Self-regulated Learning Strategies and Achievement in an Introduction to Information Systems Course

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The shift from behaviorism to cognitivism in educational psychology has placed an increasing responsibility on learners for their own learning, and self-regulated learning has become a frequent area of educational research. The Motivated Strategies for Learning Questionnaire (MSLQ) is a widely used instrument to assess college students' self-regulated learning. This research investigated effective self-regulated learning strategies in a lecture-led concept learning environment versus a hands-on computer lab learning environment for an introduction to information systems course. The findings revealed that effort regulation had a positive effect and peer learning had a negative effect on learning computer concepts. The findings on effective strategies for hands-on computer lab learning were inconclusive. Further research is needed to examine the appropriateness of MSLQ in assessing students' self-regulated learning in a computer lab learning environment.

The framework for understanding the psychological basis of learning has gradually shifted from behaviorism to cognitivism since the 1960s (Anderson, Reder, & Simon, 1995; Bredo, 1997). Increasingly learners are perceived to have more responsibility for their own learning. Learners are no longer viewed as passively being 'instilled' with information and knowledge; they are actively involved in reorganizing and reconstructing their existing knowledge with new knowledge (Perkins, 1992). Research shows, furthermore, that the personal capabilities that enable students to be independent learners and to develop a core of resiliency are highly related to achievement (Wang & Lindvall, 1984; Zimmerman & Martinez-Pons, 1986). Understanding the concept of self-regulation is important in the development of these achievement capabilities for both teachers and students. Self-regulated learning is a self-initiated action that involves goal setting and regulating one's efforts to reach the goal, self-monitoring (metacognition), time management, and physical and social environment regulation (Zimmerman & Risemberg, 1997).

To assist students to be effective in their learning, teachers should help students become aware of alternative ways of approaching learning situations (McKeachie, 1988), but Weinstein and Mayer (1986) suggest that learning strategies appropriate for one type of learning situation may not be appropriate for another. One course that involves different types of learning is an information systems course. Generally, this type of course consists of lectures to cover computer concepts and lab activities to provide students hands-on experience. A lecture environment requires students to listen, to take notes, and to take pencil-and-paper exams, while a lab environment requires students to follow instructions to perform tasks on the computer. Compounded with these two different types of learning environments, the diversity in students' existing computer knowledge and skills provides multiple challenges when teaching an information systems course (Lippert & Granger, 1998). In order to handle the complexity in teaching this type of information systems course, instructors need information on the effects of various learning strategies and prior computer experience on achievement. With the rapid changes in the computer industry, educators also need to know the effects of the software used on

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learning outcomes when using less than up-to-date software for instruction.

A widely used instrument for investigating self-regulated learning strategies is the Motivated Strategies for Learning Questionnaire (MSLQ) developed by Pintrich, Smith, Garcia, and McKeachie (1991). This instrument has been used extensively in various disciplines, but little is known on the use of self-regulated learning strategies and achievement in an information systems course. With this information, teachers can make students aware of effective learning strategies in various types of learning environments and help students use the appropriate learning strategies in later learning situations. Since the self-regulatory process of learning gives students a sense of control and encourages students to pay attention to their methods of learning (Zimmerman, Bonner, & Kovach, 1996), teachers can teach students how to learn by training students to use different learning strategies.

Purpose of the Study

The purpose of this study was to identify the effective self-regulated learning strategies in a lecture and in a hands-on computer lab learning environment of an information systems course. In addition, this study investigated the effect of students' prior computer experience and software used in these two types of learning environments. Specifically, this study investigated the following questions:

1. What self-regulated learning strategies are related to achievement in a lecture learning environment in an information systems course? Does prior computer experience and software used affect achievement?
2. What self-regulated learning strategies are related to achievement in a computer hands-on learning environment of an information systems course? Does prior computer experience and software used affect achievement?

Review of Literature

This section will first discuss the different learning environments involved in an information systems course. Then, it will define self-regulated learning and discuss various aspects of self-regulated learning, including metacognition, physical and social environment management, time management, and effort regulation. In addition, relevant research on the relationships between these aspects and achievement will be discussed. Finally, detailed information on the Motivated Strategies for Learning Questionnaire will be provided.

