MONTANA STATE UNIVERSITY

Promoting use of effective learning strategies in a college chemistry course through structured course assignments
by Rita Torrisi Rozier

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Montana State University
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Abstract:
Demographic analysis showed that statistically significant gender differences occurred among students in the non-treatment group so that women earned higher scores in homework and labs while men earned 9.65% fewer A and B grades, 6.16% more C and D grades, and 3.49% more F and W grades than women in their group or men and women in the treatment group. There were also indications that mid and low range students in the treatment group tended to get higher overall grades and passed the course at a higher rate than students in the non-treatment group, but these findings were not statistically significant and so were inconclusive. However, the numbers are compelling in that the treatment group had 6.5% more B grades, 5.2% fewer C grades, and a 2.3% higher pass rate than the non-treatment group.

In addition, the findings tend to agree with homework research data, showing that students beyond middle school age benefit in terms of learning from homework (Cooper et al, 1990), and with Supplemental Instruction data that support peer learning through use of study strategies (Martin, 1998). The particular pattern of a lower withdrawal rate and increased success for mid-range students of the treatment group (more B's and fewer C's and withdrawals) agree with SI data, but the gender-related aspect may be unique.

In regards to the second research questions, the comparison of pre- and posttest results for the Learning and Study Strategies Instrument (LASSI) and qualitative interviews with students indicated that the treatment did not affect students' use of learn strategies or metacognitive awareness of them. This is also in keeping with previous findings that assimilation of learning strategies occurs when students are made explicitly aware of them and encouraged toward metacognitive oversight of their own learning. Given that the modeling and feedback components of the research plan were not fully implemented, these findings were not surprising.

The answer to the remaining qualitative question, in terms of ease of use and cost, was the use of structured homework assignments manageable from the instructor's perspective, remains debatable. From his experience with the research and prior to learning the answers to the first two questions, the instructor said that he was unlikely to continue the investment of time and effort necessary to create homework assignments and answer keys. However, there was no financial cost and during the subsequent semester of chemistry, he implemented a modified program of structured homework assignments, reducing the emphasis on group work and using assignments from the book as needed. Other instructors may be open to alternative formats that encourage the functional elements of peer learning and the use of SGCP strategies and that provide modeling and feedback on the use of strategies.

Recommendations Despite the complexity of the research findings, the consistency of success of students who participated in the treatment group speak to its efficacy in assisting students to learn and to persist. The initial research model was based on educational programs of instruction and literature

that indicate that learning can be enhanced at the college level by promoting use of study skills, group interaction, and attention to how to learn. The particular format followed in the current research lacked elements of structure that would likely have enhanced student learning and its observable effects. According to the review

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COURSE ASSIGNMENTS

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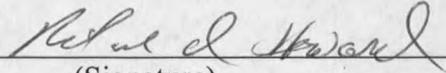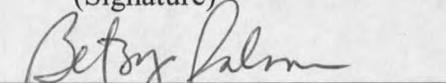Bozeman, Montana

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This dissertation has been read by each member of the dissertation committee and has been found to be satisfactory regarding content, English usage, format, citations, bibliographic style, and consistency, and is ready for submission to the College of Graduate Studies.
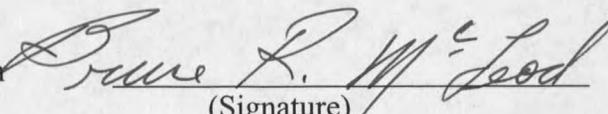
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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

Educating a diverse population of entry-level college freshmen in a demanding course is a multifaceted endeavor. Initially, both instructors and students face the challenge of reaching a "consensual domain" regarding academic discourse. The establishment of a consensual domain, defined as the cooperative development of a common frame of reference for linguistic interactions (Maturana & Varela, 1980), reduces the subjectivity of understanding and assists people of diverse backgrounds to communicate more efficiently and fully. A second challenge for instructors involves finding a method and rate of instruction that allows students optimal assimilation of new vocabulary and concepts. Traditionally, the failure of some students to keep pace with the instructor and class has been viewed as a function of the student's cognitive facility and application of effort (Vygotsky, 1978). However, since the Higher Education Act of 1965, there has been official recognition in the United States that students' success within the college classroom is intrinsically linked to a variety of factors, some of which are only peripherally related to innate cognitive ability or effort (Muraskin, 1997). As an example, students who enter college with existing knowledge of culture and vocabulary linguistically similar to the consensual domain have an obvious advantage over students who are less familiar with the discourse used in college classrooms (deMarrais & LeCompte, 1999; Wertsch, 1998). Additionally, there is evidence that some students lack knowledge of effective learning strategies and their use (Boyer, 1987; Najar, 1999; Palincsar & Brown, 1984; Wertsch, 1998).

Research has shown that the failure of students such as these can be attributed in varying degrees to environmental factors beyond individual control (Bandura, 1997; Department of Health and Human Services (DHHS), 2000; Vygotsky, trans.1978). Lack of control and the perception of a lack of control over the ability to learn directly affect motivation (Bandura, 1997; Maddux, 2002; Seligman, 1990). In his studies of self-efficacy, Albert Bandura found that, "Unless people believe they can produce desired effects by their actions, they have little incentive to act" (1997). Reduced incentive severely limits student outcomes in higher education where student persistence affects conscious decisions such as whether to enroll, where to enroll, how to fund, and what major to pursue and courses to take, and less conscious decisions involved in daily choices regarding actions, thought processes, and the amount of effort students put forth (Bandura, 1997; Boyer, 1987; McKeachie, 1986). As research has identified environmental factors affecting efficacy and learning, schools have taken increasing responsibility for providing instruction that transcends limitations in students' academic preparation (DHHS, 2000). At the college level, community and junior colleges prioritize the quality of teaching and provide a graduated entry to the more rigorous coursework of four-year colleges for urban students (Boyer, 1987). In rural states such as Montana, students have fewer options for higher education. At Montana State University-Bozeman, where freshmen range from high school salutatorians to provisional admits who fail to meet the admission criteria[*], many instructors feel they have no choice but to "dumb

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[*] Admission criteria for traditional-age students at Montana State University-Bozeman are: Diploma from accredited high school with GPA of 2.5 or above, or rank in upper half of class, or GED; ACT composite score of 22 or SAT of 1030 or higher; and successful completion of a H.S. curriculum that included 4 years of English, 3 years of math and social studies, 2 years of lab science, and two years of other approved coursework. Admission criteria are waived for non-traditional age students.

down" freshman courses, reducing and easing course content or artificially raising grades to allow more students to pass (Trout, 1999). In the more challenging courses, alternatives to "dumbing down" or curving grades are failing an unusually high proportion of students or assisting poorly prepared students to keep pace with their class. For political, practical, professional, and ethical reasons, educators prefer to see their students keep pace.

