THE EFFECTIVENESS OF INTERVENTION PROGRAMS TO HELP COLLEGE STUDENTS ACQUIRE SELF-REGULATED LEARNING STRATEGIES: A META-ANALYSIS

by

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Abstract

THE EFFECTIVENESS OF INTERVENTION PROGRAMS TO HELP COLLEGE STUDENTS ACQUIRE SELF-REGULATED LEARNING STRATEGIES: A META-ANALYSIS

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A meta-analysis was conducted to determine the effectiveness of interventions designed to help college students acquire self-regulated learning strategies. Fifty-five primary studies were included in the analysis, and ninety-three effect sizes were calculated and grouped into three outcome categories: academic achievement, strategy use, and self-efficacy. Total sample size consisted of 6, 669 students. The overall weighted effect size (Hedge's *g*) for all studies was 0.335 (95% CI = 0.240, 0.431), a significant small to medium effect. Interventions were coded based on their theoretical bases: metacognitive, social-cognitive, motivational, or an integration of these. Interventions based on social-cognitive theory produced the largest effect sizes. Moderator analyses were conducted on several variables: content area, group work, type of assessment instrument, computer-mediated instruction, type of college/university, randomization of subjects, and intervention length. These analyses showed differential effect sizes for some variables, although moderators accounted for little of the between-studies variation. Educational implications and recommendations for future research are proposed.

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Chapter 1

INTRODUCTION

Historically, educational researchers have sought to increase the effectiveness of students' learning, and self-regulated learning (SRL) is a construct that has developed over the last several decades to address this issue (Winne, 2005). Self-regulation has been defined as "self-generated thoughts, feelings, and actions that are planned and cyclically adapted to the attainment of personal goals" (Zimmerman, 2000, p. 14). For example, students who ask questions, take notes, and consciously plan how to allocate time and resources are in control of their own learning. In contrast, those who daydream and ignore assignments do not demonstrate SRL. In more technical terms, SRL refers to metacognitive processes, motivational beliefs, and studying/ practicing behavior that can enhance students' achievement (Zimmerman, 1989; Boekaerts et al, 2000). A major reason for studying academic self-regulation is that measures of students' skills and abilities alone have not fully explained students' achievement levels (Zimmerman, 2001). The proposed research investigates the effectiveness of intervention programs designed to help college students become more self-regulated as learners.

This first chapter will initially concern the multifaceted nature of self-regulation research. Then the interactive relation between students' self-regulated learning skills and their motivation will be discussed. I will also briefly examine the role of students' self-efficacy beliefs in self-regulation and then will then consider the development of self-regulation to inform instructors regarding how to incorporate self-regulatory training into their lessons. The concluding sections of this chapter will summarize the findings of recent meta-analyses conducted on primary and secondary school level intervention studies to promote self-regulation, and the research questions that will be addressed in this dissertation study. These questions will focus upon issues which previous research findings have yet to resolve regarding the most effective ways to design and implement SRL interventions.

Multifaceted Focus of Self-Regulation Research

To explain individual differences in students' self-regulatory expertise, researchers have identified diverse metacognitive, motivational, and behavioral/contextual factors (Pintrich & Zusho, 2002). For example, researchers have found that highly self-regulated learners have greater metacognitive awareness of themselves and their tasks, and they are more motivated to initiate and exert effort than poorly self-regulated learners (Schunk, Pintrich, & Meece, 2008). Students' level of self-regulation can be developed by teaching self-regulatory strategies, such as study time and environmental planning and management. Strategies for controlling negative thoughts or affect and enhancing perceptions of personal efficacy can also enhance self-regulation (Bandura, 1997). Finally, self-regulation seeks to enhance behavioral dimensions of learning, such as studying, practicing, and learning in hypermedia environments.

Motivational Aspects of Self-Regulation

Personal control beliefs and emotions are viewed as primary sources of motivation to engage and persist in self-regulatory and achievement-related behaviors (Shell & Husman, 2008). These beliefs and emotions include beliefs about c*ontrol*, which refer to the extent to which persons believe they can control or influence their environment to attain desired outcomes (Schunk & Zimmerman, 2006; Skinner, 1996).

These beliefs also refer to personal competence, such as self-efficacy beliefs. Beliefs about control and competence are thought to interact with other motivational constructs, such as *goal orientations* (Pekrun, Elliot, & Maier, 2006). In addition to motivational beliefs, students' self-regulatory success depends on their *affect and emotions* through the use of various coping strategies that help them deal with negative affect, such as fear and anxiety (Boekaerts & Niemivirta, 2000).