Learning Environments in a Information Systems Course

Computer skills are essential for business students to be successful in their jobs upon graduation, and many university business schools have an information systems course. This usually is a required course for all undergraduates and is a prerequisite to other business courses. The goal of this first information systems class is to prepare students to use the acquired computer knowledge and skills in other upper-division business classes, such as accounting, finance, and management (Lippert & Granger, 1998). Since the goal is for students to acquire both computer knowledge and software skills, this course usually consists of lectures and hands-on computer labs. The lectures discuss concepts and theories related to computer hardware and software in particular, and business information systems in general. The hands-on computer labs generally involve the use of an operating system, a word processor, an electronic spreadsheet, and sometimes presentation software (Lippert & Granger, 1998). The learning of computer and information systems concepts usually involves listening to lectures, taking notes, participating in discussions, and taking tests that are aimed to provide an overall measure of how much is learned. The most commonly used approach in a computer lab, on the other hand, requires students to follow some type of step-by-step instructions to complete projects or assignments on computers (Lambrecht, 1999), and the projects and assignments are evaluated for mastery of the computer software.

When learning computer concepts in this level of information system course, students basically learn facts, for example, facts about computer hardware components, types of computer software and their main functionality, and information systems used in various aspects of running a business. On the other hand, students learn to operate computers in hands-on activities. Students follow instructions and then manipulate objects and icons on the computer screen to accomplish tasks. If students operate the machine correctly, they get the desired results. If students manipulate objects and icons incorrectly, the computer will not generate correct results, and students may not understand why. After a few tries, students will need to seek help from other resources. Therefore, these two types of learning are different, and different learning situations may require different learning strategies to be successful (Weinstein & Mayer, 1986).

Self-regulated Learning

According to Zimmerman (1989), self-regulated learners are individuals who are “metacognitively, motivationally, and behaviorally active participants in their own learning process” (p. 4). One feature of this definition is how and why students choose to use a particular process or strategy. Since this motivational aspect had been analyzed in Chalupa and Chen’s study (in press), the current study focused specifically on self-regulation-related learning strategies and achievement. A main feature of self-regulated learning is *metacognition*. Metacognition refers to the awareness, knowledge, and control of cognition; the three processes that make up metacognitive self-regulatory activities are planning, monitoring, and regulating (Pintrich et al., 1991). Other aspects of self-regulated learning include time management, regulating one’s own physical and social environment, and the ability to control one’s effort and attention (Pintrich, 1995; Zimmerman & Risemberg, 1997). Self-monitoring and various aspects of self-regulated learning will be discussed in later sections of this literature review.

Research has revealed that high achievers reported more use of self-regulated learning strategies than lower achieving students (Pintrich & DeGroot, 1990; VanZile-Tamsen & Livingston, 1999), and the assumptions of self-regulated learning offer optimistic implications for teaching and learning. Self-regulation is neither a measure of mental intelligence that is unchangeable after a certain point in life nor a personal characteristic that is genetically based or formed early in life. Students learn self-regulation through experience and self-reflection (Pintrich, 1995). Teachers can teach in ways that help students become self-regulating learners (Coppola, 1995; McCombs, 1989). Since self-regulation is not a personality trait, students can control their behaviors and affect in order to improve their academic learning and performance. In addition, self-regulated learning is particularly appropriate for college students, as they have great control over their own time schedule, and how they approach their studying and learning (Pintrich, 1995).

When self-regulated learners find inadequate learning strategies, they regulate their learning activities. Regulating refers to “the fine-tuning and continuous adjustment of one’s cognitive activities” (Pintrich et al., 1991, p. 23). Regulating activities enhance learning by employing a feedback loop during learning (Zimmerman, 1989), and self-monitoring training has been found to enhance performance across a wide variety of academic measures (Mace, Belfiore, & Shea, 1989). Thus, students can become better learners if they become more aware of their learning and then choose to act on that awareness.

