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College Students' Metacognitive Awareness of Difficulties in Learning the Class Content Does Not Automatically Lead to Adjustment of Study Strategies[1]

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ABSTRACT

This study examined college students' awareness of difficulties in learning class content and selection of study strategies to address the perceived challenges. Data consisted of responses by 94 students to two survey questions on 11 weekly monitoring worksheets. Data analyses, using the constant comparative method and Chi-Square tests, revealed that students' awareness of different kinds of difficulties in learning the class content did not lead to adjustment of study strategies. Students reported relying primarily upon passive rehearsal strategies throughout the semester rather than strategies supported by previous literature as being more effective. Suggestions for promoting students' abilities to self-regulate the learning process were discussed.

Key words: metacognitive awareness, metacognitive skills, self-regulated learning, study strategy, college student

INTRODUCTION

A primary goal in the study of self-regulated learning is to come to a better understanding of the process by which learners monitor and then regulate or improve their tactics when learning (Winne & Hadwin, 1998). Thus, related research highlights the importance of enabling students to monitor and control the learning process (Hartman, 2001; Schunk & Zimmerman, 1998, 2003). The present investigation built upon two important lines of research related to study strategies: the ability to regulate one's approach to learning and the choice of particular learning strategies themselves.

The ability to regulate the learning process is a key component of self-regulated learning that relates to the interplay between metacognitive knowledge and metacognitive skills. Metacognitive

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knowledge refers to knowledge of one's own thinking process. In the classroom setting, metacognitive knowledge allows students to become aware of what they know and what they do not know about a certain topic. This awareness affords students a baseline for planning for learning and allocating time and effort to study. Metacognitive skills refer to intentional regulation of study strategies. During a learning process, metacognitive skills allow students to select an appropriate strategic intervention, monitor the execution of the strategy, and evaluate its effectiveness (Boekaerts, Pintrich, & Zeidner; McCormick, 2003). Recent research suggests that these two major components of metacognition, metacognitive knowledge and regulatory skills, are intercorrelated (Schraw, 2001; Sperling, Howard, Staley, & Dubois, 2004).

More importantly, classroom research shows that metacognitive strategies distinguish student abilities in transfer and problem solving (Campione & Brown, 1990; Pellegrino, Chuowsky, & Glaser, 2001; Rozencwajg, 2003), self-regulation (Butler & Winne, 1995; Schunk & Zimmerman, 2003), self-efficacy and motivation (Wolters & Pintrich, 2001; Zimmerman, 1995, 1998), development of expertise (Sternberg, 2001), and academic achievement (Hartman, 2001; Justice & Dornan, 2001; McCormick, 2003; Peverly, Brobst, Graham, & Shaw, 2003; Schraw, 1994). Promoting student metacognitive strategies may enhance academic performance.

A second line of research on students' study strategies focuses directly on students' choice of particular learning strategies. Learning strategies refer to any behaviors or thoughts that facilitate encoding in such a way that knowledge integration and retrieval are enhanced (Weinstein, 1988). These thoughts and behaviors constitute organized plans of action designed to achieve a certain goal (Weinstein & Mayer, 1983, 1986). This research shows that the use of learning and study strategies is associated with students' perceived and actual ability (Ames & Archer, 1988; Borkowski, Carr, & Pressley, 1987; Pintrich & De Groot, 1990; Williams & Clark, 2004), coordination of metacognition and prior knowledge (Pressley, Borkowski, & Schneider, 1987), and various measures of academic achievement (Bernardo, 2003; Biggs, 1987; Entwistle & Ramsden, 1983; Everson, Weinstein, & Laitusis, 2000; McKeachie, Pintrich, & Lin, 1985; Sinkavich, 1991). Higher achieving students use more learning strategies than do lower achieving students (Schraw & Dennison, 1994; Zimmerman & Martinez-Pons, 1988).

Furthermore, this research distinguishes different types of learning strategies. For instance, reading and rereading the textbook chapters--the most frequently selected method among students (Carrier, 2003)--is considered a relatively ineffective approach to learning, as it is not active (Mackenzie, 1994), involves shallow processing (Craik & Tulving, 1975), and provides no feedback (Winne & Hadwin, 1998). In contrast, positive correlations have been found between active strategies and student academic performance. These strategies, such as studying lecture notes, making chapter notes, outlining, and coming to office hours, involve deep processing and might promote understanding of the course material (Justice & Dornan, 2001).