Early in the 20th Century, Lev Vygotsky (trans. 1978) investigated factors that affect variability among students in classroom performance. His work and subsequent studies by his students with the "zone of proximal development" (ZPD) showed that the "intelligence" of students, defined here as their ability to learn, was more likely to be underestimated in terms of potential to assimilate learning if students were educationally disadvantaged due to social class or financial constraints than if they were of a more advantaged social class and background. Vygotsky theorized, and findings showed, that with guidance from teachers or more advanced peers, students with large ZPDs (those whose ability had been underestimated) were able to reach a level of learning comparable to more highly rated students with smaller ZPDs (those whose instruction kept pace with their intellectual development). In addition to discrete units of information, Vygotsky's disadvantaged learners assimilated the learning strategies of their peer guides (Vygotsky, trans. 1978; Wertsch, 1998).

In a related area, Annemarie Palincsar and Ann Brown (1984) determined that reading comprehension among middle-school children was in part a function of the knowledge of, and ability to use, learning strategies. They noted that students' existing linguistic experience (or lack thereof) affected comprehension: students with low

comprehension were capable of decoding written texts but were unable to distinguish the relative value of details versus concepts, conduct a meaningful dialogue regarding the main ideas, or effectively summarize material (Palincsar and Brown, 1984; Palincsar, Brown & Campione, 1993). Practitioners had identified strategies necessary to effective reading and reasoning as those of "questioning," "summarizing," "clarifying," and "predicting," but had not been successful in introducing them to students in a manner that caused them to understand and appropriate the strategies (Wertsch, 1998). The Palincsar and Brown method, called Reciprocal Teaching, was highly successful in encouraging students to appropriate strategies, resulting in significant and lasting improvement in students' intermental functioning Palincsar & Brown, 1984; Wertsch, 1998), or internal use of socially acquired understanding (Vygotsky, 1978).

Another and very similar method, Supplemental Instruction, was introduced by Deanna C. Martin at the University of Missouri at Kansas City (UMKC) in 1973 to assist learners in historically difficult college courses. Both Reciprocal Teaching (RT) and Supplemental Instruction (SI) used teacher- or advanced student-led groups of students to identify and use learning strategies that encourage individuals to summarize, generate questions, clarify, and predict. Both credit their success to a combination of emphasis on strategy and the social role-playing method by which the strategies are taught: when placed in the role of teacher, students are motivated to act the part.

Additionally, both methods address the concern noted by some educational researchers (Dimon, 1988; Keimig, 1983) that it is difficult to teach transferable learning skills in isolation from educational content. Both also utilize a step in learning that is often overlooked but is considered essential by Albert Bandura (1997) and Lev Vygotsky

(trans. 1978), in that desirable behaviors should be modeled for learners and the modeling attended by learners. Vygotsky further postulated that "doing" proceeds "knowing," thereby giving further credence to the portion of RT in which students parrot teachers' words before recognizing the value of the particular words chosen—a value that differentiates between concepts and supporting details of those concepts. Although the methods target completely different groups of learners, in that RT is used primarily with elementary and middle-school students who are resistant to usual methods of learning to read, and SI with college students enrolled in historically challenging courses, the intent, methodology, and results are remarkably similar and impressive. A third similar method, Learning to Learn (LTL), predates both RT and SI in that it grew from research conducted during the 1960's, and has been used with success in post-secondary education, adult education, and business formats (Heiman & Slomianko, 1988). All three methods earned wide respect and are currently (RT and SI), or have been (LTL), endorsed by the U.S. Department of Education (DHHS). However, despite the proven effectiveness of Supplemental Instruction at the college level (UMKC, 2000; see also Smith & MacGregor, 1992) and concerns regarding retention and graduation rates, many universities, including Montana State University-Bozeman, do not use SI. Although SI was developed to reduce the expense of one-to-one tutoring (Smith and MacGregor, 1992), cost is a principal drawback to its use, as is the organizational effort required, including personnel, training, assessment, and supervision.

Organizational effort has been a deterrent to collaborative approaches to education in general (McKeachie, 1994; Smith & MacGregor, 1992). While lauded for its role in encouraging creative, higher-level thinking in rich and challenging contexts,

collaborative, small-group learning has been associated by some with administratively complex and time-consuming projects in which assessment is viewed as subjective and somewhat dubious (McKeachie, 1994; Smith & MacGregor, 1992). On the other hand, SI, RT, and LTL represent collaborative learning programs that occur in addition to or outside of required coursework and which may also be administratively complex and expensive. The current research was undertaken to investigate an alternative, simpler approach to achieve results similar to SI but with the following considerations:

1. Students must be encouraged to use the effective learning strategies of questioning, summarizing, clarifying, and predicting in a social learning context.

2. The instructor should retain the locus of control over the content of the learning materials, but not be burdened with complex, costly, or time-consuming preparations.

3. Rather than replacing course components, the learning materials should be supplemental, complementary, and assist students in learning required material and in assimilating effective learning strategies.

Statement of the Problem

The problem is that students in challenging freshman-level science courses have diverse levels of preparation and understanding of how to learn difficult content and college instructors do not have manageable, effective ways to induce students to use learning strategies that are proven to promote learning.

Statement of the Purpose

The purpose of the experimental study was to investigate structured course assignments versus unstructured assignments in relation to students' assimilation of learning strategies and measures of learning outcomes. In addition, the study provided a format for qualitative investigation of the manageability of structured course assignments from the instructors' perspective regarding ease of use and cost, and students' attitude towards and use of learning strategies.

Research Questions

1. Are there significant differences in measures of students' learning outcomes between the treatment group in which homework assignments were structured to induce use of learning strategies and those of the untreated group whose homework assignments were not specially structured?

2. Are there significant differences in pretest-posttest scores between the treatment group and the non-treatment group on measures of attitude and use of learning strategies?

3. Are the experimental strategies manageable from the instructor's perspective in terms of ease of use and cost?

4. Do students gain in understanding of learning strategies by completing course assignments that are structured to encourage their use?

Importance of the Study

Administrative concerns regarding the retention of college students and student concerns regarding the rising costs of higher education have led to increased scrutiny of student success within the classroom. While factors regarding teaching are addressed in faculty training, tenure, and research, less organized attention is directed toward student use of learning strategies. The current research is of interest because it investigated a modification of a common component, course assignments, to assist college instructors to induce freshmen-level students to use learning strategies that have proven successful in a variety of alternative contexts. A research project on this topic has the potential to be beneficial on several levels with regards to learning, teaching, and retention:

1. As with Supplemental Instruction, incoming freshmen of diverse backgrounds could be led to incorporate efficient and effective learning strategies, leading to increased learning and persistence in difficult courses, higher GPA's, less need to repeat courses, and greater overall persistence in college (UMKC, 2000). Like SI, the results may be expected to be effective for disadvantaged, non-traditional, and minority college students.