Metacognitive Self-regulation. The main aspect of self-regulation is metacognition, and it includes planning, monitoring, and regulating activities (Pintrich et al., 1991). Planning involves setting educational goals and outcomes as well as task analysis. Self-regulated learners set specific learning or performance outcomes, and then monitor the effectiveness of their learning methods or strategies and respond to their evaluations (Zimmerman, 1989). Self-monitoring is essential in enhancing learning. It helps students focus their attention on and discriminate between effective and ineffective performance and reveals inadequate learning strategies. It improves time management as well (Zimmerman & Paulsen, 1995).

Physical and Social Environment Management. Regulating one’s physical and social environment includes study environment management and help seeking (Zimmerman & Risemberg, 1997). Management of *study* areas requires locating a place that is quiet and relatively free of visual and auditory distractions so that one can concentrate.

Zimmerman and Martinez-Pons (1986) found that high achievers reported greater use of environment management than low achieving students, and self-regulated learners tend to restructure their physical environment to meet their needs.

Once identified with dependency, substantial evidence now indicates that seeking assistance from others is a valuable self-regulating, proactive learning strategy that can provide the foundation for autonomous achievement (Karabenick, 1998). Evidence exists that students characterized as having achievement-motivated, active, master/task-oriented approaches to learning are more, rather than less, likely to seek help when necessary, which supports the perspective that seeking academic assistance reflects an appropriate, strategic response to learning (Ames & Lau, 1982; Karabenick & Knapp, 1991). However, help seeking is different from other learning strategies in that it is also a social interaction. Therefore, it is likely that social motives will influence the use of help seeking (Ryan & Pintrich, 1998).

Time Management. Another aspect of students' learning involves their use of time. Time management involves scheduling, planning, and managing one's study time. Research found 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 (Zimmerman, Greenberg, & Weinstein, 1994). Britton and Tessor (1991) sought to determine a link between student time management and cumulative grade point average (GPA) in college students. They concluded that students' beliefs in planning time and their short-range planning were more strongly related to their academic achievement than were their SAT scores.

Effort Regulation. Another self-regulatory capability is the ability to deal with failure and building resiliency to setbacks. Effort regulation, or volition, is "the tendency to maintain focus and effort toward goals despite potential distractions" (Corno, 1994, p. 229). According to Corno (1989), the term volition was equated with motivation and had appeared rarely in psychological research reports. Modern volition theory, however, can be reconceptualized within a general information-processing theory and viewed as an action control strategy. It reflects a commitment to completing one's study goals by directing and controlling one's energy toward them. In an academic situation, effort regulation can be used to build learning skills gradually and to help students handle many distractions in and outside of schools (Alderman, 1999). Research shows that effort regulation was a strong predictor of academic success (Doljanac, 1994; Lee, 1997). Yet, traditional college instruction generally assumes that students possess such skills and do not provide opportunities for effort regulation skills to develop (Trawick & Corno, 1995).

As discussed in this literature review, research found that both self-monitoring and effort regulation training resulted in achievement. Abundant research revealed that higher achievers use more self-regulatory strategies, control their physical environment to meet their needs, seek help when needed, and use time management skills. Limited research, however, was conducted specifically in an information system course context. In one study conducted to investigate students' motivation and use of learning strategies in a business information systems course and a microcomputer applications course, no relationship was found between any of the learning strategies and course grade (Chalupa & Chen, in press).

Research Instrument: MSLQ

The MSLQ was developed at the National Center for Research to Improve Postsecondary Teaching and Learning at the University of Michigan. The instrument has been under development since 1986 when the Center was founded. It was designed to assess college students' motivational orientations and their use of different learning strategies in college courses. Two sections comprise the MSLQ, a motivational section and a learning strategies section. Table 1 lists these two sections and their subscales.

The MSLQ instrument has been used widely in investigating students' motivation and learning strategies in many countries, such as Arabia (Almegta, 1997), Australia (Fuller, 1999), Canada (d'Apollonia, Galley, & Simpson, 2001), China (Rao, Moely, & Sachs, 2000), Japan (Yamauchi, Kumagai, & Kawasaki, 1999), and Taiwan (Lee, 1997). In the U.S., MSLQ has been used

