THE RELATIONSHIP BETWEEN
SELF-REGULATORY LEARNING STRATEGIES
AND
THE ACADEMIC ACHIEVEMENT OF
HIGH SCHOOL CHEMISTRY STUDENTS

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Recent studies have established a link between self-regulation and high academic achievement, but few studies have demonstrated this link during students' test preparation and performance in naturalistic settings. This study replicates Kitsantas's (2002) work on whether psychology college students' examination scores are influenced by their use of self-regulatory strategies during test preparation and performance. Sixty-one college preparatory chemistry high school male students were interviewed to assess learning strategies they used before, during, and after a testing period. Results indicated that (a) high test scorers used more self-regulatory processes to enhance their test preparation and performance compared to low test scorers; (b) self-regulation positively affected test performance; and (c) self-regulatory skill and self-efficacy beliefs predicted subsequent test performance. There was no significant difference between high and low self-regulators' perceived task value.
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CHAPTER 1
INTRODUCTION

Regardless of the recent educational movement towards alternative assessment in determining academic achievement, many high school teachers still rely heavily on assessing students via traditional pen-and-paper examinations. In fact, an argument can be made that scores on pen-and-paper examinations make up the majority of students' grades in certain high school courses such as math and science (Stiggins, 1995; Wiggins & McTighe, 1998). Students who excel in this assessment format are usually awarded with higher grades than students who, although capable, may not have the necessary skills to do as well on these types of tests. For example, students who demonstrate proficiency and understanding in a science lab experiment may not demonstrate the same level of proficiency on a multiple-choice exam. The central problem here is that poor test scores affect students' college placement; many schools will not consider admitting a student who has a GPA below a 3.0. Thus, there may be students who are denied access to higher learning—not necessarily due to lack of ability, but because they may not possess or use the skills that would enable them to score higher on tests. Because of this, educators need a better understanding of the strategies, if any, of those students who perform well on examinations. A learning strategy is defined as a “conscious plan that integrates a set of specific behaviors in order to accomplish a recurring task successfully” (F. Bail, personal communication, December 10, 2004). According to the literature, using learning strategies is a significant way that students learn how to regulate their academic behavior (Weinstein & Mayer, 1986).

Self-regulation refers to self-generated thoughts, feelings, and actions that are planned and systematically adapted to affect one's learning and motivation (Schunk,
1994; Zimmerman, 1989, 2000; Zimmerman & Kitsantas, 1996). In other words, self-regulating students are active participants in their own learning process. Students who do not engage themselves mentally, motivationally, and behaviorally in an academic task may not learn. Bandura’s (1986) social cognitive theory represents the underlying foundation of this basic tenet: self-regulated learning is a function of the reciprocity between the student’s environmental, behavioral, and cognitive processes. Students who purposefully change either their environment, behavior, or their thinking will impact the other two factors. To illustrate this idea, a student who wishes to study for thirty minutes in order to prepare for a quiz can regulate her study efforts by acting on her study environment—removing distractions such as a TV set, for instance. This in turn affects her study behavior because she is able to study longer and persist through the academic task. When her efforts pay off with an A on the quiz, this increases her personal belief that she can accomplish similar tasks in the future. Self-regulating students use learning strategies as the tools to make changes anywhere along this triadic feedback loop in order to accomplish an academic task. These strategies may include setting clear and realistic goals, monitoring and evaluating progress, and managing resources such as time, environment, and effort. Choosing the best strategy is a continuous and interactive process between the students’ behavioral outcomes, personal efforts, and environment (Zimmerman, 1989). In fact, students’ specific choice of strategy use may be determined from several of these behavioral and personal factors, including the value the students place upon the specific academic task (task value) and their belief that they can accomplish the academic task (perceived self-efficacy).
Self-regulation allows students to decide proactively which strategies are necessary to achieve their academic goals; in this way, students have more control over their learning (Zimmerman, 2002). Zimmerman also believes that improving students' self-regulatory skills is one of the most promising solutions for raising achievement scores in the United States (Zimmerman, 1994). Thus, identifying students' learning strategies becomes very important in dictating how educators can help students score higher on pen-and-paper tests.

*Purpose of Study*

This study seeks to extend Kitsantas' (2002) work on whether psychology college students' examination scores are influenced by their use of self-regulatory processes during test preparation and performance. Kitsantas' study is unique in that it is the first to follow the learning strategies that students use before, during, and after an exam. Kitsantas called for expanding the research to include lower achievers as well as different subject areas. My research addresses Kitsantas' recommendations by following college-preparatory chemistry students' self-regulatory processes during their test preparation and performance. Moreover, I am expanding Kitsantas' research by sampling high school students: Is there a difference between the self-regulatory processes of high school students compared to college students? In order to compare my results directly with Kitsantas' study, I am using the same research questions she explored in her research.

Kitsantas identified three purposes of her study: (a) to identify self-regulatory processes used by high test scorers to enhance test preparation; (b) to examine the effect of self-regulation on test performance; and (c) to determine the effect of self-efficacy
beliefs and task value on students' test performance. This study will therefore investigate the following three questions:

1. Will high test scorers use more self-regulatory processes to enhance their test preparation and performance compared to low test scorers?

2. Will self-regulation positively affect test performance?

3. Will self-regulatory skill, self-efficacy beliefs, and task value predict subsequent test performance?
CHAPTER 2
LITERATURE REVIEW

Correlational Approaches to Self-Regulation

Studies on self-regulation grew out of the idea that "...students' deficiencies in learning were attributed to a lack of metacognitive awareness of personal limitations and an inability to compensate" (Zimmerman, 2002, p. 65). Increasingly, educational researchers no longer viewed learners as passive, but perceive them to have more responsibility for their own learning; thus, investigators began to focus on the self-regulatory processes that affect student achievement and motivational beliefs. Today, many of the studies on self-regulation and learning can be placed into two categories (Williams, 1996). Correlational studies, in which researchers identify variables in self-regulation that relate to academic performance; and experimental studies, in which researchers manipulate variables in self-regulation and attempt to establish casual relationships with student learning. Since the purpose of my research is to explore the relationship, if any, between students' self-regulatory strategies and their performance on pen-and-paper examinations, only the correlational approach will be considered.

Correlational studies involving self-regulation and academic achievements fall into two categories: (a) studies that correlate student performance with the number of self-regulation strategies used; and (b) studies that assess the relationship between specific self-regulation strategies and student achievement. In the first category, research shows that there is a strong positive relationship between the total number of strategies students possess and their academic achievement (Joo, Bong, & Choi, 2000; Pintrich & DeGroot, 1990; Vanzile-Tamsen & Livingston, 1999; Zimmerman, 2000; Zimmerman, 2002). Zimmerman and Martinez-Pons' (1986) were among the first researchers to
establish this link in a naturalistic setting; they could predict 93% of the high-achieving group just by looking at their reported self-regulated learning strategies. In addition, Kitsantas (2002) found that among high-level psychology college students, the number of strategies reported predicted which students would score higher on exams. This relationship between the number of strategies and academic performance seems to be based on the idea that students who possess more strategies have more options and control in deciding how to accomplish their academic goals (Zimmerman, Bonner, & Kovach, 1996). Using unstructured interviews to inquire about the learning strategies of seventh graders, De Groot (2002) stated, “...it appeared that students who described themselves as better students had a greater number of strategies to choose from and used these with discretion” (p. 42). Thus, it appears that possessing more learning strategies gives students more control over environmental, behavioral, and personal factors needed to accomplish an academic task successfully (Wood, Motz, & Willoughby, 1998).