Our classroom observation and study reports from others (e.g., Peverly et al., 2003; Pressley et al., 1998) suggest that students believe that the strategies should vary with the characteristics and demands of courses and assignments. Students claim to use a variety of strategies in the pursuit of good grades, including strategies aimed at keeping themselves on task. They seem to know that strategy use is an important factor in preparation for an examination and performance and that some strategies are better than others when preparing for different types of examinations. However, research shows that students' selections of strategies are not always optimal (Garner, 1990; Peverly et al., 2003) or that students are not carrying out the effective strategies efficiently (Justice & Dornan 2001; Pressley et al., 1998; Wilhite, 1990). More research is needed to address the discrepancy between theories that students seem to hold about the selection and use of the study strategies and their actual strategy use in the learning process in order to improve student learning.

Recent research has begun to address this issue. Numerous programs and courses have been implemented trying to increase awareness of the importance of using effective study strategies and to enhance students' ability to manage their learning process to promote academic success, particularly among the first year college students. One of the purposes of these programs is to focus on teaching students to monitor their selection and use of various learning and cognitive strategies (Albaili, 1997; Curley et al., 1987; Derry & Murphy, 1986). Again, this research has revealed complex relationships between study strategies and academic performance. For instance, Smith (2003) found that successful completion of a study strategy course had a significant effect on

grade point average, but it did not positively influence scores on the School Strategies Scale. Similarly, Jakubowski (2003) found that students reported significant decreases in active self-regulation and self-efficacy, and significant increases in anxiety from the beginning of the course to the end. These changes did not adversely affect academic achievement, as students who did well in the learning and study strategies course tended to have higher grade point averages in their other courses. In a study that examined developmental changes in metacognitive and motivational variables and their relationship to course performance between traditional-age (18-23 years) and nontraditional-age (24-64 years) college students, Justice and Dornan (2001) found that older students reported more use of two higher level study strategies: generation of constructive information and hyperprocessing. However, their increased use of the strategies did not relate to course performance. The inconsistency of these results calls for further research to develop a better understanding of the complex relationship between the way students engage in the learning process and academic performance. This understanding bears a great significance in promoting self regulated learning and academic achievement.

The present study responded to this call by examining how college students' metacognitive knowledge relates to regulation of their study behaviors during the classroom learning process. The purpose of the study was to (a) document difficulties that the students perceived in learning class content and study strategies they subsequently selected to deal with challenges over a semester, and (b) examine the relationship of students' awareness of the difficulties with their strategy selection and test performance. Specifically, we addressed four research questions: 1) What kinds of difficulties did students perceive in learning the class content over the semester? 2) What types of study strategies did students select to deal with the perceived difficulties over the semester? 3) How did the perceived difficulties relate to students' selection of study strategies? 4) What were the relationships between students' perceived difficulties, selected study strategies, and test performances? We predicted that students would encounter various difficulties in learning the class content over the semester and that they would customize their selection of strategies to deal with their evolving learning difficulties.

METHOD

The participants included a total of 94 undergraduate college students enrolled in two sections of an educational psychology course in a mid-size university in the southeast US. Their age ranged from 18 to 43 (M=23, SD=5.98); there were 76 females (81%) and 18 males (19%). The sample represented a diverse racial background (80% White, 15% Black, 3.3% Hispanic, and 1.7% Asian American), similar to the student population of the university as a whole. Full institutional review board approval was obtained for the recruitment of students, and an alternative project option was offered in lieu of study participation. All students volunteered to participate in the study and signed the informed consent form. The course was taken during the junior or senior year after admission to the teacher education program. Both classes followed an identical class schedule, used the same course materials, and covered the same major topics. No significant difference was found between the two classes on the pretest of the course content, GPA, or cognitive abilities. The classroom environment was constructed to facilitate students' reflection on achievement goals and study strategies according to their actual performance throughout the semester.

Data Source and Procedure

Each class met separately once per week for sixteen weeks. A monitoring worksheet (Appendix A) was given to students at the end of each class except the first class to introduce the course, the three quiz days during the semester, and the last class for the final exam. As a result, the students completed the monitoring worksheet at the end of each class for a total of 11 weeks. From now on, we refer to the eleven weeks in which the monitoring data were collected as Week 1 to Week 11 for ease of presentation.

The monitoring worksheet asked students to estimate their overall understanding of the content of the class and offered three review questions for self-assessment of their understanding. Answers to these review questions were discussed by the end of the class. Also, the students were provided feedback on their performance on the first three tests and overall monitoring accuracy scores of

each test. To facilitate self-regulation of the learning process, students were encouraged to revisit the worksheets and monitor their performance on a weekly basis, and were required to keep the monitoring worksheets for a portfolio to be handed in at the end of semester.

Apart from making judgment of learning and answering the review questions on the weekly monitoring worksheet, students were required to respond to two open-ended questions: "What concepts from today's class did you find difficulty to understand?" and "Specifically, what will you do to improve your understanding of the concepts you listed above?". Students' responses to these questions were the primary data source for the present study. Students' performances were measured through four closed-book classroom tests. The three quizzes consisted of 25 four-option multiple-choice items and each quiz covered a unit of the course content. The final exam contained 50 items of the same format and was designed as a comprehensive measure of all the content covered in the course. The test items were either created by the instructors or selected from the test bank accompanying the textbook (Ormrod, 2003).