Table 1: Listing of Motivation and Learning Strategies in MSLQ

Scale	Subscale
Motivation	1. Value Components a. Intrinsic Goal Orientation b. Extrinsic Goal Orientation c. Task Value
	2. Expectancy Components a. Control Beliefs b. Self-Efficacy for Learning and Performance
	3. Affective Components a. Test Anxiety
Learning Strategies	1. Cognitive and metacognitive Strategies a. Rehearsal b. Elaboration c. Organization d. Critical Thinking e. Metacognitive Self-Regulation
	2. Resource Management Strategies a. Time and Study Environment b. Effort Regulation c. Peer Learning d. Help Seeking

extensively in studies concerning motivation and learning strategies. The research areas include motivation and performance (Lin & McKeachie, 1999), motivation, learning strategies and achievement (e.g., DeKeyrel, Dernovish, Epperly, & McKay, 2000; Pokay & Blumenfeld-Phyllis, 1990), self-efficacy (Bong, 1998), and self-regulated learners and web-based learning (McManus, 2000). It also has been used in various disciplines, such as educational psychology (Hammann & Stevens, 1998), biology and social science (Lin & McKeachie, 1999), accounting (Eide, 1999), dietetics (Silagyi-Rebovich, 1996), and teacher education (McClendon, 1996).

Method

This section addresses research instruments used, demographics, and statistical design. The research used two instruments for data collection: a demographic instrument and the MSLQ.

Research Instruments

To collect data on demographics and prior computer skills, students were administered a demographic survey at the beginning of the semester. Two weeks before the final examination, students were administered the MSLQ to assess their self-regulated learning strategies used during the semester. All students who finished the course participated in the study.

Demographic Instrument. The demographic instrument asked for gender, college major, year in school, and prior work experience with software, and prior software courses. Students were instructed not to include any software courses that they were enrolled in at the time as prior computer courses taken.

Subjects. The subjects were 197 students in a business information systems course during the school years of 1999 and 2000. These students, from six different course sections, were taught by the same instructor in the College of Business at a Midwestern university. The business information systems course consisted of approximately 60 percent lectures and 40 percent computer labs. While lectures covered mainly computer hardware and concepts on application software and operating software, the hands-on labs included the use of DOS, Windows 95, a word processor, and an electronic spreadsheet. All six sections of the class used the same textbook and were required to take three pencil-and-paper examinations. All six sections used the DOS and Windows 95 operating systems. Two sections in 1999 used WordPerfect and Lotus 1-2-3, and four sections in 2000 used Microsoft Word and Excel for the computer lab activities. The computer lab textbooks for all six sections were written by the same authors and the projects and assignments required were very similar in the level of difficulty, although WordPerfect and Lotus were used in one book and Word and Excel were used in the other. The DOS and Windows 95 portion of the textbooks were identical.

Gender and College. Eighty-four (42.6%) of the 197 students were female and 113 (57.4%) were male. As to their majors, the majority of students (70.1%) were business majors, and 12.7 percent of the students were sciences and humanities majors. The rest of the students (14.7%) were architecture, fine arts, teachers college, and Communication, Information, and Media (CIM) students, with few students who had not decided their majors.

Year in School and Course Requirement. The majority of students (57.9%) were sophomores, 32 students (16.2%) were freshmen, 35 students (17.8%) were juniors, and only 14 (7.1%) students were seniors. The information systems class was a required course for 154 (78.2%) students.

Prior Software Work Experience and Software Courses Taken. The demographic information in the survey instrument included two blocks of items. One block dealt with the amount of experience using software at work, and the other block dealt with the number of courses on software taken by the students. In each block, questions referred to the same classes of software: word processing, spreadsheet, database, presentation, e-mail, Internet, desktop publishing, programming, computer-aided drafting (CAD), and web page design. The question about experience working with software allowed for four levels of increasing experience: no experience, 1-4 months, 5 months to 1 year, and 2 or more years. The question about software courses had three levels: none, 1 course, and 2 or more courses.

MSLQ Instrument. The instrument was purchased from the developers (Pintrich et al., 1991) at the National Center for Research to Improve Postsecondary Teaching and Learning. The learning strategies section has 50 items regarding students' use of different cognitive and self-regulated learning strategies. Only five scales in the learning strategies section are relevant to self-regulated learning and were used in this study. They were metacognitive self-regulation, time and study environment, effort regulation, peer learning, and help seeking. Appendix A lists the scales and the items in each scale. Responses were scored using a 7-point Likert type scale, from 1 (not at all true of me) to 7 (very true of me). Scale scores are determined by summing the items and taking an average. The scales are modular and can be used to fit the needs of the instructor or researcher.

