The effect of test design on student motivational strategies for learning and student retention

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THE EFFECT OF TEST DESIGN ON STUDENT MOTIVATIONAL STRATEGIES FOR LEARNING AND STUDENT RETENTION

A Dissertation

Submitted to the Graduate Faculty of the Louisiana State University and Agricultural and Mechanical College in partial fulfillment of the requirements for the degree of Doctor of Philosophy

in

Educational Leadership and Research

by

Jeanne C. Samuel
B.S., Excelsior College, 1994
M.Ed., University of Phoenix, 2003
August 2012
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DEDICATION

I dedicate this dissertation to my family, friends, and colleagues who have supported me emotionally and spiritually throughout this academic expedition. To my cohorts still travelling, I thank you for your support and leave you these words of wisdom that encouraged me along the way.

- Try to strive for balance between forever ABD and PHD. “There are two kinds of dissertations, perfect and done” – unknown author
- Keep this in mind as you collect and analyze data. “I have not failed. I've just found 10,000 ways that won't work” – Thomas Edison.
- Keep this in mind as you draft your conclusion. “A man should look for what is, and not for what he thinks should be” – Albert Einstein
- When you are ready to give up and toss in the towel, remember the words of Vince Lombardi, “It's not whether you get knocked down; it's whether you get up”.
- “The ultimate purpose of the dissertation is to complete it” – I heard at a recent conference

But, seriously, and specifically, I dedicate this to my family. I lost both parents during the journey process. My mother Doris encouraged me to listen and think. I never had a day that I did not know and feel that she loved me. My father Alan was the poster child of academia for me. It was not until his funeral that I learned from his own words why he chose to be an academic. His words lifted any doubts I had about pursuing the degree. To my siblings I appreciate you supporting me through the ups and the downs of the post-coursework challenge. Cliff, my son, I thank you for your willingness to share time with me with and my coursework and books. I appreciate you not permitting me to feel guilt when I was too busy to attend many of your
performances. I am so proud of you! To Suzi, part of the dynamic duo of Jan & Suzi, who kept me grounded and encouraged me every step of the way. You, like Cliff, hung in there a long time, patiently waiting for the day I would put down my computer, stop reading articles, and re-join the living. I am ready to take out the trash, wash cars, and cook a homemade meal.
ACKNOWLEDGEMENTS

I thank Dr. Eugene Kennedy who guided me to and through the finish line. I thank Dr. Yiping Lou, who challenged me to think deeply and taught me how to move from application thinking to conceptual. Abundant times thank you to Dr. Janice Hinson my first advisor and academic mentor. Were it not for Dr. Hinson’s dedication, enthusiasm, and expertise I would be forever ABD. Dr. Hinson is part scholar, part coach, and part cheerleader. Thank you to the LSU education faculty who taught me that educational technology is not about the current “it”. Thank you to my committee members for listening, challenging, and guiding: Dr. Earl Cheek, Dr. Eugene Kennedy, Dr. Janice Hinson, and Dr. Malcolm Richardson.
PREFACE

This study was presented at the Society of Technology and Teacher Education in March 2012, and received position recognition based upon the timeliness of this work. Reviewers commented that the paper “is a good and well-presented manuscript. It is well situated in the literature and the purpose and methods are clearly described. The ideas are also fairly novel”. The reviewers asked for “examples of the multiple choice test to picture how exactly it works - maybe some screenshots. Also, I would have liked to hear a bit more about the relationship between assessment (multiple choice)”. Another reviewer added,

Your submission deals with an interesting and important topic. The paper provides a good exploration of utilizing testing methods other than multiple choice exams. This provides an excellent starting point for those that are interested in moving away from multiple choice exams, with their inherent pitfalls, and looking for alternative methods that are still reasonable for use with large groups and not so time intensive in grading.

The recommendations have been incorporated into this dissertation.
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ABSTRACT

Large numbers of students attending community college lack essential college success skills (motivation and study strategies). Many of these students do not complete their degree programs. Identifying learning and teaching methods that promote the development of lifelong learning skills in addition to content acquisition is essential. This quasi-experimental research design study examined the effect of alternative multiple-choice question design on student motivational strategies for learning and retention. Participants were 59 students enrolled in a Microsoft® Office applications course at a public gulf coast community college. The discrete-option multiple-choice (DOMC) test was designed to limit cheating and guessing on tests. The designers of the test suggested that the test format might require students to change how they prepare for exams. Results showed that the test format can change both the motivational beliefs and learning strategies of students. The present study indicates that it is possible, to affect student retention at the course level by changing the test format. Students who have low levels of interest and lower levels of intrinsic goal orientation may be at risk for non-retention. Students taking the alternate form of multiple-choice test versus the traditional format held higher levels of intrinsic value overall. Results indicate that the discrete-option multiple-choice (DOMC) question format promoted student self-efficacy (SE) and intrinsic value (IV) in the treatment group. The significant change in the control group (traditional multiple-choice test format) was the decreased score of intrinsic value from semester start to end. Student grade point average continues to be an indicator of college completion. This research may be of interest to educators and instructional course designers.
CHAPTER 1: INTRODUCTION

Successful retention programs “do not focus on the goal of retention per se but on the broader goals of educating students” (Tinto, 1987, p. 8).

During the 2006-2007 academic year, 6.2 million students were enrolled in 1,045 U.S. community colleges (NCES, 2008). Sixty percent of new community college students enroll in remedial courses. According to Joanne Jacobs (Community Spotlight Blog, September, 2010) community colleges spend $2 billion a year teaching basic skills. Additionally, fewer than 25 percent of remedial students earn a degree within eight years of starting school (Bailey, 2009). Although this study focuses on community college students, retention and persistence to graduation are issues that concern administrators at many institutions of higher learning.

According to Bowler (US News and World Report, Education, 2009), “Thirty percent of college and university students drop out after their first year. Half never graduate, and college completion rates in the United States have been stalled for more than three decades,” (para 2). Reasons include demographic differences (Waller & Tietjen-Smith, 2009), the quality and availability of support services (Ackerman & Schibrowsky, 2007), or feelings of not being connected to the educational learning community (Wasley, 2006). In addition, Tinto (1987) cites academic difficulty, adjustment, goals, uncertainty, commitments, incongruence, and isolation as reasons students are not retained. The solution to the retention problem according to Tinto is not a “quick fix”:

…the secret to successful retention lies, [as] it always has, in the very foundations of the higher educational enterprise rightly understood, namely that it is at its core an enterprise committed to the education of all of its student, faculty, and staff members (p. 3).
Tinto (1987) recommends that “institutions should invest their energies to enhance the education of their students” (p. 17). If enhancing the education of students is key to student retention, and instructors have the most contact with students, what can instructors do to promote student retention? Is there a way to affect long-term retention from the short-term, per course, level?

As noted earlier, there are many factors that contribute to student attrition. One finding consistent in much student retention research is that the single most important retention factor is first semester grade performance (Allen, Robbins, Casillas, & Oh, 2008). However, by the time the first semester grade point average (GPA) data were available, the at-risk of attrition students are gone. What instructors need is an early indication of a students’ likelihood to complete the semester satisfactorily. Identifying student at-risk performance is not enough. What instructors need is a model that shows the inter-relationship of factors that affect student performance. For example, let us assume that a model that shows high student self-efficacy, moderated by appropriate use of learning strategies, promotes student academic performance; and, that high student performance promotes sustained student self-efficacy. Then, instructors can monitor and observe students’ motivational beliefs and learning strategy use in conjunction with the students’ performance. Instructors can introduce effective interventions as needed.

Research supports that self-efficacy moderated by cognitive strategy use leads to higher student persistence and effort (Gao & Newton, 2009; Sungur, 2007). Promoting student self-regulation can enhance learning and positively influence student performance (Pintrich & DeGroot, 1990). This study examines the impact of assessment, specifically multiple-choice testing design, on student motivation for learning and on student retention. The question that drives this research is: What is the impact of test question design on community college students’ motivational strategies for learning and retention?
Table 1.1
Definitions

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>Cost</td>
<td>Trade-off in terms of limiting other activities to engage in task (Gao &amp; Newton, 2009); amount of effort; cost may be emotional</td>
</tr>
<tr>
<td>Effort</td>
<td>Energy amount expended in the process (Gao &amp; Newton cite Zimmerman &amp; Riesenburg, 1997)</td>
</tr>
<tr>
<td>Elaboration</td>
<td>Learning strategies such as building connections between prior knowledge or experiences and new information (Lewalter, 2003); paraphrasing or summarizing the material, creating analogies, note taking and connecting ideas in students’ notes (Mousoulides &amp; George Philippou, 2005)</td>
</tr>
<tr>
<td>Importance</td>
<td>Attainment value (Gao &amp; Newton, 2009); importance of doing well in terms of task competence or achievement</td>
</tr>
<tr>
<td>Interest</td>
<td>Intrinsic value (Gao &amp; Newton, 2009); enjoyment the individual gets from engaging in or performing the task</td>
</tr>
<tr>
<td>Intrinsic Goal Orientation</td>
<td>Belief that learning ability can be improved through effort (Sungur, 2007)</td>
</tr>
<tr>
<td>Intrinsic Value</td>
<td>“Intrinsic value is the enjoyment one gains from doing the task” (Wigfield and Eccles 2000, p. 72). The intrinsic value sub-scale is comprised of the interest, intrinsic goal orientation, and task value micro-scales.</td>
</tr>
<tr>
<td>Organization</td>
<td>Identifying the main idea, outlining the text or material, and selecting and organizing the ideas in the material (Mousoulides &amp; George Philippou cite Garcia, T. &amp; Pintrich, P.R. (1994).)</td>
</tr>
<tr>
<td>Persistence</td>
<td>Continued effort or engagement in an activity regardless of obstacles (Gao &amp; Newton cite Zimmerman &amp; Riesenburg, 1997)</td>
</tr>
<tr>
<td>Rehearsal</td>
<td>Learning strategies such as memorizing by recitation or recapitulation (Lewalter, 2003)</td>
</tr>
<tr>
<td>Self-efficacy</td>
<td>Belief that they are able to perform a task and responsible for their own performance (Pintrich &amp; DeGroot, 1990); Expectancy</td>
</tr>
<tr>
<td>Self-Regulation</td>
<td>Setting goals, monitoring oneself, and evaluating oneself are examples of self-regulatory behavior (Zimmerman, 2000).</td>
</tr>
<tr>
<td>Task Value</td>
<td>Student perception about the importance of doing well on a specific task (Gao &amp; Newton, 2009)</td>
</tr>
<tr>
<td>Usefulness</td>
<td>Utility Value (Gao &amp; Newton, 2009); perception of usefulness;</td>
</tr>
</tbody>
</table>

1.1 Research Questions

R1. Can multiple-choice question design effect student motivational beliefs and learning strategy use?
R2. Can multiple-choice question design effect student retention?

1.2 Significance of the Study

The premise of this study is that altering the format of multiple-choice examination can affect student motivational beliefs, self-regulated study behavior, and student retention. This investigation sought to determine the impact of test format on student motivation, study habits and course completion. Self-regulation is a component of motivation. High student motivation promotes student academic performance (Pintrich & De Groot, 1990). Identifying a test method that motivates students to develop better student study skills may lead to higher grades, course retention, and graduation rates. The alternate question format proposed in this study can use and protect available course test banks. Therefore, teachers do not need to spend too much time creating new reliable and valid test questions. The alternate test format used in this study is only viable through the use of technology assistance. A computer or student response system delivery method collects student responses for grading, item analysis, and report generation. Furthermore, automated scoring provides immediate feedback to students for reflection and self-assessment. An additional benefit of the proposed test format is that it provides student learning diagnostics for instructors and students.

1.3 Study Limitations

Limitations of this study were that the study participants were self-selected (they registered for specific sections). In other words, the study cohorts were not randomly selected. Another study limitation was that the sample sizes for the treatment and control groups were small. Although a pilot study was conducted in the semester preceding this research, the data for this study was collected during only one semester. The Motivated Strategy for Learning
Questionnaire (MSLQ) is a self-report instrument and subject to the limitations of a student self-report.

1.4 Summary

Large numbers of students attending community college lack essential learning skills. Identifying learning and teaching methods that promote the development of lifelong learning skills in addition to content acquisition is essential. This quasi-experimental study investigated the impact of an alternate multiple-choice test format on student motivation and learning strategies and on student retention.
CHAPTER 2: LITERATURE REVIEW

2.1 High Enrollment. Low Graduation Rates

The 2009 American Association of Community Colleges (AACC) survey of member colleges (Mullin & Phillippe, 2009) revealed that,

On average nationally, students enrolled in credit-bearing courses at U.S. community colleges in fall 2009 was 11.4% higher than it was in fall 2008 and 16.9% higher than it was in fall 2007. The largest growth came in the full-time student population, which grew by 24.1% between fall 2007 and fall 2009 (p. 5).

Ninety-five percent of “community colleges have an open admissions policy” (NCES, National Center for Education Statistics, 2008). The Community Spotlight Blog post by Joanne Jacobs (Jacobs J., 2010) states that although community colleges “spend $2 billion a year teaching basic skills”, within eight years of starting school, “fewer than 25 percent of remedial students earn a degree”. This statistic is daunting when you consider that 60 percent of entering community college students need to take at least one developmental course (AACC calls on colleges to redesign, reinvent and reset, 2012). In a 2010 study, Measuring Success by Degrees: The Status of College Completion in Southern Regional Education Board States, Louisiana ranked 9th in the nation for high school graduates enrolling in 2- and 4-year colleges within a year of getting their diplomas (Collins, 2010). That is about 70% of Louisiana high school graduates. These findings were based on 2008 data. Based on 2002 data, only 53% of 4-year college enrollees graduated. Based on 2005 data, only 6% of 2-year college enrollees graduated (Collins, 2010). These statistics are comprised from students who graduated from the same school in which they enrolled and within 6 years of enrolling in the school. The next section presents some of the reasons attributed to low student graduation rates.
2.2 Many Students Lack Success Skills

Some researchers focus on the amount of time students spend studying. Student study time in 2003 was just over half of what it was in 1961 (Babcock & Marks, 2010). Regardless of declared major or demographic subgroup, students study only fourteen hours per week. This is ten fewer hours outside of class per week than 1961 students. The authors cite one research study where a forty-minute reduction in study time translated to a 24-point reduction in GPA. The analysis was based on data collected from several different studies of full-time students attending four-year colleges in the United States during 1961, 1981, 1987–89, and 2003–2005. This change was not due to an increase in time working (for pay or volunteer). Many of the study hours were re-allocated to outside leisure activities. For more than 50 years, for every course credit-hour, students have been expected to study two or more hours per week. At minimum, one, 3-credit-hour course requires six hours of study.

There are many reasons for this change in student study time. Babcock and Marks (2010) suggest two reasons. Some drops in study time may have been due to technology reducing time on task. One example of time on task is writing a paper using a word processor rather by hand. Another example of time on task is conducting research using the Internet versus physically going to a library. Babcock and Marks also suggest that there exists unspoken consent in this change. They state this change results from grade inflation due to academic requirement leniency. They propose that students as consumers ask for more leisure time and faculty who need research time comply with the student request. Students voice their preferences by evaluating faculty and courses. Lack of college success skills and insufficient study time of today’s students is a challenge for community college faculty. This section mentioned some
factors contributing to students’ lack of college success. The next section will present the purpose of assessment.

2.3 Class Assessment

“Teaching without learning is just talking”. – Angelo & Cross

The “central purpose of Class Assessment is to empower both teachers and their students to improve the quality of learning in the classroom” (Angelo & Cross, 1993, p. 4)... There are two types of classroom assessment; formative and summative. Generally, there are two differences between formative and summative assessment. Formative assessment tends to be a low or no stake assessment presented before a course or at the end of a unit. It is primarily used to by students and teachers to adjust the course. Summative assessment is used to measure learning or for assigning a grade to a student. It is conducted at major course points such as at the end of a unit or at the end of the course. Class assessment according to Angelo and Cross is synonymous with formative assessment. Unlike summative, formative assessment is ungraded and not used to determine how much or how well the students have learned the material. Although used for formative purposes, the study design focuses on summative assessment. In addition to being “demonstrably reliable, valid, and free of bias”, summative assessment “must take into account student anxiety, cheating, and issues of fairness” (p. 5). In addition, regular and consistent grading increases student studying. Bean and Peterson (1998) found that students will adjust their study habits in preparation for classes which regularly grade participation.

Often, assessment is used to evaluate the success of a teaching or learning method by examining results (Cortright, Collins, Rodenbaugh, & DiCarlo, 2003). The results indicate to the teacher the content learned (Boud et al., 1999). Cortright et al. (2003) recommend using exams
to “help instructors teach and students learn” (p. 106). Applying this approach to test-based learning, the goal is to increase the average score per class and to promote student learning strategies. A shift from the current educational assessment model to one that more deeply engages students has the potential to promote learning and self-regulated behavior. Boud, Cohen, and Sampson (1999) allude to the current education model as one where assessment determines educational goals rather than follows them. Other criticisms about multiple-choice tests will be presented in the next section.

Multiple-Choice Tests are an Integral Part of Formative Assessment

One type of assessment frequently used in the United States is the multiple-choice test (Phelps, 1996). This test format has both advocates and opponents. Supporters say that multiple-choice tests can assess learning of course content more broadly (more concepts). One of the complaints about multiple-choice tests is that they often test only knowledge-based questions.

This study uses multiple-choice (MC) questions as an integral part of formative assessment. Higgins and Tatham (2003) state that knowledge-based multiple-choice questions within formative assessments are useful “to check whether students have grasped the basics” (Higgins and Tatham, 2003, p. 4). Formative assessment “helps make student’s thinking visible to themselves, their peers, and their teacher” (Bransford, Brown, & Cocking, 2000, p. 19). “Feedback is most valuable when students have the opportunity to use it to revise their thinking as they are working on a unit or project” (p. 141). Formative feedback should support students while they are “engaged in the act of production of a piece of work” and provide “opportunities to repeat” the same “task-performance-feedback-cycle” by permitting students to re-submit work (Nicol & Macfarlane-Dick, n.d., p. 5). It can transform learning by providing an opportunity for students to “critique long held assumptions and worldviews, hold them up for examination and
either reject or accept them” (Fook & Sidhu, 2009, p. 4). Frequent assessment can be useful diagnostic tools since they help teachers to “generate cumulative information about students’ levels of understanding and skill so that can adapt their teaching accordingly” (p. 7).

**How do we know students are really learning?**

The emphasis on testing as assessment can lead to the presumption that tests measure a student’s knowledge without affecting that knowledge (Marsh, Roediger, Bjork, & Bjork, 2007). Assessing student knowledge is less accurate due to a number of factors. These factors include: negative interference effect, student guessing, cheating, and student test taking abilities. Teachers use formative assessment to determine whether students are understanding concepts. Summative assessments are used to measure and grade evidence of student learning. However, often grades earned from students’ completion of multiple-choice tests are not true indications of what students know and do not know. Figure 2.1 displays the four test answer conditions (quadrants). There are two conditions for knowledge acquisition: known (knows the correct answer) and not known (does not know the correct answer). There are two conditions for answer correctness: correct and incorrect. This research seeks to investigate a testing format that promotes student responses of the Q4 quadrant type and reduces responses in the Q3 quadrant type. The Q4 quadrant is the condition where the student knows the correct answer and answers the question correctly. The Q3 quadrant is the condition where the student does not know the correct answer and answers the question correctly. Traditional MC tests reward for correct answers but there is no way to determine what amount of correct answers were guesses, wrong answers were guesses, and how many wrong answers were selected despite the student knowing or partially knowing the correct information. Confidence testing is one method of acquiring diagnostic information.
from student responses (Swartz, 2006; Taylor & Gardner, 1999) and reduces guessing (Omirin, 2007).