Sources of motivation and affect can also be influenced by other self-regulatory processes. For example, Zimmerman and Martinez-Pons (1992) reported that self-regulated learners engage in *self-consequence* techniques; they reward their good performances and punish their failures. Students can attempt to increase their *extrinsic motivation* for a task by making certain positive activities (taking a nap, watching TV, talking with friends, etc.) contingent on completing an academic task (Wolters, 1998). Wolters (1998) found that college students intentionally try to evoke extrinsic goals, such as getting good grades to help them maintain their motivation. Students can also try to increase their *intrinsic motivation* for a task by trying to make it more interesting (e.g., "make it into a game") or to maintain a more *mastery- oriented* focus on learning. Finally, Wolters (1998) found that college students would try to increase the *task value* of an academic task by attempting to make it more relevant or useful to them or their careers, experiences, or lives. In all these cases, students are attempting to change or control their motivation in order to complete a task that might be boring or difficult.

There are additional strategies that students may use to try to control their emotions. *Self-talk* strategies to control negative affect and anxiety (e.g., "don't worry about grades now," "don't think about that last question," "move on to the next question") have been noted by anxiety researchers (Zeidner, 1998). Students may also invoke negative affects such as shame or guilt to motivate them to persist at a task (Wolters, 1998). *Defensive pessimism* is another motivational strategy that students can use to actually harness negative affect and anxiety about doing poorly in order to motivate them to increase their effort and perform better (Garcia and Pintrich, 1994). In contrast to defensive pessimism, *self-handicapping* involves the decrease of effort (little or no studying) or procrastination (only cramming for an exam, writing a paper at very end of deadline) in order to protect self-worth by attributing the likely poor outcome to low effort, not low ability (Midgley et al, 1996).

After students have completed a task, they often experience emotional reactions to the outcomes (e.g., happiness at success, sadness at failure) and reflect on the reasons for the outcome – that is, they make *attributions* for the outcome (Weiner, 1986). Following attribution theory, the types of *attributions* that students make for their success and failure can lead to the experience of more complicated emotions like pride, anger, shame, and guilt (Weiner, 1986). As students reflect on the reasons for their performance, both the quality of the attributions and the quality of the emotions experienced are important outcomes of the self-regulation process. Individuals can actively control the types of attributions they make in order to protect their self-worth and motivation for future tasks (Pintrich, 2000).

Metacognitive Aspects of Self-Regulation

Metacognitive processes also play a major role in students' attempts to control their own academic behavior. Models of intentions, intentional planning, and planned behavior (Gollwitzer, 1996) have linked the formation of *intentions* to subsequent behavior in a number of different domains. In the academic learning domain, time and effort planning and management are activities that play a major role. *Effort control* involves attempts to control effort to do well in a course. *Time management* involves the making of schedules for studying and allocating time for courses (Hofer et al, 1998). Zimmerman and Martinez-Pons (1986) have shown that self-regulating learners do engage in time management activities. As part of time management, students also may make decisions and form intentions about how they will allocate their effort and the intensity of their work.

Another metacognitive strategy that can be very helpful for learning is *help-seeking.* Good self-regulators know when, why, and from who to seek help (Newman, 1998). Help-seeking is a social strategy because it involves a learner's procurement of help from others in the environment (Ryan & Pintrich, 1997).

Contextual control processes seek to regulate the tasks and context that college students confront on campus. In comparison to regulation of cognition, motivation, and behavior, controls of the tasks or context may be more difficult because they are not always under direct control of the individual learner. Models of *volitional control* usually include a term labeled "environmental control" that refers to attempts to control or structure the environment in ways that facilitate goals and task completion (Corno, 1993). In terms of self-regulated learning, most models include strategies to shape or control or structure the learning environment as important strategies for self-regulation (Zimmerman, 1998).

In the traditional classroom, the instructor controls most of the aspects of the tasks and context. Usually there is little opportunity for students to engage in contextual control and regulation. However, in more student-centered classrooms, students are expected to control and regulate the academic tasks and classroom climate and structure personally. They are often asked to design their own projects and experiments, work together in collaborative or cooperative groups, design how their groups will collect data or perform the task, develop classroom norms for discourse and thinking, and even work together with the teacher to determine how they will be evaluated on the tasks. These types of classrooms obviously offer a great deal more autonomy and responsibility to the students, and they provide multiple opportunities for contextual regulation.