Data Analysis

Both qualitative and quantitative procedures were used to analyse the data. We started with the qualitative procedure to analyse the verbal data generated by the two open-ended questions. All students' responses to the two questions were transcribed verbatim and saved as a Microsoft Excel spreadsheet file. The responses to the monitoring worksheet each week served as a unit of data analysis. The constant comparative method (Glaser & Strauss, 1967) was used to extract themes from the verbal data and to develop the profiles of students' perceived difficulties in learning the class content and those of the study strategies they selected to deal with the difficulties. Following the data-driven grounded approach (Glaser & Strauss, 1967), we used a five-step procedure to reduce the data into categories and properties. First, a team of three coders independently read and coded the unit of the first week's data. Each coder independently derived theoretical categories (conceptual elements arising from patterns in the data) and properties (smaller, definable aspects of the categories) based on the data. As the independent coding proceeded, the initial categories and integrated properties were collapsed. The categories were considered saturated when new incidents from the data no longer added new properties to the categories.

Second, after coding the first unit, the team compared and discussed categories and properties generated by each individual coder. Disagreements were resolved through rereading and multiple sessions of discussion of the verbatim data among the team. As a result of the discussion, the initial categories and properties were refined through consensus to better capture the meaning of the transcripts. The team reached an agreement of 95 percent on a preliminary code table (Appendix B) of seven kinds (enumerated) of students' perceived difficulties in understanding the class content and a 100 per cent agreement on a second code table (Appendix C) that included four types (enumerated) of selected strategy. Inter-coder reliability was calculated by dividing the number of agreement with the combination of the number of agreement plus the number of disagreement (Kirk & Miller, 1986).

Third, after establishing the inter-coder reliability of the code table, the team used the agreed upon categories as a guide and independently coded and numerated the last week's data, deliberately searching for disconfirming evidence for each category which we used to modify and further refine the categories. Fourth, the team compared the coding results again and further modified the categories through consensus until we were satisfied that the categories and properties reflected our interpretations of students' perceptions of the difficulties in learning the class content and the strategies they selected to deal with the challenges. In the end, the team reached an agreement of 100 per cent in this coding exercise. Finally, with this satisfactory consistency, the first author proceeded and coded the rest of the data. This qualitative data analysis procedure resulted in two profiles: One delineates students' perceived difficulties in learning the class content and the other describes strategies students selected to deal with the challenges over the semester. The two profiles were presented in Figure 1 and 2 below.

To complement and triangulate results of the qualitative data analysis, we used two types of quantitative procedures to analyze the data. Limited by the categorical nature of our data, we first used a series of Chi-square procedures to test the significant patterns among the eleven units of the data and to corroborate the profile of students' perceived difficulties in learning the class content

and the profile of their selected strategies over the semester, both established by the qualitative data analysis. Second, we used a nonparametric correlation procedure (Gall, Gall, & Borg, 2003) to address the last research question about the relationship between the students' perceived difficulties, selected study strategies, and test performances. In the following section, we report results of the data analyses in order of the four research questions listed above.

RESULTS

1) What kinds of difficulties did students perceive in learning the class content over the semester?

This question was addressed in two steps. First, we identified different kinds of difficulties that students perceived in learning the class content each week. The frequency of the difficulties each week was presented side by side to examine the possible variation of the difficulties over the semester. As Figure 1 shows, having difficulty understanding a particular concept and distinguishing similarity and difference between concepts were the two mostly reported difficulties that students encountered over the semester. In particular, having difficulties understanding a particular concept was the most frequently reported problem throughout the semester, except for Week 4 and 5. Examples of such a problems were: "The diagram of the long-term memory was a little difficult" and "I just found understanding the terms confusing."