Figure 2.1. Test Error Quadrants: 4 Answer Conditions

As Fook and Sidhu (2009) state, when formative assessment indicates that students lack understanding or skill, the teacher makes adjustments to the teaching process (course flow and presentation). However, often the student makes little or no adjustment to their learning process. Finally, there is the problem with opportunity to cheat (Foster & Miller, 2009). Cheating is the act of memorizing or copying test items and/or sharing them with other students. Discrete-option multiple-choice (DOMC) testing is the term given for a multiple-choice test design that displays the answer options one at a time. DOMC testing may decrease the effect of negative memory interference, theft of test items during testing and review, and encourage students to prepare for tests. It is the latter benefit which in part, is a focus of this study – motivating students to employ strategies for learning.

The rest of this chapter will present learning theory, test question design, and the role of question design on student self-regulated behavior and on retention. In addition, advantages and
disadvantages of multiple-choice questions will be presented, followed by possible solutions devised to overcome the disadvantages of traditional multiple-choice format.

2.4 Learning Theories and Models

Self-regulated Learning

Alfred Bandura described self-regulation as controlling our behavior through self-observation, judgment, and self-response (Boeree, n.d.). “Self-regulated learning (SRL) is used to describe the attributes of successful learners” (Schloemer & Brenan, 2006, p. 81). These learners “use various learning strategies and continually monitor their progress” (Schloemer & Brenan, 2006, p. 81) and “modify their behavior in an effort to improve their learning process” (p. 82). Schloemer & Brenan cite changes in length of time to study, number of times to read materials, and the need for tutoring as examples of behavior modification. Learning, introspection, and modification are parts of an iterative process repeated until the students discover a successful formula for learning (Schloemer & Brenan, 2006, p. 82). Pintrich, Smith, Garcia, and McKeachie (1991) developed the Motivated Strategies for Learning Questionnaire (MSLQ). The MSLQ is a self-report instrument used as a whole or modules of the whole to measure students’ levels of motivation and cognitive learning strategies. Keller identified four categories of learner motivation and Gagne identified nine instructional events. Gagne’s Nine Instructional Events can be mapped to Keller’s learning motivation model. McKeachie and Pintrich developed a conceptual model of teaching and learning in college classrooms that combine aspects of self-regulated learning theory and student performance. Peng’s (2006) diagram of McKeachie and Pintrich’s model follows. Sungur (2007) and Gao and Newton (2009) developed achievement goal theories by conducting path analyses on the components in the latter half of Peng’s diagram.
Keller and Gagne

Keller’s ARCS Model of Motivation identifies four categories of learner motivation in instruction: attention, relevance, confidence, and satisfaction. Figure 2.2 displays the categories. The categories correspond to learner characteristics in response to internal and external motivation prompts.

Figure 2.2. Keller's ARCS Model of Motivation

Gagne outlined events and corresponding cognitive processes (Gagne, Briggs, & Wager, 1992 S cited by Kearsley, n.d.) that can be merged with ARCS as follows:

Table 2.1
Gagne's Nine Instructional Events

<table>
<thead>
<tr>
<th>Keller’s Categories</th>
<th>Gagne’s Events</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Attention</strong></td>
<td>(1) gaining attention (reception)</td>
</tr>
<tr>
<td><strong>Relevance</strong></td>
<td>(2) informing learners of the objective (expectancy)</td>
</tr>
<tr>
<td></td>
<td>(3) stimulating recall of prior learning (retrieval)</td>
</tr>
<tr>
<td></td>
<td>(4) presenting the stimulus (selective perception)</td>
</tr>
<tr>
<td><strong>Confidence/Satisfaction</strong></td>
<td>(5) providing learning guidance (semantic encoding)</td>
</tr>
<tr>
<td></td>
<td>(6) eliciting performance (responding)</td>
</tr>
<tr>
<td></td>
<td>(7) providing feedback (reinforcement)</td>
</tr>
<tr>
<td></td>
<td>(8) assessing performance (retrieval)</td>
</tr>
<tr>
<td></td>
<td>(9) enhancing retention and transfer (generalization)</td>
</tr>
</tbody>
</table>
2.5 Self-Regulation Models (Theoretical Framework)

Figure 2.3 is an adaptation of Peng’s (2006) diagram of Mckeachie and Pintrich’s conceptual framework of teaching and learning in college classrooms.

![Conceptual Framework: Teaching and Learning in College Classrooms](adapted from Peng, 2006)

It is a mesh design model demonstrating that there is not a linear process from the skills students have when they enter a course to those they possess at the conclusion of a course. Student perception about the value of the tasks, student motivation, and student self-regulation affect learning in addition to the instructional methods and task characteristics.

The model follows the process of students entering a course through their academic performance at the end of a course. Students enter with unique characteristics, the instructor develops and presents the course using preferred methods unique to him or her, and the course tasks also have different characteristics. For example, one task may require a student to be able to define a term while another task may require a student to solve a problem. How students approach the tasks and feel about the tasks are the boxes named student motivation, student
cognition, and student involvement in self-regulated learning. These three boxes are the focus of the present study. They are the student motivational beliefs and learning strategies. The studies by Gao and Newton (2009) and Sungur (2007), presented later in this chapter, break down the three motivational belief and strategy for learning boxes to demonstrate the inter-relationship between the different belief scales and strategy scales.

**Achievement Goal Theories**

Two models of motivational beliefs and strategies for learning were synthesized by this author to create a conceptual framework for this study. These models were Sungur’s (2007) and Gao and Newton’s (2009) achievement goal theories. For clarity and consistency, the term cognitive strategy use (CSU) will be used instead of metacognitive strategy use. The applicable findings of the Sungur study were that predictors of cognitive strategy use by students were intrinsic goal orientation, task value, control of learning beliefs, and self-efficacy. The effect of motivational beliefs for learning on effort regulation was mediated through cognitive strategy use in the Sungur model. The conclusion of the researchers was that for students to engage in a task, they must be motivated to use known cognitive strategies for learning. The models by Gao & Newton (2009) and Sungur (2007) included both correlation values and relationship directions. Both studies used path analysis to construct the models. The relationship directions will be assumed for the present study and new resulting correlational values will be calculated. A classroom learning model would add a box after the persistence/effort box for academic performance. Back channel lines could be drawn from academic performance to self-efficacy, interest, and strategy use -- mediated by self-regulation (to indicate student that performance affects how students feel and respond to performance feedback). Figure 2.4 is the combined (comprehensive) model of motivation and learning strategies being used for the present study.
Both Gao and Newton (2009) and Sungur (2007) researched the role of strategy use as mediator on motivational beliefs. Gao and Newton research the relationships between students’ self-efficacy (ability beliefs), goal orientation (interest and usefulness), task value (adequate incentives), and persistence/effort (participate or continue to participate in a task following failure). Their research supports previous findings that self-efficacy and task values predict student achievement. From the data, the authors developed an integrated model that may be used to predict strategy use and ultimately impact persistence or effort (self-regulation). The sample was 194 middle school physical education students (105 boys, 89 girls). Motivation and learning strategy data were collected via a self-report instrument. Ranked by greatest impact, the findings indicate that self-efficacy (SE), perceptions of usefulness, and interest contributed to strategy use (CSU) and ultimately achievement behavior.
Their hypothesis and findings were:

**Supported Hypotheses (Gao & Newton, 2009)**

- SE - perceptions of importance, interest, and usefulness, would significantly affect persistence/effort (supported)

**Unsupported Hypotheses (Gao & Newton, 2009)**

- SE - perceptions of importance, interest, and usefulness, would significantly predict strategy use (unsupported - importance to strategy use relationship)
- CSU would mediate the relationship between motivational beliefs and persistence/effort (unsupported)
- CSU would be the strongest predictor of persistence/effort followed by SE and perceptions of interest (unsupported – SE/perceptions of interest played similar and more predictive role than CSU on persistence/effort)

Sungur’s (2007) conceptual model was based on eight conventional beliefs:

1. “Students with high levels of self-efficacy and control over learning beliefs set challenging goals, use different strategies and find new strategies when old ones fail, put forth more effort to accomplish a task, and persist longer” (cite Hoy, 2004, p. 317).
2. “Students with intrinsic goal orientations engage in a task to learn and master it…Students with extrinsic goal orientation engage in a task for the purpose of demonstrating their ability to others or getting better grades” (p. 317).
3. “Students intrinsic goal orientations believe that ability to learn can be improved through effort, which is the main cause of their learning. They want to learn even
when performance is poor; thus, when they are challenged they do not give up, but adjust their effort using new strategies” (p. 317).

4. “Beliefs about control over learning have been found to have influence on goal orientations” (p. 318).

5. Students “with a high sense of self-efficacy and students who perceive the learning task as important and useful are expected to be intrinsically goal-oriented” (p. 318).

6. Students “who believe they have control over their learning are more likely to be self-efficacious in their learning” (p. 318).

7. Metacognitively “active students have a great deal of knowledge related to what cognitive strategies are available and what strategies are likely to be useful in learning” (p. 318).

8. Students “who are self-efficacious in their learning tend to persist at a task even when there are difficulties or distractions” (p. 318).

Note that the correlation values in the studies are low. In the study by Gao & Newton (2009), the correlation between self-efficacy (SE) and cognitive strategy use (CSU) was the most significant predictor of effort (.29). In the Sungur (2007) study, the relationship between SE and CSU was low (.15); with the best predictor of cognitive strategy use being intrinsic goal orientation (IGO). In the Gao & Newton and Sungur studies respectively, the relationship between self-efficacy and effort were .25 and .33. In the Gao & Newton study, the interest (a sub-scale of SE) relationship with effort was .34. The relationship between cognitive strategy use and effort, were .23 and .41 for the Gao and Newton and Sungur studies respectively.

In sum, the process of self-regulated learning is iterative. High self-efficacy and task value appear to correlate with high intrinsic goal orientation. Students with higher intrinsic goal
orientation tend to persist even when tasks are difficult; as do students with high self-efficacy. Students with high intrinsic goal orientation are likely to employ cognitive learning strategies. Those with high levels of self-efficacy belief tend to adjust cognitive strategies as appropriate.

**Motivation and Academic Success**

Gao and Newton (2009) reported that self-efficacy and task value predicted student achievement. They also found a significant correlation between self-efficacy and cognitive strategy use. Sungur (2007) found that the best predictor of cognitive strategy use was intrinsic goal orientation. Both studies revealed correlations between cognitive strategy use and effort and between self-efficacy and effort. Effort is a type of self-regulation strategy. Zusho, Pintrich, and Coppola (2003) researched the role of motivation and cognition in the learning of college chemistry. The authors divide strategies into two categories, superficial and those requiring deeper processing of course material. They examine three cognitive learning strategies: (1) Rehearsal, (2) Elaboration, and (3) Organization. They examined a fourth group of strategies, self-regulatory. Self-regulatory strategies included planning strategies, monitoring strategies, and strategies controlling their cognition. End of course grades were used as an outcomes variable. Although tests included both closed-ended (multiple-choice) and open-ended (case study) questions, the data analysis did not report the relationship between test format type and the students’ responses to motivational beliefs and learning strategies use. The findings were that over time, high-achieving students increased in self-efficacy over time and low-performing decreased. There were no significant changes in average student self-efficacy responses over time. They findings were the same for task value and for interest.
Ahmed and Khatib (2010) also researched predictors of student performance. They found that intrinsic goal orientation, self-efficacy, test anxiety, and self-regulated learning were significant predictors of student performance. One limitation of their study was that they studied five different courses. The MSLQ instrument is designed as a course-specific instrument. Differences in instructor pedagogy, course topic, and assessment type, for example, might affect the accuracy of the generalizability of the findings to specific courses, pedagogy, or assessment type. That said, the limitation also is a benefit. Findings in the study may most likely be generalizable across many different courses.

Justice and Dornan (2001) investigate the role of college student age (traditional versus non-traditional) on metacognition and motivation. Non-traditional students are age 25 and older. This study is relevant to the present study since the community college demographic is quite diverse. The study used multiple-choice testing for all assessments. Regarding age and gender, the research findings indicated that non-traditional students and female students were more likely to be self-motivated (initiative) when processing difficult materials than traditional students and male students. They found that in general, older students employed comprehension-focused strategies while traditional students used surface-level strategies. However, although the non-traditional students used two higher level cognitive strategies (elaboration and organization), the use did not relate to student course performance. They also found that older female students and younger male students are more likely to report using self-regulation (cognitive monitoring activities) than younger females and older males. More than any other group, older females reported higher levels of interest. For all except older students, self-regulated behaviors correlated negatively with student performance. Finally, the Justice and Dornan state that, “As the strategy becomes more familiar and the effort necessary to execute it decreases, the strategy
becomes more effective, and its use improves performance” (p. 246). They also suggest that although students, especially male students, may be “aware of the need to use strategies to learn course material, they may have lacked sufficient expertise to carry them out effectively” (p. 246).

2.6 How do we know students will complete the course?

Past research supports that student grade point average is the best predictor of student retention (Allen et al., 2008; Cameron & McLaughlin, 2008). The best predictors of academic performance are self-efficacy, test anxiety, and self-regulation (Pintrich & De Groot, 1990). Student motivation in addition to knowledge of cognitive strategies is necessary to promote student achievement (Pintrich & De Groot). Three motivational components linked to student self-regulated learning are expectancy, value, and affective. Expectancy “includes students’ beliefs about their ability to perform a task” (Pintrich & DeGroot, p. 33. This is measured by the self-efficacy scale in the MSLQ. A value component may be the students’ interest in a task or the belief that the task is important. This is measured by the intrinsic value scale of the MSLQ. Affective components may be the students’ belief that they are capable of or responsible for performing well or not. Affective components are measured within several scales of the MSLQ. The Pintrich and DeGroot study was conducted to determine how motivation and self-regulation influence academic performance (either independently or jointly). This study adds to the literature linking student motivation and self-regulation to retention. This study used test format to affect student motivation and self-regulation.

2.7 Traditional Multiple-Choice (MC) Test Format

The traditional multiple-choice question format is a stem (the question) followed by two or more alternative responses (key and distractors). It has been in use since it was introduced in
1914 by Frederick J. Kelly of the University of Kansas (Matthews, 2006). Refer to Figure 2.5 for the structure of a typical multiple-choice question design.

![Image of a computer file system]

**Figure 2.5. Anatomy of a Multiple-Choice Question**

Clegg and Cashin (1986) wrote a guide for improving multiple-choice tests. The following table comparing the strengths and limitations according to Clegg and Cashin was constructed from their article (See Table 2.2). Added to the below list of limitations are: negative memory interference (Toppino & Luipersbeck, 1993), testing effect (March et al., 2007), and repetition effect (Bacon, 1979), and ease of cheating or copying test items (Foster & Miller, 2009).
Table 2.2
Strengths and Limitations of Multiple-Choice Questions (Clegg & Cashin, 1986)

<table>
<thead>
<tr>
<th>Strengths of Multiple-Choice Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ MC items can be used to test all levels of learning (knowledge to evaluation)</td>
</tr>
<tr>
<td>▪ MC items can assess the ability to integrate information from a variety of sources</td>
</tr>
<tr>
<td>▪ MC items are useful for diagnosing student difficulties</td>
</tr>
<tr>
<td>▪ MC items can promote post-test discussion</td>
</tr>
<tr>
<td>▪ MC items can test the breadth in range of content, content difficulty, and comprehension of learning (more items can be asked)</td>
</tr>
<tr>
<td>▪ MC items require less student time to answer</td>
</tr>
<tr>
<td>▪ MC items can be easily scored by machine or person</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Limitations of Multiple-Choice Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ MC items are open to misinterpretation (students read more into questions than was intended)</td>
</tr>
<tr>
<td>▪ MC items may be perceived by students as too picky</td>
</tr>
<tr>
<td>▪ MC items may cause student anxiety when written to assess higher learning levels</td>
</tr>
<tr>
<td>▪ MC items limit demonstration of knowledge only to the options provided</td>
</tr>
<tr>
<td>▪ MC items are difficult to phrase such that all students interpret it the same way</td>
</tr>
<tr>
<td>▪ MC items take time and skill to construct</td>
</tr>
<tr>
<td>▪ MC items often fail to test higher levels of thinking</td>
</tr>
<tr>
<td>▪ MC items encourage guessing (on one right answer only questions)</td>
</tr>
<tr>
<td>▪ MC items may be easily guessed making it difficult to assess learning</td>
</tr>
</tbody>
</table>

2.8 Multiple-Choice Test imitations and Student Assessment Behavior

Students and Guessing

Students do not always accurately assess how well they understand course material. Zakay and Glicksohn (1992) found that when compared with students who were not overconfident, overconfident students had lower academic performance. Poorer students exhibit significant overconfidence with difficult questions (Koku & Qureshi, 2004). Generally students display under confidence with easy questions (Koku & Qureshi). Positive confidence answers are correct about 89.2% of the time. Educated guesses are correct approximately 75% of the time.
Wild guesses are correct approximately 60% of the time (Hammond et al., 1998). Students guess more near the end of the test (Taylor & Gardner, 1999).

Table 2.3
Percentage of Students Answering Correctly by Student Response Confidence

<table>
<thead>
<tr>
<th>Confidence Level</th>
<th>Confidence Description</th>
<th>% Correctly Answered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct Response</td>
<td>Student knows the correct answer</td>
<td>89.2</td>
</tr>
<tr>
<td>Educated Guess</td>
<td>Student thinks he/she knows the correct answer</td>
<td>75</td>
</tr>
<tr>
<td>Wild Guess</td>
<td>Students knows she/he is guessing</td>
<td>60</td>
</tr>
</tbody>
</table>

Practice, Memorization, Negative Lures, and Test Security

Guessing & Certainty

There is about 20% student uncertainty on tests. Ambiguous answers may be spotted by more able students while less able students overlook the ambiguities. In this scenario, better students are penalized (Taylor & Gardner, 1999). Hammond et al. (1998) recommend students make educated and wild guesses. Practicing with traditional multiple-choice question tests can lead to increased test scores (Foster & Miller, 2009). Test items are easily memorized or captured through technology and shared with others. The entire item content is displayed during traditional multiple-choice testing and review (Foster & Miller). To add precision (accuracy) to the format, researchers have employed various formats and scoring strategies such as confidence testing, discrete-object multiple-choice, weighting response options, and penalizing for guessing.

Negative Memory Interference

Negative testing effect is when students misinterpret repeat questions as more correct than new questions/distractors. Item repetition can result from pre- and post-test scenarios,
repeating quiz questions in tests and/or exams, or during exam review sessions. Negative option lures can affect memory and recall. The order of distractors and answer can affect recall.