In postsecondary settings, students have much more freedom to structure their environment in terms of their learning. Much learning takes place outside the college lecture hall or classroom, and students have to be able to control and regulate their study environment. Monitoring of their study environment for distractions (music, TV, talkative friends or peers) and subsequent attempts to control or regulate their study environment to make it more conducive for studying (removing distractions, having an organized and specific place for studying) are means to facilitate learning through self-regulation (Zimmerman, 1998). In addition, the ability to work well with peers in study groups or cooperative learning groups can be important as more and more college courses require peer interaction and learning.

The situated nature of self-regulation is important (Winne, 1995). Boekaerts (!995, p.197) has stated that “only by studying students’ cognitions, feelings, and behavior in context, will person-environment transaction units that form the basis for self-regulated learning be allowed to surface.” Corno (1995) has noted that: “Perhaps, as with other situationally grounded psychological constructs, SRL comes about from the continuing interchange between students and the educating elements of their environments" (p. 205). Zimmerman (1995) has suggested that "like other forms of human functioning, SRL is affected profoundly by variations in social-contextual variables, such as task features" (p. 220). Schunk and Zimmerman (1997) developed a social cognitive model of the development of self-regulation to capture its social and contextual dimensions.

Thus, several years ago research began to shift away from solo conceptions of the self-regulated learner to socially situated conceptions of self-regulated learning (SRL) which emphasize transactions between the learner and the social context. For example, Zeidner, Boekaerts, and Pintrich (2000) assert that more recent thinking emphasizes the importance of taking contextual variables into consideration. They assert the need for more research focusing on sociocultural variables and to incorporate these variables into models of self-regulated learning.

Self-Efficacy and Self-Regulation

In conjunction with self-regulation is the concept of *self-efficacy*, which refers to the competence belief that one is capable of performing expected tasks (Bandura, 1997). In a study with seventh grade students, Pintrich and De Groot (1990) found a significant positive relationship between self-efficacy beliefs and self-regulation. They also noted a positive relation between self-regulation and students' *intrinsic motivation* for learning; that is, students engaged in a task for the sake of the task. Self-regulated learners who are also intrinsically motivated to do their academic work have high expectancy for success, task value, and feelings of competence.

Researchers have employed self-efficacy instruments in a wide range of academic settings and generally have found positive and strong effects on students' achievement and persistence with regard to specific, criterial tasks. Schunk (1991) has demonstrated that as students' self-efficacy perceptions strengthened, their academic performance improved. Pintrich and De Groot (1990) found that academic self-efficacy beliefs were positively related to intrinsic value and cognitive and self-regulatory strategy use. Zimmerman and Schunk (2003) observed that the "predictive power of self-efficacy beliefs on students' academic functioning has been extensively verified" (p. 446). A meta-analysis conducted by Multon, Brown, and Lent (1991) considered the findings of 36 academic self-efficacy studies. The meta-analysis found that students' self-efficacy beliefs are significantly and positively related to academic performance. House (2000) has found that self-efficacy beliefs were significantly related to grade performance and persistence in science, engineering, and mathematics.

Studies have found that *self-efficacy* (Schunk & Pajares, 2004), *outcome expectancies* (Wigfield & Eccles, 2002), *causal attributions* (Weiner, 2004), and *success expectancy* (Wigfield & Eccles, 2002) all influence effort, choice, strategy use, self-regulation, and achievement in academic domains (Pintrich, 2003).

Development of Self-Regulation

Another area of research has investigated the effects of interventions designed to improve students' self-regulatory skills and academic achievement. Commonly, students are taught processes such as the following: goal-setting, learning strategies, self-monitoring, note taking, task organization, and environmental structuring. Teaching of students to become more self-regulated requires a synthesis between research on how learning occurs from a student's perspective and how self-regulation instruction occurs from a teacher's perspective. Teachers need to instruct in a way that shifts responsibility for learning from themselves to their students.

Widespread agreement exists on the effectiveness of self-regulated learning on academic achievement (Paris & Paris, 2001) and on methods of self-motivation (Pintrich, 1999). There have been a substantial number of intervention studies to assist students in their acquisition of self-regulated learning strategies. These instructional programs differ in form depending on the various underlying models of self-regulated learning, and hence, it is important to analyze their effectiveness based on sources of difference and similarity with other instructional models (Zimmerman, 2001).

Even though there is a significant body of research on fostering self-regulated learning among students, there are still a number of unanswered questions. Weinstein (2000) has posited several questions requiring additional study. "What are the precursors of effective strategy use? How can we facilitate the development of these skills at differing ages? What can we do to help teachers incorporate learning-to-learn activities into their classroom teaching?" (Weinstein, 2000, p.744).