2. Instructors may find the research assists them to lead learners toward greater independence and success in learning through revised course assignments.

3. On an institutional level, the research has the potential to assist with retention efforts, affecting institutional finances and the responsibility to help students reach their educational goals.

4. The importance of self-directed learning at the college level is under-represented in

research on student acquisition or use of study skills and in the potential for

homework assignments to direct the ways in which students learn. Therefore the

research has the potential to direct more attention on these neglected areas.

Definitions

Consensual domain: The conscious effort of individuals to search beyond their personal

cognitive understanding of terms, phrases, and concepts to a socially shared

understanding of meaning results in the development of a common frame of reference, or

consensual domain, that assists in functional communication during linguistic interactions

(Maturana & Varela, 1980).

Critical Thinking: Critical thinking is a process of reflection that involves identifying and

challenging assumptions, consideration of context, analyzing and synthesizing

alternatives, and engaging in reflective skepticism (Brookfield, 1987).

Cultural Tools: Learning is contextual in that the cultural tools of language and

knowledge developed by others are passed on to learners in a manner that provides a

basis for individual achievement (Vygotsky, 1978). James Wertsch provided a

multiplication problem as an example of a cultural tool, suggesting readers multiply 345

by 762 with just paper and pencil. Most people, he asserted, would use a vertical format

to solve the problem without recognizing their dependence on the format. That format is

a cultural tool, best recognized in its absence (Wertsch, 1998).

Efficacy: Efficacy is defined as one's belief in his or her ability to accomplish desired

outcomes (Bandura, 1997).

Perceived self-efficacy: An individual's expectation of success in attaining goals as a
result of organized personal effort is defined as perceived self-efficacy (Bandura,
1997). People have both general and specific efficacy beliefs that may be constantly
revised as a result of personal experience and social feedback (Bandura, 1997;
Seligman, 1990).

Learning Strategy: Cook & Mayer (1983) classify strategies that facilitate learning into
three groups: task-limited , goal-limited, and general strategies or higher-order strategies
that regulate the use of the first two. All three are necessary to learning, but for the
purposes of clarity, in this document, the term "learning strategy" will be defined as a
sequence of behaviors that learners purposefully engage themselves in and direct through
metacognition to acquire knowledge and construct meaning from new material while
integrating it with prior knowledge and understandings (McKeachie, 1986; Paris, Lipson,
& Wixson, 1983; Weinstein & Palmer, 2002).

Metacognition: The process of being aware of, thinking about, and directing one's own
thinking for the purpose of monitoring and regulating it toward a desired end is termed
metacognition (Conti and Fellenz, 1991; McKeachie, 1986). Studies such as one by Paris,
Lipson, and Wixson. (1983) suggest that one's attitudes and beliefs are involved in the
metacognitive process.

Reciprocal Teaching: Reciprocal teaching refers to the set of instructional activities that
encompass a socially structured dialogue between a teacher or advanced peer and a small
group of students. The teacher or peer models the use of all or part of the four target
strategies of summarizing, question generating, clarifying, and predicting that are used to
assist in constructing meaning from text. An essential part of the strategy involves the

social interaction that occurs when students assume the role of teacher and lead the group dialogue, getting as little or much assistance as necessary from the teacher (Palincsar, 1986; Wertsch, 1998).

SGCP: The initials, SGCP, are used in this document to refer to the summarizing, generating questions, clarifying, and predicting behaviors used in each of the teaching/learning methods Learning to Learn, Supplemental Instruction, and Reciprocal Teaching. The individual concepts defined below are, unless otherwise noted, from Palincsar and Brown's model for Reciprocal Teaching developed in 1984:

> Summarizing is verbal or written identification of the most important information of a sentence, paragraph, or passage. Summarizing requires students to identify and integrate concepts from text or lecture, and communicate them in a succinct, understandable form.

> Question generating reinforces the summarizing strategy and assists in comprehension through reflection and metacognition. To generate questions, students evaluate information to see if it provides substance for a question, then reword it in question form, and self-test or test peers. Question generating involves students in discovering what they don't know, need to know, or would like to know about a concept, and can be used in mastery learning or to infer or apply new information from text, leading to the formulation of hypotheses (Palincsar, 1986).

> Clarifying is a learning strategy particularly helpful for students who have difficulty comprehending text. These students may not be uncomfortable when words or passages are not making sense. When students are asked to clarify,

they are forced to attend to the causes of the textual difficulty such as new

vocabulary, unclear reference words, and unfamiliar or difficult concepts. The

conscious act of clarifying teaches students to recognize potential barriers to

comprehension and to take the necessary measures to restore meaning through

reading, dialogue, or reasoning. Further, clarifying emphasizes that the goal of

learning is to construct meaning from new material (Palincsar, 1986).

Predicting: In Reciprocal Teaching, predicting occurs when students

hypothesize about what an author will write next by considering what they

already know. Predicting motivates students to learn if the text will confirm or

disprove their hypotheses, and helps them to link new knowledge with

knowledge they already possess. The predicting strategy facilitates use of text

structure regarding headings, subheadings, and imbedded questions (Palincsar,

1986). In Supplemental Instruction, predicting is less formalized, but assists

with the integration of how-to-learn strategies with what-to-learn by helping

students attend to an author's or lecturer's textual construction.

Supplemental Instruction: Supplemental Instruction (SI) was originally developed by

Deanna C. Martin, University of Missouri-Kansas City, in 1973. SI is now a formalized

and commercially marketed technique documented by the U.S. Department of Education

to be effective in assisting student learning in historically difficult college-level courses.

It involves four key people or groups (UMKC, 2002):

1. An SI supervisor trained at UMKC in SI identifies courses, gains faculty support,

    selects and trains SI leaders, and monitors and evaluates the program.

2. Faculty members who teach historically difficult courses may choose to invite the SI supervisor to organize support sessions for their class. In doing so, they agree to screen and select peer leaders for competency in course content.

3. SI peer leaders are students selected for course competency and trained in proactive learning and study strategies. They attend course lectures, take notes, read assigned materials, and conduct three to five out-of-class SI sessions a week, modeling behaviors that help students to integrate course content and learning strategies. SI leaders are paid hourly stipends or through staff release time, work study funds, or fee waivers.