Toppino & Luipersbeck (1993) studied the effect of repeating items (repeat vs. no repeat) on students’ answering correctly on a test to determine the negative suggestion effect. The study included 160 participants testing in three formats (conditions): True-False (48 items); True-False paraphrase (48 items); and 2-option multiple-choice (64 items). Students took the tests as individuals or groups of two to sixteen subjects. The study used a 3x2x2 factorial design and random assignment to the test conditions. The design was testing Condition x Item Repetition x Objective Validity. One significant finding was that the “most potent effect” may occur when false test items coincide with, and thus reinforce, students’ prior misconceptions (Toppino & Luipersbeck, 1993, p. 361). The students took a 60-item test in a 30-minute time period. The test was either True/False or two-item MC in format. They then took the test with an additional component. The students rated each statement on a seven-point validity scale. The scale ranged from 1 (definitely false) to 7 (definitely true) as follows: (1) Definitely false; (2) Probably false; (3) Possibly false; (4) Uncertain; (5) Possibly true; (6) Probably True; and (7) Definitely True. The second test was either True/False or two-item MC. There were two levels of item repetition (True/False question verbatim or True/False paraphrase). Objective validity was determined by whether the items were objectively true or objectively false. Students used the same 12 text passages to prepare for the test. Test items were single-item declarations. To provide recency and primacy memory buffering, the first and last ten of the 60 questions were not repeated on the second test. Of the 40 middle questions, half were on both the 1st and 2nd tests while 20 were unique to each test. Half the test items were true (10) while the other half false (10) in each group (new or repeat question) per test. The results indicate that prior exposure to a question increased
subjects’ belief that the question was true regardless of whether the question was true or false (Toppino & Luipersbeck, 1993, p. 360). The effect extends to multiple-choice two-option and may have a cumulative effect when teachers review true and false answers with students (p. 361). Toppino & Luipersbeck suggest that the effect may increase when extended to multiple-choice four-option tests. The researchers suggest an effective review method is to present and review “true information which contradicts each false item” (p. 362).

**Higher Order Thinking and Testing Effect**

Marsh, Roediger III, Bjork, & Bjork (2007) used four Mini-SATII tests to investigate the effect of multiple-choice tests using questions involving Bloom’s taxonomy. Questions ranging from level 1 to level 3 of Bloom’s Taxonomy were used to study on the testing effect. The average level was 2.5. Citing earlier studies conducted by the authors, the premise was that negative lures in multiple-choice questions linger. The findings were that these lures become integrated into the subject’s more general knowledge and lead to erroneous reasoning about concepts. To decrease the effect of negative lures, the researchers suggest three things: give immediate feedback to decrease negative lure effect on later tests; (2) offer an “I do not know” option with a penalty for wrong answers; and (3) ask application questions rather than definition or cued recall for tests. Testing as a study method is better than restudying material. Tests provide “retrieval cues in the form of answer options” and offer opportunities to practice retrieval (Marsh, Roediger III, Bjork, & Bjork, 2007, p. 195). The findings indicate that the positive effects of the testing effect outweigh the negative consequences. They observed a decrease in wrong answers from learning lure answers while testing.
Questions Perceived to be Repeated are Considered True by Students

Bacon (1979) investigated the effect of repeated statements on students’ ability to consistently recognize true answers. The repeated statements were ½ true, ½ false and ½ new, ½ repeated. There were two experiments in the article. Experiment 1 results found that subjects are pre-disposed to believe statements that seem to reaffirm existing knowledge and disbelieve statements that contradict existing knowledge. This may also explain Toppino and Luipersbeck’s (1993) finding that the strongest effect of negative memory interference occurs when false items coincide with students’ misconceptions. Experiment 2 results indicate that repetition is positively associated with belief. Experiment 1 (N=98) had three conditions (N=35 replication; N=32 recognition; N=31 recognition). The study used 1,000 published unrelated facts. For each fact, a false one was created. The 1,000 items were split into 10 decks of 200 statements (½ true and ½ false) out of which 195 pairs of equally plausible statements were retained for use. The final count was 120 paired statements (24 in each of 5 general categories). The initial test in the experiment was to rate each statement 1-7 as certainly true (1) to certainly false (7). The participants completed a second test 22 days later (repeated items in booklet format). The Condition 1 (Replication) group had a blank space to the left of each of 120 random order statements. Condition 2 (Recognition) was similar to Condition 1 except the participants were told to circle “yes” if the statement was repeated or “no” if the statement was new. Condition 3 (Recognition) used 24 statements from each category which appeared in a block proceeded by a category label. Condition 3 was treated as a repetition of Condition 2 since the format change produced no effects (Bacon, 1979). The findings were that items perceived to be recognized (old) are thought to be true regardless of “whether or not the test statement is old” (p. 248). The second experiment had 64 participants from the original experiment (N=32, N=32).
Condition 1 (Uninformed) was one in which the subjects were told 30 statements were new, 30 were changed statements from earlier statements (now true became false and false became true), and 30 were verbatim repetitions of earlier statements. Condition 2 (Informed) was one in which headings above each block indicated the statement category were: “These are new statements that were not presented last time”, “These statements have been changed from last time; they have been re-written so that if they were true last time they are false now, and vice versa”, and “All of these statements are identical to statements presented last time” (p. 251). Regardless of whether statements are repeated, new, or changed, if they are judged to be repeated (perceived to be repeated versus actually repeated), they are considered true by subjects. Statements are more likely to be considered false if both are considered changed. “Correctly labeled contradictions” are considered false (p. 251). A limitation to this study is whether mislabeling categories would yield the same results. In sum, the findings indicate decisions to consider statements as true is dependent upon “recognition decisions” rather than memory for prior ratings, content familiarity, or other more complex cognitive procedures: (Bacon (1979, p. 252).

2.9 Strategies to Overcome Limitations of Traditional Multiple-Choice Tests

Limiting Guessing

As mentioned in the last section, Hammond et al. (1998) recommended guessing as a test strategy. Betts, Elderly, Hartley, and Trueman (2009) also recommend that students guess on tests when there is no penalty for guessing. Since students guess more at the end of a test (Taylor & Gardner, 1999), allow ample time for students to complete assessments. Present and review true information that contradicts each false item (Toppino & Luipersbeck, 1993). In addition, alternate question design is used to improve the accuracy of tests by limiting guessing, limiting cheating, and promoting self-regulated behavior (Foster & Miller, 2009). Confidence testing is
used as a diagnostic tool by teachers to determine guessed answers from known answers.

Confidence testing is also a mechanism used to promote reflection in students and to promote self-regulated behavior. Weight scoring is employed to discourage guessing (Davies, 2002; Frary, 1989; Koku & Qureshi, 2004; Swartz, 2006; Taylor & Gardner, 1999).

**Negative Testing Effect**

Marsh et al., (2007) make the following four recommendations: use testing as a study method rather than restudy material; offer immediate feedback to decrease negative lure effect; add an “I don’t know” option; use application cues instead of definitional cues. Since negative testing effect is cumulative, limit the number of answer options on multiple-choice tests (Toppino & Lupersbeck, 1993). Swartz (2006) recommends limiting the number of options to three.

**Optimal Multiple-Choice Question Design and Pedagogy**

Although three to five response options is most common, research states that three options are the optimal number (Davies, 2002; Petr, 2001) and that the fourth option “often resulted in writing a throwaway choice that added no value to the item” (Swartz, 2006, p. 216). Students perform better when they must justify their answers by providing contradicting reasons for their choices. It is useful to provide immediate per question feedback rather than at the end of tests (Koku & Qureshi, 2004). Embedded lecture questions using clickers are often used to promote discussion, to provide feedback, and as a diagnostic for both teachers and students to assess learning (Bruff, 2009). Instructors can use the test review activity to present true information that contradicts each false item (Toppino & Luipersbeck, 1993).
Test Strategies to Promote Self-Regulated Learning Behavior

Grade Weights

Past research has demonstrated greater testing accuracy by using grade weights, altering test delivery method and design, and changing testing strategies. Betts et al. (2009) deducted 1/3 point per incorrect answer. Students scored higher and left fewer unanswered questions without a correction for guessing. Frary’s (1989) literature review finds weighted multiple-choice tests are still valid and reliable as traditional multiple-choice tests. Hammond et al. (1998) used a lose 1 point scale for incorrect answers.

Confidence Level

Confidence Level (CL) is also referred to as confidence score and Information-Referenced Testing (IRT). Confidence Level testing/Information-Referenced Testing (CL/IRT) improves testing accuracy. Kleitman and Stankov (2005) broke student response strategies into four categories. For general knowledge questions, students employed the immediate recognition strategy. Students guessed when they answered encyclopedia type questions. When students were not able to easily access knowledge or content from memory, and the questions and the answers provided hints to the students, they used inference to answer the questions. When hints were not provided and students were not able to easily access the knowledge or content from memory, they used intuition. Davies (2002) stated that students’ confidence fell into six categories (p. 121):

- I know it
- I’m not quite sure, but I think I know it
- I’m not quite sure, now that I see the answers, I know it
Perhaps I can identify the answer by a series of deductive processes on the distractors

I guess then I will have a 33% [3 option test] chance of getting it correct

I really know it, of not, I’ve got it wrong!

Gardner-Medwin and Gahan (2003) describe the levels of a person’s belief as knowledge, uncertainty, ignorance, misconception, or delusion. They stated that confidence testing was designed to improve the study habits of students.

To encourage an awareness that uncertain but correct answers, or lucky guesses, are not the same as knowledge and that confident wrong answers deserve special attention: consideration of why the student assigned such a high confidence and how their thinking about the issue can be adjusted for greater reliability (p. 148).

Regarding confidence, Rosenthal et al. (2010) found that when students are queried prior to an assessment, they are overconfident. The researchers found that when students reported their level of confidence that their responses were correct on a per question level (micro-level), not per exam (macro-level), the “proportion of questions answered correctly increased with confidence-rating: (p. 61). Therefore, the recommendation is that for more accurate student self-assessment, students should report their confidence in their knowledge on a per question basis. Furthermore, students should rate their confidence after not before answering each question,

The pedagogical advantage of CL testing is that the teacher can determine when students are guessing (Swartz, 2006). Table 2.4 is a summary of Swartz’s Confidence Level testing (p. 217).
Table 2.4
Swartz’s Summary of the CL/IRT Testing Model

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Student Action</th>
<th>Root Cause</th>
<th>Credit Earned</th>
<th>Pedagogical Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student is “fully”</td>
<td>Chooses correct option from first level</td>
<td>Student confidently comprehended the objective</td>
<td>1.0</td>
<td>None</td>
</tr>
<tr>
<td>informed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student is “partially”</td>
<td>Chooses correct option from second level</td>
<td>Student is not confident or comprehends only part of the objective</td>
<td>0.5</td>
<td>Adjust the scope of the instruction and study to “fill” in the “gaps”</td>
</tr>
<tr>
<td>informed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student is “uninformed”</td>
<td>Chooses “I don’t know”</td>
<td>Student cannot answer the item</td>
<td>0.3</td>
<td>Cover the material again fully and increase confidence</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student is “misinformed”</td>
<td>Chooses incorrect option from first or second level</td>
<td>Student is confident but wrong</td>
<td>0.0</td>
<td>Re-evaluate learning; use alternative methods of instruction to correct the problem</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CL design is “an attempt to improve multiple choice format by allowing students to express a level of confidence in the answers they chose” (p. 215). Valid tests remain valid with CL (Taylor & Gardner, 1999). Tests using CL require increased time for students to think (Davies, 2002). CL helps students develop better calibration since it requires students to carefully consider alternate answers (Koku & Qureshi, 2004). Their findings include that students perform better when they must justify their answers by providing contradicting reasons for their choices.

**Discrete-Option-Multiple-Choice**

One alternate design method used for this research is the discrete-option multiple-choice (DOMC) question. Foster & Miller (2009) introduced a multiple-choice test format, DOMC. This alternate design to multiple-choice items reveals only one distractor at a time. Depending on the student response, branch logic selects and presents the next question. The benefits of DOMC
are that (1) fewer item options are shown at one time; (2) the format improves fairness since it is less easy to cheat or beat (through test-taking strategies); and (3) students need to take a more demanding approach to studying for exams. Multiple-Choice questions are formatted as single statement items that may be answered by a YES or a NO response. Students see the next distractor in a question item series while the question is answered correctly (response to a false distractor is No and to a correct distractor is Yes). Refer to Figure 2.6 for an example of the DOMC style question.

Foster and Miller (2009) developed and conducted preliminary tests for their multiple-choice test format. The goal was to improve upon the way student content knowledge and skills are measured and to improve test security. The DOMC format takes an initial multiple-choice question, presents the stem (question), followed by the answer options (randomly), one at a time, rather than at the same time.

Limiting the answers to one at a time presentation reduces the risk of exposing all answer options for theft or memorization. More importantly, it limits the risk of creating learning misinformation. Foster & Miller (2009) provide a demonstration of DOMC test delivery on the Internet site: http://www.webassessor.com (login: fosteritem, password: samples, register for a
new assessment → Get Now → Checkout → Done). The authors note flaws with traditional multiple-choice tests. For example, with practice, student test scores can increase and test items can easily be memorized and shared with others. The impetus for the DOMC design was to provide tests which were fairer, since students do not gain points by being better test-takers and/or cheaters. Figure 2.7 is an example of a DOMC question series.

Figure 2.7. Example of a DOMC Question Series

Depending on how many options are displayed per item, DOMC tests may take more or less time to complete than traditional multiple-choice tests. The findings in the Foster and Miller studies indicate that DOMC formatted tests took 10% less time to complete than traditional multiple-choice tests.

Foster & Miller (2009) presented twenty multiple-choice items in random order with random order distractors. Each question was one stem and five distractors. There were three experiments conducted over two semesters (one academic year). In experiment 1 (N=39), students completed four assessments during the semester. Each test contained two, 20 item sets (one traditional MC and one DOMC). Randomly, half the students were presented with DOMC questions first and half the traditional MC questions first. Experiment 2 (N=150) employed three online assessments; all in the DOMC format. The third experiment (N=70), was the same as experiment 1 except that students also completed a survey. The purpose of the survey was to determine the level to which students perceived that DOMC questions were easy to memorize,
copy, and/or share. Students by a greater proportion thought it was more difficult to cheat, memorize or share DOMC questions with others. Additionally, the researchers asked students to state whether DOMC questions were difficult when compared with traditional MC questions. The experiments show a drop of approximately 10% in student performance scores using DOMC question format. This result may indicate a more accurate student performance assessment than using the traditional multiple-choice format. One finding was that fewer answer options are displayed for more difficult DOMC questions. More difficult questions were answered incorrectly early into the options. The researchers suggest that in addition to being a more fair and accurate assessment format, DOMC tests may require students to change how they study and prepare for exams.

2.10 Technology

Assessment Delivery Technology

Educational institutions often provide a learning management system for their faculty and students to share resources, post assignments, and house grades. An advantage of using technology is the ability to automate many of the tasks. Commercial systems such as Blackboard or Desire to Learn and open source packages such as Moodle or the Sakai project can be used to deliver assessments, grade assessments, provide assessment statistics, and provide timely student feedback. These tasks can be performed in less time than paper-based assessment. Technology may be perceived by students as less biased than a teacher. Technology-based assessment can easily present and grade multiple versions of an assessment. They can present questions and answer options in randomized order. Furthermore, an important benefit of using a learning management system is the ability for the instructor to see student usage statistics.
Other methods of automating assessment may be Scantron machines, Computer-based delivery, and student response systems.

**Clickers (ARS, PRS, SRS, CRS)**

Student Response Systems (SRS) systems enable an instructor to ask all students a question at the same time, allow all students to respond at the same time, anonymously or confidentially, and display the results in the form of a histogram. Clickers in the classroom provide a mechanism for students to express “I am here”, “I am prepared”, “I am interested”, “I do”, “I learn”, “I understand”, or “I apply” (Woelk, 2008, p. 1400). Mayer et al. (2009) found that a question-based instructional method supported by clicker technology can enhance student performance. The results are consistent with the generative theory of learning. Generative learning theory propositions that when students engage in “appropriate cognitive processes during learning”, “students learn better” (p. 56).

The act of trying to answer sample questions and then receiving immediate feedback may encourage active cognitive processing in three ways: (a) before answering questions, students may be more attentive to the lecture material, (b) during question answering, students may work harder to organize and integrate material, and (c) after receiving feedback, students may develop metacognitive skills for gauging how well they understood the lecture material and for how to answer exam-like questions (p. 53).

Sprague and Dahl (2010) found that students preferred questions during class rather than at the end.)
- 0% Strongly Disagree
- 12% Disagree
- 25% No Opinion
- 42% Agree
- 14% Strongly Agree

They also found that students felt that the optimal number of questions for an 80-minute class was five to seven questions (Sprague & Dahl, 2010).

- 3% One to Two
- 26% Three to Four
- 54% Five to Seven
- 9% Eight to Ten
- 1% More than Ten

Clicker use is a quick and efficient way to encourage students to prepare for class, check the level or preparedness, and provide immediate feedback on the degree of preparation (Woelk, 2008). Expectation of a quiz will “lead to improved engagement” (p. 1402). Perez et al. (2010) recommend that whenever possible, do not display the histogram (results) to students during think-pair-share discussion sessions since seeing the most common answer influences “students of all grade levels” (p. 137). Perez at al. also found a positive correlation between the amount of student clicker participation (engagement) and student performance.
CHAPTER 3: METHODS

3.1 Conceptual Framework

Common relationships of Sungurs’ (2007) and Gao and Newton’s (2009) models were combined to create the following conceptual model. Figure 3.1 is one design of the conceptual model used in the present study.

![Conceptual Model of Self-Regulation and Student Effort](image)

Figure 3.1. Conceptual Model of Self-Regulation and Student Effort

Past correlational research studies indicates cognitive strategies are predicted by intrinsic goal orientation (Sungur, 2007) and that student self-efficacy and cognitive strategy use were the most significant predictors of student persistence/effort. Interest may be mediated by self-efficacy and other intrinsic value sub-scales. The conclusion reached was that students need to be motivated to use known cognitive strategies for learning before they will engage in a task (Gao & Newton,
2009; Sungur, 2007). The dotted lines represent possible relationships. The present study’s focus is limited to the effect of test format on motivation and strategies for learning and on student retention. Foster and Miller (2009) designed a test format to limit student guessing and cheating. The researchers suggested that the test design might encourage students to change how they prepare for exams. The Motivated Strategies for Learning Questionnaire is a self-report instrument designed to collect student responses about motivational beliefs and learning strategies use.

3.2 Setting and Participants

The present study started with 59 participants enrolled in three Spring 2011 sections of an introductory computer applications course within the Business and Technology Division of a public community college. After excluding data for students who did not complete all sections of the first administration of the MSLQ survey, the number of students in the study was reduced to 44. Two sections were combined to create the treatment group and once section, the control group.

3.3 Variables

The first dependent variable in this study was student motivational beliefs and strategies for learning (self-regulated learning). The second dependent variable was student retention (course completion). The independent variable was assessment format (traditional multiple-choice test versus discrete-option multiple-choice test). The authors of the DOMC test format reported that students thought that the DOMC format tests were more difficult to cheat, memorize, and share with others.
3.4 Measures

There are two versions of the Motivated Strategies for Learning Questionnaire (MSLQ). For this study, the MSLQ used by Pintrich and DeGroot (1990) was employed to measure student motivational beliefs and student strategies for learning. The Pintrich and DeGroot version is a 44-item self-report instrument with five scales. The version used by Duncan and McKeachie (2005) had 81-items and 15 scales. In both versions of the MSLQ students respond to items using a 7-point Likert scale. The scale ranged from 1 = not at all true of me to 7 = very true of me. This version was selected to limit student response fatigue and to easily be completed during a 50-minute class session.

The MSLQ used in this study is divided into two scales: motivational beliefs and self-regulated learning strategies. Three sub-scales provide designations for distinct motivational factors: self-efficacy (9 items), intrinsic value (9 items), and test anxiety (4 items). Two sub-scales contribute to the self-regulated learning strategies scale: cognitive strategy use (13 items) and self-regulation (9 items). The motivation and strategy use micro-scales used in this study were formed from subset questions of the five MSLQ sub-scales. These questions were mapped to the 15-scales of the 81-item MSLQ to create classifications such as the interest scale or the rehearsal strategy scale.