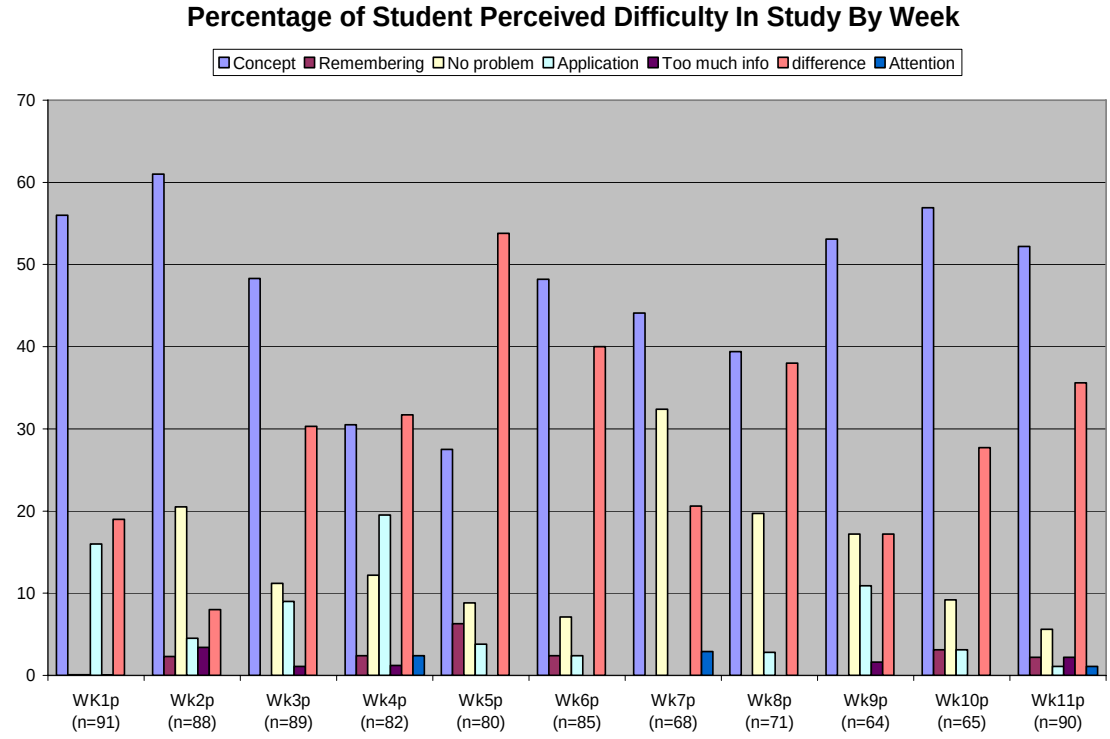

Figure 1: Percentage of student difficulty in study by week

For Week 4 and 5, students reported more problems in differentiating relationships between concepts than the difficulties in understanding a particular concept as the challenge in learning the class content. An example of this type of problem was students had difficulty in: "Keeping meaningful learning and elaborate learning separate & knowing definition of each." or "Keeping the knowledge organization terms from being mixed up." The content covered in Week 4 related to higher level thinking skills such as transfer, problem solving, and metacognitive skills, while the content for Week 5 dealt with behaviourist views of learning and introduced concepts such as positive and negative reinforcement and

presentation and removal punishment. These results show that students perceived mostly two different kinds of difficulties in learning the class content over the semester. One pertained to obtaining comprehension of a specific concept while the other was concerned with ascertaining relationships between the concepts, a more integrated higher level learning outcome (Bloom et al., 1956).

Figure 1 also shows that the proportion of the two kinds of difficulties remained about the same in the first and the second half of the semester. More students reported having no problem in learning the content in the second half than in the first half of the semester, implying a higher comfort level might have been developed among the students with the course expectation, class routine, and the format of the tests. Students who reported no problem and who chose not to respond to the survey questions made the number of response entries vary from week to week.

In a second step, we conducted a series of one-sample Chi-Square tests to triangulate the qualitative observation of frequency count. The results confirmed the qualitative observation that students perceived different kinds of difficulties in learning the class content for seven out of the ten weeks. Specific statistics of the Chi-Square tests are reported in Table 1 below, together with the results to research question three.

2) What types of study strategies did students select to deal with the perceived difficulties over the semester?

Similar to the approach to addressing the research question one, we first identified types of study strategies that the students selected to deal with the perceived difficulties in learning the class content each week. The frequency of the strategy selected each week was presented side by side to observe the pattern of students' strategy selection over the semester. As can be seen in Figure 2, rereading the textbook or lecture notes was the predominant strategy (66% to 94%) that students selected throughout the semester. Apart from the rehearsal strategy, a variety of study strategies, such as elaboration, critical thinking, organization, selecting alternative strategies, and seeking help, were also reported in dealing with the challenges for the first five weeks. However, this variety decreased to a negligible level (mostly less than 10%) from Week 5 to the end of the semester. At the same time, the tendency of students' selecting the rehearsal strategy rose from 66% in first week to 94% at Week 6 and sustained around the 90% level until the end of the semester. This finding shows that the students did not vary their study strategy selection over the semester even when they perceived different kinds of difficulties. In the context in which they were learning about when and why more effective study strategies should be used to enhance the performance, the participants chose to stay with the default rehearsal strategy throughout the semester. Interestingly, the help seeking strategy appeared to a certain degree in Week 1 and then re-emerged to a considerable level in Week 11 when the students were pressed by the final comprehensive examination, suggesting that the instructional structure may still influence students' selection of study strategies.