Meta-Analyses of Self-Regulated Learning

In order to determine which characteristics of training programs are the most effective, it is useful to compare the various types of interventions systematically. Meta-analyses are an appropriate methodology in this regard (Becker, 2001). Previous meta-analyses have reviewed training programs that were developed to foster effective learning in schools. Hattie, Biggs, and Purdie (1996) analyzed the impact of various training characteristics of interventions to foster skill development for students as young as kindergarten age through young adults. They compared 51 interventions published up to 1992 that aimed at improving students' learning by improving their use of study skills. Their analysis incorporated programs which focused on task-related skills as well as self-management skills (including motivational and affective components). The results showed that interventions were most effective when they were contextually-situated and when they fostered a high amount of student activity and metacognitive awareness.

More recent meta-analyses were conducted with studies published between 1992 and 2008 by Dignath and Buttner (2008). They conducted two meta-analyses separately; included were 49 studies conducted with primary school students and 35 studies conducted with secondary school students. The first meta-analysis showed that self-regulated learning can be taught effectively with children who were of primary school age. An important result of the first meta-analysis by Dignath and Buttner (2008) as well as the meta-analysis conducted by Hattie and colleagues (1996) was the greater effectiveness of researcher-directed interventions than interventions directed by teachers. In addition, in both meta-analyses, there were higher effect sizes for interventions among younger rather than older primary school students. Dignath and Buttner (2008, p. 7) reported their decision to do their second meta-analysis in order to take a closer look "at the particularities determining the effectiveness of interventions for the different age groups…and the differences in acquiring self-regulation strategies at different ages."

Additional research is needed regarding the issue of age differences in the acquisition and instruction of self-regulatory skills (Zeidner, Boekaerts & Pintrich, 2000). Pressley, Graham and Harris (2006) have proposed that interventions should be conducted at different age levels to allow for insight into developmental changes in the effectiveness of interventions. Meta-analyses can provide insight regarding these changes in the effectiveness of interventions by combining individual studies of interventions conducted at different age levels. Thus, a methodological comparison and review of intervention studies in the last 25 years with college students would be valuable in guiding subsequent research on self-regulated learning. It would extend the continuing question regarding age differences in acquisition of SRL. Future intervention studies should be based upon the most effective characteristics of interventions, including those most helpful to particular age levels.

Research Questions

The meta-analysis conducted in this study will fill this important void by investigating several research questions. First, are interventions to foster self-regulated learning effective at the college level? Second, what types of self-regulated learning interventions are most effective? Third, which specific training components, if any, make interventions most effective? The latter question addresses a number of sub-issues needing to be examined. Does the underlying theoretical model on which the intervention is based make a difference? Is one type of strategy (i.e., cognitive, metacognitive, motivational) more effectively learned, relative to the others? Does the academic content impact effectiveness of training? Are interventions more effective when conducted by researchers or instructors? Does the duration of the intervention make a difference? Does the instrument used to assess the intervention have an influence on effect sizes?

Chapter 2

LITERATURE REVIEW

This chapter will describe how self-regulated learning (SRL) has become a major focus of research in educational psychology and how the research has been translated into classroom practices. Research during the past several decades on students' learning and achievement has increasingly emphasized cognitive strategies, metacognition, motivation, task engagement, and social support. SRL has evolved as a construct which has encompassed these points of emphasis, and it has offered more cohesive views of the knowledge, skills, and motivation that learners attain. The value of SRL has been recognized by researchers who desire to intervene in schools in order to benefit students and teachers. Three examples of SRL in classrooms include: strategies for reading and writing, cognitive engagement in tasks, and self-assessment. SRL may be viewed as a set of skills which may be taught directly and/or as processes that students develop through experience. Regardless of the perspective, educators may provide information and opportunities to students at all levels that will enable them to become strategic, motivated, and more independent learners.

This chapter will summarize the contributions of research in SRL to classroom practices which facilitate instruction and learning. More specifically, this chapter will consider theories that have guided research on SRL. Then I will summarize research on learning strategies, metacognition, instructional issues, reading and writing, and literary strategies within SRL. Then, this chapter will survey research on cognitive engagement, the development of academic self-regulation, acquisitions of skills, and age differences in

SRL. Finally, I will draw conclusions from this research and will formulate research questions and hypotheses.

Theories of SRL

A variety of theoretical models have been proposed to identify and explain the many variables that make up this multifaceted construct. Among these models are Zimmerman's (1989, 2000) social cognitive view of academic self-regulation, Winne and Hadwin's (1998) Four Stage Model of Self-Regulated Learning, and Pintrich's (2000) general framework for self-regulated learning. Each of these models will be outlined briefly.