3.5 Treatment Group

The researcher, who was also the instructor, modified the textbook publisher’s test bank questions to discrete-option format. For every traditional multiple-choice question presented to the control group, up to three discrete-option questions were presented to the treatment group.
Response options were limited to three as recommended by previous research (Swartz, 2006). DOMC question format employs a decision tree.

Only one answer option was presented to students at a time. All DOMC questions employed Yes and No distractors. Students continued to be presented with options while they selected the correct response or the correct answer. At that point, students were presented with another question (stem) and option series (answer options). If the student selected a correct answer option correctly (Yes) then the first question of the next question series was displayed. If the student answered a distractor (false option) as false (No), the student was shown the next answer option in the question series. This is similar to computer-aided feedback for children’s software where a sound rather than words indicate correct or incorrect student response. This process continued until the student gave either the wrong response or the correct response to the question. At that point, the next question series was presented. Figure 3.2 diagrams the process flow of a DOMC question series.

![Diagram of a DOMC question series](image)

Figure 3.2. Process Flow of a DOMC Question Series
The DOMC format used in the present study provided immediate feedback to students. Immediate feedback is a recommended teaching and learning practice (Koku & Qureshi, 2004; Marsh et. al, 2007). The students received points for each correct item (question series) and an informational prompt for each response (“that is correct” or “that is not correct”). Students were asked to answer a confidence level question at the conclusion of the exam stating how well they thought they did on the test. A confidence level inquiry was employed to encourage student reflection as recommended by Davies (2002) and Koku & Qureshi (2004).

3.6 Control Group

The traditional multiple-choice format used 2-option and 3-option questions. The instructor re-wrote the textbook publisher’s stem plus 4-option questions written as stem plus 3-option. When taking the test, students saw the entire question stem and all response options at one time. Although random question order was a delivery option for the traditional multiple-choice tests, it was not used. The delivery method for the treatment group did not have the random question order feature. Random answer order was implemented for the control group.

3.7 Data Collection Procedures

Test and Exam Delivery

Delivery of the DOMC question format tests and exams was made possible through technology use. Technology enabled test and exam delivery, immediate grading, and immediate feedback of the multiple-choice questions in general. The treatment group unit tests and final exam were delivered by macro-enabled PowerPoint slideshows. The technology enabled the presentation of student response options one at a time and branching to the next logical question. As mentioned earlier, students received per response feedback regarding the correctness of their
response. Additionally, the assessments were automatically graded, and the student’s responses were stored. The final screen of the tests and exams enabled the students to print results, feedback, and their responses. The traditional multiple-choice tests and exams were delivered to the control group by the community college’s learning management system (Blackboard). A list of resources and code used to create the DOMC decisions and branching is in Appendix A.

Motivational Beliefs and Strategies for Learning Questionnaire Delivery

The college’s learning management system (Blackboard) facilitated delivery of the Motivated Strategies for Learning Questionnaire and collection of the student responses. Appendix B contains the paper-based version of the MSLQ survey that the participants completed. Part A of the MSLQ collected motivation belief data (self-efficacy, intrinsic value, and test anxiety sub-scales). Changes in student study habits were collected via Part B of the MSLQ. There are two sub-scales in Part B of the MSLQ. One is the cognitive strategies use sub-scale and the other is the self-regulation sub-scale. Appendix C is the copy if the letter students received about the MSLQ. Using the Learning Management System’s (LMS) adaptive release feature, upon completion of the MSLQ survey, students gained access to a Student Learning Skills Guide. Appendix D contains a copy of the guide provided to the participants. After the students completed the MSLQ the first time, they received personal results. The results presented their scores in addition to the class mean, and 25%, 50%, and 75% class quartile results. Appendix E is a copy of the form the participants received after the first MSLQ administration was completed by the students.
Student Demographic Survey and Instructor Observation Journal

The study used confidential polling (embedded lecture questions using a student response system) to encourage student class discussion participation. Confidential polling provides immediate feedback to the teacher and students to illuminate weak and strong concept understanding. Collaborative testing was used to promote discussion and argumentation. Discussion and argumentation have been found to promote higher order thinking (Gokhale, 1995), student performance (Blood & Neel, 2008; Bloom, 2006), and better retention of course information (Liu, Gettig, & Fjortoft, 2010). In addition, embedded questions are a form of active learning. Frequent graded course work was recommended by Bean and Peterson (1998) to encourage student class preparation. The confidential polling data was used by the instructor to evaluate student progress and content understanding. It was also intended to be a vehicle to help students recognize their own performance compared with other students’ performance (reflection). An example of questions completed during an embedded review session is included as Appendix F.

Collaborative review sessions were conducted prior to unit tests. In addition, students received partial note handouts of lecture material prior to lectures. These handouts were missing key words and phrases. Students were encouraged to read ahead and take online concept reviews prior to attending lecture. It was recommended that students complete the skeletal guide as best they could while reading before class. Students were expected to verify their answers and complete the guide during the lecture time. The purpose of the guide was to provide a framework to help the students to develop productive study habits. An end of course quiz and survey was completed by students regarding the skeletal guides. Students completed a demographic survey as seen in Appendix G. The survey collected information for example, about when the student
graduated from high school, why he/she enrolled the course, and whether she/he had completed the college success skills course prior to attending the course. In addition, the teacher maintained an observation journal regarding students’ behavior, test delivery process, and test format issues.

**Retention Data, GPA, and Academic Performance**

Retention data was collected for each course sections. Some students drop the course before the 14th day and may never have attended a class or completed any coursework. If students have never attended class by the 14th day of the semester, they are dropped by the instructor. Many of these students are attempting to collect financial aid. The mid-term is the next milestone for student attendance. After the mid-term students have one last date to withdraw from the class without academic penalty. Again, some students want to stay on the course roster long enough to collect financial aid. Students who drop a course early are “drops”, students who withdraw after the mid-term are “withdrawal”, and students who the instructor drops after the mid-term but by the last date to withdraw are “drops”. There are some students who short of completing the course stop coming. In this manuscript, they are referred to as “stops”. But, administratively, they are designated “FN” by the school. That code lets the financial aid administrators know that this student did not complete all course assessments and/or stopped attending class.

Although not dependent or independent variables, student grade point averages test scores, exams scores, and final course grade were collected for analysis. GPA is a strong indicator for predicting successful student academic performance and student retention. It was used to compare with academic performance and MSLQ scores to provide context for interpreting results. Student academic performance adds anecdotal information for interpreting the effect of the test format on motivational beliefs, strategies for learning, and student retention.
3.8 Data Analysis

MSLQ

ANOVA analysis was used to determine that the treatment and control groups were similar prior to treatment (using the results of the treatment and control group’s student motivational strategies for learning Time 1). Chronbach’s alpha correlation was used to verify the internal validity of each scale, sub-scale, and micro-scale. Micro-scales are subset questions from the five MSLQ sub-scales that measure specific motivational beliefs and learning strategies. Correlation analyses were used to determine whether relationships existed between MSLQ sub-scales, performance indexes, and retention for all students who completed the MSLQ Time 1. The cognitive strategy use sub-scale had one question that was written negatively. The self-regulation sub-scale had three negatively phrased items. Student responses for the four negatively worded items were reversed for the purposes of accurate measurement and comparison. Means were used to calculate MSLQ scales. Depending upon applicability means were collected by student or by question.

Retention and Academic Performance Data

Retention was calculated by counting the number of students enrolled in the course. The percentage of students who completed all assessments was the retention percentage. Retention and student academic performance data was analyzed by all students, gender, and treatment or control group to help interpret the results. When using academic performance data to compare with data from the first MSLQ administration and the second, only data for students who completed both MSLQ surveys and all academic assessments were included. The relationship between retention and final grade was calculated using t-test analysis. Retention and effort
correlation was calculated using t-test analysis. In addition, t-test analysis was used to determine the relationship between effort and final grade.
CHAPTER 4: RESULTS

The purpose of the study was to determine the effect of an alternate multiple-choice question design on student motivational strategies for learning and on student retention. In this study, retention is synonymous with course completion. Student motivational strategies for learning were measured by a self-report survey, the Motivated Strategies for Learning Questionnaire (MSLQ). Student retention data were derived from the course sections’ completion data.

4.1 Retention Data

The three course sections started with 59 students. Table 4.1 displays student GPA and gender by section and final course grade.

<table>
<thead>
<tr>
<th>Section</th>
<th>GPA Mean</th>
<th>High</th>
<th>Low</th>
<th>Male</th>
<th>Female</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment 1 - W</td>
<td>1.2</td>
<td>1.7</td>
<td>0.6</td>
<td>3</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Treatment 1 - FN</td>
<td>1.17</td>
<td>2</td>
<td>0.67</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Treatment 1 – C</td>
<td>2.11</td>
<td>2.8</td>
<td>1.5</td>
<td>1</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Treatment 1– B</td>
<td>2.91</td>
<td>3.85</td>
<td>1.95</td>
<td>3</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Treatment 1 – A</td>
<td>3.5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Treatment 2 - W</td>
<td>2</td>
<td>4</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Treatment 2 - FN</td>
<td>1.97</td>
<td>2.27</td>
<td>1.67</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Treatment 2 – C</td>
<td>2.67</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Treatment 2 – B</td>
<td>2.75</td>
<td>3.12</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>Treatment 2 – A</td>
<td>3.4</td>
<td>4</td>
<td>2.71</td>
<td>1</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Control - W</td>
<td>1.17</td>
<td>2</td>
<td>0.5</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Control - FN</td>
<td>1.07</td>
<td>1.8</td>
<td>0.33</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Control – C</td>
<td>2.26</td>
<td>2.5</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Control – B</td>
<td>2.31</td>
<td>3.15</td>
<td>2.33</td>
<td>1</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Control – A</td>
<td>3.17</td>
<td>3.92</td>
<td>2.83</td>
<td>1</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
Non-completion of the course for all three sections was 34%. An equal number of males (10) and females (10) did not complete the course. More males withdrew (8) from the course than stopped attending (2). More females stopped attending the course (7) than withdrew (3). A higher percentage of treatment group students (38%) did not complete the course than control group students (25%). Two of the “B” students in the treatment group who withdrew from the course did not have a grade point average. Both of these students were male.

4.2 The MSLQ Scales

The MSLQ has two primary scales: motivational beliefs and self-regulated learning strategies. The motivational beliefs scale has three sub-scales: self-efficacy, intrinsic value, and test anxiety. Micro-scales are subset questions from the sub-scales that measure specific motivational beliefs and learning strategies. Micro-scale subset questions map to questions in the 81-item MSLQ. Self-efficacy is the student’s belief that he/she will be able to succeed and is responsible for his or her success. The intrinsic value sub-scale is comprised of three micro-scales: interest, task value, and intrinsic goal orientation. Interest is the enjoyment the individual gets while performing or engaging in a task (Gao & Newton, 2009). Intrinsic goal orientation is a students’ belief that through effort he/she can improve his or her ability to learn (Sungur, 2007). Task value is the perceived importance of doing well (Gao & Newton, 2009).

The self-regulated learning strategies scale has two sub-scales: cognitive strategy use and self-regulated learning. The cognitive strategy use sub-scale is comprised of three micro-scales for test preparation: rehearsal, elaboration, and organization. Rehearsal is a strategy for example, where one repeats important concepts over and over to prepare for tests. Examples of elaboration are to put something into one’s own words or to tie a concept to a previous lesson or life experience. An example of organization is the act of highlighting information in notes by main
idea. The self-regulated learning sub-scale contains one micro-scale in this study. Self-regulated learning is a students’ application of learning strategies, reflection of interest, reflection of success, and reflection of difficulty. The persistence/effort micro-scale contains a subset of questions from the self-regulated learning sub-scale. It is comprised of the negatively worded self-regulation sub-scale questions about effort and persistence.

### 4.3 Internal Validity of the Scales

Table 4.2 displays the significant internal validity for all MSLQ sub-scales and micro scales (n=44).

<table>
<thead>
<tr>
<th>MSLQ Scales sub- / micro-</th>
<th>Alpha</th>
<th>Mean</th>
<th>SD</th>
<th>Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>SE</td>
<td>0.91</td>
<td>6.0</td>
<td>0.87</td>
<td>1, 2, 3, 4, 5, 6, 7, 8, 9</td>
</tr>
<tr>
<td>IV</td>
<td>0.71</td>
<td>6.3</td>
<td>0.48</td>
<td>1, 2, 3, 4, 5, 6, 7, 8, 9</td>
</tr>
<tr>
<td>INT</td>
<td>0.65</td>
<td>6.3</td>
<td>0.72</td>
<td>IV3, IV8</td>
</tr>
<tr>
<td>TV</td>
<td>0.83</td>
<td>6.6</td>
<td>0.58</td>
<td>IV2, IV4, IV7</td>
</tr>
<tr>
<td>IGO</td>
<td>0.45</td>
<td>6.1</td>
<td>0.62</td>
<td>IV1, IV5, IV6, IV9</td>
</tr>
<tr>
<td>TA</td>
<td>0.86</td>
<td>3.7</td>
<td>1.80</td>
<td>1, 2, 3, 4</td>
</tr>
<tr>
<td>CSU</td>
<td>0.85</td>
<td>5.8</td>
<td>0.80</td>
<td>1, 2, 3R, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13</td>
</tr>
<tr>
<td>RE</td>
<td>0.75</td>
<td>5.9</td>
<td>0.94</td>
<td>CSU2, CSU6, CSU7, CSU8, CSU11</td>
</tr>
<tr>
<td>ELAB</td>
<td>0.79</td>
<td>6.0</td>
<td>0.87</td>
<td>CSU1, CSU4, CSU9, CSU10, CSU13</td>
</tr>
<tr>
<td>ORG</td>
<td>only one question</td>
<td>CSU12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SR</td>
<td>0.54</td>
<td>5.1</td>
<td>0.77</td>
<td>1, 2R, 3, 4, 5, 6R, 7R, 8, 9</td>
</tr>
<tr>
<td>PE</td>
<td>0.77</td>
<td>3.7</td>
<td>1.8</td>
<td>SR2R, SR6R, SR7R</td>
</tr>
</tbody>
</table>

There was strong internal validity for the following MSLQ sub-scales: self-efficacy scale (SE), intrinsic value (IV), and cognitive strategy use (CSU). There was also strong internal validity for the following intrinsic value micro-scale, task value (TV). The rehearsal (RE) micro-scale and
elaboration (ELAB) micro-scale of the cognitive strategy use sub-scale had strong internal validity. Although there was not strong internal validity for the self-regulation sub-scale, there was strong internal validity for the self-regulation micro-scale, persistence/effort (PE). In table 4.2, the far left column identifies the five subscales of the MSLQ. The second column from the left identifies the MSLQ micro-scales. Column three provides the Chronbach Alpha values for the sub-scales and micro-scales. Columns four and five display the descriptive statistics (mean and standard deviation). The last column displays question reference numbers for the scales. The complete MSLQ first administration internal validity data is in the Appendix H.

4.4 Correlation Data for All Students MSLQ Time 1

Correlational relationships were significant (p < .05) unless otherwise specified. Table 4.3 displays the correlation data for the five sub-scales for the first MSLQ administration.

Table 4.3
Correlation Data for the Five MSLQ Sub-scales (Time 1)

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. SE</td>
<td>1.00</td>
<td>.55*</td>
<td>.18</td>
<td>.26</td>
<td>.18</td>
</tr>
<tr>
<td>2. IV</td>
<td>1.00</td>
<td></td>
<td>.34*</td>
<td>.68*</td>
<td>.22</td>
</tr>
<tr>
<td>3. TA</td>
<td></td>
<td>1.00</td>
<td>.02</td>
<td></td>
<td>-.20</td>
</tr>
<tr>
<td>4. CSU</td>
<td></td>
<td></td>
<td>1.00</td>
<td></td>
<td>.40*</td>
</tr>
<tr>
<td>5. SR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.00</td>
</tr>
<tr>
<td>Mean</td>
<td>6.02</td>
<td>6.34</td>
<td>3.74</td>
<td>5.76</td>
<td>5.13</td>
</tr>
<tr>
<td>SD</td>
<td>0.88</td>
<td>0.47</td>
<td>1.79</td>
<td>0.79</td>
<td>0.76</td>
</tr>
</tbody>
</table>

* p < .05 n = 44

Strong correlations exist between intrinsic value and cognitive strategy use r(44) = .68. Strong correlations between intrinsic value and cognitive strategy use micro-scales were rehearsal r(44) = .64 and elaboration r(44) = .68. A strong correlation was found between intrinsic goal orientation and elaboration r(44) = .75. This may explain the relationship between cognitive
strategy use and intrinsic goal orientation $r(44) = .66$. There was an $r(44) = .67$ relationship between interest and organization; which may explain the relationship between interest and CSU $r(44) = .59$. See Appendix I for complete, significant, correlational data.

Paired t-tests analysis indicated the following low, moderate significant results. The relationship between final grade and retention was $r(44) = .38$ and the relationship between effort and retention was $r(44) = .33$. The correlation between effort and final grade was $r(44) = .26$ but not significant ($p = .09$).

4.5 Motivational Beliefs by Grade (All Students, Time 1)

Regarding self-efficacy, responses to the MSLQ Time 1, indicate that students who ultimately earn a letter grade of C or who do not complete the course are overconfident. Results indicated that overconfident, non-completers score higher than other grade categories for the following questions:

- Compared with other students in this class, I think I am a good student
- I expect to do very well in this class
- I am sure I can do an excellent job on the problems and tasks for this class
- I think I will receive a good grade in this class
- I know that I will be able to learn the material for this class

Students who withdrew from the class scored the highest of all groups for the question, “I am certain I can understand the ideas taught in this course”. With the exception of that question, the students who withdrew from the course responded similarly as the “A” and “AB” students. “A” students scored a full point higher than the next highest response group for the question, “My study skills are excellent compared with others in this class”. For the question about skills, the
mean for “A” students was 6.4, followed by “C” students (5.4), then students who stopped attending (4.9), followed by “B” students (4.6), and finally the students who dropped the course (4.3). “B” students responded higher than the other groups for the question, “Compared with other students in this class, I know a great deal about the subject. In sum, poor (“C”) students and non-completers are overconfident about successfully completing the course but recognize that they do not know as much about the subject as other students and that their study skills are weaker when compared with other students. Higher performing students (“A” and “B”) perceived that they had the better study skills and knowledge but responded lower on the other self-efficacy questions.

Figure 4.1. Intrinsic Value (Time 1)

Notice in figure 4.1, that the “A” students most believed that what they were learning was useful to know and that understanding the subject was important to them. Questions IV3 and IV8 on the intrinsic value sub-scale comprise the interest micro-scale. “C” students were least interested in what they were learning (question IV8).
Test anxiety was highest for “C” students and students who did not complete the course. “C” students responded the highest of any group for all questions except for the question, “When I take a test I think about how poorly I am doing”. It is not known whether this question reflects a negative impact on performance from stress or a positive impact resulting from reflection.

4.6 Self-Regulated Learning Strategies by Grade (All Students, Time 1)

“C” students responded the highest for two rehearsal questions (CSU sub-scale), “When studying for a test, I try to remember as many facts as I can” and “When I read materials for this class, I say the words over and over to myself to help me remember”. “A” students scored highest for practicing important facts “over and over” for test preparation. “A” students try to connect class lecture and text materials. The instructor observed that “A” students are able to identify important facts. Although “C” students attempted to use elaboration techniques and make connections from past assignments to new assignments, the task was difficult since they could not isolate important information from less important. “C” students focused on facts rather than concepts. Consequently, they tried to memorize everything as opposed to trying to figure out how they fit together (big picture thinking).