Again, we conducted Chi-Square tests to triangulate the qualitative observation of students' strategy selection. The results support our qualitative observation that students selected predominantly (for 8 out of 10 weeks) rehearsal as the strategy to deal with the difficulties they perceived in learning the class content. Specific statistics of the Chi-Square tests are reported in Table 1 below.

3) How did the perceived difficulties relate to students' selection of study strategies?

We addressed this research question in two steps. First, we conducted two sets of Chi-Square tests. The first set of Chi-Square tests was used to determine whether students reported significantly more difficulties in understanding a concept than other kinds of difficulties each week. The second set of Chi-Square tests was used to determine whether more students selected rehearsal as the appropriate study strategy to deal with the perceived difficulties than other types of study strategies each week. Then, we presented results of the two sets of Chi-Square analyses side by side to examine how students' perceived difficulties

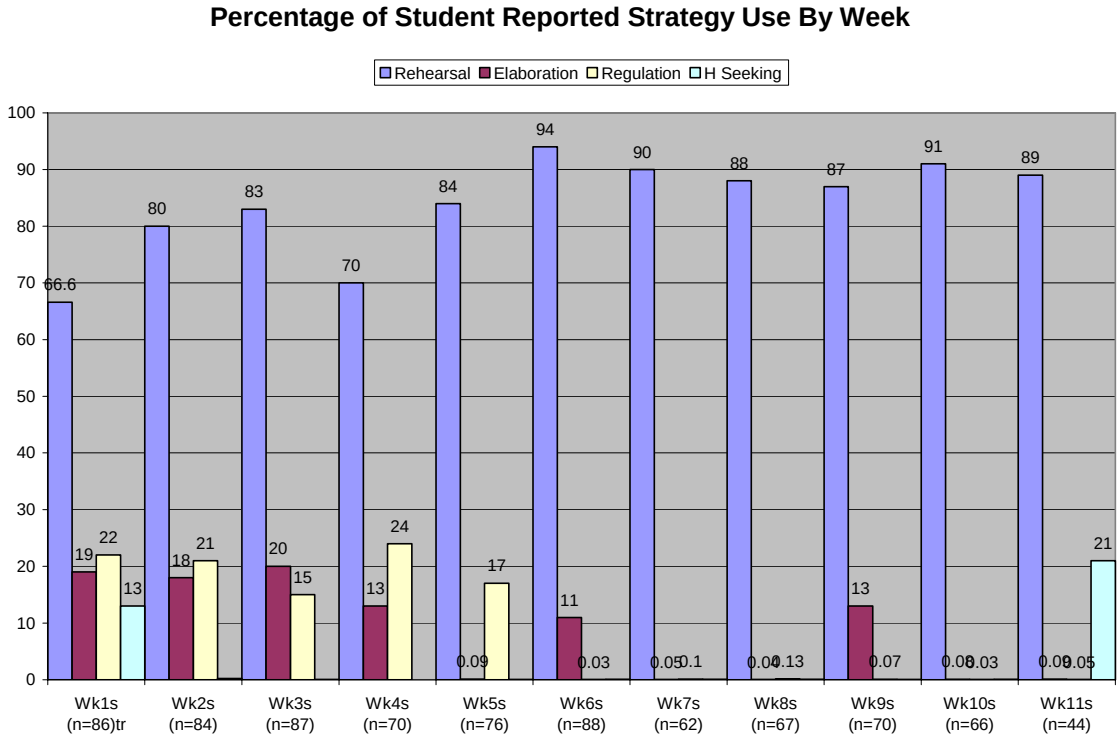

Figure 2: Percentage of student reported sta6tegy use by week

in learning the class content coordinate with the study strategies they selected to deal with these difficulties. As can be seen in Table 1, the kinds of difficulties students perceived in learning the class content varied from week to week. Although students perceived more difficulties in understanding specific concepts than other kinds of difficulties throughout the semester, there was no significant difference among the kinds of difficulties throughout the semester, except for Week 2, 4, and 5. In Week 2, students perceived significantly more problems in understanding a concept than other kinds of difficulties combined (χ^2=4.55, df=1, p=.03). In contrast, students perceived significantly more difficulties in distinguishing differences between concepts than the difficulty in understanding the concept in Week 4 (χ^2=12.49, df=1, p=.00) and Week 5 (χ^2=16.20, df=1, p=.00).