Specific Self-Regulation Learning Strategies

The literature also indicates that several specific self-regulation strategies are related to students’ academic performance: setting goals and planning, using appropriate strategies, directing one’s study efforts through managing resources such as time and study environment, seeking help from social and nonsocial sources, self-monitoring progress, and self-evaluating progress. In order to understand these specific strategies within the context of the current study, specific self-regulatory processes that are presumed to be involved in students’ test preparation and performance will be used as examples.
Setting Goals and Task Value

Self-regulated students begin the process of preparing for an exam by setting either goals or the outcomes they expect to receive for their efforts. Outcome expectations such as praise from one’s parents, getting good grades for college, or experiencing internal satisfaction when students receive an A on an exam is a major motivating factor that determines whether students will attempt to learn. Aside from the outcomes that students expect, the perceived value of the learning task is also important (Schunk & Ertmer, 2000). How valuable is learning the exam’s chemistry content to the student? The value of the task depends on how important or interesting it appears to the student; high task value fosters intrinsic motivation, which in turn, leads to deeper cognitive engagement (Pintrich & Schrauben, 1992). If the value of the learning task is low, then students will have a difficult time regulating their learning, which may result in lower academic achievement (DeGroot, 2002). Students engage in activities because they believe their efforts will lead to positive outcomes; thus, students who set clear, realistic, moderately difficult, short-term goals become more committed to attaining them, and this leads to higher academic achievement (Locke & Latham, 1990). Setting goals relates to academic achievement because goals provide specific performance standards by which students can gauge their progress.

Research also shows that the type of goal students set is related to academic achievement. Students who set mastery goals are more likely to perform better on tests than students who set only performance goals (Kitsantas, 2002). Mastery goals are methods and strategies that can help students master a task, while performance goals reflect only the desired results. In this study, I expected that the high-achieving students
would set goals that involve trying to understand the chemistry processes underlying the chemistry concepts, and that the low-achieving students would state performance goals such as, "I want an A", or, "I want to get all the questions correct." Once a goal or outcome is established, self-regulated students reach these goals by engaging in strategic planning.

*Strategic Planning*

Based on the student's perceived task value of the course material, the difficulty and proximity of the goal, and several other possible factors as illuminated by Bandura's social-cognitive theory (Bandura, 1986), self-regulated students select appropriate strategies that they believe will enable them to accomplish their goals. This selective use of appropriate strategies is highly related to academic achievement (Wood et al., 1998). For example, high-achieving students will use more elaborative and organizational strategies than low-achieving students (Gaskins & Elliot, 1991). Rewriting their notes, selecting main ideas, and outlining the text allow for a deeper processing of the course material compared to just using rehearsal strategies for basic memory tasks (Wood et al., 1998). Conversely, students who just read their notes or text repeatedly in order to memorize the information may only develop a superficial understanding of the material.

To make sure that their learning strategies are implemented, self-regulated students incorporate several resource management strategies. The self-regulatory capability that combines the various learning strategies necessary to regulate students' study efforts is called effort regulation.
Effort Regulation: Managing Resources

Corno (1989) defines effort regulation as the students’ ability to control their effort and attention in the face of distractions and uninteresting tasks. According to Doljinac (1994) and Lee (1997), effort regulation is a strong predictor of academic success. Students rating themselves as poor, average, or better in their skill to regulate and persist through an academic task do differ in the grades they receive (DeGroot, 2002). Because learning is an active process, it requires effort; however, just increasing the amount of study time does not necessarily result in higher academic achievement. Delucchi, Rohwer Jr., and Thomas (1987) concluded that students’ “... academic success depends not on total time spent studying but on effective time management, along with other self-management skills” (p. 64). Gall, Gall, Jacobsen, and Bullock (1990) believe that students who are taught these self-management skills would be better able to develop and maintain their own motivation, and Alderman (1999) feels it would help students handle distractions in and out of school, allowing students to develop their learning skills gradually. Students may really be desirous of accomplishing their academic goals, but do not know how to structure their efforts in order to plan and carry out those goals. Effort regulation is not simply a reflection of students’ desire to finish a task, but a self-management strategy that consists of incorporating several other resource management strategies, such as study environment and time management (Pintrich, Smith, Garcia, & McKeachie, 1991).

Students who choose a study environment that is free of distractions so they can concentrate or restructure the physical environment to be more conducive in preparing for an exam will achieve higher scores than students who make no changes to their study
environment (Zimmerman & Pons, 1986). These self-regulated students will remove items from their study area such as a television, or clean and organize their study area before they actually begin an academic task. In my own experience as a teacher, I have observed some of my low-achieving students attempt to study for an upcoming exam in the school cafeteria while eating and talking to their friends. In addition to having a quiet place to study, time management is also an important factor in determining students’ academic achievement.

Research shows that time planning and management training helped students to better self-regulate their use of study time and, in turn, improved students’ grade point average (Britton & Tesser, 1991; Zimmerman, Greenberg, & Weinstein, 1994). I would predict that high-achieving chemistry students would begin to study at least a week before a major exam, at a time they are most productive during the day. These students would also spread their study time evenly throughout the week, and set daily study goals. In contrast, students who are poor self-regulators will cram just before the test and hope for the best; these students have been shown to have lower academic performance (Biggs & Moore, 1993). Students who incorporate these self-management strategies into their academic repertoire develop their ability to persist through and finish academic tasks. If students find themselves having difficulty with the material, then self-regulated students seek help and additional information from both social and nonsocial sources.

Seeking Help From Social and Nonsocial Sources

Students who seek more help from their peers, their teachers, or adults perform better academically than students who do not seek help (Kitsantas, 2002). In fact, many of the learning strategies that students possess come from these social sources. Seeking
help from others who can model ways in which to learn the material can be internalized and used to produce even more learning by the student, which results in higher academic scores (Schunk, 1987). In addition, nonsocial sources such as the Internet, course textbook, and the encyclopedia provide additional avenues for students to better understand the processes and concepts they are trying to learn. Zimmerman and Martinez-Pons (1986) found that students who purposefully made efforts to use either form of support predicted the students’ achievement track in school. Thus, the extra help from social and nonsocial sources, regulating their study efforts, using elaboration and organizational strategies, and the setting of clearly defined goals, all ensure that students have prepared adequately for the upcoming exam.

Self-Monitoring

Throughout the study process, self-regulating students monitor the effectiveness of their learning strategies. Self-monitoring is defined as deliberately paying attention to an aspect of one’s behavior (Brenan & Schloemer, 2003; Lan, 1996). Research has found that students who monitor their progress towards their goals, especially mastery goals, display higher skill acquisition; according to the research this self-monitoring is essential for enhancing learning (Schunk & Ertmer, 2000). Self-monitoring helps students focus their attention on and discriminate between effective and ineffective performance and reveals inadequate learning strategies. Students who perceive they are progressing academically, in turn, are motivated to achieve even more. As a result of monitoring their progress, students are then able to reflect upon the effectiveness and the efficiency of those learning strategies and then make any necessary changes.
**Self-Evaluation**

Self-evaluation occurs when individuals respond to their efforts and modify their learning strategies by comparing outcomes of performance with a standard goal (Schunk & Ertmer, 2000). Students who are self-regulated often attribute poor performance to strategy deficiency rather than to lack of ability; this allows these students to make better adaptations: replacing their strategies with more effective strategies, seeking assistance from others, and restructuring their learning environment so that it is conducive to learning. To make these adaptations students must also have metacognitive strategies.

Metacognition is a major feature of self-regulated learning because it involves the awareness, knowledge, and control of cognition (Chen, 2002). Learning requires that one mentally manipulate knowledge. Students who raise their metacognitive awareness in order to self-evaluate their academic progress also validate their belief in their effectiveness as learners. This belief is known as a student's perceived self-efficacy and is a strong predictor of students' academic performance (Schunk & Pajares, 2002).