Based on Bandura's (1986) triadic model, a social cognitive perspective of SRL (e.g., Zimmerman, 1989) views self-regulation as the interaction of personal, behavioral, and environmental processes. This model suggests that learners can self-regulate covert personal (metacognitive and motivational), behavioral, and environmental processes. In an effort to explain the interdependence of specific forms of SRL, Zimmerman (1998, 2000) asserts that self-regulatory processes occur through three phases: forethought, performance or volitional control, and self-reflection processes. The forethought phase includes processes that precede learning, such as goal setting, strategic planning, and self-motivational beliefs. The performance phase includes processes that occur during learning, such as self-instruction strategies and self-monitoring. The self-reflection phase includes processes that follow learning, such as self-judgment and self-reaction. It is important to note that according to this social cognitive model of self-regulation, the social and physical environment is viewed as a resource for enhancing the forethought, performance and self-reflection phases of self-regulation. According to this triadic perspective, learners who neglect to use social and physical environmental resources will be less effective in their self-regulation.

Winne and Hadwin's (1998) model has four basic stages: task definition, goal setting and planning, enactment, and adaptation. During the first phase, the learner generates a perception about what the task is and the resources that are available. During the second phase, the learner generates goals and formulates a plan for addressing the task. In the third phase, the plan generated by the learner in stage 2 is executed through the use of the appropriate cognitive learning strategies. Finally, in stage 4, the learner makes changes to the cognitive structure that will affect future study, based on perceptions of his/her performance in stages 1 through 3.

Pintrich (2000) synthesizes elements from other models of SRL in an effort to develop a general framework. Pintrich asserts that while there are a variety of models of SRL, these somewhat diverse models share some assumptions. First, most models view the learner as an active, constructive participant in his/her learning. Second, most models assume that the learner can monitor and control aspects of their cognition, motivation and the environment. Third, most models assume the presence of an evaluation criterion or standard against which performance is judged. Fourth, in most models, self-regulatory activities serve as mediators between personal and contextual characteristics and academic performance.

Pintrich (2000) synthesizes the work of a variety of self-regulation theorists into a general organizing framework. This framework suggests that there are four phases of self-regulation. The first phase includes the learner's perceptions and knowledge of the task. The second phase involves metacognitive processes, such as planning. The third phase involves such processes as the selection and adaptation of cognitive strategies. The fourth phase involves reflections on both aspects of the self and the learning context.

Pintrich (2000) asserts that in traditional classroom contexts, the teacher controls most of the aspects of the task, and so the students have little opportunity to engage in contextual control. However, in student centered classrooms, students are asked to do much more in terms of the control and regulation of academic tasks.

Although there are a number of different conceptual approaches to SRL, it is important to note the practical applications of SRL to classrooms. Historical changes are evident in research on cognitive strategies and instruction that contributed to the attention given to SRL.

Learning Strategies

By and large, cognitive research in the 1970's examined separate aspects of thinking. Studies examined specific strategies, such as summarizing text and the diverse ways in which readers respond to text. In the 1980's, researchers conducted experimental investigations of variables influencing the effectiveness of strategies. In the 1990s, studies focused on classroom programs of strategy intervention. During these decades, the diversity of strategies increased. Weinstein and Mayer (1986) summarized the major categories of learning strategies, such as rehearsal strategies, elaboration strategies, organizational strategies, comprehension monitoring strategies, and affective strategies.

In the last 25 years or so, research on learning strategies has been conducted in classrooms, with researchers examining the strategies that students use as they read and write or as they solve mathematical and science problems. There has also been increased attention to the methods and materials that teachers use to help students learn how to use strategies.

Studies were conducted to examine the social support needed to promote students' usage of productive strategies. Teachers have utilized reciprocal teaching (Palincsar & Brown, 1984) and collaborative learning to promote peer coaching among learners. Learning strategies have been shown to be effective when used by teachers to model and promote students' learning in many academic disciplines.

A major component of academic self-regulation is that of SRL strategies, defined by Zimmerman (1989) as "actions and processes directed at acquiring information or skills that involve agency, purpose, and instrumentality perceptions by the learners" (p. 329). Zimmerman and Martinez-Pons (1986), using interviews with high school students, found evidence for 14 types of strategies, including: organizing and transforming information, self-consequating, seeking information, and rehearsing and using memory aids. Students' use of these strategies was highly correlated with their achievement and with teacher ratings of their self-regulation in a classroom setting. In fact, students' reports of their use of these self-regulated learning strategies predicted their achievement track in school with 93% accuracy, and 13 of the 14 strategies discriminated significantly between students from the upper achievement track and students from lower tracks.