4. Students who choose to participate in SI out-of-class sessions are the fourth component of the SI network. They take turns leading the group in each of the four activities of summarizing, clarifying, generating questions, and predicting under the direction of a peer leader. (UMKC: http://www.umkc.edu/cad/SI/Sidocs/SIoverviewdoc.htm:)

Zone of Proximal Development (ZPD): Lev Vygotsky suggested this term in the 1930's as part of his genetic account of development. It refers to a range of potential learning of an individual in which the bottom of the zone is defined by a level of testing or accomplishment that the individual can attain without assistance and the top is that which can be attained with guidance and assistance from advanced peers or instructors. Vygotsky showed that learning takes place within the zone and is mediated by the social environment that provides cultural tools and semiotic signs (Vygotsky, trans. 1978).

Brief Overview of the Methodology

The research approach to the first two questions involved quantitative evaluation of

the effectiveness of structured course assignments in promoting learning and in eliciting

use of learning strategies, followed by qualitative assessment of the manageability and

effectiveness of their use. Mixed methodology was chosen so that:

1. Quantitative measures could establish whether homework assignments could provide

    adequate structure to replicate the benefits of traditional Supplemental Instruction;

    and,

2. Qualitative methods could establish the dimensions of the context in which

    assignments might be of value and the ways the structure might be altered to increase

    its value to participants.

The course, General Chemistry I, was chosen because it met the SI criteria of being an

historically challenging course with a high rate of failure and withdrawal at Montana

State University-Bozeman. The primary experimental component measured learning

outcomes between the treatment and non-treatment groups, including test scores, course

grades, and the percentage of students who pass the course. A MANOVA followed by *t*-

test comparisons and chi squares were the primary statistical tools. The same

experimental treatment was also measured in relation to students' perceptions of their

study skills and attitudes, using pre- and posttests of a commercially available instrument,

the Learning and Study Strategies Instrument (LASSI). The LASSI was given to three

stratified cluster samples from each group of students, those who were given structured

homework assignments during the semester, and those who were not. The qualitative

portion of the research was designed to investigate the ease of use of the structured assignments from the instructor's perspective and the degree to which students expected to incorporate learning strategies into future coursework.

The between-groups measures arose from potential differences in learning between students in the Tuesday/Thursday labs whose homework was less structured, and those in Wednesday/Friday sections, whose homework assignments were more highly structured. The structure was comprised of two elements: wording of problems using language specifically designed to invoke summarizing, question generating, clarifying or predicting (SGCP) responses, and the strong suggestion to work on homework in groups of two or more. The qualitative research component consisted of observation throughout the term, and individual and focus-group interviews that sought feedback from the course instructor, teaching assistants, and students. The instructor, teaching assistants, and focus-group interviews were recorded and transcribed to facilitate accurate interpretation of results and use of quotes. Individual student interviews were conducted by telephone following the term and were not recorded. Results were analyzed for content of response patterns with attention to chronology, key events, processes, and issues (Patton, 1990).

<div align="center">Assumptions, Limitations, and Delimitations</div>

Assumptions

The following assumptions support the design of the proposed research:

1. Students will do their own work, as an individual or with a study partner, in the required SGCP activities: In addition to turning in assigned work, the concern that

students perform the work themselves will be monitored through the qualitative portion of the research (see Appendix B).

2. Chemistry 131 is a course with room for improvement in student test scores. As in SI, this course was chosen because it represents an historically difficult course at MSU-Bozeman, in which a significant number of students drop out or fail, and where instructors are known to curve grades to achieve adequate success rates among students. According to records kept by the Dean of Students at MSU, for some years Chemistry 131 has had the lowest student success rate, or highest rate of withdrawal and failing grades, for entering freshmen at MSU-Bozeman.

3. The results of the research can be inferred to apply to other populations of college students. Due to research limitations and the particular course chosen, inference will be limited to college students enrolled in historically difficult college courses that rely on homework for student learning. However, since SI has been used successfully in a variety of course styles, further research is indicated.

A final assumption of the research is that the order of SGCP activities is flexible and that the modeling and social learning components can be provided through a combination of written and oral instruction and informal group interaction. Both RT and SI have been adapted to a variety of circumstances with reasonably consistent results. In planning the research, attention was given to identifying and preserving the essential elements of SGCP that assist learning while adapting to the instructor's course design. Since ease of implementation is essential to future use of the SGCP by instructors, flexibility of design will be necessary.

Limitations

The population of students who were given more highly structured homework assignments (the test measure) were one half of all students who enrolled in either of two lecture sections of the experimental course, an historically-difficult freshman-level course in college chemistry. Students self-enrolled in lab sections that contained a mix of students from each lecture; students in Wednesday /Friday labs were chosen by a toss of a coin to receive the experimental treatment, and those in Tuesday /Thursday labs to serve as the control. All students were expected to meet the course prerequisite of two years of high school math to include Algebra, or an ACT score of 25 or higher, SAT score of 570 or higher, or completion of Math 105, Algebra for College Students. Students' were able to enroll whether or not they met prerequisites, but the mere existence of prerequisites was thought to limit student enrollment somewhat to mathematically-capable incoming freshmen and students who have come up through the ranks of math courses at MSU-Bozeman. In addition, the study-skill pre-test gave a measure of equivalence between the two groups.

As with Supplemental Instruction, the results may not apply to all students, but in this case to students in historically difficult college-level courses with problem-based homework assignments. In regards to the ease-of-use aspect of the structured homework, the college chemistry course follows a common science format and may therefore provide an accurate assessment of transitional issues.

Delimitations

General chemistry was chosen as a focus for the research because, as an historically difficult course offered to freshmen, it fit the profile for comparison to other studies involving Supplemental Instruction. MSU-Bozeman was chosen for researcher convenience, but also to represent a medium-sized land-grant institution with typical student success rates and financial concerns. A freshman-level course was chosen due to institutional retention concerns regarding freshmen, and research that shows the greatest need for assimilation of learning strategies among college students occurs among first year students.

The design of the study allowed both within-subject and between-group measures, with random assignment of treatment in regard to lecture section, with approximately one half of the students from each in the treatment and control groups respectively. The mixed design lent strength to findings and the likelihood that meaningful inferences could be drawn. Due to research limitations and the particular course chosen, inference was limited to college students enrolled in historically difficult college courses that rely on homework assignments and student autonomy for significant amounts of learning. However, since SI has been used successfully in a variety of course styles and institutions, general implications with a broader interpretation are discussed in the final chapter.

The research was intended to determine if students' test scores are affected by the use of structured course assignments. The "structure" provides students with a model of learning strategies that encourages them to engage in behaviors of summarizing, clarifying, generating questions, and predicting in a social learning environment. The

research did not concern itself with past findings that already validate portions of the strategy. For instance, time-on-task alone has been shown to increase learning, as has modeling, study groups, and active learning strategies. Rather, the research acknowledges that each component of the desired learning strategy is proven to be successful, but addresses the need to elicit use of the strategies by students in freshman-level college courses. The qualitative portion of the research was used to relate quantitative findings to the use of the experimental strategies, and reinforce the importance of using learning strategies by students.