On the other hand, Table 1 shows that students selected rehearsal as their primary study strategy in dealing with different kinds of difficulties throughout the semester except for Week 1 (χ^2=1.16, df=1, p=.28) and Week 4 (χ^2=3.66, df=1, p=.06). These results show that there was a lack of coordination between students' perceived difficulties and strategy selection. The data of Week 5 are particularly illustrative on this point. In Week 5, students still selected the rehearsal strategy when they perceived having significantly more problems in distinguishing relationships between concepts which require more advanced strategies to deal with. Our data clearly show that even though students perceived different kinds of difficulties in learning the class content, this awareness did not lead to variation in selection of the study strategies.

4) What were the relationships between students' perceived difficulties, selected study strategies, and test performances?

To address this question, we first converted the kind of difficulties students perceived in learning the content and the type of strategies they selected to deal with the difficulties into two artificial dichotomous variables. As results of the above qualitative analysis indicate, understanding specific concepts was the most occurring difficulty that students perceived in learning the class content over the semester (Figure 1). Therefore, the perceived difficulties

Table 1: Chi-Square Test of Observed and Expected Difficulties in Content Learning and Selected Study Strategies by Week

Unit	Difficulty in Understanding Concept		χ^2	Rehearsal Strategy Selection		χ^2
	Observed	Expected		Observed	Expected	
Week 1	49 (n=91)	45.5	.54	38 (n=86)	43	1.16
Week 2	54 (n=88)	44	*4.55	51 (n=84)	42	*3.86
Week 3	43 (n=89)	44.5	.10	55 (n=87)	43.5	*6.01
Week 4	25 (n=82)	41	*12.49	43 (n=70)	35	3.66
Week 5	22 (n=80)	41	*16.20	54 (n=76)	36	*13.47
Week 6	41 (n=85)	42.5	.11	69 (n=88)	44	*28.41
Week 7	30 (n=68)	34	.94	48 (n=62)	31	*18.65
Week 8	28 (n=71)	35.5	3.17	50 (n=67)	33.5	*16.25
Week 9	34 (n=64)	32	.25	53 (n=70)	35	*18.51
Week 10	37 (n=66)	33	.97	56 (n=67)	33.5	*30.22

Note: * Indicates results significant beyond the .05 level; **Week 11 data not included as it is a review week.

variable was coded dichotomously with the value (1=conceptual understanding; 0=all other reported difficulties). Similarly, since the rehearsal strategy was the most selected strategy over the course of the semester (Figure 2), the selected strategy variable was coded as a dichotomous variable with the value (1=rehearsal; 0=other types of reported strategies). Then, we combined the eleven weekly dichotomous data to compute a total raw score over the semester for the perceived difficulty and the selected strategy variables respectively (Huck, 2004, p. 61). Since the test score was a continuous quantitative variable, we combined the test scores of the three quizzes and the final exam to get a raw score of students' test performance for the semester. Next, we used the Pearson correlation procedure to examine the relationship between students' perceived difficulties, selected study strategies, and test performance of the three quizzes and the final exam. Our data did not yield a significant relationship among these variables.

DISCUSSION

We set out to document difficulties that students perceived in learning the content of educational psychology and the strategies they selected to deal with these challenges over a semester. In particular, we were interested in examining the coordination of students' perceived difficulties and selection of their study strategies. In other words, we intended to examine how students' awareness of the difficulties in learning the class content is related to their self-regulation of the study process. We further attempted to understand the relationship between students' perceived difficulties, selection of study strategies, and test performance. Our ultimate purpose was to find methods for reducing the commonly observed discrepancy between theories students seemingly possess about study strategies and their actual use of the strategies in order to enhance students' ability to self-regulate the learning process.

Our data show that students perceived various kinds of difficulties in learning the class content over the semester. These difficulties ranged from problems in understanding a particular concept, to concerns with processing the information in a limited period of time, and to challenges in distinguishing compare and contrast relationships between concepts. Our data also show that students employed the same rehearsal type of strategy--i.e., "reread textbook chapter and study the lecture notes," "memorize each concept of each theory" and "review terms, make flash cards, and read chapter"--predominately as the study strategy throughout the semester. Students did not vary their study strategies according to the different kinds of difficulties they perceived in the learning process.

This finding challenged our prediction that students' awareness of the different kinds of difficulties in learning the class content would influence their selection of study strategies. In particular, we assumed that students would select more sophisticated strategies such as elaboration, organization, summarization, self-questioning, and help seeking when they

perceived more challenging problems such as distinguishing differences and similarities between course concepts, and applying the difficult concepts in the discussion and analysis of classroom scenarios. Our finding rejected this assumption. Students' awareness of the various types of difficulties in the learning process did not prompt strategy shifting.