The MSLQ self-regulation scale, like the self-efficacy scale, revealed some differences between students who did not complete the course and the students who did complete the course. Non-completers give up or only do the easy parts when the work is hard. They do not understand course reading material. According to the student responses, non-completers also indicate that they tend not to understand or listen to the teacher. In sum, for students who did not complete the course, high test anxiety may have been a factor in addition to low effort or ability to persist when work is difficult to understand or complete. Non-completers reported lowest on the self-
efficacy scale compared with students who completed the course. Non-completers expect to do well and earn a good grade but do not think they are good students compared with other students or that they can do an excellent job on the course problems and task.

4.7 Motivational Beliefs All Students Time Two

Unlike the first administration of the MSLQ, on the second administration, “A” students scored highest on all self-efficacy questions. “A” students responded similarly as “C” student on two questions. “C” students continued to least feel that what they were learning was interesting. They responded the highest of the three groups that the subject was important to them. In other words, “C” students were not interested in the course but thought the topic was important. It is unknown whether intrinsic importance (IGO) contributes to students being retained rather than leaving when they have low course interest. It is possible, though, since the “C” students had the strongest correlation between interest and intrinsic value (Time 1).

The Chronbach alpha for intrinsic goal orientation (IGO) did not indicate strong internal validity $r(44)=.45$. The 81-item version of the MSLQ survey instrument’s IGO scale alpha was .74. Therefore, future researchers may want to use those IGO scale questions:

- In a class like this, I prefer course materials that really challenge me so I can learn new things
- In a class like this, I prefer course materials that arouse my curiosity, even if it is difficult to learn
- The most satisfying thing for me in this course is trying to understand the content as thoroughly as possible
When I have the opportunity in this course, I chose course assignments that I can learn from even if they don’t guarantee a good grade.

The correlation between interest and intrinsic goal orientation for all students (Time1) was strong, $r(44) = .87$. The correlation between interest and intrinsic goal orientation for students by grade was significant or approached significance for students earning A, B, or C grades for the first administration of the MSLQ. Table 4.4 presents student interest and intrinsic goal orientation by earned grade.

Table 4.4
Interest and Intrinsic Goal Orientation by Grade (Time 1)

<table>
<thead>
<tr>
<th>Earned Grade</th>
<th>$r$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>.65</td>
<td>.029</td>
</tr>
<tr>
<td>B</td>
<td>.52</td>
<td>.052</td>
</tr>
<tr>
<td>C</td>
<td>.82</td>
<td>.013</td>
</tr>
</tbody>
</table>

However, even though the correlation was high for “B” and “C” students for the second administration, the $p$ values only approach significance ($p = 0.055$ and $p = 0.076$ respectively. Interestingly, there was a low, non-significant correlation between interest and intrinsic goal orientation for non-retained students using the first administration of the MSLQ data. It is also interesting to note that “C” students had the lowest interest scores and highest intrinsic goals orientation scores of students who completed the course. Students who withdrew from the course had the second highest interest score (after “A” students) and a similar intrinsic goals orientation score as “B” students.
Referring to Table 4.5, students who stopped attending and did not complete the course had the lowest interest scores and second highest IGO scores (after “C” students). The number of “C” students was 8 and the number of non-completer (FN) students was 8. The small sample size warrants caution when interpreting the relationship between interest and intrinsic goal orientation of “C” students and students who stopped attending. Therefore, although it is possible that when student interest is low, a higher level of intrinsic goal orientation is required for students to complete a course, the relationship is unconfirmed. Also, there may be a tipping point where interest level is too low to be compensated by intrinsic goal orientation.

4.8 Self-Regulated Learning Strategies (All Students, Time 2)

On the second administration of the MSLQ, “A” student responses were higher than “B” and “C” students on the majority of cognitive strategy use sub-scale questions (9 of the 13). This includes question 12, organization strategy. “A” students tied with “B” students on the 13th question (elaboration). The elaboration questions states, “When reading, I try to connect the things I am reading about with what I already know”. Based upon the results, “C” students

- are apt to concentrate in facts rather than concepts,
- have a difficult time identifying the main ideas while reading,
• are least likely to put important ideas into their own words when studying,

• are less inclined to outline book chapters to help study when compared with “A” and “B” students,

• are not likely to organize topics to make everything fit together, and

• are less likely than “A” or “B” students to work on non-required activities.

Refer to table 4.6 to compare “A” student and “Non-completer” student characteristics.

Table 4.6  
Characteristics of "A" Students and Non-Completers Compared

<table>
<thead>
<tr>
<th>A Students</th>
<th>Non-Completers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liked what they were learning more than the other students.</td>
<td>Give up or only do the easy parts when work is hard.</td>
</tr>
<tr>
<td>Believed that what they were learning was useful to know.</td>
<td>Do not understand course reading material. Have a difficult time identifying main ideas while reading.</td>
</tr>
<tr>
<td>Understanding the subject was important to them.</td>
<td>Tend not to understand or listen to the teacher.</td>
</tr>
<tr>
<td>Scored highest for practicing important facts “over and over” for test preparation.</td>
<td>Reported lowest on the self-efficacy scale.</td>
</tr>
<tr>
<td>Try to connect class lecture and text materials.</td>
<td>Expect to do well and earn a good grade.</td>
</tr>
<tr>
<td>On most questions scored highest in self-efficacy compared with other students.</td>
<td>Do not think they are good students compared with other students.</td>
</tr>
<tr>
<td></td>
<td>Do not think that they can do an excellent job on the course problems and task.</td>
</tr>
<tr>
<td></td>
<td>Are least likely to put important ideas into their own words when studying. Are less inclined to outline book chapters. Are not likely to organize topics to fit everything together.</td>
</tr>
<tr>
<td></td>
<td>Are less likely than “A” or “B” students to work on non-required activities.</td>
</tr>
<tr>
<td></td>
<td>Concentrate in facts rather than concepts.</td>
</tr>
<tr>
<td>High levels of persistence/effort.</td>
<td>Low levels of persistence/effort.</td>
</tr>
</tbody>
</table>
“C” students give up or only do the easy parts when work is difficult. This finding is consistent with responses from students who did not complete the course. On all negatively worded self-regulation sub-scale questions (persistence/effort), non-completing students scored highest on the MSLQ Time 1 while “A” students scored the least on Time 2. When reversing the scores for analysis, these questions (which comprise the persistence/effort micro-scale), indicate that non-completers have low levels of persistence/effort while “A” students, high levels. The questions in the persistence/effort micro-scale were:

- When work is hard I either give up or study only the easy parts.
- I often find that I have been reading for class but don’t know what it is all about.
- I find that when the teacher is talking I think about other things and don’t really listen to what is being said.

4.9 Motivational Beliefs and Learning Strategies by Group

There were 26 students in the treatment group (16 female, 10 male) and 18 (10 female, 8 male) in the control group.

Table 4.7 
Descriptive Statistics for the Motivated Strategies for Learning Questionnaire (Time 1)

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>Low 25%</th>
<th>Med 50%</th>
<th>Top 25%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
<td>26</td>
<td>5.43</td>
<td>0.60</td>
<td>5.15</td>
<td>5.39</td>
<td>5.84</td>
</tr>
<tr>
<td>Control</td>
<td>18</td>
<td>5.36</td>
<td>0.57</td>
<td>5.01</td>
<td>5.30</td>
<td>5.65</td>
</tr>
<tr>
<td>All</td>
<td>44</td>
<td>5.40</td>
<td>0.56</td>
<td>5.05</td>
<td>5.38</td>
<td>5.70</td>
</tr>
<tr>
<td>Male</td>
<td>18</td>
<td>5.36</td>
<td>0.57</td>
<td>5.01</td>
<td>5.30</td>
<td>5.65</td>
</tr>
<tr>
<td>Female</td>
<td>26</td>
<td>5.43</td>
<td>0.60</td>
<td>5.15</td>
<td>5.39</td>
<td>5.84</td>
</tr>
<tr>
<td>Treatment (Male)</td>
<td>10</td>
<td>5.39</td>
<td>0.58</td>
<td>5.10</td>
<td>5.29</td>
<td>5.49</td>
</tr>
<tr>
<td>Treatment (Female)</td>
<td>16</td>
<td>5.45</td>
<td>0.63</td>
<td>5.16</td>
<td>5.56</td>
<td>5.90</td>
</tr>
<tr>
<td>Control (Male)</td>
<td>8</td>
<td>5.44</td>
<td>0.73</td>
<td>5.01</td>
<td>5.34</td>
<td>5.64</td>
</tr>
<tr>
<td>Control (Female)</td>
<td>10</td>
<td>5.29</td>
<td>0.44</td>
<td>4.91</td>
<td>5.30</td>
<td>5.63</td>
</tr>
</tbody>
</table>
Table 4.7 displays the descriptive statistics for each administration of the MSLQ survey by gender and group. ANOVA statistical analysis indicated no significant difference between the treatment and control groups prior to treatment. Students in the treatment group completed the discrete-option multiple-choice tests while the control group completed traditional multiple-choice tests. While 44 of the initial 59 students in the study completed the first administration of the MSLQ only 33 students completed the second administration of the MSLQ; 22 in the treatment group and 11 in the control group. ANOVA statistical analysis approached significance that the groups were different post-treatment $F(1, 31) = 3.89, p = 0.06$. In other words, the type of test format may have affected student motivational beliefs and strategies for learning. After dropping students who completed both administrations of the MSLQ, 27 students remained in the sample. A t-test analysis was conducted to determine whether either group changed in motivational beliefs and strategy use post-treatment. There was a significant effect of the test format (IV) on the MSLQ scale (DV) at the $p<.05$ level. While the students in the treatment group ($n = 16$) dropped (.08) in the MSLQ overall scale, the control group ($n=11$) students’ increase was (.54) and significant $t(10) = -.09, p < 0.01$. The control group females increased almost $\frac{1}{2}$ point (.45). The difference was significant $t(7) = -3.82, p < 0.01$. The treatment group females’ ($n=12$) decrease in the overall MSLQ score was both small and not significant. Although not significant, the treatment group males’ overall MSLQ scores dropped nearly $\frac{1}{3}$ point (.31). The control group males ($n=3$) increased almost 1 point (.78). Although the difference in the control group male results were significant, the sample size was only three students. In summary, there were significant changes between the administrations of the MSLQ between the treatment group and the control group. For the control group, the MSLQ score increased from Time 1 to Time 2. The overall score includes all five MSLQ sub-scale questions.
MSLQ by Group – Treatment

In previous sections, characteristic differences between groups by earned grades for both administrations of the MSLQ were presented. Some characteristics of “A” versus “C” students were identified from the results. More importantly, some characteristics and patterns were identified for non-retained students. This section will look at the data to identify differences in the motivational beliefs, learning strategy use, and retention by test question format difference for the treatment group. The second MSLQ administration for the treatment group (n=12) resulted in strong, significant correlations between task value and the use of cognitive strategies for learning. For the rehearsal strategy and task value, the correlation was $\alpha=.68$ and for the elaboration strategy and task value, the correlation was $\alpha=.78$. There were no significant correlations between test anxiety and any scale for the treatment group.

Retention by Group – Treatment

The retention and effort relationship data were significant ($p < .05$) and the alpha was a moderate, negative value (-.43). Since the questions for the persistence/effort micro-scale are reversed for comparison with the MSLQ means, in actuality, there was a positive correlation between retention and effort ($\alpha=.43$). The correlation between retention and final grade was strong and significant ($\alpha=.73$). Retention and GPA correlation was $\alpha=.62$) and also significant. Similar to other research (Allen et al., 2008; Cameron & McLaughlin, 2008), there is a high correlation between GPA and final grade ($\alpha=.81$). See Appendix G for correlation data for the MSLQ second administration of the treatment group.

In review, the second administration of the MSLQ for the treatment group revealed several significant findings. There was a strong correlation between students’ perceived course
value and their use of cognitive learning strategies. There was also a strong correlation between a
students’ grade point average and their final grade in the course; and between student final
course grade and retention.

Instructor Observations of the Treatment Group

The instructor observed that the morning treatment section (1) appeared to increase in test
anxiety and was performing poorly compared with the evening treatment section (2). The
instructor reminded students how to approach the DOMC style tests. The instructor also
observed that students who took extremely long to complete the test did not perform well on the
test. Most students in the treatment group completed the tests and exams within 10 to 15 minutes.
Many poor performers took an entire class period (50 minutes). Some students in the treatment
group attempted to cheat by restarting the test. The students felt that if they could take it several
times that their score would improve. Unlike with multiple-choice, unless the students took
detailed notes of questions, responses, and computer feedback while taking the test, scores did
not increase with repetition. Regardless, a timer was added to the DOMC style test to track the
number of times a student attempted the test. A few students did increase their scores on a
repeated attempt. But, many did not understand the test process. This was evident from student
comments. Regardless of participating in practice sessions and discussions, they exclaimed
sentences similar to, “These questions are all the same”. In other words they could not
differentiate between the distractors and correct answer when they were presented after the
question stem serially rather than all at one time. It is not clear why these students did not
understand the process. It is possible that they had less exposure than other students due to
rolling absenteeism (missing practice sessions, quizzes, and embedded lecture questions).
Many students in the evening treatment group (2) expressed that they perceived traditional style multiple-choice tests to be easier and preferred them to the DOMC format. One student expressed this feeling, “Hmm, I don’t like how this is going down” after the class was introduced to the new test format. This perception is consistent with the findings of Foster and Miller (2009). Students taking the DOMC-format tests completed the quizzes, tests, and exams very quickly compared with students taking the traditional exams. This may indicate that the inability to go back and review past questions was a disadvantage to the DOMC students. It also may indicate that the treatment students guessed and moved on. One high-performing student noted that there was much more varied material to study than topics covered by the DOMC format versus a traditional multiple-choice test. This was a very astute observation. This indicated to the teacher that this student wanted to focus on content that “would be on the test” and not learn all the assigned content. The student was making a time management decision, not trying to cutting corners. This student demonstrated a sincere effort to understand course material and concepts. The student asked questions and brought notes to class from home seeking clarification. The students comment reflected the condition that a 30 question test might only cover 10 concepts.

MSLQ by Group – Control

The students in the control group took traditional multiple-choice question assessments. There were several significant findings in the second administration of the MSLQ for the control group (n=11) students. Unlike the treatment group, the control groups’ overall score for the second administration of the MSLQ was significantly different from the first.

Using t-test analysis of paired means, the control group increased overall (p = .0001). The intrinsic value sub-scale decreased significantly (p > .05), the task value micro-scale decreased
significantly (p < .01), and the intrinsic goal orientation micro-scale showed an approaching significant decrease (p < .06). In others words, while overall intrinsic value for the course increased for the treatment group, it decreased significantly for the control group. Table 4.8 compares the MSLQ survey administration results by time and group.

Table 4.8
Changes in the Intrinsic Value Scores by Group

<table>
<thead>
<tr>
<th>Scale</th>
<th>Group</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV Time 1</td>
<td>Treatment</td>
<td>6.19</td>
<td>.31</td>
</tr>
<tr>
<td>IV Time 2</td>
<td>Control</td>
<td>6.54</td>
<td>.14</td>
</tr>
<tr>
<td>IV Time 1</td>
<td>Control</td>
<td>6.13</td>
<td>.55</td>
</tr>
</tbody>
</table>

There were many strong correlation values for the second MSLQ administration for the control group. Test anxiety and persistence/effort was negative (α= -.91), intrinsic value and intrinsic goal orientation (α=.87), intrinsic value and rehearsal (α=.79), interest and cognitive strategy use (α=.72), interest and rehearsal (α=.79), intrinsic value and cognitive strategy use (α=.69), interest and elaboration (α=.72), and task value and test anxiety (α=.78). For the control group, while test anxiety was negatively correlated with student persistence/effort, it was positively correlated with task value. Task value and persistence/effort were negatively correlated (α= -.67). Additional strong correlations were between intrinsic goal orientation and cognitive strategy use (α=.71), intrinsic goal orientation and rehearsal (α=.81), rehearsal and elaboration (α=.85), and rehearsal and organization (α=.81). There were no significant correlations for academic performance (tests 1-4, the mid-term examination, and the final examination) and MSLQ sub-scales or micro-scales for the control group. See Appendix J for correlation data for the MSLQ second administration of the control group.
To summarize, control group students with high test anxiety tend to value tasks but put forth low effort. When interested, these students are likely to use strategies for learning. Control group students with high intrinsic goal orientation (the belief they can improve performance through effort) are likely to employ all three cognitive learning strategies (rehearsal, elaboration, and organization).

**MSLQ by Gender All Groups**

T-tests were conducted to identify significant changes in student MSLQ-related scores from the first administration to the last by gender. Although self-efficacy in women increased overall between the two MSLQ administrations, only the female “A” students, increased (from a mean of 5.84 to 6.41). Self-efficacy is the students’ belief they are capable of earning a good grade though skills they possess. Female “B” and “C” students decreased in self-efficacy. The decrease in self-efficacy for “C” students was significant from a mean of 6.54 to 6.32. Note again, that “C” students started higher in response than “A” and “B” students. For men, significant results \( p = .02 \) indicated that cognitive strategy use and the elaboration strategy increased from the beginning of the semester to semester’s end. The organization strategy also increased and approached significance \( p = .07 \). Only task value decreased from time 1 to time 2 for men. The value approached significance \( p = .07 \). In general, it appears that females change how they feel about a course (self-efficacy and intrinsic value) while males change what they do (strategy use).

**Treatment Group**

In the treatment group, females reported higher levels of self-efficacy, intrinsic value, and cognitive strategy use than did males when analyzing the sub-scales. However, when analyzing
the micro-scales, although females had higher levels of cognitive strategy use overall, males had higher levels of elaboration strategy use and organization strategy use. Also, although females had higher levels of intrinsic value overall, males had higher levels of intrinsic goal orientation.

Refer to table 4.9 for the discrete statistics for the MSLQ scales by gender.

Table 4.9
Treatment Group Means by Gender (Time 2)

<table>
<thead>
<tr>
<th></th>
<th>SE</th>
<th>IV</th>
<th>TA</th>
<th>CSU</th>
<th>SR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>6.24</td>
<td>6.41</td>
<td>3.38</td>
<td>6.06</td>
<td>5.16</td>
</tr>
<tr>
<td>Male</td>
<td>6.10</td>
<td>6.35</td>
<td>4.43</td>
<td>5.99</td>
<td>5.17</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>INT</th>
<th>TV</th>
<th>IGO</th>
<th>RE</th>
<th>ELAB</th>
<th>ORG</th>
<th>PE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>6.50</td>
<td>6.64</td>
<td>6.17</td>
<td>6.32</td>
<td>6.27</td>
<td>5.60</td>
<td>3.29</td>
</tr>
<tr>
<td>Male</td>
<td>6.43</td>
<td>6.48</td>
<td>6.29</td>
<td>5.97</td>
<td>6.31</td>
<td>6.00</td>
<td>2.95</td>
</tr>
</tbody>
</table>

Females in the treatment group reported higher levels of interest, task value, use of the rehearsal strategy, and persistence/effort. Using t-test analysis, there were no significant differences for MSLQ scale data for the treatment group women (n=12) from Time 1 to Time 2. For the men (n=4) in the treatment group, there was an approaching significance change in test anxiety (p = .052). Low test anxiety is preferred to high. Test anxiety decreased from a mean of 5.69 (first administration) to a mean of 3.06 (second administration). The variance was smaller on the first administration (.56) than on the second (4.52).

