inappropriate (Purdie & Hattie, 1999) or undirected learning strategies (Sankaran, 2001) more so than high-accountability students.

Students in the high-accountability group slightly lessened their effort regulation. The emphasis on students reinforcing their knowledge of algebraic topics outside of the classroom prior to receiving a unit examination may have influenced the regulation of effort reported by the high-accountability group. Instructors questioned students who were held highly accountable and did not manage their time and effort to complete homework effectively to meet semester target dates. Students regulated their effort effectively when they demonstrated concern about *how* to reach their goals (Bandura, 1986; Schunk, 1983). Although high-accountability students' rate for time management did not change and effort regulation slightly declined, supportive instructional styles, such as high accountability for online-homework and formative assessment, encouraged students' effort regulation (Rakes & Dunn, 2010) to yield optimal management of study time for developmental algebra I.

Developmental algebra I students reported a strong relationship between effort regulation and self-efficacy for learning and performance, while self-efficacy for learning and performance approached a significant difference between groups. The high-accountability group decreased as the low-accountability group increased in self-efficacy for learning and performance. High accountability for online homework and formative assessment may have encouraged students to align their actual effort and ability to their true formative outcomes in learning algebraic concepts.

As in previous studies, hard work and persistence did not increase self-efficacy (Schunk, 1982) and were not the student-preferred processes for achieving (Schunk, 1982, 1983). However, hard work and persistence proved to develop self-efficacy over time with more skillful task performance (Schunk & Hanson, 1985). Students, who were improving their learning strategies, found that effort improves performance in more challenging, advanced coursework (Lynch, 2006). Students in the high-accountability group were guided to apply their effort into effective and deep learning strategies. Continuous high accountability for online homework and formative assessment with students may positively influence their self-efficacy, effort regulation, and achievement in developmental algebra I.

Test anxiety negatively related to self-efficacy, performance on exams (Cassady, 2002; Hembree, 1988; Pintrich & De Groot, 1990), and effort regulation, and did not predict or affect final-examination grades in developmental algebra I. At the beginning of the semester, students considered their test anxiety to be a neutral feature in learning algebra. College freshmen who viewed their test anxiety as low learned passively, reduced their study time, and performed poorly (Lynch, 2006; Rachal, Daigle, & Rachal, 2007; Schwarzer, 1986). Furthermore, researchers noted that poor performance caused test anxiety, while better performance reduced it (Elliot & McGregor, 1999; Hembree, 1988).

At the conclusion of this study, test anxiety in the low-accountability group increased considerably, while it slightly decreased in the high-accountability group. This significant interaction between groups revealed that low student accountability and summative assessments had adverse effects on students' test anxiety. Formative assessment (Khanna, 2015) and high accountability for online homework are instructional practices that treat students' weaknesses, strengthens study-skills, and positively affects student test anxiety in developmental algebra I.

Control of learning beliefs strongly and positively related to self-efficacy for learning and performance. These two variables were the most highly rated variables by developmental algebra I students. Students rated them as somewhat true or weak motivators in learning developmental algebra I. Developmental algebra I was most likely viewed as a review of prior knowledge, which perception has been known to influence self-efficacy (Schunk, 1981; Schunk & Hanson, 1985) and positively affect students' control beliefs (Pintrich, 1993). Students in this study overestimated their ability to monitor effective study plans to review and learn algebraic concepts. Students who held a dismissive view of the task of reviewing unmastered algebraic topics often experienced repeated failure and devoted little time or effort toward remediation. In this situation, Zimmerman and Schunk (1989) found that when instructors questioned students' math ability, students gave illogical reasons or excuses for possible failures. This may have hindered students from obtaining new or deeper understandings (Pintrich et al., 1993) of algebraic concepts and future achievements in developmental algebra I.

Participants considered peer learning to be a somewhat not true resource while learning developmental algebra I. In corroboration of this study, Micari and Pazos (2014) found that less-confident or less-prepared college students opposed social-comparison between peers. Students may have perceived peer learning as a threat that caused academic anxiety due to the requirement to perform in front of others with similar abilities (Micari & Pazos, 2014; Micari & Drane, 2011). This perception did not change throughout the course of this study and peer learning was an insignificant predictor of final examination grades. Peer learning positively related with test anxiety, and therefore most likely had an adverse affect on student test anxiety and performance.