**Perceived Self-Efficacy**

Perceived self-efficacy is “…the belief about one’s capabilities to learn or perform behaviors at designated levels” (Schunk, 2001, p.126). Effective self-regulation depends on feeling self-efficacious for using skills to achieve mastery (Bandura, 1986; Bouffard-Bouchard, Parent, & Larivee, 1991; Zimmerman, 1994). Positive self-evaluations of progress indicates to students that their learning strategies are working, which increases their perceived self-efficacy. Conversely, critical self-evaluations allow students to make the adjustments necessary to raise their academic performance (Bandura, 1988). An argument can be made that the ability to regulate one’s effort is tied
to students' perceived self-efficacy (Schunk, 2001). Multon, Brown, and Lent (1991) found that self-efficacy was related both to academic performance ($r = .38$) and to persistence ($r = .34$). This increased self-efficacy leads the learner to persist longer and work harder which has a direct effect on academic achievement (Kanfer & Gaelick, 1986). Collins (1982) and Chemers, Hu, and Garcia (2001) found that students who persisted longer in their mathematical computations and problem solving also had higher self-efficacy. Students who do well on an exam may experience increased self-efficacy, which results in more effort towards their academic goals.
Participants

Participants included 61 male students, from 14-to 17-years-old, with a mean of 15.4 years. These students were enrolled in my three college-preparatory chemistry courses at an all-boys Catholic high school on O'ahu, Hawai'i. There were 36 sophomores (59%), 6 freshman (10%), 15 juniors (24%), and 4 (7%) seniors. The chemistry class is a required course for students in a college-preparatory track. All 61 students completed the study and received points for participating in each phase of the research, which was added to their final semester grade. Participation was voluntary and students and their parents completed informed consent forms (see Appendix E).

Research Instruments

I used five instruments to measure students' self-regulatory processes, self-efficacy beliefs, task value, and academic achievement.

Self-regulation pre-exam interview questionnaire

A 14-item questionnaire (see Appendix A), modified from Kitsantas' (2002) study, was used to assess the self-regulatory strategies that students generally employ before, during, and after test taking. There were two modifications made to the instrument used in Kitsantas' (2002) study: First, I eliminated questions that pertained to essays since all chemistry exams used were multiple-choice. Second, I reworded a few of the questions to make them more appropriate for high school students. For example, I changed the question, “When you are taking a multiple choice Chemistry course test, do you review and revise your responses?” to “When you are taking a multiple choice Chemistry course test, do you check or change your answers?”
I conducted all the interviews and recorded them with a digital tape recorder. I transferred all interviews into a digital voice editor and labeled each interview using the students' ID number. Next, I transcribed the recorded interviews using voice recognition software. After printing out a hard copy of each transcript, I coded the students’ reported learning strategies into different categories based on a slightly expanded version of Zimmerman’s (1986) list of 14 self-regulation strategies (see Appendix B). The category of reviewing records was expanded to include laboratory reports and the course’s online practice chemistry quizzes; both of which students often use to prepare for their exams.

Table 1 lists all strategies and example behaviors reported in the pre-exam interview by the students.

Table 1

<table>
<thead>
<tr>
<th>Self-Regulatory Strategies and Example Behaviors Reported in Pre- and Post-Exam Interviews</th>
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<tbody>
<tr>
<td><strong>Strategy</strong></td>
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<tr>
<td>Goal setting and planning</td>
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<tr>
<td>Keeping records and monitoring</td>
</tr>
<tr>
<td>Rehearsing and memorizing</td>
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<tr>
<td>Reviewing records</td>
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<tr>
<td>Organizing and transforming</td>
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<tr>
<td>Seeking information and help</td>
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<tr>
<td>Environmental structuring</td>
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<td>Self-consequences</td>
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<td>Self-evaluation</td>
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<td>Planning appropriate responses</td>
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<td>Reviewing responses</td>
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<tr>
<td>Test Anxiety Strategies</td>
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Two undergraduate students from a local college coded the data in the following way. If a student answered “yes” to a question and provided an appropriate strategy, then a point was scored for each strategy mentioned. No point was scored for students who answered “no”, or who provided a nonstrategic answer.

The coders were trained by initially coding three randomly selected student interviews that I also coded with them. We discussed discrepancies and confusion with the scoring protocols. The biggest challenge was in determining whether some strategies fit under the definitions that I had established. For example, one student stated in his interview, “When I get nervous during the test, I bite my pencil.” From this statement, it was difficult to determine whether the student bit his pencil as a result of being nervous or whether the student bit his pencil as a conscious strategy to calm his nerves. Subsequently, the coders and I agreed that any ambiguous statements such as this would not receive a point.

The agreement between myself and coder #1 and coder #2 was 89% and 84% respectively. The agreement between the two coders was 85%. The disagreements centered around two areas: there was still some disagreement on whether some statements should be categorized as an actual student learning strategy as well as into which category a few specific learning strategies fit. For example, one coder felt that students who checked their scores from previous tests could be scored in either the keeping records and monitoring category or in the self-evaluation category. Although the student did write down his test scores, he still kept a running tabulation in his mind, and this served as an indicator of his academic progress. After some discussion, it was decided that if the student does actually write down the information, it would be scored
under the category of self-monitoring. If the students acts upon the information and changes his behavior accordingly, then it would be scored under the category of self-evaluation. Through these types of discussions, the two coders and I reached consensus on any disparity in our coding.

*Self-regulation post-exam interview questionnaire*

To discover which strategies students' actually used in their test preparation and performance for a specific exam, I interviewed the students again two days after they took an exam. Interviewing students two days after the exam enabled the students to receive their exam results the day after the test and gave them a chance to act upon that information if they so desired. The drawback of interviewing students two days later was that their memories of what learning strategies they used may have been distorted. The questionnaire instrument used in the post-exam interview consisted of the same questions found on the pre-exam interview, except that questions #4 and #14 were eliminated because they were only pertinent to the students' exam preparation (see Appendix C). In addition, I reworded the pre-exam interview questions to fit the post-exam interview time frame. For example, I changed the first question on the pre-exam interview questionnaire from, "What kind of things do you do when you are studying for a Chemistry test?" to a more appropriate post-exam interview question, "What kind of things did you actually do when you were studying for the Chemistry test?"

Similar to the pre-exam interview, I conducted all the post-exam interviews and recorded them with a tape recorder. Next, I transcribed and coded the responses into categories following the same procedures as the pre-exam interview. The same coders for the pre-exam exam interview coded the post-exam interviews. This time, coder #1 and I
reached a 97% agreement and coder #2 and I agreed 95%. Agreement between coder #1 and coder #2 was 90%. The disagreements again focused mainly on the same two areas mentioned above in the pre-exam interviews, but these discrepancies were solved through discussion. All strategy categories reported in the pre-exam interview were also reported in the post-exam interview as shown in Table 1.

Perceived self-efficacy

In Kitsantas’ (2002) study the students’ perceived self-efficacy was measured with a three-item measure developed by Bandura and Schunk (1981). In that study, the psychology students were asked how sure they felt that they would get a grade of A, B, or C on their psychology exam. Because my research involved using several exams, I did not think it was practical to ask the students to respond to the same question repeatedly. Instead, to measure my students’ perceived self-efficacy for chemistry exams in general, an 8-item subscale of the Motivated Strategies for Learning Questionnaire (MSLQ) was used (see Appendix D). The MSLQ is a self-report instrument designed to measure motivation and learning strategies in specific academic contexts. The MSLQ consists of 15 different subscales which can be used together or singly (Pintrich et al., 1991). The questionnaire uses a 7-point Likert scale, from 1 (“not at all true of me”) to 7 (“very true of me”). Reported scores are computed by taking the mean of the items that make up the scale. The MSLQ is a reliable and valid instrument with Cronbach’s alphas ranging from .52 to .93. and scale correlations to final grades being reported as significant (Pintrich et al., 1991). In addition, the MSLQ has been used in many different subject areas (Chen, 2002), and at various age levels (DeGroot, 2002; Garcia & Pintrich, 1994; Pintrich & Smith, 1993). The questions found in Appendix D that measure students’ perceived self-
efficacy in this study's questionnaire are #2, #3, #5, #6, #8, #9, #13, and #14. The internal reliability coefficient of the perceived self-efficacy scale of the MSLQ is $\alpha = .93$ (Pintrich & Smith, 1993).