Table 4.10
Test Anxiety, Final Grade, and Elaboration Strategy Means for Treatment Group Males

<table>
<thead>
<tr>
<th></th>
<th>TA1</th>
<th>TA2</th>
<th>Final Grade</th>
<th>ELAB1</th>
<th>ELAB2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male1</td>
<td>5.50</td>
<td>5.25</td>
<td>B</td>
<td>5.40</td>
<td>7.00</td>
</tr>
<tr>
<td>Male2</td>
<td>6.00</td>
<td>4.50</td>
<td>B</td>
<td>4.60</td>
<td>5.60</td>
</tr>
<tr>
<td>Male3</td>
<td>4.75</td>
<td>1.50</td>
<td>B</td>
<td>5.00</td>
<td>6.20</td>
</tr>
<tr>
<td>Male4</td>
<td>6.50</td>
<td>1.00</td>
<td>A</td>
<td>7.00</td>
<td>6.60</td>
</tr>
</tbody>
</table>
Note however, that the n value of 4, for Time 2 treatment group males, is a very small sample. See Table 4.10 for the treatment group male responses for the test anxiety and elaboration scales by grade. The cognitive strategy, elaboration increased for the treatment group men (approaches significance \( p = .07 \)).

Control Group

Table 4.11 displays the control group responses for the second administration of the MSLQ by gender. The only scale where control group females scored higher than the males was on the task value micro-scale. Remember however, that lower test anxiety is preferable to higher.

<table>
<thead>
<tr>
<th></th>
<th>SE</th>
<th>IV</th>
<th>TA</th>
<th>CSU</th>
<th>SR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>6.11</td>
<td>6.04</td>
<td>3.53</td>
<td>5.63</td>
<td>4.97</td>
</tr>
<tr>
<td>Male</td>
<td>6.52</td>
<td>6.37</td>
<td>3.75</td>
<td>6.41</td>
<td>5.81</td>
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</tbody>
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<table>
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<th></th>
<th>INT</th>
<th>TV</th>
<th>IGO</th>
<th>RE</th>
<th>ELAB</th>
<th>ORG</th>
<th>PE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>5.75</td>
<td>6.50</td>
<td>5.84</td>
<td>5.95</td>
<td>5.75</td>
<td>5.25</td>
<td>3.42</td>
</tr>
<tr>
<td>Male</td>
<td>6.50</td>
<td>6.11</td>
<td>6.50</td>
<td>6.73</td>
<td>6.73</td>
<td>6.00</td>
<td>4.10</td>
</tr>
</tbody>
</table>

For females in the control group (n=8), change between the first administration of the MSLQ to the last administration was significant for the following scales: MSLQ increased overall \( t(7) = -3.82, p = .003 \); intrinsic value decreased \( t(7) = 2.53, p = 0.02 \); interest decreased \( t(7) = 2.59, p =.02 \); task value decreased \( t(7) = 2.2, p =.03 \); intrinsic goal value decreased \( t(7) = 2.65, p =.02 \). In other words, for intrinsic value overall, and all three intrinsic value micro-scales, women in the group taking traditional multiple-choice tests responded negatively. Intrinsic value and intrinsic value micro-scales decreased for all except one "B" student. Elaboration use decreased for all but one "A" student and one "B" student - the one with increased intrinsic value
scores. All students except for one "A" student decreased or remained the same value for organization strategy use. In sum, control group females reported lower values than males on all scales except task value. Task value increased significantly. They also had lower test anxiety than the males.

**MSLQ by Gender and Final Grade**

Student responses to the MSLQ survey were evaluated for trends. The students were sorted by group (treatment or control), within the groups by gender (male or female), and then by final grade (A, B, or C). Student responses per question, per student, for each MSLQ administration were reviewed for directional change. There were only 3 men in the control group who completed both MSLQ administrations, an “A”, “B”, and “C” student. Looking at mean data, the “A” student reported higher levels both times for self-efficacy, cognitive strategy use, and self-regulation. The “A” student decreased in intrinsic value while both “B” and “C” students increased; the “B” student increased the most. The “A” and “C” students decreased in test anxiety; the “A” student had the least test anxiety both times. Regarding the interest, task value, intrinsic goal orientation, and elaboration for control group men, the “A” student reported higher levels than the other students. The “A” student reported the highest level for the rehearsal and organization strategy scales. The “B” student remained the same or increased on all scales. The “B” student reported the least amount of persistence/effort both times. The “C” student decreased in task value, remained the same in organization, and increased in all other scales. The treatment group “A” student male reported highest score both times for all MSLQ micro-scales except for elaboration and persistence/effort. The “B” students increased in interest, intrinsic goal orientation, elaboration and, and organization. The “B” student males in the treatment group decreased in value for the task value scale. It appears that for the control group, the males
earning “B” and “C” final grades increased in the intrinsic value and learning strategies use while the “A” student decreased. It is possible that the “A” student valued the course less (decreased intrinsic value) since that student did not have to work as hard (decreased CSU) as the “B” and “C” students. This is consistent with the findings of Gijbels, Segars, and Struyf (2008) who found that students will adopt a surface learning strategy when they view that the clarity of goals, usefulness of materials, and appropriateness of the workload negatively.

All females, in the control group, regardless of final grade decreased in intrinsic value (interest, task value, and intrinsic goal orientation). In the treatment group, the “A” females increased in interest and task value while the “C” student females decreased. In the treatment group, the “A” student females increased in the learning strategies elaboration and organization. All female students in the treatment group increased in the rehearsal learning strategy. Treatment group females who earned C’s decreased in value for the organization scale. “B” treatment group females increased in organization and persistence/effort. In other words, for the treatment group females, task value and interest corresponded with earned grade; higher for “A” students and lower for “C” students. Female “C” students also reported less organizational strategy use.

4.10 Academic Performance

Academic Performance by Assessment Type

Student academic performance was examined to provide context for interpreting group responses. Results indicate that there were differences in the two groups post-treatment. It appears that the treatment group used different learning strategies for the conceptual test (test 4). Both the treatment and control group assessments for test 1 were the same (pre-treatment). Refer to Figure 4.2 to view the results per group by assessment type (test or exam).
The test content was Microsoft PowerPoint and the test format was traditional multiple-choice. The second test content was Microsoft Word. The third test was Microsoft Excel and the fourth, Microsoft Office and computer literacy terms. The terms test required students to understand concepts not just memorize definitions.

![Academic Performance by Group](image)

**Figure 4.2. Academic Performance by Group**

The mid-term exam included content from the first two tests. Excel can be challenging for students since it requires understanding and applying math concepts. The final exam included content from all four tests. The control group test and exam formats were traditional multiple-choice. The treatment group assessments were the discrete-option multiple-choice (DOMC) format excluding test 1. The DOMC was designed to limit student cheating and guessing. The DOMC format was employed as a possible instrument to change student study habits (learning strategies). Note that both groups’ scores were similar on the first test (pre-treatment). Both groups’ score decreased on the second test. On the fourth test, the conceptual assessment, the treatment group increased in performance relative to the previous assessment (test 3), while the control group decreased. Note also, that on the fourth test, the groups scored similarly. The mid-term was administered between tests 2 and 3. At this point in time, students in the treatment group had limited experience with the DOMC format assessment while control group students
continued to take assessments for which they potentially had much experience, by comparison. Treatment group students decreased in performance from test 2 to the mid-term, while the control group students increased in performance. Control group students decreased in performance from test 3 to test 4 and remained at that level for the final exam. The treatment group students’ performance increased from mid-term to test 3 and again from test 3 to test 4. The performance decreased from test 4 to the final exam. Performance differences on test 4 suggest that the treatment group students used different test strategies than did the control group.

It is unknown why the treatment students did not continue to perform as well or better than control group students on the final exam. It is possible that the treatment group students did not learn the early course material well. Foster and Miller (2009) found that there was an approximately 10% reduction in student performance for the DOMC format tests versus traditional multiple choice. The findings in the present study were similar between the treatment group and control group. They add that the drop in performance is due to more accurate testing. It is also possible that for the control group, seeing questions from test 1, using the same test format was an advantage for recognition and recall. Bacon (1979), Marsh et al. (2007), and Toppino & Luipersbeck, (1993) researched the effect of question repetition.

**Academic Performance by Assessment in Chronological Order**

Two course sections formed the treatment group. As stated earlier, the treatment group and control group were not different at the start and end of the semester. When analyzing the treatment group sections separately, the sample sizes were small. However, for anecdotal purpose, performance trends for all sections are provided. The two treatment sections were different from each other in several ways. Treatment group 2 (pm) was an evening class and was
comprised of older working students. In addition, more of the evening section students had completed or were currently taking the college success skills course provided by the college. Figure 4.3 shows academic performance in chronological order and by section.

These factors may explain some differences in academic performance between the treatment group sections. The treatment group 2 decreased in performance on test 2 as did the other groups. However, the students performed similarly on the mid-term and test 3 as on test 2, increased in performance on test 4, and surpassed the performance of the control group on test 4. Furthermore, although performance decreased slightly, the treatment group 2 did outperform the control group on the cumulative content of the final exam.
CHAPTER 5: DISCUSSING THE FINDINGS AND DRAWING CONCLUSIONS

This study examined whether a multiple-choice question format designed to decrease cheating and guessing on tests would promote student motivated strategies for learning. Although the sample size was small, there are significant trends worth noting. The primary contribution of this study is the demonstration that test design can affect student motivational beliefs and learning strategies. In general, it appears that females change how they feel about a course (self-efficacy and intrinsic value) while males change what they do (strategy use).

Findings show that students who completed the alternate test format (treatment group) increased in the perception that the course had value. Although efficient, it appears that the traditional multiple-choice test format can negatively affect student motivation and learning strategy use. This result is important since increasing numbers of courses use traditional multiple-choice test format to assess student learning. Additionally, it seems that it is possible that low interest and low intrinsic goal orientation can lead to student attrition. Students in the treatment group reported higher levels of intrinsic value than the students in the control group.

This study found that students with extremely high levels of self-efficacy and low interest (poor-performing students) may require a higher level of intrinsic goal orientation in order to complete a course than do higher-performing students. There also appears to be slight differences in how students respond to self-efficacy questions. Non-completers and students who earned “C” grades held the highest levels of self-efficacy as a group on the first administration of the Motivated Strategies for Learning Questionnaire. These findings will be discussed in detail in the following section.
5.1 Research Question 1: Can Multiple-Choice Question Design Effect Student Motivational Beliefs and Learning Strategy Use?

The results lead to six significant findings regarding motivational beliefs and strategies for learning. They are

1. The treatment group held higher levels of intrinsic value;
2. Females who earned the grade of “C” decreased significantly on the self-efficacy scale;
3. Students in the treatment group used different strategies for conceptual tests and for fact-based tests;
4. Poor performers report lower levels of persistence/effort;
5. Task value and interest correspond with earned grade’ and
6. Poor students are over confident.

Results also indicated differences between the treatment group and the control group regarding intrinsic value and strategies for conceptual versus fact-based testing. These results show that changing test formats may affect both students’ motivational beliefs and their strategies for learning.

Treatment group held higher levels of intrinsic value

Although the control group students’ increase of the overall MSLQ scale between administrations was significant, students taking the tests in the discrete-option multiple-choice format held higher levels of intrinsic value overall (interest, task value, and intrinsic goal orientation). Students taking the traditional form of the multiple-choice tests decreased significantly in intrinsic value. Women in the group taking traditional multiple-choice tests
(control) responded negatively for intrinsic value overall, and for all three intrinsic value micro-scales. Only task value decreased from Time 1 to Time 2 for males and the value approached significance. Control group females responded lower than males on all scales except task value. Task value increased significantly for females in the control group between MSLQ administrations. This means that over time, females in the control group felt that it was important to do well on the coursework they were assigned.

“C” female students decrease significantly in self-efficacy

Results indicated that the decrease in self-efficacy level between MSLQ administrations for “C” female students was significant but still high. Females who earned good grades responded that they anticipated doing well in the course; yet, they also responded that when compared with other students, they did not have the ability or expected to do as well. Based on this, it seems that initial high efficacy may be the result of a defense mechanism for poor-performing students. For example, Zuckerman, Kieffer, and Knee (1998) refer to a behavior called self-handicapping where students create impediments to preserve or enhance their self-esteem. In cases where these students fail, they do not take ownership of the failure. Therefore, it is possible that these students maintain higher levels of self-efficacy than expected since their success skills are lacking.

Students in the treatment group used different strategies for conceptual versus fact-based test

Based on the results, it appears that the treatment group used different learning strategies for the conceptual test. Additionally, cognitive strategy use, which refers to the strategies of rehearsal, elaboration, and organization (Pintrich & DeGroot, 1990), increased significantly for
males from the beginning of the semester to semester’s end. The organization strategy, which refers to identifying the main idea, outlining the text or material, and selecting and organizing the ideas in the material (Mousoulides & Philippou cite Garcia & Pintrich, 1994), also increased and approached significance for males. This result is consistent in part with the findings of Justice and Dornan (2001) who found that older females and younger males were more likely to use cognitive monitoring strategies to assess their progress throughout the semester.

Justice and Dornan (2001) also found that unlike traditional students, non-traditional students were more likely to use comprehension-focused strategies rather than surface level strategies. This may explain differences in performance success of the evening treatment group versus the daytime treatment group. Also, it may be necessary for students to become more familiar with a strategy before they can use it more effectively. Therefore, as students become more familiar the DOMC formatted tests; these strategies will help them be more effective test takers.

**Poor performers have lower levels of persistence/effort**

There were differences in the relationship between intrinsic goal orientation and student course interest by grade earned. The results indicate that when student interest is low, a higher level of intrinsic goal orientation is required for students to complete a course. However, there may be a tipping point in this relationship – a point at which student interest level is too low to be offset or compensated by intrinsic goal orientation. Additionally, when comparing high performing students with poor performing students, poor performers have lower levels of persistence/effort, because non-completers either give up or only complete easy tasks. The results from this study found that, although they do not think they can do an excellent job on course problems and tasks, they still expect to do well and earn a good grade. These findings are
supported by Justice and Dornan (2001) who reported that non-traditional females were more likely to self-motivate when the work gets more difficult. This may explain the difference between the performance of the day treatment group and the evening treatment group since the students in the evening group were, in general, non-traditional, older students.

**Task value and interest correspond with earned grade**

For the treatment group females, task value and interest corresponded with earned grade; higher for “A” students and lower for “C” students. Control group students with high test-anxiety tended to value tasks but put forth low effort. However, when they were interested in the material, these students were likely to use strategies for learning. Control group students with high intrinsic goal orientation were likely to employ all three cognitive learning strategies (rehearsal, elaboration, and organization).

**Poor students are overconfident**

These findings indicate that “C” students and students who do not complete the course were overconfident about successfully completing the course but recognize that they do not know as much about the subject as other students or have adequate study skills when compared with other students. Higher performing students (“A” and “B”) perceived that they had the better study skills and knowledge but responded lower on the other self-efficacy questions. “C” students focused on facts rather than concepts. This finding is supported by the work of Taylor and Gardner (1999) who found that students who perform poorly academically may benefit when answering questions that are ambiguous because they guess correctly. Skillful students recognize the ambiguities and may be less certain of the answer, while poor students fail to spot the ambiguities. In other words, they don’t know what they don’t know. This leads to poorer
students exhibiting significant overconfidence with difficult questions (Koku & Qureshi, 2004). Zakay and Glicksohn (1992) also found that when compared with students who were less sure, overconfident students had lower academic performance.

5.2 Research Question 2: Can Multiple-Choice Question Design Effect Student Retention?

The second research question that guided this study focused on whether multiple-choice question design can affect student retention. Results indicate that there were differences in the two groups post-treatment, and that question design can affect student retention directly. In this study, there was a strong correlation between student retention and grade point average. As a result, course grades may be improved by encouraging students to use higher level learning strategies, and this has an impact on student retention. Results showed that the test format can change both the motivational beliefs and learning strategies of students. The present study indicates that it is possible, to affect student retention at the course level by changing the test format. Students who have low levels of interest and lower levels of intrinsic goal orientation may be at risk for non-retention. Students taking the alternate form of multiple-choice test versus the traditional format held higher levels of intrinsic value overall. Other significant findings regarding student retention are that: (1) Students differ by gender regarding whether they drop a course or stop coming to class and (2) College success skills courses may contribute to student success and retention.

Gender and Age Differences

Some gender differences are evident from the results. Although the same number of females and males did not complete the course, more men withdrew rather than stopped attending, while more females stopped attending as opposed to dropping the course. It is not
known why there was this difference in course completion status by gender. It is possible that female students wanted to succeed but were overconfident in their ability to successfully complete the course. It is also possible that female students had competing responsibilities for their time and eventually were overwhelmed. In addition, as noted earlier, there may have been differences due to age and completion of a college success skills course. For students who did not complete the course, high test-anxiety may have been a factor in addition to low effort or ability to persist when work is difficult to understand or complete.

5.3 Importance of the Study

The present study is important since it is a piece of a consequential issue – student retention. It sheds light on the effect of multiple-choice test format and student performance as moderated by motivational beliefs and cognitive strategy use. Past research found that multiple-choice tests are easy to deliver and grade (Clegg & Cashin, 1986). Web-based multiple-choice tests can provide students with immediate and corrective feedback. Detractors say that a problem with the multiple-choice test format is that writing good multiple-choice questions can take time to create (Piontek, 2008; Roberts, 2006; Simkin & Kuechler, 2005). Multiple-choice tests are easily compromised through student memorization, copying, and sharing (Foster & Miller, 2009). In addition, traditional multiple-choice tests may not accurately assess student knowledge or high-order cognitive skills (Piontek, 2008; Roberts, 2006; Simpkin & Kuechler, 2005). Students guess (Hammond et al., 1999; Piontek, 2008; Taylor & Gardner, 1998) or hold misconceptions (Brown, Brown, Mosbacher, & Dryden, 2006; Roediger & Marsh, 2005). There is a concern that the process of testing may change the knowledge while measuring it (Marsh, Roediger, Bjork, & Bjork, 2007; Kang, McDermott, & Roediger, 2007; Roediger & Marsh, 2005). Without immediate corrective feedback, test-takers may accept their selected answers as
correct. Students may arrive at the correct answer for the wrong reason (Toppino & Luipersbeck, 1993). Multiple-choice tests can be unfair to students with poor verbal skills or those for whom English is the second language (Simkin & Kuechler, 2005). Furthermore, test design may impact student study habits in negative ways (Simkin & Kuechler, 2005). For example, multiple-choice tests may encourage students to study in a superficial manner (Roberts, 2006). Students will study enough to be able to regurgitate information on a test rather than for deeper understanding of the content.

The present study sought to identify whether an alternate multiple-choice test design can limit the disadvantages of multiple-choice testing while maintaining the benefits. Furthermore, the study investigated whether the alternate test design could promote student self-regulated behavior and student retention. The two research questions were: (R1) Can multiple-choice question design effect student motivational beliefs and learning strategy use and (R2) Can multiple-choice question design effect student retention? Regarding research question 1, there is support for the expectation that changing the assessment format to a different format can change students’ motivational beliefs and learning strategy use. The format in this case was one designed to inhibit cheating and guessing and perceived to be more difficult.