As a classroom instructional strategy, peer learning, with students in small groups, may worsen morale and be difficult to implement because of inconsistent attendance and rates of attrition. Research has found that students' level of social concern and academic anxiety in the classroom lessened when instructors shared student-related experiences of student academic struggles or modeled errors of thinking (Hattie & Timperley, 2007; Micari & Pazos, 2014).

Developmental algebra I students' metacognitive self-regulation displayed a moderate relationship with control of learning beliefs and a strong relationship with help seeking. Self-regulation, defined as a learning strategy and the level of active participation students had in their own learning, motivated them to act with a purpose and action plan (Boekaerts & Corno, 2005; Pintrich, 2004; Zimmerman & Schunk, 1989). Those who self-regulated effectively knew when, why, and whom to seek help from (Pintrich & DeGroot, 1990). Students regarded their metacognitive self-regulation and control of learning beliefs as somewhat true or weak contributors for learning developmental algebra I. High accountability for online homework only allowed students who completed their homework assignments to take a unit examination. This allowance changed the mind-set of many developmental algebra I students and forced them to self-assess their self-regulating behaviors while studying mathematics. Throughout the study, students' ratings for metacognitive self-regulation did not change. Developmental algebra I students most likely perceived high accountability for online homework as a learning task imposed upon them, rather than a learning strategy they could use to actively participate in their own learning.

Unlike results reported by Pape, Bell, and Yetkin (2003), students in developmental algebra I reported no significant relationship between metacognitive self-regulation and final-examination grades in mathematics. Students who held themselves accountable had greater self-regulation (Clancy, 2005) and those with low self-regulation most often paused their learning and waited for instructions on how to remediate their learning strategies (Hattie & Timperely, 2007). Researchers found that self-doubters hesitate to use known skills (Bandura & Cervone, 1983), abandon tasks when initially unsuccessful, and are apprehensive about how to implement necessary courses of action (Bandura, 1986).

Dependent students wait for instructors to provide structure and strategy to promote active learning and produce high-quality outcomes (Gillespie, 2009). Beal, Qu, and Lee (2008) also found that students frequently and appropriately use computer-assisted instruction for support when they are given high performance expectations for mastery learning. In this study, online-homework grades were significantly higher in the high-accountability group. High accountability and formative assessment influenced instructions to guide students through pauses in learning and self-regulation. These instructional practices may have initiated self-regulating behaviors or independent learning practices that improved homework performance (Lynch, 2006) in developmental algebra I.

Developmental algebra I students' metacognitive self-regulation displayed a moderate relationship with online-homework grades and was an insignificant predictor of final examination grades. However, increased self-regulation is known to cause persistence in academic work and has been found as the best predictor of academic performance (Butler, 1995; Zimmerman & Martinez-Pons, 1990). Lynch (2006) found that students recognized effort regulation and time management as important resources for learning as they became more independent and intentional learners. Moreover, Bembenutty (2009) found effective time management for college freshmen in an introductory mathematics course related to student achievement.

As with the research of Kitsantas, Cheema, and Ware (2011), self efficacy for performance and learning strongly related to mathematics achievement and positively predicted achievement for all levels of student ability (Collins, 1982) in developmental algebra I. Self-efficacy for learning and performance was a stronger predictor of final examination grades for the high-accountability group than the low-accountability group. The frequency of setting homework completion goals was known to positively relate to student self-efficacy beliefs (Bembenutty, 2009). Moreover, those who self-monitored their progress experienced greater self-efficacy and academic achievement (Clancy, 2005). High student accountability and formative assessment promoted self-efficacy as a supportive role in student cognitive engagement (Pintrich & De Groot, 1990) and positively influenced expectations of performance (Bandura, 1977; Brown Jr. & Inouye, 1978; Pintrich & De Groot, 1990). Online homework was a management tool that increased self-efficacy (Bembenutty, 2009), properly reinforced instruction, and inspired independent learning (Singh, Granville, & Dika, 2002), self-regulatory skills, and matured help seeking behavior.