Statistical Procedures

The dependent variables in this study were test scores and lab assignment scores. Students were required to take three tests to evaluate their understanding of computer concepts and knowledge from the lecture portion of the class. Students demonstrated their hands-on computer skills by completing 22 assignments. The total points for the tests were 300, and the total possible points for the 22 assignments were 300 points, as well.

Data gathered on prior software courses revealed that not many students had taken software classes, so this block of data was not used in the study. The block of data on prior software work experience was subjected to principal component analysis. This procedure is designed to work with nominal and ordinal (discrete) data, using the method of alternating least squares (ALS) to derive "optimal scores" to be used in the extraction of principal components (Van de Geer, 1993). The procedure produces object scores that are similar to the factor scores produced by factor analysis. The ten software work experience items can be reduced to a scale variable. The scale provides the amount of prior work experience with software, positive values indicating little work experience with software and negative values indicating more experience.

For the software used variable, students who used Microsoft Word and Excel were assigned the value 0, and students who used WordPerfect and Lotus were assigned the value 1 for analyses.

Multiple regression is a general statistical procedure used to analyze the relationship between a single dependent variable and several independent variables (Hair, Anderson, Tatham, & Black, 1998). The procedure was used in this study since both research questions involved one dependent variable (test or labs) and seven independent variables: all five MSLQ subscales, prior computer experience, and software used.

Findings

Research Question 1: What self-regulated learning strategies are related to achievement in a lecture learning environment in an information systems course? Does prior computer experience and software used affect achievement?

The dependent and independent variable scores were standardized to obtain a common unit of measurement. Table 2 illustrates the descriptive statistics.

Table 2: Descriptive Statistics of Tests and Independent Variables

Variables	Mean	Standard Deviation
Tests	231.99	22.48
Metacognitive self-regulation	4.30	.97
Time and study environment mgt.	4.60	.91
Effort regulation	4.79	1.01
Peer learning	3.36	1.41
Help seeking	3.82	1.19
Prior computer experience	-.02	.98
Software used	.32	.47

When all variables were entered into the multiple regression analysis, results showed an adjusted R^2 of .229. An analysis of variance revealed an $F(7,189)$ of 9.327, which is statistically significant ($p < .001$). Table 3 lists the regression coefficients.

As indicated in Table 3, when all variables were included in the equation, only effort regulation and software used were statistically significant ($p < .01$) in predicting test scores.

Since the β coefficients provide a guide to the relative importance of the independent variables included in the equation (Hair et al., 1998), a decision was made to exclude variables that had a β value of less than 0.1 from the equation. The reduced set of variables included the dependent variables and the independent variables effort regulation, peer learning, and software used. The regression analysis of these variables showed an adjusted R^2 of .236, which was slightly higher than that of the regression equation with all variables ($R^2 = .229$). An ANOVA showed an $F(3,193)$ of 21.181, $p < .000$ level. Table 4 lists the regression coefficients for the second analysis.

When the independent variables that had a β value of less than 0.1 were not included in the regression equation, effort regulation, peer learning, and software used predicted test scores significantly ($p < .001$). Each one-point increase on a 7-point Likert scale on the MSLQ effort regulation subscale predicted a 6.894 point increase on the test scores. Each one-point increase on a 7-point Likert scale on the peer learning subscale predicted a 3.643 point decrease on the test scores, which indicated that students who studied more with their peers earned lower grades.