Task Value

To measure students' task value of the test, I used a 6-item subscale of the MSLQ that measures task value. I did not utilize the 1-item measure that Kitsantas (2002) used to measure the psychology students' perceived instrumentality (outcome expectations) because I was not sure if the question would produce enough variability in scores to demonstrate a difference between high and low-achieving students. The questions found on the questionnaire (see Appendix D) that measure students' value they place upon the course content, are #1, #4, #7, #10, #11, #12. The internal reliability coefficient of the task value scale of the MSLQ is $\alpha = .90$ (Pintrich & Smith, 1993).

Chemistry achievement tests

To measure the academic achievement of the chemistry students, three multiple-choice tests were used which I previously developed for my course. Each test covers the subject matter of one chapter and contains 50 multiple-choice questions; each correct answer receives 2 points, for a possible total score of 100 points per test. These three tests have not been modified over the past three years and the average scores from year to year remain consistent. Thus, these tests provide a reasonable baseline from which to judge students' academic achievement in the chemistry class.

Grade point average

Students' grade point average was obtained from school's records.
Procedure

The first chemistry exam that was given to the students is typical of the course, but was also a means of allowing students to gain experience with their learning strategies. Between the first and second exams (approximately 3 weeks), I interviewed and audio tape recorded student responses using the 14-item pre-exam interview questionnaire in order to determine the strategies that students use before, during, and after a testing period. During the administration of the second exam, each student received the 14-item questionnaire. Two days after the second exam, I interviewed and audio tape-recorded the students again using the 12-item post-exam interview questionnaire to determine what reported strategies were actually used on the second exam. After students completed the third exam, all students were debriefed concerning the purposes and findings of the study.
CHAPTEIR 4
RESULTS

Differences between the reported learning strategies of high and low achievers were examined using descriptive statistics, t-tests, and univariate and multivariate analyses. Regression analysis was used to evaluate the combined predictiveness of self-regulatory skill, self-efficacy, and task value on exam performance. I used the SPSS statistical software to analyze the data gathered in this study. To code the different academic and self-regulatory groups, I categorized the high academic and self-regulatory groups as 1, and the low academic and self-regulatory groups as 2.

Self-Regulatory Processes Implemented by High and Low-achieving Examinees for Test Preparation

Students were placed into high or low-achieving groups based on their average score over three exams. The overall mean of all three tests was $M = 68.4$ ($SD = 9.67$, $n = 61$). To determine whether these scores were relatively equal to past test scores, I compared the mean for the three tests from the previous year, $M = 69.7$ ($SD = 10.16$, $n = 70$) and the mean for the three tests two years previous, $M = 68.2$ ($SD = 8.22$, $n = 89$). No significant differences were found between the three exams, $F(2, 219) = .37, p > .69$. Because the students were college-preparatory and the average score was in the D+ range, scores that were at least ten points above the mean ($n = 13$), in the C+/B- range and above, were determined to be high test scorers. Students who scored at least 10 points below the mean ($n = 15$) in the F range were considered as low test scorers. Significant differences were detected between the low and high-achieving groups in
grade point average, $t(26) = -7.56, p < .001$ and exam scores, $t(26) = -17.94, p < .001$.

(see Table 2)

Table 2

*Descriptive Statistics for High and Low-achieving Groups: Age, GPA, and Exam Scores*

<table>
<thead>
<tr>
<th>Variables</th>
<th>Low test scorers ($n=15$)</th>
<th>High test scorers ($n=13$)</th>
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<tr>
<td></td>
<td>$M$</td>
<td>$SD$</td>
<td>$M$</td>
</tr>
<tr>
<td>Age</td>
<td>15.53</td>
<td>.83</td>
<td>15.15</td>
</tr>
<tr>
<td>Grade point average</td>
<td>2.54</td>
<td>.44</td>
<td>3.71</td>
</tr>
<tr>
<td>Exam scores</td>
<td>57.15</td>
<td>3.12</td>
<td>82.88</td>
</tr>
</tbody>
</table>

** $p < .001$.**

To determine whether high test scorers used more overall strategies than low test scorers during test preparation and performance, I added the strategies reported for each time frame (before, during, and after) separately. Significant differences were found between the two groups on these three summed scores of self-regulatory strategies, Wilks's $\lambda = .67, F(3, 27) = 4.01, p < .01$. Univariate analyses of variance revealed significant differences in the self-regulated strategies before test taking between the two groups, $F(1,27) = 6.92, p < .01$ High test scorers reported more self-regulatory processes before test taking ($M = 1.38, SD = .39$) than did low test scorers ($M = 1.02, SD = .32$).

Table 3 shows the differences between low scorers and high scorers in terms of the specific self-regulatory processes. High test scorers significantly outperformed low test scorers in reviewing records and seeking information and help and, though they were also more likely to use self-regulatory processes such as self-consequences and self-evaluation, these differences did not achieve statistical significance (see Table 3).
During test taking, there was no significant difference between high and low test scorers in terms of number of strategies or specific strategies reported. (see Table 3).

Finally, significantly more self-regulatory processes were reported by high test scorers after test taking ($M = .28, SD = .27$) than by low test scorers ($M = .11, SD = .15$), $F(1,27) = 4.56, p < .05$. High test scorers reported significantly more goal setting and planning than low test scorers. Though high test scorers reviewed notes of old tests and self-evaluated more than low test scorers, these differences were not statistically significant (see Table 3).

Students also reported during the pre-exam interview the type of goal they had set for the exam, the type of memorization strategies they used, and whether they would still make an effort on an unimportant test. Eighty-nine percent of the students reported setting performance goals while no mastery goals were reported. The most common performance goals reported consisted of desired letter grade or grade percentage. All students reported using repetition as a memorization strategy, mostly consisting of reading the content material over a few time, while 18% percent of the students reported using mnemonic strategies or relating the material to their previous knowledge as a way to learn the material. Finally, 87% of the students stated that they would still make an effort on an unimportant test, while 13% stated that they would not make an effort. The most common reason given by students on why they would still make an effort was that they felt that the exam content might later be on their chemistry final or needed for college.

To determine whether high test scorers actually reported, in the post-exam interview, more strategies than low test scorers during test preparation and performance
Table 3

Means of Self-Regulatory Processes Used by High Versus Low Test Scorers Before, During, and Following Completion of the Test: Pre-Exam Interview