Help seeking was considered a neutral or undetermined resource for learning by students in developmental alegbra I. Classroom structure (Newman, 1990), student goals, and adequate feedback (Renkl & Atkinson, 2003), such as high accountability and formative assessment, directly affected students' feelings about seeking help and their engagement in mathematical tasks (Ryan & Pintrich, 1997). The high-accountability group reported self-efficacy as a positive and help seeking as a negative predictor of final-examination grades in developmental algebra I. Participants who held themselves accountable increased their self-efficacy (Clancy, 2005) and reduced their constant need for assistance while studying algebra. High-accountability students most likely adapted deeper learning techniques in order to master algebraic concepts and become instrumental learners (Ames & Archer, 1988; Nelson 1985). Instrumental learners (a) effectively use help-seeking strategies (Pintrich & DeGroot, 1990; Ryan & Pintrich, 1997), (b) use computer (Beal et al., 2008; Vassen, 2014) and teacher (Karabenick & Berger, 2013) resources appropriately, (c) independently solve problems with adequate effort, (d) believe in high-performance expectations, and (e) are not worried about their self-esteem (Newman, 1990). When students put effort into appropriate learning strategies that elaborated and caused deeper understandings of concepts, their achievement increased (Purdie & Hattie, 1999). High accountability and formative assessment prompted students to monitor their progress, use available resources effectively, and apply adequate effort in order to increase achievement in developmental algebra I.

Recommendations for the Field

Social promotion, high-stakes testing, and seat time may be factors in primary and secondary grades that promote passive learning and instruction. High-school courses or freshmen seminars that utilize high accountability and formative assessment may encourage students to become practical, reflect on how they could complete assignments, and be prepared for examinations. This might positively affect students' study skills and performances during mathematics remediation or in college-level mathematics.

Since continuing onto higher education is a student choice and not a state mandate, community-college instructors often assume that developmental algebra I students will learn independently and actively participate as students who attend their college-level courses. Remediation is the gateway to higher education and instruction should condition students to become active and independent learners. High accountability for online homework and formative assessment were proven to increase study time outside of the classroom, reduce test anxiety, and help students regulate their effort to learn algebraic concepts.

With the utilization of an online homework system, high accountability for homework coupled with formative assessment may be the performance management plan needed for students in developmental algebra I. This study's results suggest that this plan helped students to recognize their actual performance, assess their true capability, become intentional help seekers, and regulate their effort to learn algebra and achieve good grades.

By the end of this study's semester, a majority of high-accountable students were not given an examination or formative assessment for half of the course's content due to incomplete homework. Therefore, most highly accountable students received the final examination with a 50 percent range of mastery in the course's content. It is likely that these students were not motivated enough to devote extra time or effort to focus and learn all the developmental algebra I content needed to test into college courses.

Students who re-enrolled into developmental algebra I and repeated the same behavior possibly would never remediate and ultimately drop out of college. Many instructors have proposed student motivation as an important factor for successful remediation in mathematics (George, 2010). High accountability for online homework and formative assessment were performance management strategies that focused students on skills to become active developers of their own goals, competence, and mastery (Gillespie, 2009). The following systemic modifications are recommended prototypes that might promote student motivation in developmental algebra I. For readability, unit one and two were named module one and unit three and four were named module two.

Mathematics Instructors

When an instructor pilots these instructional strategies, high accountability for online homework and formative assessment, at least one class meeting should be held in a computer lab, one week before target dates for benchmarks, to assess student progress, address questions on content, and have students monitor the time and effort they require to reach a performance goal. Some instructors may argue that time in the lab will shorten the time available to cover all course content. Lab time (a) promotes remediation of learning, (b) will most likely increase teacher-student discourse, (c) improves accuracy in students' judgments of their own ability and capability to learn topics, and (d) reduces passive instructional and learning behaviors often exhibited in developmental algebra I (Gillespie, 2009). Active learning eliminates constant review of simpler tasks and allows ample time to master new ideas. Cumulative review of topics should take place with additional instruction to reinforce concepts that were misunderstood to achieve deeper learning after each respective formative assessment.

Departments of Mathematics

To support these instructional strategies, departments should organize all sections of developmental algebra I to deliver the same (a) topics within a module, (b) online homework questions, (c) concise unit examinations, and (d) a cumulative exit examination. Students should be required to complete and receive satisfactory grades in modules one and two in developmental algebra I in order to receive an exit examination. The approach of high accountability and formative assessment may lead to new levels of independent and active learning within developmental algebra I, which may ultimately improve remediation rates in developmental mathematics.