Table 3: Multiple Regression with Test Scores as the Dependent Variable and All Independent Variables

	Unstandardized Coefficients		Standardized Coefficients		
Variables	B	Std. Error	b	*t* value	Sig.
Intercept	205.306	9.085		22.597	.000
Metacognitive self-regulation	-1.354	1.998	-.058	-.678	.499
Time and study environment mgt.	2.360	2.135	.095	1.105	.270
Effort regulation	6.131	1.877	.276	3.266	.001
Peer learning	-2.729	1.475	-.172	-1.850	.066
Help seeking	-.885	1.570	-.047	-.564	.574
Prior computer experience	-1.344	1.494	-.059	-.899	.370
Software used	15.099	3.307	.314	4.972	.000

Table 4: Multiple Regression with Test Scores as the Dependent Variable and Selected Independent Variables

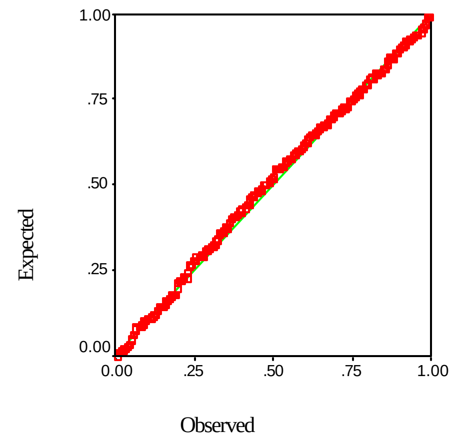
	Unstandardized Coefficients		Standardized Coefficients		
Variables	B	Std. Error	b	*t* value	Sig.
Intercept	206.320	7.681		26.861	.000
Effort regulation	6.894	1.385	.311	4.977	.000
Peer learning	-3.643	.995	-.229	-3.662	.000
Software used	15.356	3.008	.319	5.105	.000

The coding for software used was Microsoft software 0 and WordPerfect and Lotus 1. The positive β value of software used indicates that using WordPerfect and Lotus predicted a 15.356 point increase in test scores.

To evaluate whether the regression model met the assumptions of regression analysis, residual analysis was used (Hair et al., 1998). A normal probability plot of the residuals was generated to provide a visual examination. Figure 1 illustrates the plot.

The diagonal line in Figure 1 indicates a normal distribution of subjects. Since the plotted values fall closely along the diagonal line, the residuals are considered to represent a normal distribution; therefore, the regression model met the assumption of normality.

Figure 1: Normal Probability Plot of Regression Standardized Residuals: Tests



Research Question 2: What self-regulated learning strategies are related to achievement in a computer hands-on learning environment of an information systems course? Does prior computer experience and software used affect achievement?

The dependent variable of this research question was lab assignment scores, and the independent variables were five self-regulated learning strategies, prior computer experience, and software used. As in analyzing research question 1, the dependent and independent variable scores were standardized to obtain a common unit of measurement. Table 5 illustrates the descriptive statistics.

All variables were entered into the multiple regression analysis, and the model yielded an adjusted R^2 of .069 and an $F(7,189)$ of 3.065. Although the R^2 was small, the F ratio was statistically significant at the .005 level. Table 6 lists the regression coefficients. As indicated in Table 6, only time and study environment management predicted lab assignment scores.

As in the regression analysis of research question 1, variables that had β value less than 0.1

Table 5: Descriptive Statistics of Labs and Dependent Variables

Variables	Mean	Standard Deviation
Lab assignments	252.08	35.57
Metacognitive self-regulation	4.30	.966
Time and study environment mgt.	4.60	.91
Effort regulation	4.79	1.01
Peer learning	3.36	1.41
Help seeking	3.82	1.19
Prior computer experience	-.02	.98
Software used	.32	.47

Table 6: Multiple Regression with Lab Assignment Scores as the Dependent Variable and All Independent Variables

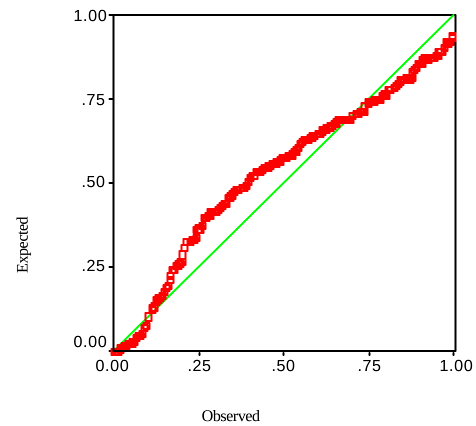
	Unstandardized Coefficients		Standardized Coefficients		
Variables	B	Std. Error	b	*t* value	Sig.
Intercept	215.148	15.799		13.618	.000
Metacognitive self-regulation	-5.185	3.474	-.141	-1.493	.137
Time and study environment mgt.	9.448	3.713	.241	2.544	.012
Effort regulation	4.728	3.264	.135	1.448	.149
Peer learning	.919	2.565	.037	.358	.721
Help seeking	-2.191	2.731	-.073	-.802	.423
Prior computer experience	2.083	2.598	.057	.802	.424
Software used	-4.723	5.281	-.062	-.894	.372