<table>
<thead>
<tr>
<th>Self-regulated strategies</th>
<th>Low test scorers (n = 15)</th>
<th>High test scorers (n = 13)</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
</tr>
<tr>
<td>Goal setting and planning</td>
<td>.80</td>
<td>.56</td>
<td>.92</td>
</tr>
<tr>
<td>Keeping records and monitoring</td>
<td>.67</td>
<td>.90</td>
<td>.46</td>
</tr>
<tr>
<td>Rehearsing and memorizing</td>
<td>2.67</td>
<td>1.45</td>
<td>2.77</td>
</tr>
<tr>
<td>Reviewing records</td>
<td>2.40</td>
<td>1.24</td>
<td>3.62</td>
</tr>
<tr>
<td>Organizing and transforming</td>
<td>.33</td>
<td>.62</td>
<td>.38</td>
</tr>
<tr>
<td>Seeking information and help</td>
<td>1.27</td>
<td>1.16</td>
<td>2.54</td>
</tr>
<tr>
<td>Environmental structuring</td>
<td>.33</td>
<td>.62</td>
<td>.46</td>
</tr>
<tr>
<td>Self-consequences</td>
<td>.53</td>
<td>.74</td>
<td>.85</td>
</tr>
<tr>
<td>Self-evaluation</td>
<td>.13</td>
<td>.35</td>
<td>.38</td>
</tr>
<tr>
<td>Planning appropriate responses</td>
<td>.40</td>
<td>.51</td>
<td>.46</td>
</tr>
<tr>
<td>Organizing and transforming</td>
<td>.07</td>
<td>.26</td>
<td>.00</td>
</tr>
<tr>
<td>Reviewing responses</td>
<td>.60</td>
<td>.51</td>
<td>.77</td>
</tr>
<tr>
<td>Process of elimination</td>
<td>.80</td>
<td>.41</td>
<td>.92</td>
</tr>
<tr>
<td>Test anxiety</td>
<td>.20</td>
<td>.41</td>
<td>.08</td>
</tr>
<tr>
<td>Goal setting and planning</td>
<td>.00</td>
<td>.00</td>
<td>.23</td>
</tr>
<tr>
<td>Reviewing notes of old test</td>
<td>.20</td>
<td>.41</td>
<td>.54</td>
</tr>
<tr>
<td>Self-evaluation</td>
<td>.20</td>
<td>.41</td>
<td>.38</td>
</tr>
<tr>
<td>Keeping records and monitoring</td>
<td>.07</td>
<td>.26</td>
<td>.08</td>
</tr>
<tr>
<td>Seeking information and help</td>
<td>.07</td>
<td>.26</td>
<td>.15</td>
</tr>
</tbody>
</table>

*p < .05. **p < .01.

for the second exam, I completed the same statistical analysis as mentioned above. As shown in Appendix F, there were no significant differences between the groups; in fact, there were slight numerical differences in the means showing that low test scorers reported using more strategies in the categories of organizing and transforming, seeking information and help, planning appropriate responses, and using more process of elimination. The only large numerical differences favoring the high achievers were that
they reviewed notes of old tests and self-evaluated more than the low achievers. To check whether there might be a relationship between the high scorers and low scorers and their reported self-regulatory strategies based just on this one exam, I split the students into high and low achievers to see if there was a relationship between the number of strategies reported actually used for this particular exam and test score. I found no statistical differences between the groups.

*Test Scores and Motivational Beliefs of High Versus Low Self-Regulated Examinees*

I split the students into high and low self-regulatory groups based on the median number of overall strategies reported during the pre-exam interview. A significant difference was found between the low and high self-regulatory groups in test performance, \( t(59) = -1.96, p < .05 \). As shown in Table 4, high self-regulated students averaged significantly better on the three tests than the low self-regulatory group. In addition, high-self-regulated examinees reported significantly higher perceived self-efficacy than the low self-regulated examinees. In terms of task value, no significant differences were found between the two groups. Finally, to compute effect sizes, I divided the mean difference of the two groups by the pooled standard deviation. Table 4 contains the means, standard deviations, and effect sizes of total test scores, as well as self-efficacy and task value scores for each self-regulatory group. Moderate effect sizes emerged between the two groups for the test scores and self-efficacy measures.

*Effects of Reported Strategy Use, Self-Efficacy, and Task Value on Test Performance*

To determine the extent to which total number of self-regulatory strategies reported, self-efficacy, and task value would jointly predict the students' performance on the three tests, a regression analysis was used. Table 5 shows that strategy use, self-
efficacy, and task value significantly predicted the total score on all three tests \((R^2 = .25)\), \(F(3,60) = 6.18, p < .001\). The strongest single predictor was self-efficacy, followed by strategy use.

Table 4


<table>
<thead>
<tr>
<th>Measures</th>
<th>Low ((n = 32))</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(M)</td>
<td>(SD)</td>
<td>(M)</td>
<td>(SD)</td>
<td>(t)</td>
<td>(ES)</td>
<td></td>
</tr>
<tr>
<td>Test scores</td>
<td>66.11</td>
<td>7.72</td>
<td>70.86</td>
<td>11.05</td>
<td>-1.96**</td>
<td>.52</td>
<td></td>
</tr>
<tr>
<td>Self-efficacy</td>
<td>4.71</td>
<td>1.14</td>
<td>5.22</td>
<td>1.12</td>
<td>-1.77**</td>
<td>.46</td>
<td></td>
</tr>
<tr>
<td>Task Value</td>
<td>4.81</td>
<td>1.18</td>
<td>4.82</td>
<td>1.53</td>
<td>-.03</td>
<td>.01</td>
<td></td>
</tr>
</tbody>
</table>

**\(p < .01\).**

Table 5

*Multiple Regression with Test Scores as the Dependent Variable and Total Strategies, Task Value, and Self-Efficacy as the Independent Variables*

<table>
<thead>
<tr>
<th>Variables</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(B)</td>
<td>Std. Error</td>
</tr>
<tr>
<td>Intercept</td>
<td>45.404</td>
<td>5.823</td>
</tr>
<tr>
<td>Total Strategies</td>
<td>.563</td>
<td>.280</td>
</tr>
<tr>
<td>Task Value</td>
<td>-.389</td>
<td>1.031</td>
</tr>
<tr>
<td>Self-efficacy</td>
<td>3.540</td>
<td>1.220</td>
</tr>
</tbody>
</table>

**\(p < .01\).**
CHAPTER 5
DISCUSSION

The purpose of this study was to determine whether high-achieving, high school chemistry students would report a higher number of learning strategies used in exam preparation than would low-achieving students. The results from students’ pre-exam interviews corroborated Kitsantas’ (2002) findings that high-achieving psychology college students reported more overall strategies. While these two studies are unique in that they followed students throughout their test preparation and performance, other studies support the idea that a strong relationship exists between the number of strategies that students’ possess and their academic achievement (Eshel & Kohavi, 2003; Schunk, 2001; Zimmerman & Schunk, 2001).

This finding suggests that students who possess numerous strategies may experience a higher sense of control to accomplish an academic task than low achievers, and would have a higher self-efficacy for that particular task or subject domain. According to Schunk and Ertmer (2000), “Compared with students who doubt their learning capabilities, those with high self-efficacy are more likely to choose to engage in activities, work harder, persist longer when they encounter difficulties, use effective learning strategies, and demonstrate higher achievement” (p. 632-633). The fact that perceived self-efficacy was the most powerful predictor of exam scores in this study further supports this idea.

The results from students’ post-exam interviews, however, did not support the hypothesis. One possible reason for this finding is the difference between knowledge of strategies and use of strategies. Several studies have shown that even though students
may have more elaborate or strategic learning strategies, they do not always use them (Wood et al., 1998). This suggests that just asking students what strategies they actually use does not reveal the depth of their learning strategy repertoire. For this particular exam, high-achieving students may have only needed to use a few appropriate strategies to accomplish their academic goal.

High-achieving students reported two specific strategies more often than low achievers before taking the test in the pre-exam interview: reviewing records, and seeking information and help. Kitsantas (2002) also found that high-achieving college students sought more information and help than low-achieving students. This implies that students who make better use of the resources available to them—e.g., using their notes or asking a friend for help—perform better on tests. This finding also suggests that the type of learning strategy may be just as important as the number of strategies students’ possess. Students who use strategies that require social interaction may receive more guidance and modeling to accomplish an academic task than if they did it completely on their own. Although younger learners may need more social assistance to learn a skill, older students who are able to practice their skills more independently still need assistance from teachers to help refine their skills (Schunk, 2001).