This result concurs with observations that students' selection of study strategies are not always optimal (Peverly et al., 2003), will likely not promote deep processing in a closed-book examination (Carrier, 2003), and tend to be relatively ineffective approaches to preparing for multiple-choice tests (Mackenzie, 1994). These observations indicate that after many years studying in school, college students are still not good at selecting appropriate study strategies (Garner, 1990; Justice & Dornan, 2001; Pressley et al., 1998; Wilhite, 1990) and self-regulating their learning process (Pressley, Borkowski, & Schneider, 1987; Peverly et al., 2003; Winne & Hadwin, 1998). Our results support the contention that "developmental changes in metacognitive awareness of study strategies appear to continue into adulthood" (Justice & Dornan, 2001, pp. 247-248; Schneider & Pressley, 1989).

Furthermore, our finding suggests that metacognitive awareness may not automatically translate into self-regulatory behaviors in learning. This finding raises a series of fundamental questions about the nature and function of metacognition in the process of learning: How are metacognitive knowledge and metacognitive skills related to each other in the learning process for students? What is the critical point or strength that is needed for metacognitive knowledge to break habitual ways of studying and to trigger regulatory behaviors that improve strategy use among students? How do regulation processes feedback to students' metacognitive awareness of their learning process? To what extent do motivational factors need to be considered in examining metacognitive process? How do the metacognitive factors and motivational factors converge to trigger self-regulatory behaviors in students' learning?

Current literature has started addressing the multiplicative relations between components of self-regulated learning. According to the self-regulation theory, self-regulated learners rely on systematic internal monitoring and feedback systems (Butler & Winne, 1995; Carver & Scheier, 2000; Schraw, 2001; Winne 1995). They are typically aware "of strategic relations between regulatory processes or responses and learning outcomes" (Zimmerman, 1990, p. 5). They intentionally regulate, monitor, and control their cognition, even though these functions may not occur at all times. A key feature across various models of self-regulated learning points to the importance of students' control of the learning process (Pintrich, 2000). However, the existing research and our findings suggest considerable effort is needed to clarify the relationship between components of self-regulated learning and, more importantly, to develop ways to promote self-regulated learning among students.

Our findings also bear practical implications to the classroom instruction. Previous research indicates that course characteristics and the degree of instructor support for metacognitive activity affect students' metacognitive monitoring (Curley et al., 1987; Justice & Dornan, 2001). In our course, we intentionally introduced the concept of metacognitive knowledge and skills, utilized weekly monitoring exercises to prompt students' reflection on their understanding and selection of study strategies, and provided feedback on students' test performances throughout the semester. However, our results did not show desirable results of these interventions. This unexpected result inspires us to further explore effective instructional strategies to promote metacognitive skills among students. Future research should examine alternative instructional strategies that provide more robust intervention to promote metacognitive skills among college students.

Our findings revealed no relationship between students' perceived difficulties, study strategies, and test performance. This result confirmed the previous finding that use of the study strategies does not relate to course performance (Justice & Dornan 2001). The lack of relationship between choice of study strategies and test performance indicates that classroom learning is a complex process, which involves other contextual and social-cognitive variables such as course characteristics and motivation (Wolters & Pintrich, 2001). Existing research shows that the use of learning and study strategies is related not only to the actual ability level of students, but also to their level of perceived ability (Ames & Archer, 1988; Pintrich & De

Groot, 1990; William & Clark, 2004). Future research should examine the relationship between cognitive variables such as strategy use and motivational variables such as self-efficacy of strategy use (Schunk & Zimmerman, 2003; Zimmerman, 1995, 1998). In addition, interventions aiming at developing students' self-regulatory abilities should consider it as a complex, long-term, and thoroughly social process (Justice & Dornan, 2001, Pressley, 1995; Schneider & Pressley, 1989).

An alternative explanation for our non-significant correlational findings, however, involves the relationship between strategy use and course assessment. Studies by Curley et al. (1987) and Weiss and Rohwer (1986) found that strategy use was affected by course characteristics and type of testing. The students may have perceived the rehearsal strategy as appropriate for the level of learning they intended to achieve and the type of assessment they had to deal with. In the current study, although multiple choice questions were used in both classes, the types of questions used would be expected to vary based on course and instructor. Thus, the lack of relationship between strategy use and performance might stem from a failure of the students to "match" their strategies to the course assessment. For example, the use of high-order cognitive strategies may not affect performance on primarily knowledge-based assessments.

SUMMARY

The present study provides some empirical evidence that research on student learning needs to continue addressing the observed discrepancy between students' theory of study strategy selection and use and their actual use of the study strategies. Our data show that college students use predominately less effective study strategies in learning. Their awareness of different kinds of difficulties encountered in learning the class content did not lead to adjustment of their study strategies. There is a lack of coordination between students' metacognitive awareness of the learning process and metacognitive regulatory behaviors. Our results show that metacognitive awareness does not automatically lead to regulatory behavior in student learning. This finding suggests a complex relationship between metacognitive awareness and metacognitive skills in the classroom learning context and calls for more research in this area.