Summary

On entry, students of freshman-level college courses have diverse approaches to learning and diverse levels of academic preparation. Retention data show that even students who earned high grades in secondary schools may experience difficulty achieving their goals regarding grades and understanding in college-level courses, while academically disadvantaged students may find themselves particularly affected by the increased expectations of learning in college. Students experiencing academic difficulties may not easily comprehend that study skills that sufficed previously are now insufficient or know how to learn at a greater rate or depth.

The research homework structure is based on three learning-strategy based approaches that have proven effective in improving students' grades, their ability to persist, and their knowledge of how to learn. Each taught the use of an integrated series of learning strategies that included summarizing, clarifying, generating questions, and predicting in a social learning forum with tutorial modeling and oversight. One,

Supplemental Instruction, has been used with historically difficult college courses for nearly thirty years, but requires a significant investment in terms of time, personnel, and expense. Consequently, it is currently at use in only 146 colleges in this country. The current research design is an attempt to incorporate similar academic assistance and structure through course assignments in a manner that prioritizes ease of use and cost-effectiveness from the instructor's perspective.

CHAPTER 2

REVIEW OF THE LITERATURE

Since the beginning of formal education thousands of years ago, educators have considered student learning in relation to teaching. On most college campuses today, that relationship is standardized through a dual measure of accountability and assessment, the course grade (Boyer, 1987; McKeachie, 1994), which indicates the degree of success attained through the teaching/learning contract. The learner's responsibility is to acquire knowledge and construct meaning from new material while integrating it with prior knowledge and understanding at a rate commensurate with course content (Seaman & Fellenz, 1989). The goal of the teacher is similar: to stimulate construction of meaning by students, or to impart a pre-determined body of knowledge and understanding from instructor to students within the confines of the course (Lowman, 1984; McKeachie, 1995). Despite the common objective, the interaction between teaching and learning in the college classroom is complex and imperfect, and there is often a wide disparity of success among students in achieving learning (deMarrais & LeCompte, 1999; Muraskin, 1997; Najar, 1999). Consequently, educators have investigated many strategies for classroom teaching and learning in efforts to improve the consistency of success in learning (McKeachie, 1995).

Until recent decades, the bulk of research was applied to teaching methods rather than learning strategies. Preparatory teachers are professionals who receive professional education and guidance regarding their teaching abilities, and are held accountable for the

outcomes of their teaching. They are thus intrinsically interested in improving

educational outcomes (McKeachie, 1994), but generally find it easier to modify and

assess their own behavior as teacher than the behavior of learners. At the college level,

the same principles apply with an added twist, the perception that, given resources such

as content, an imperative to learn, and adequate instruction, learning is a function of

students' cognitive facility and application of effort (McKeachie, 1994; Muraskin, 1997;

Najar, 1999).

Consequently, certain trends in learning have been slighted by the research. Namely,

even where improved classroom instruction has resulted in overall improvement in

student outcomes at the college level, individual student learning continues to vary

widely, especially among first-year students (Muraskin, 1997; Tinto, 1993). Notably,

students who are high-risk in terms of persistence due to sub-optimal levels of motivation

or preparation for higher education, or who have hidden or physical disabilities or low

income status, tend to have lower grade-point averages (GPA's), more fluctuation in term

grades, more dropped courses, and more withdrawal from higher education than students

who are not at high risk (Levitz & Noel, 1995; Muraskin, 1997). Alternatively,

individuals who are not considered at-risk tend to have greater stability in grades, or less

deviation in course grades from their GPA, an accepted measure of student learning. That

is, students who are not at-risk and who get high, medium, or low grades in a given term

tend to achieve them across the board (Noel, Levitz, & Saluri, 1995). Students who fit the

at-risk profile tend to have less stability in grades, often having a combination of high and

low grades in a single grading period that corresponds to a variety of factors ranging from

academic and personal issues to their efficacy in regard to course content, to time of day

(or day of week), and instructional technique (Muraskin, 1997).

Both groups of students are at greatest risk of not persisting in college during their

first year, with the result that, on a national level, more than half of college freshmen will

not progress to become sophomores (Muraskin, 1997; Tinto, 1993). Although the leaving

rate related to poor academic performance has increased in recent decades (Tinto, 1997),

with at-risk students disproportionately represented (Muraskin, 1997), students who leave

because they were suspended, expelled, or placed on academic probation account for only

one third of leavers; the other two thirds of leavers were academically adequate

(Muraskin, 1997). A study conducted at MSU-Bozeman in the fall of 2000 indicated that

41% of students' withdrawals were attributed to lack of readiness for college or college fit

issues (Stryker, 2000). Retention researcher Vincent Tinto found that initial academic

experiences at college and students' perception of their "academic fit" (Tinto et al, 1993)

are crucial to successful adjustment to college life regarding both academic and social

adjustment (Tinto, 1997). He wrote that "…the roots of successful student retention lie in

better education during the first year" (Tinto et al, 1993) and advocates organization of

course instruction and study through learning communities as a way to foster a perception

of social and academic belongingness (Tinto, 1997) and to develop affirming connections

with faculty and staff (Tinto1997, 1993). In future, understanding of academic fit may

also be addressed in terms of recent research on the motivation to learn. Nakamura &

Csikszetmihalyi (2002) developed satisfaction and happiness indices that improve

understanding of motivation of learning in terms of "flow," the human drive to stretch

one's abilities by striving for clear, proximal goals while receiving feedback; Schulman (2002) investigated motivation in terms of the passion to know.

Tinto's approach focuses primarily on affective components of the social and academic atmosphere conducive to the success of college students, a place when and where students can learn. Research on learning communities and social learning also address who will learn and how students learn in terms of both affective and cognitive aspects of learning. Cognitive research on learning by authorities such as Albert Bandura (1977, 1997), Lev Vygotsky (1978 trans.), and to some extent, Jean Piaget (1954), note the attention and imitative behaviors that lead to observational learning, while psychologists studying social cognition, Bandura (1977, 1990, 1997), Bem (1972), Festinger (1957), Maddux (1992), Martin (1973), Rotter (1954), and Seligman (1967, 1990) affirm additional sources of motivation for social learning, causing Hannifin (1997) to conclude that effective teaching must be grounded in an appropriate social environment.

The importance of using learning strategies in learning is equally well documented. Najar (1999) asserts that in higher education, learning independence is essential, and that Salomon & Perkins (1989) found learning strategies provide necessary framework for independence in learning. Further, Brown, Collins, & Duguid (1989) found that the task of learning, which incorporates learning strategies, is a primary and inseparable part of learning. Regardless of importance, Chamot & O'Malley (1987), King (1994), McKeachie (1994), and Muraskin (1997) note that formal instruction in the value and use of learning strategies is largely assumed rather than authentic and is insufficient for students' needs.