Compared to the college students in Kitsantas’ study, even high-achieving high school students in this study reported fewer specific learning strategies overall. These results are not surprising because students use more self-regulatory strategies in areas in which they are given the opportunities to self-regulate (Schunk & Ertmer, 2000; Weinstein & Mayer, 1986). Learning to self-regulate is not considered an innate ability but develops within the context of modeling and instruction from adults and peers.
(Zimmerman, 2002). Students who have limited chances to self-evaluate, monitor, or
plan their academic goals in the classroom will be limited in their initiative to direct their
own learning. For this particular chemistry class, the students are given the opportunity to
choose from several different resources with which to prepare for an exam, and thus
demonstrate the highest amount of self-regulatory behavior in this area. A similar
argument can be made for information and help seeking. High school students ideally
have extensive contact with their peers, teachers, and parents, which increases the
opportunity to ask for help or to obtain information.

Another reason that high-achieving students in this study may have reported so
few specific strategies is the type of goal and memorization strategies the students
reported. For example, almost ninety percent of the students stated performance goals
(no mastery goals were reported), and the remaining students reported no goals. Research
indicates that students who set performance goals develop a more superficial
understanding of concepts than students who set mastery goals (Weinstein & Mayer,
1986). Students who focus only on the outcome of the test may not use techniques and
strategies needed to truly understand the course material; thus, they may need just a few
learning strategies to reach their academic goal. The fact that many students used
rudimentary memorization strategies to learn the course concepts supports the idea that
students may have only been processing the material at a superficial level.

All sixty-one students used repetition as their main memorization strategy—only
eleven students reported using some type of mnemonic device. While high use of
repetition strategy is common in high school (Wood et al., 1998) and correlates with
performance goals (DeGroot, 2002), the lack of variability in the strategies students
reported indicates a possible lack of exposure to more elaborate memorization strategies. The school which the chemistry students attend does not have any formal training programs to teach learning strategies, and there is no concerted effort by the faculty to incorporate learning strategies into their classrooms. Thus, for example, these students probably have never been taught how or been given the opportunity to organize and transform their notes, or to self-evaluate their performance. According to DeGroot (2002), school culture plays a critical role in determining how students’ learning strategies and self-efficacy develops.

The only specific strategy reported that reached significance for the after test-taking period in the pre-exam interview was goal setting and planning. Upon closer inspection, the difference may solely be attributed to the answers of three high-achieving students. When these students were asked during the interview what they planned to do with the results of their exams, they all stated a new performance goal, but did not indicate clearly specify how they planned to reach this new goal. All the other students said they either put the exam into their backpack or threw it away. Thus, based on these results, it is difficult to conclude that high-achieving students set goals and make plans more than low-achieving students after they receive the results of their tests.

I also hypothesized that high self-regulators would score higher on exams, have higher self-efficacy, and would perceive learning the course content as more valuable than would low self-regulators. The results supported the first two hypotheses, but not the third. These results also support Kitsantas’ (2002) findings that psychology college students who are high self-regulators performed better on exams and had higher self-efficacy beliefs. Research studies show that students who can direct their academic
abilities will achieve academic success and increase their self-efficacy (Schunk & Ertmer, 2000; Zimmerman & Pons, 1986). Perhaps there was no difference between the two groups regarding the students’ perceived task value because both groups considered the course content equally as valuable. The responses from question fourteen on the pre-exam interview questionnaire indicated that 87% percent of the students would still put forth an effort on an exam even if the test were not important to them. This may indicate that despite their personal feelings, the information on the test may represent something valuable to most of the students, such as questions on the final exam or knowledge needed for college. In contrast, these responses may also be more reflective of social desirability factors than to accurate self-reporting. This issue is discussed further in the limitation section.

Despite finding no significance differences regarding task value between high and low self-regulation groups, regression analysis indicated that 25% of the variance was explained by total strategy use, self-efficacy, and task value. This result parallels very closely Kitsantas’ (2002) finding of 24%. The main difference found between this study and Kitsantas’ (2002) regression analysis is that, in the present study, self-efficacy was a stronger predictor of academic performance than the total number of strategies used. Regardless of the predictability strength of either self-efficacy or total strategies used, students’ motivational and strategy use are both important indicators of students who perform well academically.

Implications

Because a large majority of students’ grades is still determined through traditional assessment in high schools, students who are unable to score well on these types of tests
are at a definite disadvantage when compared to high-scoring students. Although these students may be just as capable in other academic abilities, students who score low on traditional tests may have lower GPAs, which in turn, may affect their college placement. The finding of this study and Kitsantas’ (2002) work, that the reported number of students’ learning strategies are predictive of their scores on pen-and-paper examinations, is critical in its theoretical implication that students learn to self-regulate and in its pedagogical implications for teachers.

**Theoretical implications**

According to social cognitive theory, self-regulatory behavior is situationally specific and is dependent on the interactions of students’ personal, behavioral, and environmental factors. This means that students may not naturally acquire self-regulation, but rather that it has to be taught to students specifically within the domain of a particular academic task (Schunk, 2001). According to Zimmerman (1994) there are six areas in which students are able to develop their self-regulatory skill for any particular domain: motives, methods, times, outcomes, physical environments, and social environments. The extent to which students can exert strategic control over each area determines the degree of self-regulation. Experimental studies have demonstrated casual links between students’ academic achievement and their control over such specific learning strategies such as self-monitoring (Lan, 1996). Although this study and Kitasantas’s study are both correlational and only included high school and college students, the findings suggest that students—regardless of age—who have control over their learning strategies perform better on academic tasks. This is not to say that the number of strategies are directly responsible for students’ academic success but may indirectly reflect motivational factors.
such as students' level of perceived self-efficacy and task value. Students who value the learning task and perceive that they are able to complete the assignment may actively seek strategies to help them accomplish the task and may persist longer than students who do not value task or have low self-efficacy (Schunk & Pajares, 2002). The fact that self-efficacy was also a predictive factor for academic achievement at both the high school and college level support this idea that the number of learning strategies and self-efficacy are positively correlated. Moreover, Kitsantas' findings that the total number of learning strategies that college students report is more predictive of academic achievement than self-efficacy (unlike that was found for high school students in this study) suggests that the dynamics of this relationship between knowledge of learning strategies and self-efficacy may change over time. Bandura (1986) states that older and more experienced students self-regulate better because they have had more opportunities to develop their control of learning strategies in a particular academic domain. This suggests that in order to develop self-regulation in students, teachers should introduce self-regulatory learning strategies as early as possible to students in school and provide them with ample opportunities to practice self-regulatory behaviors in a variety of academic domains. At the same time, teachers should also foster students' self-efficacy.

Pedagogical implications

Over the last few decades, many schools have implemented adjunct programs that attempt to teach learning strategies inside and outside the context of specific academic domains. Researchers have found that in order for these programs to be successful, the learning strategies need to be contextualized within students' normal academic schedules, the students need ample practice time to internalize a few strategies at a time, and the
students need to receive explicit instructions including modeling of the learning strategy (Pressley, El-Dinary, Wharton-McDonald, & Brown, 1998). Since automatic use of learning strategies and its subsequent transfer across academic domains requires years of practice within the content of normal class, it seems necessary for the teaching of learning strategies to be introduced as part of teacher's pre-service educational programs. Although evidence of the relationship between strategies and achievement remains mostly correlational, the research indicates that teaching self-regulatory strategies or providing the opportunity to do so only results in benefits for the students, in terms of higher self-efficacy or higher academic achievement. However, because teaching self-regulated learning strategies is not considered a formal part of teacher training, a concerted effort should be made to first provide teachers with the tools needed to incorporate these learning strategies into their curriculum. The most important aspect of this training would be to teach teachers how to embed opportunities for students to self-regulate in their existing instructional strategies. At the same time, pre-service training should also enhance teachers' appreciation of self-efficacy as the motivational power behind self-regulatory behavior and to provide teachers with the instructional strategies to develop it in their students. Teachers who build students' perceived self-efficacy belief, coupled with appropriate self-regulatory strategies, provide students with the necessary tools to achieve academic success where normally they might fail. In addition, teachers should also be trained in providing opportunities for self-regulatory behavior to occur. Students will have difficulty developing their self-regulatory skills if the teacher dictates what, where, and how they should accomplish their goals. If teachers want their students
to self-regulate, then teachers need to give them reasons and opportunities to self-regulate.