The present study was conducted in an educational psychology course, in which the students were exposed to theories and research of learning. The students were expected to develop a sufficient understanding of the utility of effective study strategies and explore ways, through their own experience, to promote learning among their future students by applying various effective study strategies. Our results indicate that merely exposing students to a variety of study strategies and providing monitoring exercises are not enough to ensure students' application of the theories and the effective study strategies. More intensive intervention is needed for students to not only understand but also master the recommended strategies. The current study was limited by a relatively small sample and in one subject area. A larger scale study examining both the strategies used by the students and the demands and support for different strategies in various subject areas and at different course levels will be needed to address the effects of characteristics of classroom environment on strategy use and class performance.

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Biographical Notes

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APPENDIX A
Sample Weekly Monitoring Exercise Sheet

Research/Cognitive Development
Please indicate below your overall understanding of the content from today's class:

0% _____ 100%

What concept(s) from today's class did you find difficult to understand?

Specifically, what will you do to improve your understanding of the concept(s) you listed above?

1. Experimental research requires which one of the following?

A. Manipulating an aspect of the environment
B. Being able to predict two or more variables
C. Describing each variable in considerable detail
D. Studying behavior in an actual classroom environment

0% _____ 100%
Confident Confident

2. Mr. Johnson teaches a class of twenty 8-year-old third graders. His goal for the upcoming school year is to help at least 50% of his students reach formal operations. Judging from Piaget's theory, we would expect that Mr. Johnson's goal is:

A. An easy one to attain
B. Almost impossible to attain
C. Attainable only if he emphasizes abstract reasoning throughout the school year
D. Attainable only if his students have had enriched educational experiences most of their lives

0% _____ 100%
Confident Confident

3. From a Vygotskian perspective, scaffolding serves what purpose in instruction?

A. It gives an idea of what they need to do to get good grades
B. It keeps school tasks within their actual developmental level
C. It lets them learn by watching one another
D. It supports them as they perform difficult tasks

0% _____ 100%
Confident Confident

APPENDIX B

Category of Students' Perceived Difficulties in Learning the Class content

Code	Type of Problem	Example
1	Understanding specific concept	"I really need to look again negative reinforcement" "I still have problems holding on to the definition of efficacy."
2	Confidence/need to remember content	"I understand the material but am not sure if I can remember it later." "Concepts very clear, just hope can remember later"
3	No Problem	"nothing the concepts were well presented today and I enjoyed the video it was a well needed break from lecture." "I don't feel I full grasp all the concepts but I didn't have a problem w/ anything specific"
4	Applications	"applying positive/negative reinforcement v. punishment" "Finding the consequences & response from the operant conditional examples." "How to do cooperative learning and be successful"
5	Too much info/content	"the handout charting the different teaching styles had a lot of information on it." "I understand concepts its just so much material at one time, especially w/out the days notes in front of me"
6	Understanding relationship b/w concepts	"I get confused sometimes on different types of reinforcement and punishment." "the difference between entity and incremental theory of intelligence"
7	Paying attention	"I had a hard time focusing so I suppose all" "I had a hard time paying attention today. It seemed like so much information to take in that I couldn't focus on the lecture."

APPENDIX C
Code for Selected Study Strategy

Code	Strategy	Strategy	Example
1	Rehearsal	Rehearsal	"Read the text again and go over notes." "Print some slides I have not already printed-do vocabulary words and definitions."
2	Meaningful	Elaboration	"Study over them and make easy to remember examples." "Read more carefully in the textbook & relate material to my own experiences/knowledge."
		Organization	"read chapter, review notes, make a chart of information" "Read over notes and draw some diagrams. Use some memory tricks and apply to my background knowledge."
		Critical Thinking	"read over them more to distinguish the differences among them." "work problem solving" "read and understand why variable is better than fixed. Study the schedules of reinforcement."
3	Self-Regulatory	Metacognitive Self-Regulation	"I definitely need to learn my stages of thinking and reasoning. I need to define Piaget and Vygotsky/ likes vs. differences." "Read it more thoroughly and try to apply it to different situations (quiz myself)"
		Time & Study Environment	"Try to go over the 3 concepts more on my own time." "Preview before class"
		Effort Regulation	"I will go over home & study correlations & try to figure out problem #3 on focus group activity." "I will read the chapters involved with the lecture and make note cards covering main topics to organize the info."
4	Help Seeking	Peer Learning	"Read the book & discuss with peers." "I will go home and read over the material more and if need more help I will ask either another student or the professor."
		Help Seeking	"I will read more about it in the book & if I'm still confused I'll ask for help." "Reread the chapter, look at the specific, ask instructor if any questions after re read."