The learning strategies involved in Supplemental Instruction integrate various aspects of social, cognitive, and metacognitive learning about learning and apply it to the needs of students in challenging college-level courses. The current research in turn borrows heavily from SI, and in fact changes it as little as possible except in the areas of its limitations: SI is costly, complex, time consuming, and voluntary. Each of these detracts from the universality of its use for the institution, instructors, and students. There are also limitations on the research design, which relies on the minimal structure of written course assignments and opportunities for modeling and feedback that may occur within the lab portion of the class. The intended contribution of the current research is in terms of usability and in defining essential components of SI to integrate into structured course assignments that mimic SI in terms of eliciting student behaviors important to optimal learning. Additionally, the learning strategies involved in the research are useful to students in general, but are particularly important to at-risk students who may be unaware that useful strategies exist (Bandura, 1997; Palincsar & Brown, 1984; Vygotsky, 1978) or how to use them to promote academic success (Bandura, 1997; Brown et al, 1984; Najar, 1999; Vygotsky, 1978).

Given the considerations above and the central thesis of the research, the scope of this review of the literature will discuss learning and the role of homework in learning, then each of the following premises:

Premise 1: Learning strategies are effective in promoting learning.

Premise 2: A significant proportion of students do not use effective learning strategies.

Premise 3: The learning strategy promoted in Supplemental Instruction is effective in difficult college-level courses.

Premise 4: Students are more likely to use time-consuming study strategies that are required course assignments than the same strategies if not-required.

Premise 5: Students are less likely to procrastinate when assignments are broken down into apparently manageable blocks.

Premise 6: College instructors design course assignments in part for ease of use.

These premises will be included in the "Review of Previous Research Findings, and Opinions." The remainder of this chapter is divided into sections on reviewing criteria for selecting the literature, the context of the problem, the current understanding of the problem, the review, a review of methodologies used in other studies, a summary of the review, overall weaknesses and strengths, gaps and saturation points, and finally, avenues for further inquiry.

Criteria for Selecting the Literature

In choosing literature for review, major theorists were selected, particularly where theories overlapped and corroborated each other on themes relevant to this research. Lev Vygotsky and Albert Bandura, for instance, identified highly similar components in their respective theories of learning, all of which are applied in the strategies selected for comprehensive attention in this review. In turn, the selected strategies, SI, RT, and LTL, use similar learning processes for widely divergent groups of learners with good result, and each has been corroborated by the United States Department of Education.

Despite the paucity of research on learning strategies in comparison to teaching strategies, research is available on numerous theories currently in use. Therefore, the review of the literature includes discussion of learning theories that are related to SI in

greater or lesser ways. Included are collaborative (or cooperative) learning, instructional design, video-based supplemental instruction, heuristic theory, situated learning, information pick-up, social development theory, constructivism, discovery learning, anchored instruction, conversation theory, genetic epistemology, cognitive apprenticeship, complex learning theory and others. In general, the variation on SI proposed in the current research was supported by each of the learning theories discussed, but the specific method of implementation—structured course assignments—was not found. In contrast, most of the research involves preparatory students and high levels of supervision; some target specific populations of students. Significant attention is given to particular themes that suggest variations on methods that have been in continuous use for significant periods of time. Supplemental Instruction, the primary model, has been used at the college level for approximately three decades.

Context of the Problem

The current research was based on the premise that students of entry-level college courses at MSU-Bozeman have varying levels of academic preparation, including their knowledge of, and ability to use, learning strategies. The University and instructors are motivated to improve student outcomes in regards to learning in a manner that promotes the campus-wide mission of excellence. Toward that end, the research was designed to investigate how learning is affected by altering course assignments to promote use of learning strategies that have been shown to increase learning in other contexts. The wording of course assignments designed for approximately one half of the students in

general chemistry, Chemistry 131, was altered to require students to use the SGCP behaviors while working homework problems in groups of two or more.

The researcher is a student of Adult and Higher Education who has particular interest in learning strategies and has worked in Academic Affairs with Student Support Services and Retention, and with several academic departments. In these contexts, she has seen intelligent and capable students flounder academically due to their confusion regarding how and what to learn, and has seen students experience a related loss of efficacy regarding their studies. Tutoring helps many students pass classes and can build study skills for those receiving assistance, but is costly, reaches too few students, and may result in dependency and continued low efficacy (Annis, 1983; Bandura, 1997). The current research was designed to reach half of all students enrolled in a targeted course while building efficacy and skills by having students learn with peers.

An unknown factor of the research was whether students would experience a crucial benefit of SI through the less formal group work proposed: the anticipation of teaching causes learners to mentally organize information more thoroughly and to learn differently, in what Deanna Martin (SI, 1973) calls "a deeper and more connected way." The commonly experienced sentiment, "I never really learned it until I had to teach it," is an important component of social learning (Coleman, 1998; Martin, 1973). Learning theorists Albert Bandura (1997) and Lev Vygotsky (trans. 1978) include attention to modeling and assimilation of cultural tools (Vygotsky, 1978) as important aspects of social learning. All of these are included in the review of the literature as relevant components of SI with the caveat that the SGCP model of structured course assignments

of the current investigation may not induce a sufficient level of social stimulus to contribute to learning.

Current Understanding of the Problem

The problem stated in chapter one is that college instructors need to have improved and manageable ways to induce students to use learning strategies that are proven to be effective in promoting learning. The connotation discussed in the introduction is that instructors share responsibility with students for their learning and therefore have an interest in promoting use of effective strategies. There are several reasons why instructors might take an interest in improving student learning:

1. For reasons of professionalism, ethics, and personal gratification, instructors view increased student learning as a direct and effective measure of their own efficiency in accomplishing the goals of teaching (McKeachie, 1994).

2. Increased learning, especially as it contributes to consistency among students in terms of keeping pace with the rate and level of instruction of content, aids in classroom management, morale, and progress.

3. In a more personal way, instructors may also be invested in their students' success, and find teaching satisfaction directly related to student learning.