To begin with, teachers can start each academic task by having the students state their own personal goal of what they want to accomplish. In this way, the teacher has an opportunity to explain and model the differences between performance goals and mastery goals. Then, the teacher can introduce how to keep track of that goal by using a recording system e.g., planner, in order to write it down. Many of my chemistry students stated that they have forgotten about an exam because they did not have a permanent place in which to write down the test date. This simple self-monitoring strategy may not necessarily motivate students to suddenly begin keeping track of their academic progress, but it does provide the student with another option by which to manage a task. Giving students more control over their learning increases self-efficacy, which allows students to persist and finish an academic task.

Limitations of the Study

The limitations of the study involve self-reporting issues, the small sample size, and it being a convenient sample. At the beginning of the study, I had some concern regarding whether students’ self-reports would be significantly alter the results because I, as their teacher, was conducting the interviews. However, since my results were consistent with Kitsantas’ (2002) findings, self-reporting does not appear to have been a major issue, but the validity and reliability of the findings must still be considered within the context of the limitations found in self-reporting, specifically, interviewer effects and memory distortions.
Research has shown that interviewers themselves affect both the quality and type of respondents' answers (Sudman, Bradburn, Blair, & Stocking, 1977). Social desirability issues such as sensitive or threatening questions, questions that relate to the interviewer, and similarities in race and gender may lead to biases in responses, which affects the quality of the answer (Sudman, Bradburn, & Schwarz, 1996). In order to minimize interviewer effects in this study, I tried to show no reaction to students' responses, and I attempted to redirect any superfluous conversations that went beyond the scope of the interview. However, since this was a convenient sample and I had known these students for about four months, some interaction as the roles of teacher and student was unavoidable during the interview. For example, during an interview one student asked me to help him recall a collaborative learning technique I used in class to help better illustrate how he used his friends to help him study. Obviously, my presence did have an effect on some of the answers; however, because I was their teacher, I was able to informally validate the responses of many of the students with their actual behavior in class. For example, students who reported in the interview that they used online material to prepare for their exams would bring in printouts of the online material and use them to study before a test. Overall, the students' responses during the interviews were consistent with other students' responses and consistent with their behavior in the classroom; thus, any interviewer effects that may have influenced the data were likely minimal.

Poor reliability of the students' responses due to their memory distortions during the interview was also minimal. Research has also shown that nonregular observation provides misleading results and that proximity of recall to the event is crucial to accurate self-reports (Mace, Belfiore, & Shea, 1989). The consistent responses found between the
pre-exam interview and the post-exam interview provides evidence that self-reporting of students was reliable. In addition, the post-exam interview was conducted within two days after the students took the exam, which also helped minimize any distortions of memory.

**Implications for Future Research**

This study and Kitsantas' study are unique in that very few studies, if any, have followed students' test preparation and performance in a naturalistic setting; future research should concentrate on determining whether the number of learning strategies is also predictive of academic achievement in younger students and across different academic domains and cultures. Interviewing elementary students about their test preparation and performance using protocols similar to those used in this study would help determine whether learning strategies have any relationship in determining academic performance for students who most likely have very little experience in controlling their own learning. In addition, such a study could help establish the strength of self-efficacy as a predictor of academic performance compared to high school and college students. If it's true that as older students gain more experience with their learning strategies their perceived self-efficacy becomes less of a predictor of academic performance, then such a study with elementary students should find that self-efficacy would be the greatest predictor of their academic performance.

In addition, future studies using this study's protocols could measure particular cohort responses across various academic domains. How would the relationship between students' depth of strategy knowledge and academic performance translate to their other classes? Would the students use the same strategies or would they adapt their strategies to
the situation? Would their level of self-efficacy remain consistent across domains?

Similarly, the same questions and protocols may be used to measure whether the findings in this study are applicable to other cultures. Following the test preparation and performance of students in Japan or in Africa, for example, may provide valuable insight in understanding whether students' academic performance in those cultures are under similar influences found in this study.

Finally, future research should include a larger, randomly selected sample including a wider range of students. This particular study focused on 61 boys at a private Catholic high school, where each of the subjects were students in my own chemistry classes, thus the data generated here may only be representative of a particular population. Using a larger and wider sample of students would offer a more thorough and complete understanding of the relationship between self-regulatory learning strategies and the academic achievement of all students.
REFERENCES


APPENDIX A

Chemistry Course Study Pre-Exam Interview Protocol

This interview will ask you about your Chemistry course study behaviors and activities.

1. What kind of things do you do when you are studying for a Chemistry test?
2. When you study for a Chemistry test, do you establish goals? What goals?
3. When you study for a Chemistry test, are there any things that you do to keep track of your progress in learning? What are they?
4. What kinds of things will you do when you study for the Chemistry final?
5. What do you do when you study for Chemistry and find the material boring? Are there any techniques or strategies you use to stay motivated? What are they?
6. What do you do when you study for Chemistry and find the theories difficult to understand? Are there any techniques or strategies you use to resolve the difficulty? What are they?
7. What do you do when you study for Chemistry and find the theories difficult to understand? Are there any techniques or strategies you use to stay motivated? What are they?
8. If you are taking a Chemistry test and experience nervousness, do you have any techniques to help you relax or cope better? What are they?
9. When you are taking a multiple choice Chemistry course test and you are not sure of the answer, do you have any strategies to help you select the best response? What are they?
10. When you are taking a multiple choice Chemistry course test, do you have any techniques to help you recall key facts? What are they?
11. When you are taking a multiple choice Chemistry course test, do you check or change your answers? Describe this process.
12. When you receive your Chemistry test results, what do you do with that information?
13. What if the results were disappointing to you, what do you do?
14. When the results of a Chemistry test are not that important to you, do you still make a good effort anyway? If so, why?
### APPENDIX B

Zimmerman and Martinez-Pons (1986) Modified Categories of Strategies

<table>
<thead>
<tr>
<th>Categories of Strategies</th>
<th>Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Self-evaluation</td>
<td>Statements indicating student-initiated evaluations of the quality or progress of their work, e.g., “I check over my work to make sure I did it right.”</td>
</tr>
<tr>
<td>2. Organizing and transforming</td>
<td>Statements indicating student-initiated overt or covert arrangement of instructional materials to improve learning, e.g., “I make an outline before I write my paper.”</td>
</tr>
<tr>
<td>3. Goal-setting and planning</td>
<td>Statements indicating student setting of educational goals or subgoals and planning for sequencing, timing, and completing activities related to those goals, e.g., “First, I start studying two weeks before exams, and I pace myself.”</td>
</tr>
<tr>
<td>4. Seeking information</td>
<td>Statements indicating student-initiated efforts to secure further task information from nonsocial sources such as an encyclopedia or the internet when undertaking an assignment, e.g., “Before beginning to write the paper, I go to the library to get as much information as possible concerning the topic.”</td>
</tr>
<tr>
<td>5. Keeping records and monitoring</td>
<td>Statements indicating student-initiated efforts to record events or results, e.g., “I took notes of the class discussion.” “I kept a list of the words I got wrong.”</td>
</tr>
<tr>
<td>6. Environmental structuring</td>
<td>Statements indicating student-initiated efforts to select or arrange the physical setting to make learning easier, e.g., “I isolate myself from anything that distracts me.” “I turned off the radio so I can concentrate on what I am doing.”</td>
</tr>
<tr>
<td>7. Self-consequences</td>
<td>Statements indicating student arrangement or imagination of rewards or punishment for success or failure, e.g., “If I do well on a test, I treat myself to a movie.”</td>
</tr>
<tr>
<td>8. Rehearsing and memorizing</td>
<td>Statements indicating student-initiated efforts to memorize material by overt or covert practice, e.g., “In preparing for a math test, I keep writing the formula down until I can remember it.”</td>
</tr>
<tr>
<td>9-11 Seeking social assistance</td>
<td>Statements indicating student-initiated efforts to solicit help from peers (9), teachers (10), and adults (11), e.g., “If I have problems with math assignments, I ask a friend to help.”</td>
</tr>
<tr>
<td>12-16 Reviewing records</td>
<td>Statements indicating student-initiated efforts to reread tests (12), notes (13), textbooks (14), lab books (15), or online quizzes (16), to prepare for class or further testing, e.g., “When preparing for a test, I review my notes.”</td>
</tr>
<tr>
<td>17. Other</td>
<td>Statements indicating learning behavior that is initiated by other persons such as teachers or parents, and all unclear verbal responses, e.g., “I just do what the teacher says.”</td>
</tr>
</tbody>
</table>
APPENDIX C