The self-regulated learning strategies described by Zimmerman (1989) encompass three classes of strategies that students use to improve self-regulation: of their personal functioning, of their academic behavioral performance, and of their learning environment

(Zimmerman, 1989). Zimmerman (1989) explained that, for example, students use organizing and transforming strategies (i.e., rearrangement of instructional materials to enhance learning) and goal-setting and planning strategies (i.e., setting educational goals and subgoals and planning, timing, sequencing, and completing goals) to optimize their personal self-regulation. Furthermore, learners employ strategies of self-evaluating (i.e., evaluation of the quality or progress of their own work) and self-consequating (i.e., rewarding oneself for good work) to enhance their behavioral self-regulation. Additional strategies include seeking social assistance (e.g., seeking help from peers, teachers, and other adults), seeking information (e.g., doing research in the library), and keeping records (e.g., keeping a list of misspelled words) in order to optimize learning. In sum, researchers have found a strong relation between academic achievement and the use of self-regulated learning strategies by low and high-achieving students and students with learning disabilities (Pintrich et al, 1994). Models of SRL provide a useful description of what effective learners do in college courses to succeed academically (Butler, 1998).

Metacognition

Metacognition can be divided into two parts: knowledge of cognition and regulation of cognition. Students can regulate their cognition through goal setting, strategy use, and self-monitoring (Flavell, 1979). Although metacognition has not included motivational variables historically (Zimmerman, 1995), Pintrich (1994) included them. First, he hypothesized that metacognitive processes can provide active control over learning-related behaviors, such as when, how much, and with whom a student is learning. Second, he hypothesized that metacognitive processes can regulate motivation and affect. For example, students can learn how to control their emotions and even use them in goal setting. Third, he hypothesized that metacognitive processes can control various cognitive strategies for learning, such as rehearsal and memory strategies.

Use of metacognitive strategies may be linked to efficient ways to improve performance in academic and work environments. For example, young adults in college regulate their learning behavior with a variety of specific strategies (Pintrich, 1994). They manage their own time, decide with whom to study, and monitor their comprehension with a variety of internal (self-regulation, strategies) and external (peers, family, faculty) supports. Analyzing one's performance provides a great opportunity to improve on future tasks. Explicitly teaching students to analyze their test performance can help them to better assess the understanding of their own metacognitive awareness (Flavell, 1979). This means that when students become aware of what they do and do not know about specific content, they develop greater metacognitive awareness.

It is important that students learn how to gauge how well their perception of performance correlates with their effort. In the literature, this comparison is called *calibration* of performance. In general, there appears to be a positive relation between an accurate calibration of performance and achievement (Lin, Moore, and Zabrucky, 2001).

In addition, several studies have shown that metacognition is not a set of idiosyncratic behaviors but a finite set of common skills that are highly correlated with academic success (Pintrich, 1994). Reis, McGuire, and New (2000) described qualitative patterns focusing mainly on motivational aspects in support of the hypothesis that metacognition plays a major role in the success of students with learning disabilities. Several researchers on college students with disabilities suggest that metacognition is a strong predictor of academic success (Smitely, 2001).

Instructional Issues

The nature of instruction has changed dramatically in the last several decades, from primarily direct instruction to more reflective approaches. Early strategy training studies were conducted more frequently under laboratory conditions than in classroom settings. Ann Brown (1978) referred to the earlier studies as “blind training” and later studies as “informed” because the nature of instruction evolved to become more cognitive and reflective.

Research in the 1980’s evolved in several distinct ways. First, metacognition emerged as a construct, and training programs incorporated explanations concerning how strategies operate and why they are fruitful in addition to cookbook-like recipes on how to use them. Explicit instruction on declarative, procedural, and conditional knowledge (that underlies effective strategic learning) became an integral characteristic of strategy training in the 1980s (Paris, Wixson, & Palincsar, 1986; Pressley, Harris, & Marks, 1992). Second, the notions of emotion and motivation were considered along with the metacognitive notions of learning. Third, strategies were incorporated into distinct content areas, starting with reading in the 1970’s and then to math, science, and social studies as researchers realized that each area offered a distinct framework for organizing knowledge (Alexander, 1995). Fourth, research transitioned from the laboratory into schools due to the fact that researchers desired to test the notion that students could be trained to utilize productive strategies in their everyday classes.

It has been clear that strategy instruction should involve these factors. Students should be prodded to reflect on tasks and on the multiple solutions available to them.