In addition, there are two reasons why instructors' academic departments and institutions may have a growing interest in supporting measures that increase student learning. The first reason is monetary. Shifts in national and state economics and political priorities during the 1990's have reduced levels of fiscal support provided to public institutions while general accountability has increased (Stryker, 1999). In 1999, Courtney

Stryker, Director of Retention at MSU-Bozeman, reported that since the advent of the

1990's, institutions of higher education in general, and public institutions in particular,

have been the focus of constant fiscal scrutiny from both within and without. Again, the

causes are many, including demographic shifts, an economic trend in this country toward

service and informational industries, national embrasure of down-sized, "lean-mean"

models of efficiency, and greater competition for students (Stryker, 1999). Like the

majority of the country's public institutions, MSU-Bozeman receives less state financial

support than it did in 1990, has a more diversified financial base, has increased tuition

and fees, left some vacant positions unfilled, and cut personnel, course offerings, and

"non-essential" expenses (Stryker, 1999; MSU-Bozeman Office of Institutional Research,

2002). In light of these changes, improvements in student success and satisfaction

translate into fiscal support in terms of retention of students already enrolled, future

enrollment figures, state support, and private contributions.

Similarly, minority access to higher education is of concern in terms of the university

mission, accountability, and fiscal responsibility. Factors that increase student learning

and help academically disadvantaged students to interact competitively with their peers

are attractive to institutions and their academic departments. Prior to the 1960's, the

failure of some students to keep pace with the instructor and class was viewed as a

personal failure on the part of the student attributable to individual effort and ability.

However, post-World War II research and civil rights legislation of the 1960's provided

public acknowledgement that environmental factors such as students' or parents' levels

of income, parents' education, and students' disabilities, posed barriers to education that

were beyond the control of individual students. Changes in admission criteria and low-

cost federal loans and grants increased access and TRIO programs provided student support services to 5-7 percent of eligible disadvantaged students, but among African Americans, Hispanic, and Indian students, success rates continue to lag far behind majority population students (DHHS, 2000; Muraskin, 1997).

Supplemental Instruction, on which the research is based, is used with comparable success for all student groups (Martin, 1973, 1998). However, SI results apply only to students who voluntarily choose to engage in the program which, as the name implies, involves attendance at supplemental learning sessions. Ideally, voluntary programs allow students to choose whether they need and want additional assistance in learning course material; in a less than ideal world, however, many students experience hidden barriers to participation in voluntary programs. Three causes of non-participation are:

1. Low income and non-traditional age students with financial and family commitments may be unable to justify "extra" time for optional study programs.

2. First generation and other educationally disadvantaged students may have less understanding of the existence or value of learning strategies (Muraskin, 1997; Palincsar et al, 1993) and therefore underrate the importance of participation in supplemental programs.

3. Since SI attracts motivated students, students with low efficacy in the course may anticipate, and be intimidated by, an assumption of academic rigor.

In lieu of SI, a second program, Video-based Supplemental Instruction (VSI), has been found to be highly successful with at-risk students. VSI uses many of the same components of the original SI, but in a more structured format that substitutes attendance at live lectures with attendance at a showing of the video-taped lecture in which groups of

students are encouraged to play back lectures while stopping periodically to discuss challenging or confusing aspects. Again however, drawbacks to using VSI include institutional expense, organizational complexity, and administrative time. Given the arguments above, a second alternative to SI is warranted. The current design, which would lead to specially structured course assignments for students in historically difficult courses, has the potential to provide many of the benefits of SI with fewer drawbacks. Its design assists all course participants, including those with greatest need, without implying remedial assistance, in a low-cost, forthright manner that keeps the locus of control with the instructor.

Review of Previous Research, Findings, and Opinions

Learning

In recent decades, research on learning has consistently revealed complex interaction between affective and cognitive factors that exist within the person, and among the person, the environment, and their behavior. Learning is an integral and primary form of behavior that occurs constantly throughout life (Bandura, 1977; Piaget, 1954; Vygotsky, trans. 1978), causing individuals to serve as the principal agent of their own change (Bandura, 1977). Thus, learning is a self-regulatory behavior informed by reflexive thought that in turn, determines ensuing behavior (Bandura, 1977). Motivation for learning is equally complex. Fundamental learning through direct experience occurs due to overt consequences of incentives, no outcomes, or punishing outcomes. However, with behavior as an interactive agent that initiates as well as receives, learning cannot be limited to experiencing the effects of one's own performance responses. Instead, in his

book on social learning, Albert Bandura (1977) explains, "virtually all learning

phenomena resulting from direct experience occur on a vicarious basis by observing other

people's behavior and its consequences for them" (p. 12). This capacity to learn through

observation permits learners to "acquire large, integrated patterns of behavior" (p. 12) in

a safe and time-efficient manner. However, observational learning is not a passive

activity. Observers must attend to the behaviors of others, including verbal and social

cues, and to the consequences the model experiences. Further, learners reflectively

process the vicarious experiences and preserve them in symbolic form where they may

solve problems and plan behavioral changes (Bandura, 1977). Bandura found that

observations, then, are mediated by:

1. attentional processes, in which the observer's selective attention is mediated by

   associational patterns (models with whom the learner associates) and the observer's

   capacity to perceive and process information, which in turn are influenced by the

   observer's perception of the potential benefits of learning;

2. retention processes, in which the observer attends to the behavior of another and

   subsequently organizes response patterns in verbal and imaginal memory, enhanced

   by mental rehearsal and physical performance, both of which increase memory and

   proficiency;

3. motor reproduction processes, that involve cognitive organization, initiation,

   monitoring, and refinement; and,

4. motivational processes, that affect both what is observed, the level of attention it

   receives, and what is enacted in that learners who observe valued outcomes are more

   likely to adopt modeled behaviors.

Learning that does not come from direct or vicarious experience occurs through cultural tools that support symbolic representation such as written and spoken language and thought (Bakhtin, 1979, 1981; Vygotsky, 1978; Wertsch, 1998). While avoiding the temptation to reduce the incredible complexity and social imbeddedness of mental activity, it is important to note that non-experiential learning is mediated by similar processes of attention, retention, motivation and reflection, and that it is a form of social learning. Vygotsky (trans. 1978) viewed intramental functioning as inherently social for two reasons. The first is that thought is socioculturally situated, or based on language, culture, experiences, and knowledge that exist in the mental sphere as a result of social interaction (Vygotsky, 1978; Wertsch, 1998). The second is that learning occurs according to the "general genetic law of cultural development" in which all facets of an individual's cultural development appear first between people as socialpsychological interaction before appearing within the individual as intermental functioning (Vygotsky, 1981; Wertsch, 1998). Vygotsky (trans. 1978) saw close connections between inter- and intramental functioning due to the forms of dialogic speech that support all mental functioning.