Chemistry Course Study Post-Exam Interview Protocol

This interview will ask you about your Chemistry course study behaviors and activities that you actually used for this test.

1. What kind of things did you actually do when you studied for the Chemistry test?
2. Did you establish goals for the Chemistry test? What goals?
3. When you studied for the Chemistry test, were there any things that you did to keep track of your progress in learning? What were they?
4. What did you do when you studied for the Chemistry test and found the material boring? Were there any techniques or strategies that you used to stay motivated? What were they?
5. What did you do when you studied for the Chemistry test and found the theories difficult to understand? Were there any techniques or strategies that you used to resolve the difficulty? What were they?
6. What did you do when you studied for the Chemistry test and found the theories difficult to understand? Were there any techniques or strategies that you used to stay motivated? What were they?
7. Did you experience any nervousness when you were taking the Chemistry test? If so, did you have any techniques to help you relax or cope better? What were they?
8. When you were taking the multiple choice Chemistry course test and were not sure of the answer, did you use any strategies to help you select the best response? What were they?
9. When you were taking the multiple choice Chemistry course test, did you have any techniques to help you recall key facts? What were they?
10. When you were taking the multiple choice Chemistry course test, did you check or change your answers? Describe this process.
11. When you received your Chemistry test results, what do you do with that information?
12. What if the results were disappointing to you, what do you do?
APPENDIX D

Motivated Strategies Learning Questionnaire: Self-efficacy and Task Value Subscales

The following questions ask about your motivation for and attitudes about this class. Remember there are no right or wrong answers. Answer the questions about how you study in this class as accurately as possible. Use the scale below to answer the questions. If you think the statement is very true of you, choose 7; if a statement is not at all true of you, choose 1. If the statement is more or less true of you, find the number between 1 and 7 that best describes you.

1 = not at all true of me  2  3  4  5  6  7 = very true of me

1. I think I will be able to use what I learn in this course in other courses.
2. I believe I will receive an excellent grade in this class.
3. I'm certain I can understand the most difficult material presented in the readings for this course.
4. It is important for me to learn the course material in this class.
5. I'm confident I can learn the basic concepts taught in this course.
6. I'm confident I can understand the most complex material presented by the instructor in this course.
7. I am very interested in the content area of this course.
8. I'm confident I can do an excellent job on the assignments and tests in this course.
9. I expect to do well in this class.
10. I think the course material in this class is useful for me to learn.
11. I like the subject matter in this course.
12. Understanding the subject matter of this course is very important to me.
13. I'm certain I can master the skills being taught in this class.
14. Considering the difficulty of this course, the teacher, and my skills, I think I will do well in this class.
APPENDIX E

Student Assent Form

Student Learning Strategies and Academic Achievement

Jeff Judd
Graduate Student
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1776 University Avenue Honolulu, HI 96822
phone: (808) 739-7777

The purpose of this research is to examine how student test scores are influenced by their use of self-regulatory processes during test preparation and performance. Specifically, do students who employ more self-regulatory learning strategies perform better academically?

You will be asked to participate in a study that will be conducted over the course of two months. You will be asked to complete a tape recorded pre-test interview, a tape recorded post-test interview, and answer an 85-item questionnaire. Your scores from three chapter tests will also be examined. Your test scores, your interviews, and your questionnaire will be kept confidential as allowable by law, and only used for research purposes.

Your participation is voluntary. You may choose to stop participating at any time without prejudice or penalty.

If you participate in this study, you will receive twenty-five participation points.

There are no direct benefits to your participation in the project. However, the information gathered in this study will help teachers and researchers understand how learning strategies influence academic achievement. The information will provide valuable evidence for educators in deciding on ways to help students achieve their academic goals.

I have read and understand the information above. My questions about project procedures and other matters have been answered to my satisfaction. I know that I can withdraw my participation at any time without consequence.

I agree to participate in this project. I understand that by agreeing to participate, I have not given up any legal rights and that the researchers and the institutions they represent are still responsible for upholding all laws that apply.

<table>
<thead>
<tr>
<th>Signature of Participant</th>
<th>Print Name</th>
<th>Age</th>
<th>Date</th>
</tr>
</thead>
</table>
Appendix F

Means of Self-Regulatory Processes Used by High Versus Low Test Scorers Before, During, and Following Completion of the Test: Post-Exam Interview

<table>
<thead>
<tr>
<th>Self-regulated strategies</th>
<th>Low test scorers (n = 15)</th>
<th>High test scorers (n = 13)</th>
<th>M</th>
<th>SD</th>
<th>M</th>
<th>SD</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Self-regulated strategies implemented before test taking</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Goal setting and planning</td>
<td>.73 (0.46)</td>
<td>.69 (0.48)</td>
<td>.23</td>
<td>&gt; .41</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Keeping records and monitoring</td>
<td>.33 (0.49)</td>
<td>.31 (0.48)</td>
<td>.14</td>
<td>&gt; .45</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rehearsing and memorizing</td>
<td>.33 (0.49)</td>
<td>.23 (0.60)</td>
<td>.50</td>
<td>&gt; .31</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reviewing records</td>
<td>1.13 (0.64)</td>
<td>1.23 (0.83)</td>
<td>-.35</td>
<td>&gt; .37</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Organizing and transforming</td>
<td>.13 (0.35)</td>
<td>.00 (0.00)</td>
<td>1.36</td>
<td>&gt; .09</td>
<td></td>
<td></td>
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<tr>
<td>Seeking information and help</td>
<td>.13 (0.35)</td>
<td>.00 (0.00)</td>
<td>1.36</td>
<td>&gt; .09</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Self-consequences</td>
<td>.20 (0.41)</td>
<td>.23 (0.44)</td>
<td>-.19</td>
<td>&gt; .43</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><strong>Self-regulated strategies implemented during test taking</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Planning appropriate responses</td>
<td>.40 (0.51)</td>
<td>.15 (0.38)</td>
<td>1.44</td>
<td>&gt; .08</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Reviewing responses</td>
<td>.40 (0.51)</td>
<td>.54 (0.52)</td>
<td>-.71</td>
<td>&gt; .24</td>
<td></td>
<td></td>
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<tr>
<td>Process of elimination</td>
<td>.87 (0.35)</td>
<td>.62 (0.51)</td>
<td>1.54</td>
<td>&gt; .07</td>
<td></td>
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</tr>
<tr>
<td><strong>Self-regulated strategies implemented following test taking</strong></td>
<td></td>
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<tr>
<td>Reviewing notes of old test</td>
<td>.00 (0.00)</td>
<td>.08 (0.28)</td>
<td>-1.08</td>
<td>&gt; .15</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-evaluation</td>
<td>.20 (0.41)</td>
<td>.08 (0.28)</td>
<td>.91</td>
<td>&gt; .19</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>