This study is important because many students, especially those attending community college in larger numbers lack college success skills. Furthermore, the poorest performing students lack the insight that they are underperforming. Much research has been conducted demonstrating that active learning and quick, quality feedback can promote student success. Koku and Qureshi (2004) recommended per question feedback. To facilitate assessing the increasing number of students quickly and to provide feedback quickly, many instructors use computer-assisted multiple-choice tests. The present study found that the traditional multiple-
choice test is a de-motivator. More importantly, it found that an alternate multiple-choice format, the discrete-option multiple-choice test increased intrinsic value and may promote higher-level cognitive strategy use.

Models exist demonstrating how students learn and the relationship between student self-regulated learning behavior and student success. To date, no one has solved the growing problem of student attrition. Regarding research question 2, the results indicate that changes in motivational beliefs and learning strategies can indirectly affect course retention and that test format may be a mediating variable. GPA has been and continues to be the strongest predictor of student retention (Allen et al., 2008; Cameron & McLaughlin, 2008). It is important to note that instructors can positively affect students’ GPA scores by designing courses that promote high student self-efficacy, intrinsic value, appropriate cognitive strategy use, and improved ability to gauge performance. The Discrete-Option Multiple-Choice test as an alternate format appears to be a viable assessment device to promote self-efficacy, interest, intrinsic goal orientation, and cognitive strategy use.

5.4 Implications for Action and Recommendations for Further Research

The relationship between student interest and student intrinsic goal orientation needs more research. The first step is to provide stronger evidence to support that helping weaker students who possess low course interest develop intrinsic goal motivation will lead to higher grades and retention. The second step is to help students develop intrinsic goal orientation. Further research is needed to show how to increase persistence/effort in students. Instructors may want to identify students with low self-efficacy and low interest early. Students must see a direct relationship between what they do and the results of what they do. It is possible that the DOMC format can potentially deflate student self-efficacy. It may be useful to study the relationship
between the DOMC format and student self-esteem. For example, more research needs to be conducted to tease out why despite an increase in intrinsic value, the overall MSLQ score decreased for the treatment group while it increased for the control group. One strategy may be to introduce students to the DOMC format as low-stakes self-test assessments. Students can get used to the process of the DOMC format, gain confidence in analyzing the question item stem and options, and review each question item series after completion. Students should be required to explain why each incorrect stem and option pair is incorrect and why the one correct stem and key pair is correct.

Future researchers may also want to conduct case study research to collect qualitative data about the DOMC format process and the students’ opinion about the DOMC format style test questions. The qualitative data can be collected via surveys, students journals, and instructor observation. Although students in this study received copies of the student learning skills guide, Appendix D, it is not known whether students used the guide, which students used the guide, or the effect of the guide. If a guide is provided in future research, perhaps the guide should be presented to all students in a formal lesson to provide for controlling its effect on assessments. Similarly, the weekly study planner in the guide should be collected and reviewed weekly by to encourage students to complete the guide weekly and for the instructor to track emerging patterns in real-time. More research needs to be conducted to determine the effect of the DOMC format on student test preparation and strategies used during testing.

Additionally, instructors may want to challenge their students and teach students learning strategies to complete the challenging tasks. Since test anxiety may have a negative effect on low-performing students, teaching learning strategies may reduce this effect. Test anxiety may correlate positively with effort and performance when tasks are challenging and negatively when
less challenging. In the control group, task value and test anxiety had a negative correlation with persistence/effort. In the same group, test anxiety correlated positively with task value. More research needs to be conducted to better flush out this pattern. It is not known whether the testing affects such as the repeated items findings of Bacon (1979) affected the students’ ability to answer questions correctly. It is possible, that students who could not discriminate between each stem and response option pair in an item series thought that a perceived repeated item was correct. More research needs to be conducted to determine if and why students perceived each question in a series was the same. Further research might be conducted to determine if perceived repeated questions are assumed to be correct by students. If either of these conditions is true, further research needs to be conducted to determine how to help students recognize discrete differences in question and response pairs. The motivational beliefs and learning strategies models by Gao & Newton (2009) and Sungur (2007) include both correlation values and relationship directions. Both studies used path analysis to construct the models. These models end with the persistence and effort outcome. Future research should be conducted to add a component for student retention.

Regarding gender differences, careful tracking of the date students drop or are dropped needs to be conducted in addition to the type of course withdrawal (voluntary drop, instructor drop, other). The student demographic survey did include hours worked and volunteer hours. Perhaps, a personal interview of each student early in the course can collect the needed data to help interpret the results. Few students answered the demographic survey during the present study.

The instructor felt that fewer questions overall and including more high-order thinking questions were preferable to many recall content questions. As noted earlier, test designers need
to keep in mind the amount of time needed to complete assessments since students tend to guess more at the end of tests (Taylor & Gardner, 1999). Further research might be conducted to determine whether too many DOMC style questions can cause test fatigue. Regarding test design, the trade-off of having fewer questions per DOMC format test versus a traditional multiple-choice test is that the teacher can discern what is not known and what is known with more confidence than with traditional multiple-choice format tests. A recommendation may be to add more questions to future DOMC formatted test since students tend to complete DOMC format tests more quickly than the traditional tests.

5.5 Study Limitations

The focus of this study was the student retention problem. The course selected for the study was a developmental course. The course attrition (34%) was not higher than the norm for this course, but it did contribute to low sample size. By comparison, “…56 percent of students at public two-year colleges return for the second year, a record high” (Jacobs, 2011). Future research with large samples is recommended to determine if these results are reproducible and generalizable. It is also recommended that future researchers collect extrinsic goal data. An example of extrinsic goal orientation is the motivation to earn better grades versus learning for mastery (Sungur, 2007). This may help to further tease out motivations leading to student drop and stop behavior. However, a challenge with post-drop and post-stop student behavior follow-up is that these students often do not respond to instructor contact while attending the course. Despite the small sample size, feedback from the teacher education community of practice state that the present research provides an excellent place to start for those looking for ways to assess large groups while moving away from traditional multiple-choice exams (with their inherent disadvantages). Future research should be conducted on large classes, and as a longitudinal
study for multiple-subject classes. Since the MSLQ collects course-specific data (Pintrich & DeGroot, 1990), more data from a variety of course subjects will provide a better indication of the effect of the discrete-option-multiple-choice format on student retention and student motivational strategies for learning.

5.6 Conclusion

The DOMC multiple-choice test format is a more accurate assessment of student knowledge and students value the course more than when they complete tests using the traditional multiple-choice format. Technology-supported traditional multiple-choice test format permits quick grading and feedback to students. In addition, as class sizes grow, multiple-choice tests are a logical assessment choice. Furthermore, many textbook vendors provide test banks for instructor use. This saves time in creating new tests and performing item analyses on the tests. However, in general, what is useful from a test administration viewpoint is not necessarily best from a student assessment viewpoint. The ease for student guessing and cheating on traditional multiple-choice tests encourages superficial test preparation and the students’ perception that the course is less valuable. Furthermore, it is difficult to determine from traditional multiple-choice tests what students understand and do not understand.

In this study, an alternative assessment format was used as a vehicle to alter student motivational beliefs and learning strategies. Changes in student motivation and learning strategy use were used to identify characteristics of students who completed the course and those who were not retained. Comparisons between the treatment group and the control group indicate that an alternate test format such the discrete-option multiple-choice test format does positively affect student motivation and learning strategy use. Over time, and with proper training in taking
alternate format tests, more students should improve motivationally, academically; and more should be retained.
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http://richardphelps.net/AreUSStudentsMostHeavilyTested.pdf


http://www.crit.umich.edu/gsis/P8_0.php


APPENDIX A –DOMC DESIGN RESOURCES

Macro Subroutines

Name Input Box Example:

Sub YourName()
    userName = InputBox(Prompt:="Type your name")
End Sub

Message Box for Feedback for Doing Well Example:

Sub Correct()
    MsgBox ("You are doing well, " & userName & " Your current score is: " & numCorrect)
End Sub

Incorrect Response Example

Sub Answer1Yes()
    If q1Answered = False Then
        numIncorrect = numIncorrect + 1
        answer1 = "Yes" 'ADDED
    End If
    q1Answered = True
    DoingPoorly
    ActivePresentation.SlideShowWindow.View.GotoSlide (4)
End Sub

Correct Response Example Part of Series

Sub Answer1No()
    If q1Answered = False Then
        answer1 = "No" 'ADDED
    End If
q1Answered = True
DoingWell
ActivePresentation.SlideShowWindow.View.Next

End Sub

Correct Response Last in Series

Sub Answer2Yes()
If q2Answered = False Then
numCorrect = numCorrect + 1
answer2 = "Yes" 'ADDED
End If
q2Answered = True
DoingWell
ActivePresentation.SlideShowWindow.View.GotoSlide (4)
End Sub

Go to a Specific Slide Example:

Sub qLastNo()
If qLastAnswered = False Then
numIncorrect = numIncorrect + 1
totalScore = numCorrect
answerLast = "No" 'ADDED
End If
qLastAnswered = True
Incorrect
ActivePresentation.SlideShowWindow.View.GotoSlide (63)
End Sub

Example for Going to Next Slide:

95
Sub ConfidenceHi()
    If clAnswered = False Then
        clAnswer = "high" 'ADDED
    End If
    clAnswered = True
    ActivePresentation.SlideShowWindow.View.Next
End Sub

Set up Results Slide

Sub PrintablePage() 'ADDED
    Dim printableSlide As Slide
    Dim homeButton As Shape
    Dim printButton As Shape
    Set printableSlide = ActivePresentation.Slides.Add(Index:=16, _
        Layout:=ppLayoutText)
    printableSlide.Shapes(1).TextFrame.TextRange.Text = _
        "Section: 107 " & "This is attempt number: " & numTimes
    printableSlide.Shapes(2).TextFrame.TextRange.Text = _
        "Results for " & userName & "." & Chr$(13) & 
        "Your grade is " & numCorrect & " correct or " & numCorrect * 14.29 & 
        ")" & "." & Chr$(13) & 
        "You have " & clAnswer & " confidence that you performed well on this 
        test." & Chr$(13) & 
        "Press the Print Results button to print your answers." & Chr$(13) & 
        "Question 1: " & answer1 & " " & "Question 7: " & answer7 & Chr$(13) & 

"Question 2: " & answer2 & "   " & "Question 8: " & answer8 & Chr$(13) & 
"Question 3: " & answer3 & "   " & "Question 9: " & answer9 & Chr$(13) & 
"Question 4: " & answer4 & "   " & "Question 10: " & answer10 & Chr$(13) & 
"Question 5: " & answer5 & "   " & "Question 11: " & answer11 & Chr$(13) & 
"Question 6: " & answer6 & "   " & "Question 12: " & answerlast & Chr$(13) & 
"Start Time: " & startTime & "   End Time: " & Now
Set homeButton = ActivePresentation.Slides(16).Shapes.AddShape (
(msoShapeActionButtonCustom, 0, 0, 150, 50)
homeButton.TextFrame.TextRange.Text = "Start Again"
homeButton.ActionSettings(ppMouseClick).Action = ppActionRunMacro
homeButton.ActionSettings(ppMouseClick).Run = "StartAgain"
Set printButton = ActivePresentation.Slides(16).Shapes.AddShape (
(msoShapeActionButtonCustom, 200, 0, 150, 50)
printButton.TextFrame.TextRange.Text = "Print Results"
printButton.ActionSettings(ppMouseClick).Action = ppActionRunMacro
printButton.ActionSettings(ppMouseClick).Run = "PrintResults"
ActivePresentation.SlideShowWindow.View.Next
ActivePresentation.Saved = True
End Sub

Print Results Example

Sub PrintResults() 'ADDED
ActivePresentation.PrintOptions.OutputType = ppPrintOutputSlides

ActivePresentation.PrintOut From:=16, To:=16

End Sub
**Start Again Example**

Sub StartAgain() 'ADDED

    Initialize

    ActivePresentation.SlideShowWindow.View.GotoSlide (2)
    ActivePresentation.Slides(16).Delete
    ActivePresentation.Saved = True

End Sub

https://sites.google.com/site/basis2010itca/projects/powerpoint/quizzer

http://www.youtube.com/watch?v=BVpquBe7auQ&feature=related (Interactive Quiz Part 1)

http://www.youtube.com/watch?v=5P551nbPyaw&feature=related (Interactive Quiz Part 2)

http://www.youtube.com/watch?v=wcMEOxHlj4&feature=related (Interactive Quiz Part 3)

http://www.cpearson.com/excel/PlaySound.aspx Declaration for sound
APPENDIX B - MOTIVATED STRATEGIES FOR LEARNING QUESTIONNAIRE

Note: the original study had 81 items of which 56 were initially used and later reduced to the 44 we use here. Points will be allocated and averaged as selected except for negatively worded statements which will be allocated in reverse weight. These questions are noted with an R for informational purposes and will not be included on the questionnaire presented to students.

Part A: Motivational Beliefs

Please rate the following items based on your behavior in this class. Your rating should be on a 7-point scale where 1= not at all true of me to 7= very true of me.

Self-Efficacy

__ 2. Compared with other students in this class I expect to do well
__ 6. I’m certain I can understand the ideas taught in this course
__ 8. I expect to do very well in this class
__ 9. Compared with others in this class, I think I’m a good student
__ 11. I am sure I can do an excellent job on the problems and tasks assigned for this class
__ 13. I think I will receive a good grade in this class
__ 16. My study skills are excellent compared with others in this class
__ 18. Compared with other students in this class I think I know a great deal about the subject
__ 19. I know that I will be able to learn the material for this class

Intrinsic Value

__ 1. I prefer class work that is challenging so I can learn new things.
__ 4. It is important for me to learn what is being taught in this class
__ 5. I like what I am learning in this class
__ 7. I think I will be able to use what I learn in this class in other classes
__ 10. I often choose paper topics I will learn something from even if they require more work
__ 14. Even when I do poorly on a test I try to learn from my mistakes
__ 15. I think that what I am learning in this class is useful for me to know
__ 17. I think that what we are learning in this class is interesting
__ 21. Understanding this subject is important to me

Test Anxiety

__ 3. I am so nervous during a test that I cannot remember facts I have learned
__ 12. I have an uneasy, upset feeling when I take a test
__ 20. I worry a great deal about tests
__ 22. When I take a test I think about how poorly I am doing
Part B: Self-regulated Learning Strategies

Please rate the following items based on your behavior in this class. Your rating should be on a 7-point scale where 1= not at all true of me to 7=very true of me.

**Cognitive Strategy Use**

23. When I study for a test, I try to put together the information from class and from the book
24. When I do homework, I try to remember what the teacher said in class so I can answer the questions correctly
26. It is hard for me to decide what the main ideas are in what I read (R)
28. When I study I put important ideas into my own words
29. I always try to understand what the teacher is saying even if it doesn’t make sense.
30. When I study for a test I try to remember as many facts as I can
31. When studying, I copy my notes over to help me remember material
34. When I study for a test I practice saying the important facts over and over to myself
36. I use what I have learned from old homework assignments and the textbook to do new assignments
39. When I am studying a topic, I try to make everything fit together
41. When I read materials for this class, I say the words over and over to myself to help me remember
42. I outline the chapters in my book to help me study
44. When reading I try to connect the things I am reading about with what I already know

**Self-Regulation**

25. I ask myself questions to make sure I know the material I have been studying
27. When work is hard I either give up or study only the easy parts (R)
32. I work on practice exercises and answer end of chapter questions even when I don’t have to
33. Even when study materials are dull and uninteresting, I keep working until I finish
35. Before I begin studying I think about the things I will need to do to learn
37. I often find that I have been reading for class but don’t know what it is all about (R)
38. I find that when the teacher is talking I think of other things and don’t really listen to what is being said (R)
40. When I’m reading I stop once in a while and go over what I have read
43. I work hard to get a good grade even when I don’t like a class
APPENDIX C - LETTER TO STUDENTS ABOUT THE MSLQ

Researchers have found that students need both the “skill” and the “will” to succeed in class\(^1\). Your teacher can help you will the skill part of this course. But only you can help yourself with the will part. The more active a role you take in your own learning the more you will succeed.

The purpose of this inventory\(^2\) is to gather some information about your study habits, your earning skills, and your motivation for school work\(^3\).

3 Parts of Self-regulated Learning:

- Your beliefs about your own ability to perform a task and you are responsible for your own performance (Can I do this task?)
- Your goals and beliefs about how important the task is to you and how interested you are in doing the task (Why am I doing this task?)
- Your reaction to the task (How do I feel about this task?)

There are 2 parts to this questionnaire:

A) Motivational Beliefs
   a. Self-Efficacy
   b. Intrinsic Value
   c. Test Anxiety

B) Self-Regulated Learning Strategies
   a. Cognitive Strategy Use
   b. Self-Regulation

You will complete Part A after the 1\(^{st}\) unit test and at the end of the course prior to the final examination. You will complete Part B during the 1\(^{st}\) unit test review, after the mid-course exam, and at the end of the course prior to the final exam.

At the completion of the first questionnaire you will be offered a guide to learning strategies. The feedback from the survey will help you determine your own strengths and weaknesses as a student. You will also be informed about how other students do on the MSLQ. However, what is important is for you to think about your own skills not as they compare with others in your class.

You may want to use this feedback to change your own study skills and motivation. Hints will be provided in the guide to help you change aspects of your learning style if you decide that is what you want to do.

---

\(^1\) Pintrich and De Groot (1990) page 38
\(^2\) Based on the Motivated Strategies Learning Questionnaire (MSLQ)
\(^3\) Adapted from Pintrich, Smith, Garcia, and McKeachie (1991)
APPENDIX D - STUDENT LEARNING SKILLS GUIDE

Based on the Motivated Strategies Learning Questionnaire (MSLQ)

MOTIVATIONAL CONTROLS

1) Value Component: Intrinsic Goal Orientation (is an end in itself)

What are the reasons why are you engaging in this task? Is it for the challenge, curiosity, or mastery?

People with high intrinsic goal orientation say:

- I prefer course material that really challenges me so I can learn new things.
- I prefer course material that arouses my curiosity even if it is difficult to learn.
- I feel satisfied when I try to understand the course content as thoroughly as possible.
- When I have the choice, I choose assignments I can learn from even if they don’t guarantee a good grade.

2) Value Component: Extrinsic Goal Orientation (is a means to an end)

What are the reasons why are you engaging in this task? Is it for grades, rewards, performance, evaluation by others, or competition?

People with high extrinsic goal orientation say:

- Getting a good grade in this class is the most satisfying thing for me right now.
- The most important thing for me right now is improving my overall grade point average, so my main concern in this class is getting a good grade.
- If I can, I want to get better grades in this class than most of the other students.
- I want to do well in this class because it is important to show my ability to my friends, employer, or others.

3) Value Component: Task Value

What do I think of this task? Is it interesting, important, or useful? Why am I doing this?

People with high task value say:

- I think I will be able to use what I learn in this course in other courses.
- It is important for me to learn the course material in this class.
- I am very interested in content area of this course.
I think the course material in this class is useful for me to learn.
I like the subject matter of this course.
Understanding the subject matter of this course is very important to me.

4) Expectancy Component: Control Learning Beliefs

I believe that my efforts in this class will result in positive outcomes (be worth it).

People with high control learning belief say:

- If I study in appropriate ways, then I will be able to learn the material in this course.
- It is my own fault if I don’t learn the material in this course.
- If I try hard enough, then I will understand the course material.
- If I don’t understand the course material, it is because I did not try hard enough.

5) Expectancy Component: Self-Efficacy for Learning and Performance

I expect to succeed. I am confident I can succeed in this class.

People with high self-efficacy for learning and performance say:

- I believe I will receive an excellent grade in this class.
- I am certain I can understand the most difficult material presented in the readings for this class.
- I am confident I can understand the basic concepts taught in this class.
- I am confident I can understand the most complex material presented by the instructor in this course.
- I am confident I can do an excellent job on the assignments and tests in this course.
- I expect to do well in this course.
- I am certain I can master the skills being taught in this class.
- Considering the difficulty of this course, the teacher, and my skills, I think I will do well in this class.