were excluded from the equation. The reduced set of analysis included the dependent variable lab assignments and independent variables metacognitive self-regulation, time and study environment management, and effort regulation. The regression analysis showed an adjusted R^2 of .076, which was slightly higher than the R^2 value obtained when all variables were included in the analysis (R^2 = .069). An analysis of variance (ANOVA) revealed an $F(3, 193)$ of 6.403 with a significance at the .001 level. Table 7 lists the regression coefficients.

When the independent variables that had a β value of less than 0.1 were not included in the regression equation, only time and study environment predicted lab assignment scores at the .05 level. Each one-point increase on a 7-point Likert type scale on the MSLQ time and study environment management subscale predicted a 9.285 point increase on the lab assignment scores.

As in answering research question 1, a normal probability plot of the residuals was produced to evaluate the assumptions of regression analysis. Figure 2 illustrates the plot.

Figure 2: Normal Probability Plot of Regression Standardized Residuals: Lab Assignments



Unlike the normal probability plot with tests as dependent variable, the normal probability plot for lab assignments shows substantial departures from the diagonal line. Therefore, the data collected for this study did not meet the assumption of normality. Other data are needed to investigate the variables that affect achievement in a hands-on computer lab learning environment.

Conclusion and Recommendations

The findings showed that effort regulation was the learning strategy that led to achievement in a lecture type of learning environment. When studying computer and information system concepts, students who could handle distractions and could maintain concentration achieved higher test scores. Although the regression coefficient was significant at the .001 level, a one-point increase on the MSLQ effort regulation subscale led to only a 6.894 point increase in test score, less than 2.5% of the 300 total points. It is unlikely that this would have an effect on the final letter grade. On the other hand, students who studied computer concepts with peers achieved lower test scores. Contrary to most teachers' perceptions, prior computer experience did not help students achieve higher test scores.

Previous studies using MSLQ to investigate self-regulated learning strategies and academic performance revealed mix results. Some research found that metacognitive self-regulation activities were related to performance (Eide, 1999; Pokay & Blumenfeld-Phyllis, 1990), while others found that effort management had a positive effect on academic performance (Doljanac, 1994; Lee,

Table 7: Multiple Regression with Lab Assignment Scores as the Dependent Variable and Selected Independent Variables

	Unstandardized Coefficients		Standardized Coefficients		
Variables	B	Std. Error	b	*t* value	Sig.
Intercept	207.355	14.440		14.360	.000
Metacognitive self-regulation	-4.871	2.880	-.132	-1.691	.092
Time and study environment mgt.	9.285	3.662	.237	2.536	.012
Effort regulation	4.800	3.149	.137	1.524	.129

1997). Yet, Chalupa and Chen (in press) and Hsu (1997) found that resource management had no effect on academic achievement. The learning strategies included in MSLQ were general learning strategies, and effective learning strategies might be discipline specific. For example, effort regulation was effective in a biology class (Doljanac, 1994), but none of the resource management strategies was related to performance in distance learning (Hsu, 1997). Therefore, further research is needed to investigate the appropriateness of the instrument for various disciplines.

When interpreting the results of this study, one should keep in mind that 74.1 percent of the students participating in this study were either freshmen or sophomores. This group of traditional students (between ages 18 and 20) has had experience in using computers. This group of students probably has more other social activities to distract them from studying. From the researcher's observations, this group of students tends to think that they are knowledgeable about computers. They are more interested in "hands-on" activities than learning computer concepts. Yet, seventy-eight percent of the participating students were required to take this course. This background would help in explaining why students who could maintain high concentration while studying computer concepts, in which they were not particularly interested, tended to get higher grades. The implications for instructors would be to encourage students to control their effort and attention when facing distractions and uninteresting tasks. As Alderman (1999) maintains, effort regulation should be taught to build learning skills gradually and, in turn, it will help students handle distractions in and outside of schools.