Such prodding may include explanations, guided inquiry, scaffolding, reciprocal teaching, and collaborative learning. It is particularly important for learners to be reflective at several key points: during the beginning phase of learning, while endeavoring to solve a problem, and when instructing others in the strategy utilization (Paris, Lipson, & Wixson, 1983).

In addition to metacognitive instruction, students must be motivated to study, to maintain efforts toward goals when things become frustrating, to establish realistic yet challenging objectives, and to experience self-efficacy. In addition, they must possess the volitional control to persist (Corno, 1993) and emotional control to minimize nervousness about reaching their goals (Kuhl, 1984).

It is worth noting that the inclusion of these motivational, volitional, and emotional variables along with metacognition in accounts of learning helped to bring SRL into the spotlight. Researchers have come to the realization that instructing students in effective strategy utilization requires the incorporation of metacognition, motivation, domain-specific knowledge, and elements of classroom tasks. Thus, the focus of SRL has been expansive over the years.

There has also been a transition in the application of SRL to specific subject matter areas. Research has increasingly been conducted in schools. The following sections will highlight specific examples regarding SRL in schools and the types of research on which they are based.

Reading and Writing

Much of the research on strategies in the 1960's and 1970's examined memory development in children and then moved to reading and writing development. It became apparent that prior to reading, it is helpful for a child to preview text and to set a purpose for reading. Additional helpful activities included making inferences from the text source, titles, pictures, and skimming of information prior to reading (Paris, Wasik, & Turner, 1991). Writing is facilitated in similar fashion. Instruction in prewriting and prereading strategies has shown positive benefits for elementary school children (Pressley et al, 1988).

Research on strategy instruction in reading and writing has evolved in several ways. First, reading and writing task strategies were integrated into SRL and broadened to include other strategies. Increasingly, it was realized that the effective use of literary strategies is dependent upon cognizance of procedural, declarative, and conditional knowledge, as well as motivational factors and self-efficacy. Borkowski et al (1990) referred to the orchestration of these various factors as the “good strategy-user” model. One example of this type of research is a study in which Graham (1997) examined the role of executive control strategies in the revising process of sixth-grade students who struggled with writing. It was shown that providing students with help in handling their plans and decisions had a positive impact on their revising behavior and the quality of their work. In another study, Page-Voth and Graham (1999) examined the role of goal-setting strategies in improving the writing of seventh and eighth-grade students. Students received instruction in strategies that would facilitate goal attainment by assisting them in the coordination of processes that included the generation, assessment, and inclusion of target elements into their essays. It was found that those students who learned the goal-setting strategy composed more lengthy papers, incorporated a greater number of supporting arguments, and wrote higher quality essays than those in the control group.

Second, there was a growth in effective training programs to facilitate the use of literacy strategies by children. The role of teachers, instructional practice, and materials was increasingly recognized. Palincsar and Brown (1984), for example, instructed students at the junior high level to collaborate in pairs in order to practice using reading strategies (i.e., "reciprocal teaching"). In this approach, the teacher conducts extensive modeling of strategies for students, and eventually students take turns serving as teacher. Comprehension occurs through teacher-student and student-student dialogue. Paris, Cross, and Lipson (1984) utilized class discussions to enhance comprehension of strategies by third and fifth graders. Pressley et al (1994) utilized "transactional instruction" to promote student usage of reading strategies. This instructional approach used direct explanation and mental modeling to teach students the processes that compose capable reading. Englert et al. (1991) incorporated metacognitive strategy instruction into a writing program for fourth and fifth graders. Harris and Graham (1992) instructed students in several strategies to improve the organization, planning, and revision of their compositions. These included: problem identification, task focus, strategy application, self-assessment of performance, maintenance of self-control, self-reinforcement, and self-monitoring. Harris and Graham (1996) emphasized the need to include SRL elements in instruction because persistence with and transfer of strategy usage would decrease without these SRL components.

In summary, the aforementioned training programs highlight the effectiveness of several key components. First, there must be a repertoire of strategies for students to acquire. Second, students must learn how, why, and when to utilize specific strategies. Third, students must be cognizant of and experience the impact of using specific strategies, or else they will be less likely to continue applying them. Fourth, students may help each other to learn and apply appropriate strategies. Fifth, strategy instruction in literacy may lead to transfer in other content areas, and possibly to a more self-regulated approach to learning in a more pervasive sense. Sixth, adequate opportunities to practice these strategies must be provided in different subject areas throughout the school day.