The above discussion explains more about how people learn than why. Motivation for learning, as mentioned, is also complex. As Bandura (1977) explains, "If actions were determined solely by external rewards and punishments, people would behave like weathervanes, constantly shifting in different directions to conform to the momentary influences impinging on them" (p.128). Instead, behavior is often enacted "in the absence of immediate external reinforcement" (p. 129), and is an interaction of internal, or self-generated, and external forces (Bandura, 1977). Indications that learning is a constant and

self-rewarding experience are reinforced by recent research in the areas of positive

psychology and the chemistry of the brain:

1. Positive psychology: in its findings that people are driven to achieve a state of flow,

    where happiness results from activities (learning) that challenge the actor, neither

    exceeding nor underutilizing the actor's abilities while he or she is striving for clear,

    proximal goals and receiving feedback (Nakamura & Csikszetmihalyi, 2002). The

    desire for challenge is crucial here: scaffolded learning, where the level of difficulty,

    or potential for improvement, increases incrementally as the learner learns has the

    potential to engage the actor indefinitely while learners tire of single step, stagnant

    activities.

2. Positive psychology: in research that shows the passion to know, or to seek

    information, is "ubiquitous, fundamental, and begins at birth" (Schulman, 2002), and

    has the following four components: The learner seeks to a.) identify and classify

    phenomena; b.) discern temporal patterns between some of those phenomena; c.)

    determine causal relationships behind some of those temporal patterns; and d.)

    discover how to enter into the antecedent-consequent chain and become causal agents

    (Schulman, 2002). Schulman further states, "The function of intelligence is to gain

    information in each of these domains" (qtd. from The Handbook of Positive

    Psychology, p. 314).

3. Chemistry of the brain: evidence that the body's chemistry rewards itself with

    production of pleasure-producing hormones when successful learning occurs

    (Greenfield, 1996).

The unique drive to learn is further supported by people's "extraordinary capacity" to use symbols that enable them to represent events, analyze conscious experiences, communicate with others, plan, create, imagine, and predict (Bandura, 1977). Together, these features indicate that people have the ability to learn, the drive to learn, and conscious choice of what they learn.

As it turns out, the element of choice adds new layers of complexity to learning. As mentioned above in the discussion of flow, the ideal learning activity includes clear, desirable goals, challenges the learner's abilities without exceeding or underutilizing those abilities, and provides feedback to the learner (Nakamura & Csikszetmihalyi, 2002). Learning can occur in less than ideal circumstances, but sustained learning that takes place over a period of days, weeks, months or longer is seriously compromised by a failure of any of the necessary components of goals, ability, and feedback. The sort of learning necessary for success in college courses that are the focus of the current research required sustained effort of this sort. In chemistry, successful learning of discrete portions of course information must occur, but an overall integration of concepts is also necessary in most cases. For students to choose to focus their mental energies on the tasks Bandura (1977) has outlined as attention, retention, motor reproduction, and motivation requires repetitive conscious sustained effort. Because students choose to register for course, an initial motivation to attain course goals is assumed. In order to maintain sufficient motivation to persist in learning, consider again the elements of flow: challenge, clear proximal goals, and feedback. Research reported by Jeanne Nakamura and Mihaly Csikszentmihalyi (2002) shows that motivation of effort is a complex mix of choice,

personality, perception of challenge, and efficacy. Briefly, the important points as they relate to the proposed research are as follows:

1. Motivation is higher where individuals feel they are engaging in an activity by choice rather than the perception that they have to do it;

2. When abilities are overchallenged, students feel anxious, self-conscious, and stressed;

3. Underutilization of abilities leads to feelings of boredom and apathy that challenge attentional processes necessary to learning;

4. For many students, course grades are perceived as high stakes and add to a perception that abilities are overchallenged;

5. The optimal level of challenge stretches existing skills (Vygotsky, 1978);

6. Adolescents tend to feel more motivation and happiness in low-challenge, high-skill situations than in high-challenge, high-skill situations;

7. Adults tend to prefer high-challenge, high-skill situations but have greater cultural prejudice against doing what one has to do;

8. Some personalities are more autotelic, or motivated by internal rewards, than others;

9. Some activities are more autotelic, or intrinsically rewarding, than others;

10. Efficacy, or belief in one's ability to produce desired effects by their actions, is an essential component of motivation to act (Bandura, 1997).

Clearly, successful engagement in challenging college courses requires persistent effort to keep cognitive abilities within tolerance limits of the affective needs that mediate learning. Very few students, however, arrive at college with more than a rudimentary understanding of their own learning processes and the strategies that help regulate learning (Nager, 1999). Students may therefore approach learning in a trial and error

manner, using informal strategies that brought them success in preparatory schools. Given the diversity of academic preparation students experience prior to entering college, diversity of success at college follows.

The Role of Homework in Promoting Learning

The literature regarding homework is surprisingly limited in scope, especially at the college level. Data compiled for the years 1983-84 reported in the National Assessment of Educational Progress (NAEP) show that approximately 65% of students in the 9-, 13-, and 16-year olds age range do home work (Anderson, 1986) and that 20% of the time students in the K-12 grades devote to academic tasks in this country is spent on homework (Cooper, 2000). However, homework, which Cooper defines as academic tasks assigned by school teachers to be done during non-school hours (1989), remains controversial in regards to advantages versus disadvantages, the efficacy of assignments, optimal amounts, and other considerations. In a review of literature on homework compiled in 2000 for the Minnesota Center for Applied Research and Educational Improvement, Harris Cooper noted that "it is surprising how little attention is paid to the topic of homework in teacher education. Most teachers in the United States report that in education courses they discussed homework in relation to specific subjects, but received little training in how to devise good assignments, how to decide how much homework to give, and how to involve parents" (pg. 1). At the college level, instructors tend to receive little or no formal training on any aspect of teaching, including the development of worthwhile assignments (McKeachie, 1994).

Reviews of the literature conducted between 1960 and 1987 vary widely in assessments of the role and results of K-12 homework. In a paper presented at the Annual Meeting of the American Educational Research Association (1988), Daniel Levine argued that the NAEP's publication, "The Reading Report Card," portrays a misleadingly positive relationship between homework and achievement. Instead, he found that community factors such as percent of minority students in schools and levels of parental education affected the relationship between homework and reading outcomes. Nine studies that investigated academic performance as a function of time spent on homework found that the performance of elementary students did not improve with time spent on homework, but that junior high performance increased somewhat while high school achievement showed a positive relationship with time spent on homework (Cooper, 2000). Interestingly, the benefits of time spent on homework indicated a saturation limit after which they decreased. In a study of teacher education students, Tuckman (1992) found that short assignments produced a greater quantity of work than long assignments. An NAEP report for the National Center for Educational Statistics that compared reading assessments for the years 1992 to 2000 showed average reading scores for fourth graders to be highest for students who reported doing one hour of homework per day (222), slightly lower for those reporting one half hour per day (219), but lower yet for those reporting more than one hour (212). While those spending more than one hour may reflect difficulty in completing assignments, corroborating data indicates that students become bored when homework is over-assigned, lose interest in academic tasks, experience physical and emotional fatigue, and that students from lower socio-economic homes have less assistance completing challenging assignments (Cooper, 2000). The