Mathematics departments that pilot high accountability and formative assessment might offer a module-based course for developmental algebra I. Colleges have different settings, means, and trends. Student trends observed during this study set groundwork for a more productive developmental algebra I program.

Approximately half of the students who were held accountable for online homework and formative assessment did not attempt or complete units three and four. A module-two course option should offer students, who successfully completed units-one and –two, re-enrollment into developmental algebra I with a seamless continuation of learning content in units-three and -four without spending time on topics already mastered. The offering of a module two option could provide time to actively learn difficult concepts and support the mastery learning needed in a discipline where knowledge of sequential topics is required to pursue college level coursework. To avoid a lapse of time between modules and to maximize productivity, this option may be ideal during the winter and summer sessions. Winter and summer sessions allow students to focus their instructional time and effort on one course. Such sessions might increase staffing but will most likely produce higher remediation success rates.

College Deans of Remediation

A grading policy that counted students' completed and necessary work to remediate, would improve college remediation. This policy should motivate students toward greater effort and study for the exit examinations (George, 2010). Students' progress through module one and two, as well as their passing grade on the exit examination for developmental algebra I, should be documented separately on student transcripts. College grading policies could include SA, SB, SC, and R for modules. S represents satisfactory completion; A, B, or C is the grade earned for the module, and R represents repeat of the module required. This grading scheme would help student advisors distinguish among students who must re-enroll into developmental algebra I, students who may enroll into the module two option, and students who have exited remediation and may enroll in a college mathematics course.

State and Federal Policymakers

Remedial mathematics programs were highly effective at resolving skill deficiencies for students who needed the least amount of support. Those with the greatest deficiencies were the least likely to remediate successfully (Bahr, 2008; Kowski, 2014). While the New York Statewide Plan for Higher Education Plan 2012-2020 predicted an influx of community college students needing financial aid for remediation (Boone, 2012), community colleges have spent approximately $70 million statewide (Langstaff, 2013) and $4 billion nationwide (Scott-Clayton & Rodriguez, 2012) per year on remedial programs with low success rates (Bahr, 2008). The prototype illustrated above proposes an initial, slight increase in cost, addresses student deficiencies, and will most likely increase remediation success rates, which may ultimately reduce the overall cost of remediation.

Recommendations for Further Research

The following recommendations are made to widen the scope of research on student accountability and formative assessment in mathematics education.

- Construct a rubric for each question on the cumulative final examination to determine surface and mastery learning among levels of easy, moderate, and difficult tasks between low- and high-accountability groups in developmental algebra I.

- Examine if there are differences in retention between low- and high-accountability groups in developmental algebra I.
- Identify how much time and effort high-accountability students spend on individual homework assignments. Distinguish which developmental algebra I topics students avoid, postpone, or are quick to complete.
- Conduct a qualitative study to investigate the frequency and themes of teacher-student and student-student discourse between low- and high-accountability groups.
- Replicate this study in elementary and secondary school settings.
- Replicate this study with a larger number of participants.
- Replicate this study for two semesters with the module two option. Participants would respond to the MSLQ at the end of the first semester. Offer the option of module two to students who were successful in module one and did not succeed in developmental algebra I. Participants from the module two option would respond to the MSLQ at the end of the second semester. Compare MSLQ responses and grades between the first and second semesters.

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APPENDIX A

Formative Assessment Student Worksheet

Name______________________________ Exam #2 Review

For solutions marked incorrect, please state if you understand or do not understand the mistake in your answer by placing an "X" in the appropriate box.

Question	Incorrect	Understand	Do not understand
1			
2			
3			
4			
5			
6			
7			
8A			
8B			
8C			

Questions or concerns____

APPENDIX B

Instructional Steps to Formatively Assess Students

Unit Exam, version 1

1. Mark exams only with comments. Do not put the numerical grade on the exam paper.
2. Record students' numerical grades in your grade book.
3. Return marked exams with the "Incorrect, understand, do not understand" tables.
4. Review the exam questions and answers with the whole class.
   - Students that took the exam should fill out the "Incorrect, understand, do not understand" tables accordingly.
   - Those that did not take the exam should take notes since they will take version 2 of the Unit Exam shortly.
5. Students who took the exam will return their "Incorrect, understand, do not understand" tables to you.
6. Tally the number of students who still "do not understand" their mistakes for each question.
7. Use the follow-up questions at the beginning of the classes that follow. The first follow up question should be the question(s) that scored the highest in tally.
8. While going through the follow-up questions evaluate if more practice is needed.
9. Return the "Incorrect, understand, do not understand" tables with their numerical grade.