6) Affective Component: Test Anxiety (high anxiety hurts your performance)

Negative thoughts disrupt my performance. I worry about …

People with low test anxiety say:

- When I take a test I do not think about how poorly I am doing compared with other students.
- When I take a test I only think about the question I am on not about other items on the test I can’t answer.
- When I take a test I do not think about the consequences of failing.
I do not have an upset, uneasy feeling when I take an exam.
My heart does not beat fast when I take an exam.

LEARNING STRATEGIES SCALES

7) Cognitive and Metacognitive Strategies: Rehearsal (short-term memory)

I recite items from a list to be learned for example. It helps me pay attention for simple tasks but not for learning new information.

People with high rehearsal say:

- When I study for class, I practice saying the material to myself over and over.
- When studying for this class, I read my class notes and the course readings over and over again.
- I memorize key words to remind me of important concepts in this class.
- I make lists of important terms for this course and memorize the lists.

8) Cognitive and Metacognitive Strategies: Elaboration (long-term memory)

I summarize, paraphrase, create analogies, and take notes to help learn and remember things longer. It helps me integrate new information with prior knowledge.

People with high elaboration strategies say:

- When I study for this class, I pull together information from different sources, such as lectures, readings, and discussions.
- I try to relate ideas in this subject to those in other course whenever possible.
- When reading for this class, I try to relate the material to what I already know.
- When I study for this class, I write brief summaries of the main ideas from the readings and the concepts from the lectures.
- I try to apply ideas from course readings in other class activities such as lecture and discussion.

9) Cognitive and Metacognitive Strategies: Organization

I do these things to improve my performance. Even though they take a lot of time and work, I outline material, select main ideas from reading passages, and group similar information.

People with high organization say:

- When I study the readings for this course, I outline the material to help organize my thoughts.
- When I study for this course, I go through the readings and my class notes and try to find the most important ideas.
• I make simple charts, diagrams, or tables to help me organize course material.
• When I study for this course, I go over my class notes and make an outline of important concepts.

10) Cognitive and Metacognitive Strategies: Critical Thinking

I use prior knowledge in new situations in order to solve problems, reach decisions, or make critical evaluations with respect to standards of excellence.

People with high critical thinking say:

• I often find myself questioning things I hear or read in this course to decide if I find them convincing.
• When a theory, interpretation, or conclusion is presented in class or readings, I try to decide if there is good supporting evidence.
• I treat course material as a starting point and try to develop my own ideas about it.
• I try to play around with ideas of my own related to what I am learning in this course.
• Whenever I read or hear an assertion or conclusion in this class, I think about possible alternatives.

11) Cognitive and Metacognitive Strategies: Metacognitive Self-Regulation

The keyword here is metacognition or awareness, knowledge, and control of cognition. This strategy involves planning, monitoring, and regulating. Goal setting and task analysis are types of planning. Self-testing and questioning during learning activities are types of monitoring. Checking and correcting during an activity are types of regulation. These strategies help me organize relevant content, integrate new with old knowledge, and improve performance.

People with high metacognitive self-regulation say:

• During class time do not miss important points because I let my mind wander (think of other things).
• When reading for this course, I make up questions to help focus my reading. (if my textbook has chapter questions, I review these as I read)
• When I become confused about something I am reading for this class, I go back and try to figure it out.
• If course materials are difficult to understand, I change the way I read the material.
• Before I study new course material thoroughly, I often skim it to see how it is organized.
• I ask myself questions to make sure I understand the material I have been studying in class.
• I try to change the way I study in order to fit the course requirements and instructor’s teaching style.
• When I read for class I understand what I am reading.
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.

When studying for this class I try to determine which concepts I do not understand well.

When I study for this course, I set goals for myself in order to direct my activities in each study period.

If I get confused taking notes in class, I make sure I sort it out afterwards.

12) Resource Management Strategies: Time and Study Environment

This is your ability to manage your time and study environment. Time management involves scheduling, planning, and managing your study time. How much time you set aside for study, how effectively you use that time, and whether your goals are realistic. Environment is where you study. It should be quiet, organized, and relatively free of visual and auditory distractions.

People with high time and study strategy say:

- I usually study in a place where I can concentrate on my course work.
- I make good use of my study time for this course.
- I stick to my study schedule.
- I have a regular place to study.
- I make sure I keep up with the weekly readings and assignments for this course.
- I attend class regularly.
- I do not let other activities interfere with studying for this course.
- I find time to review my notes or readings before an exam.

13) Resource Management Strategies: Effort Regulation

This is your ability to manage even though the task is not interesting or there are distractions.

People with high effort regulation say:

- I do not quit studying for this class before I plan to even if I feel lazy or bored.
- I work hard to do well in class even if I do not like what we are doing.
- I do not give up or only study easy parts even when the work is difficult.
- Even when course materials are dull and uninteresting, I manage to keep working until I finish.

14) Resource Management: Peer Learning

Working with peers has been found to have positive effects on achievement. Talking can help you clarify course material and reach insights you may not attain on your own.

People with high affinity for peer learning say:
• When studying for this course, I often try to explain the material to a classmate or a friend.
• I try to work with other students from this class to complete the course assignments.
• When studying for this course, I often set aside time to discuss the course material with a group of students from the class.

15) Resource Management: Help Seeking

Good students know when they do not know something and are able to identify someone to provide them with some assistance. Student achievement can be facilitated by peer help, peer tutoring, and individual teacher assistance.

People with high affinity for help seeking say:
• I ask the instructor to clarify concepts I do not understand well.
• When I can’t understand the material in this course, I ask another student in this class for help.
• I try to identify students in this class whom I can ask for help if necessary.

EXERCISES

Activity 1: Motivation - Interest

Skim the table of contents of the class textbook or take a look at the course syllabus and make a list of the three topics that most interest you and the three topics that least interest you.

• What is it about the three most interesting topics that makes you like them so much?
• What is it about the three least interesting topics that makes you uninterested in them?
• Can you find any of the characteristics of the three most interesting topics in the three least interesting topics?

If you identify what it is about the three most interesting topics that makes you like them so much, you may be able to apply what you found to the three least interesting ones. Perhaps, you will find those uninteresting ones aren’t so uninteresting after all.

Activity 2: Test Anxiety

Developing better study skills usually results in less anxiety. Prepare well for class and try to complete assignments on time. Try not to wait until the last minute to get things done or to get ready for an exam. Doing this should reduce test anxiety.

When taking a test, concentrate on one item at a time, and if you are stumped on a question, move on and go back to the question later. Remind yourself that you are well prepared and if you can’t answer some questions, it’s ok, you’ll still be able to answer the other questions.
Activity 3: Cognitive Strategy – Rehearsal

List the important terms and topics in the course. Define them and repeat them out loud. Break up that list into smaller lists that are made up of closely related items. Make up images or rhymes to help you remember those lists. Generate test items to help you measure your recall. Your book may provide a glossary or end of chapter word lists and concept reviews. This is a good starting point. You can add to these aids.

Activity 4: Cognitive Strategy – Elaboration

Paraphrase and summarize important information. Use your own words to describe the material covered during lecture or in assigned reading.

Pretend you are the teacher and are trying to explain the topic to students. Try to figure out how each topic relates to each other. What are the connections between what you have heard in lecture, talked about in discussion, and read in the book?

List of free mapping tools:

http://eduwithtechn.wordpress.com/2007/04/14/some-free-concept-mapping-programs/

http://cmap.ihmc.us/conceptmap.html

Activity 5: Cognitive Strategy – Organization

Outline course material and identify where the text and lecture overlap and do not overlap. This will give you a starting point in developing connections between ideas presented in two different contexts.

Make charts, diagrams, or tables of important concepts. Something like a flowchart or a tree diagram is usually very helpful in trying to understand how different ideas “go together”.

Activity 6: Metacognition

Skim the reading material before you begin to see how it is organized. Look at the headings and subheadings of the text to give yourself an idea of how things are related to each other.

While reading, ask yourself questions about the paragraph you have just read and scribble key words in the margins of the book or in a notebook.

Try to determine which concepts you don’t understand well. This will help you remember what you have read and saves you time later when studying for a test.

Activity 7: Resource Management: Time and Study Space
Keep track of what you do with your study time for a week. Write down your goals for each study period and then write down what you actually accomplished during the study period.

Analyse the chart at the end of the week. You may want to change the place where you study, or the times when you study, or who you study with. Try to come up with a study schedule that works best for you.

**Activity 8: Resource Management: Self-Effort**

Keep a list of topics you find yourself procrastinating instead of studying for. Try to analyze why you postpone studying these topics by discussing them with other students. Talking to them may lead you to consider an approach that may help you act more quickly instead of delaying studying the material.
<table>
<thead>
<tr>
<th>Date</th>
<th>Amount of Time</th>
<th>Goal</th>
<th>Accomplishment/Notes/Questions</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>
## APPENDIX E - MSLQ RESULTS

Date:
Student ID:

### Part A: Motivational Beliefs

<table>
<thead>
<tr>
<th>Factor</th>
<th>Your score</th>
<th>Class mean</th>
<th>Bottom 25%</th>
<th>Middle 50%</th>
<th>Top 25%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-Efficacy</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Intrinsic Value</td>
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</tr>
<tr>
<td>Test Anxiety</td>
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</tbody>
</table>

### Part B: Self-Regulated Learning Strategies

<table>
<thead>
<tr>
<th>Factor</th>
<th>Your score</th>
<th>Class mean</th>
<th>Bottom 25%</th>
<th>Middle 50%</th>
<th>Top 25%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognitive Strategy use</td>
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<td></td>
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<tr>
<td>Self-Regulation</td>
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</tbody>
</table>


APPENDIX F – SAMPLE EMBEDDED LECTURE QUESTIONS

2.) You want to sort the files in your My Documents folder by application type. Which view should you use? (multiple choice) Responses

<table>
<thead>
<tr>
<th>View</th>
<th>Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>List</td>
<td>2 66.67%</td>
</tr>
<tr>
<td>Thumbnails</td>
<td>0 0%</td>
</tr>
<tr>
<td>Icon</td>
<td>0 0%</td>
</tr>
<tr>
<td>Details</td>
<td>1 33.33%</td>
</tr>
<tr>
<td>Totals</td>
<td>3 100%</td>
</tr>
</tbody>
</table>

6.) Which of the following is a list of hardware? (multiple choice) Responses

<table>
<thead>
<tr>
<th>Hardware</th>
<th>Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disk drive, monitor, modem, Internet Explorer</td>
<td>0 0%</td>
</tr>
<tr>
<td>Video card, keyboard, mouse, printer</td>
<td>3 100%</td>
</tr>
<tr>
<td>Monitor, Keyboard, Anti-Virus, CPU</td>
<td>0 0%</td>
</tr>
<tr>
<td>Excel, Word, PPT, IE</td>
<td>0 0%</td>
</tr>
<tr>
<td>Totals</td>
<td>3 100%</td>
</tr>
</tbody>
</table>

10.) You deleted a file from your USB thumbdrive. When you look in the Recycle Bin, you do not see the file. Why not? (multiple choice) Responses

<table>
<thead>
<tr>
<th>Reason</th>
<th>Responses</th>
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<td>Deleted items from remote drives and removable...</td>
<td>2 66.67%</td>
</tr>
<tr>
<td>Deleted items from remote drives and removable...</td>
<td>0 0%</td>
</tr>
<tr>
<td>You removed the thumbdrive from the computer</td>
<td>0 0%</td>
</tr>
<tr>
<td>Only items from removable drives go to the Re...</td>
<td>1 33.33%</td>
</tr>
<tr>
<td>Totals</td>
<td>3 100%</td>
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</table>

20.) Change the formula in cell C5 that reads =A3:B3 to one that has A3:B3 as an absolute reference. (multiple choice) Responses

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<td>=A3:B3</td>
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<tr>
<td>=$A3:$B$8</td>
<td>2 66.67%</td>
</tr>
<tr>
<td>=$A3:$B$5</td>
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<tr>
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</tr>
<tr>
<td>Totals</td>
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APPENDIX G –STUDENT DEMOGRAPHICS QUESTIONS
(Adapted from Appendix A MSLQ, Pintrich, Smith, Garcia, & McKeachie, 1991, p. 65)

1. Gender
2. In what year did you graduate from high school?
3. Class level (freshman, sophomore, upper, other)
4. Do you plan to transfer to a 4-year college?
5. Ethnic Background
6. How many hours a week do you work for pay?
7. How many hours a week do you volunteer without pay?
8. How many other college level courses have you had in this subject area?
9. Have you had this class before?
10. Did you take this class to fulfill program requirement?
11. Did you take this class because the content seems interesting?
12. Do you think this class will be useful to you in other classes?
13. Did you take this class because you think it is an easy elective or class?
14. Did you take this class because it will improve your academic skills?
15. Did you take this class because it was recommended by a friend?
16. Did you take this class because it was recommended by a counselor?
17. Did you take this class because it will be useful for current or future employment?
18. Did you take this class because it fits into your schedule?
19. What is your major?
20. Have you completed the Student Success Skills course?
21. Are you currently enrolled in the Student Success Skills course?
## APPENDIX H - CORRELATIONAL DATA (MSLQ TIME 1)

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## APPENDIX I - TREATMENT GROUP CORRELATIONS (MSLQ TIME 2)

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## APPENDIX J - CONTROL GROUP CORRELATIONS (MSLQ TIME 2)

Control Group Correlations (Significance p <0.05 unless otherwise specified, n = 11)

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APPENDIX K – CONSENT FORM

Application for Exemption from Institutional Oversight

Unless qualified as meeting the specific criteria for exemptions from Institutional Review Board (IRB) oversight, ALL LSU research/projects using living humans as subjects, or samples, or data obtained from humans, directly or indirectly, with or without their consent must be approved or exempted in advance by the LSU IRB. This Form helps the PI determine if a project may be exempted, and helps to request an exemption.

Applicants: Please fill out the application in its entirety and include the completed application as well as parts A-E, listed below, when submitting to the IRB. Once the application is completed, please submit two copies of the completed application to the IRB Office or to a member of the Human Subjects Screening Committee. Members of this committee can be found at http://www.lsu.edu/screeningmembers.shtml

A Complete Application Includes All of the Following:
(A) Two copies of this completed form and two copies of part B thru E.
(B) A brief project description (adequate to evaluate risks to subjects and to explain your responses to Parts 1 & 2)
(C) Copies of all instruments to be used.
(D) If this proposal is part of a grant proposal, include a copy of the proposal and all recruitment materials.
(E) The consent form that you will use in the study (see part 3 for more information."
(F) Certificate of Completion of Human Subjects Protection Training for all personnel involved in the project, including students who are involved with testing or handling data, before any data is collected (see http://www.nlm.nih.gov/irb/irb2/hsedtraining/hsedtrain.html).

1) Principal Investigator: Jeanne Carol Samuel
Rank: Graduate Student
Dept: Educational Theory, Policy and Practice
Ph: 504-491-1815
E-mail: samuell@lsu.edu

2) Co-Investigator(s): please include department, rank, phone and e-mail for each
Yiping Lou, Ph.D., Associate Professor, Educational Technology, 225-578-7487, yplou@lsu.edu

3) Project Title: THE EFFECT OF MULTIPLE-CHOICE QUESTION DESIGN ON STUDENT ACADEMIC PERFORMANCE AND SELF-REGULATED STUDY HABITS

4) Proposal? (yes or no) No If Yes, LSU Proposal Number
Also, if YES, either
☐ This application completely matches the scope of work in the grant
☐ More IRB Applications will be filed later

5) Subject pool (e.g., Psychology students) Community College Computer Applications Students
*Circle any "vulnerable populations" to be used: children <18; the mentally impaired; pregnant women, the aged, etc.). Projects with incarcerated persons cannot be exempted.

6) PI Signature ____________________________ Date 4 FEB 11 no signatures

** I certify my responses are accurate and complete. If the project scope or design is altered, I will resubmit for review. I will obtain written approval from the Authorized Representative of all non-LSU Institutions in which the study is conducted. I also understand that it is my responsibility to maintain copies of all consent forms at LSU for three years after completion of the study. If I leave LSU before that time the consent forms should be preserved in the Departmental Office.

Screening Committee Action: Exempted ( ) Not Exempted ( )
Category/Paragraph 1
Reviewer Kristin J. Gansle ____________________________ Signature ____________________________ Date 02/09/11

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CONSENT FORM

The title of this study is The effect of multiple-choice question design on student academic performance and self-regulated study habits. The study will be conducted at Delgado Community College, Business and Technology Division, 615 City Park Avenue, New Orleans, LA, 70119. Questions regarding this study can be directed to the principle investigator, Jeanne C. Samuel, jsamue@dcc.edu; jsamue2@lsu.edu; or anythingpe1@cox.net. The purpose of this study is to determine primarily the effect of changing multiple choice question format and delivery on student academic performance study habits. Approximately 60 students enrolled in ADOT 105 Survey of Office Administration taught by Jeanne Samuel during the spring semester, 2011 will be asked to participate in the study. Three sections of ADOT 105 taught by Ms. Samuel will participate in the study. One section of the course will be assessed using traditional multiple-choice formatted. The other two sections of the course will use alternate assessments in the format of discrete-option multiple-choice (DOMC). DOMC is both an alternate question format as well as an alternate delivery format. Results will help to determine the effective question of question format on student academic performance and student study habits.

There is a very slight risk that data may inadvertently be disclosed. However, care will be taken to preserve the privacy and confidentiality of the data and the participants. Student grades will be stored in the online school’s course management system (Blackboard). Only the researcher will have access to the correspondence of individual student grade, survey responses per test format.

Subjects may refuse to participate in, or withdraw from, the study at any time without penalty or loss of benefit to which they may be entitled.

Results from the study may be published, but no names or identifying information will be used. Subject identity will remain confidential unless disclosure is required by law.

Signatures: This study has been approved by the LSU IRB. For questions concerning participants’ rights, please contact the IRB Chair, Dr. Robert C. Mathews, 578-8692, or irb@lsu.edu.

I agree to participate in the study described above and acknowledge the investigator’s obligation to provide me with a signed copy of the consent form.

Signature of the participant: ____________________________ Date: ______________

Study Exempted By:
Dr. Robert C. Mathews, Chairman
Institutional Review Board
Louisiana State University
203 B-1 David Boyd Hall
225-578-8692 | www.lsu.edu/irb
Exemption Expires: 2-8-2014
APPENDIX L – PERMISSION TO USE MSLQ

Dear Jeanne, you have MSLQ permission if you cite the authors to put it in your dissertation. Marie

Marie-Anne Bien, Program Secretary
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Jeanne is an advocate and practitioner of lifelong learning. With over twenty years of computer consultant/instructor and support experience, Jeanne sought a doctoral degree in educational technology to help others transparently integrate technology into curriculum. Her research interests are: technology and pedagogy; educational technology innovation adoption (the J-Curve adoption rate model); emerging technology; distance, mobile, Just-In-Time, collaborative, and personal learning; social networks and education (the contextually-partitioned web); learning management system design (collabularies and web n.0); and assessment to promote self-regulation and achievement. Jeanne has been a reviewer for the MERLOT Journal of Online Learning and Teaching (JOLT) for several years. As a faculty member at Delgado Community College, Jeanne is a newly elected member of the faculty senate and is a member of the Business and Technology Division’s Committee for Student Retention and Completion.