This study revealed an inverse relationship between peer learning and grade in a lecture type of learning environment. Further research is needed to investigate the appropriateness of using this subscale in an information systems course. Although limited research is available on peer learning in the context of self-regulated learning, the general positive effects of collaborative learning and group work in learning are well recognized. Therefore, it is not recommended to discourage students from peer learning until further findings are available.

One surprising finding of this study was that the use of somewhat outdated software in teaching led students to have higher test scores. One hypothesis would be that this group of students was more familiar with current software since they started using computers only recently, unlike returning students who might have been using software on the job for a long time. When not-so-new software was used in teaching, it might have prompted students to study harder because of its unfamiliarity. Clearly, more research is needed to further investigate this hypothesis. Data will need to be collected from students with the same demographic characteristics to either confirm or reject the effect of software used on achievement.

The finding concerning effective learning strategies for hands-on computer lab assignments was inconclusive. Since the normal probability plot indicated that the data collected did not meet the assumption of normality, the results were not interpretable. Several hypotheses could be drawn. One would be that the sample size needs to be increased and/or the sample needs to be drawn from a wider geographic area. Research is needed to collect data from the same population with a larger sample size and multiple four-year institutions to test this hypothesis. Another hypothesis would be that the MSLQ instrument was not an appropriate instrument to assess effective learning strategies. To test this hypothesis, replicated research with open questions is needed to gather learning strategies from students and then to investigate which of those strategies lead to achievement.

Since this result concerning effective hands-on learning strategies was inconclusive, this study was unable to examine the difference in self-regulated learning strategies, if any, between a lecture environment and a computer lab environment.

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Appendix: MSLQ Self-Regulated Learning Strategies Scales and Items (Note: Item numbers are the original numbers in the questionnaire)

Cognitive and Metacognitive Strategies: Metacognitive Self-Regulation

33. During class time I often miss important points because I'm thinking of other things.

36. When reading for this course, I make up questions to help focus my reading.

41. When I become confused about something I'm reading for this class, I go back and try to figure it out.

44. If course readings are difficult to understand, I change the way I read the material.

54. Before I study new course material thoroughly, I often skim it to see how it is organized.

55. I ask myself questions to make sure I understand the material I have been studying in this class.

56. I try to change the way I study in order to fit the course requirements and the instructor's teaching style.

57. I often find that I have been reading for this class but don't know what it was all about.

61. I try to think through a topic and decide what I am supposed to learn from it rather than just reading it over when studying.

76. When studying for this course I try to determine which concepts I don't understand well.

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

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

Resource Management Strategies: Time and Study Environment

35. I usually study in a place where I can concentrate on my course work.

43. I make good use of my study time for this course.

52. I find it hard to stick to a study schedule. (REVERSED)

65. I have a regular place set aside for studying.

70. I make sure that I keep up with the weekly readings and assignments for this course.

73. I attend this class regularly.

77. I often find that I don't spend very much time on this course because of other activities. (REVERSED)

80. I rarely find time to review my notes or readings before an exam. (REVERSED)

Resource Management Strategies: Effort Regulation

37. I often feel so lazy or bored when I study for this class that I quit before I finish what I planned to do.

48. I work hard to do well in this class even if I don't like what we are doing.

60. When course work is difficult, I either give up or only study the easy parts. (REVERSED)

74. Even when course materials are dull and uninteresting, I manage to keep working until I finish.

Appendix: MSLQ Self-Regulated Learning Strategies Scales and Items (Note: Item numbers are the original numbers in the questionnaire) (Continued)

Resource Management Strategies: Peer Learning

34. When studying for this course, I often try to explain the material to a classmate or friend.

45. I try to work with other students from this class to complete the course assignments.

50. When studying for this course, I often set aside time to discuss course material with a group of students from the class.

Resource Management: Help Seeking

40. Even if I have trouble learning the material in this class, I try to do the work on my own, without help from anyone.

58. I ask the instructor to clarify concepts I don't understand well.

68. When I can't understand the material in this course, I ask another student in this class for help.

75. I try to identify students in this class whom I can ask for help if necessary.

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