Unit Exam, version 2

1. Mark exams only with comments. Do not put the numerical grade on the exam paper.
2. Record students' numerical grades in your grade book.
3. Return marked exams with the "Incorrect, understand, do not understand" tables during office hours or towards the end of class.
4. Students will return their exam and the table to you.
5. Add their "do not understand" responses to the class tallies.
6. Continue to present the class appropriate follow-up questions to acquire student mastery.
7. Return students their "Incorrect, understand, do not understand" tables with their numerical grade.
8. Return version 2 marked exams after all students receive formative assessment for Unit Exam 2.

APPENDIX C

Formative Assessment Follow-Up Question

The exercise: Add $\frac{3x-8}{x^2-5x+6}+\frac{x+2}{x^2-6x+8}$ and simplify your answer.

is an example and was a follow-up question to the formative assessment of unit examination 2. (Tobey, J., Slater, J., Blair, J. Crawford, J. , 2012, p.365)

APPENDIX D

Survey Instrument

PART I: Demographics (Questions 2, 3, and 4 - Pre-MSLQ only)

Directions: Complete questions 1 through 4. All information will be kept confidential and anonymous.

1. Participant Number____________________

2. Gender (circle one). Male Female

3. What year did you graduate from high school? ______________

4. How many classes are you taking this semester? _____________

PART II

Directions: The following questions ask about your motivation, learning strategies, and study skills for Beginner's Algebra. Remember there are no right or wrong answers; just answer as accurately as possible. Use the scale provided to answer the questions. If you think the statement is very true of you, choose 7; if a statement is more true of you, choose 6; if the statement is somewhat true, choose 5; if a statement is somewhat not true of you, choose 3; if a statement is less true of you, choose 2; if a statement is not at all true of you, choose 1. Find the number between 1 and 7 that best describes you.

1	2	3	4	5	6	7
not at all true	less true	somewhat not true		somewhat true	more true	very true

1. If I study in appropriate ways, then I will be able to learn the material in this course.
2. When I take a test I think about how poorly I am doing compared with other students.
3. I believe I will receive an excellent grade in this class.
4. I'm certain I can understand the most difficult material presented in the readings for this course.
5. When I take a test I think about items on other parts of the test I can't answer.
6. It is my own fault if I don't learn the material in this course.

7. I'm confident I can understand the basic concepts taught in this course.
8. When I take tests I think of the consequences of failing.
9. I'm confident I can understand the most complex material presented by the instructor in this course.
10. If I try hard enough, then I will understand the course material.
11. I have an uneasy, upset feeling when I take an exam.
12. I'm confident I can do an excellent job on the assignments and test in this course.
13. I expect to do well in this class.
14. If I don't understand the course material, it is because I didn't try hard enough.
15. I feel my heart beating fast when I take an exam.
16. I'm certain I can master the skills being taught in this class.
17. Considering the difficulty of this course, the teacher, and my skills, I think I will do well in this class.
18. During class time I often miss important points because I'm thinking of other things.
19. When studying for this course, I often try to explain the material to a classmate or a friend.
20. I usually study in a place where I can concentrate on my course work.
21. When reading for this course, I make up questions to help focus my reading.
22. I often feel so lazy or bored when I study for this class that I quit before I finish what I planned to do. (REVERSED)
23. Even if I have trouble learning the material in this class, I try to do the work on my own, without the help from anyone. (REVERSED)
24. When I become confused about something I'm reading for this class. I go back and try to figure it out.
25. I make good use of my study time for this course.
26. If course materials are difficult to understand, I change the way I read the material.
27. I try to work with other students from this class to complete the course assignments.
28. I work hard to do well in this class even if I don't like what we are doing.
29. When studying for this course, I often set aside time to discuss the course material with a group of students from the class.
30. I find it hard to stick to a study schedule. (REVERSED)
31. Before I study the new material thoroughly, I often skim it to see how it is organized.
32. I ask myself questions to make sure I understand the material I have been studying in this class.
33. I try to change the way I study in order to fit the course requirements and instructor's teaching style.

34. I often find that I have been reading for class but don't know what it was all about. (REVERSED)
35. I ask the instructor to clarify concepts I don't understand well.
36. When course work is difficult, I give up or only study the easy parts. (REVERSED)
37. I try to think through a topic and decide what I am supposed to learn from it rather than just reading it over when studying.
38. I have a regular place set aside for studying.
39. When I can't understand the material in this course, I ask another student in this class for help.
40. I make sure I keep up with the weekly readings and assignments for this course.
41. I attend class regularly.
42. Even when course materials are dull and uninteresting, I manage to keep working until I finish.
43. I try to identify students in this class whom I can ask for help if necessary.
44. When studying for this course I try to determine which concepts I don't understand well.
45. I often find that I don't spend very much time on this course because of other activities. (REVERSED)
46. When I study for this class, I set goals for myself in order to direct my activities in each study period.
47. If I get confused taking notes in class, I make sure I sort it out afterwards.
48. I rarely find time to review my notes or readings before an exam. (REVERSED)

APPENDIX E

Letter of Consent

September 2015

Susan M. Koukounas
Doctoral Candidate and Primary Researcher
Dowling College
Oakdale, New York 11769

Your instructor is participating in a study of teaching and learning, in cooperation with Dowling College. This study will determine if certain instructional processes affect student performance in developmental mathematics.

As a participant you will be asked to respond (via Google Form) to a questionnaire at the beginning and end of the semester. The questionnaire asks you about your study habits, your learning skills, and your motivation for work in this course. In addition, we would like to collect your online homework and final examination scores.

Your participation is voluntary and not related in any way to your grade in this class. To keep anonymity on Google Form, the researcher will assign you a randomly generated participant number. The researcher will open, match your participant number to your online homework and final examination scores, and analyze your responses by computer after your final grade is posted on the student portal.

You may decide to participate now but you do not have to answer any uncomfortable questions and may discontinue answering questions at any time. During the course of the semester, you can withdraw from the study at any time without penalty and any information given from you will be destroyed and deleted from the research paper. All your responses are strictly confidential and only the researcher will see your individual responses. A summary of the findings can be made available to you and all participants upon request.

If you have any questions or concerns please contact the researcher, Susan Koukounas at smk9@dowling.edu or her research and Dowling College's Institutional Review Board chairperson, Dr. Perry at perrysm@dowling.edu.

I acknowledge that I have read and understand the above information and would like to participate in this study.

Name (Print)____

Signature____________________________________ Date__________

Course Title and Meeting Time______________________________

APPENDIX F

DOWLING COLLEGE
Institutional Review Board

To: **Ms. Susan M. Koukounas**

From: **Dr. S. Marshall Perry**
Contact Info: perrysm@dowling.edu or 631-244-1884

Date: **October 12, 2015**

Re: Review of Human Subject Research

Project's Title: DEVELOPMENTAL MATHEMATICS: STUDENT ACCOUNTABILITY AND ITS EFFECT ON MOTIVATION AND ACADEMIC ACHIEVEMENT IN A BLENDED LEARNING ENVIRONMENT

The Institutional Review Board for the Protection of Human Subjects of Dowling College has approved your project with the following provisions:

a. This approval is for one year, **starting 10/12/2015** and **ending 10/11/2016**. If you wish to conduct research beyond this period of time, you'll need to fill out the **IRB Continuing Research Progress Report** form. It is your responsibility to ensure that you have an approved protocol at all times during your research.

b. Approved consent form(s) must be used by all subjects. You are responsible for maintaining signed consent form(s) for a period of at least five years except in the case of online research.

c. All modifications and/or changes to the approved protocol must be reviewed and approved by the IRB prior to implementation.

d. All adverse events as a result of this research must be reported to the IRB at the time of occurrence.

e. All principal investigators and other key research personnel have on file with the IRB their **Computer-Based Training (CBT) Certificates (i.e., IRB Course Completion Certificates)**.

Good luck with your work!

S. Marshall Perry, Ph.D.
IRB Chair