Cognitive Engagement

Research during the 1990's focused upon the ways in which task demands and parameters of a situation affect the learning and motivation of students. This represented the bridge from "situated cognition" to "situated motivation" (Paris & Turner, 1994). Blumenfold (1992) noted that the "procedural complexity" and "social organization" of the task influence the usage of "deep-level" learning strategies.

Cognitive engagement approaches focus on the ways in which the features of academic tasks affect the degree of student learning. In situations where learners are "deeply engaged", they tend to welcome greater challenges and take more risks, and manifest increased effort to master the knowledge and skills (Newmann, Wehlage, & Lamborn, 1992). In such cases, students become more intrinsically interested and develop a sense of ownership of the task at hand (Marks, Doane, & Secada, 1996).

In light of these realizations and findings, teachers face the challenge of providing appropriate opportunities for students to develop into independent and strategic learners. Turner (1995) found that there exists great variability in the degree of independence that first grade teachers permit their students in the reading curriculum. Those who created more "open task" environments afforded students greater choice over what, where, and when they read. In the more open-ended structures, Turner (1995) found that pupils manifested greater “volitional control”, utilized a greater number of strategies, and demonstrated greater persistence. Such environments provide opportunities for pupils to make choices, establish challenging objectives, collaborate, construct meaning, and experience self-efficacy (Paris & Turner, 1994).

Cornell and Wellborn (1991) posited the importance of students’ needs for competence, autonomy, and relatedness. They stressed the importance of a good “fit” between the learner and the environment. Stipek et al (1995) compared four- to six-year-olds in child-centered classrooms with youngsters in teacher-centered classrooms and found that those in the former group demonstrated greater behaviors associated with SRL. Child-centered classrooms promoted greater peer interaction and gave pupils more choice over activities and materials. Conversely, teacher-centered classrooms focused on more activities chosen by teachers, and put more emphasis on performance goals and social comparisons.

Problem-based learning (PBL) is an example of a particular task-based approach that instructors may implement to promote SRL in students. In PBL, students conduct inquiries of authentic problems in real-world environments. Marx et al (1997) noted several necessary components of PBL. First, “projects” must be centered on issues which are meaningful to students and are feasible for them to address. Second, projects must be established, such that students are able to plan and conduct research that involves posing questions, designing experiments, collecting ideas and making inferences. Third, students must collaborate with peers, teachers, and community experts. Fourth, students must access technology.

If PBL is implemented properly, it facilitates SRL, since it necessitates self-directed learning (Marx et al, 1997). In addition to choice and control, students must utilize various strategies to plan, to generate and test hypotheses, to render solutions, and to monitor progress toward objectives. PBL fosters SRL since students are responsible to access relevant information, orchestrate appropriate behaviors and collaborate with others, and to monitor their progress toward goals. More generally, environments that facilitate intrinsic motivation, autonomy, and self-direction tend to foster SRL among students (Deci et al, 1991).

The Development of Academic Self-Regulation

Schunk and Zimmerman (1996) suggest that social as well as asocial activities contribute to self-regulation. Parents, teachers, and other significant adults form part of the social forces affecting children's development of self-regulation. Schunk (1998) found modeling to be important in the development of self-regulated practice skills for mathematics.

Zimmerman (1998) has noted that for students to develop self-regulation, learning tasks must include opportunities for them to practice these strategies on their own. He suggests "homework is invaluable because it provides students with the practice necessary to routinize a study skill" (p.11). Self-regulation skills are acquired through social sources, such as parents and teachers. Within the academic environment, self-regulated learners set academic goals and monitor and react to their perceived progress toward these goals (Schunk, 1996). Schunk argues, "students must regulate not only their actions but also their underlying achievement-related cognitions, beliefs, intentions and affects” (p.359). Academic self-regulation depends on students developing a confidence in their ability to perform well on learning tasks (Schunk and Ertmer, 2000).

The influence of self-regulation on academic success has been demonstrated repeatedly (Williams & Hellman, 1998). Self-regulating students tend to be more mentally active during instruction (Pintrich & Schrauben, 1992). Hattie, Biggs, and Purdie’s (1996) meta-analytic study revealed that learning outcomes improved as a result of learning skill instruction and that when multiple learning skills are targeted, learning outcomes are likely to improve. Lan (1998) found that students enrolled in a statistics course who employed certain self-monitoring behaviors tended to score higher on course examinations. Williams and Hellman (1998) found that self-regulation was significantly correlated with grade point average among first-generation community college students. Academic success in these and other studies is measured in a variety of ways, including grade point average, performance on course examinations and course completion.

Among the key self-regulatory processes expected to affect test preparation and performance are goal setting and planning, self-monitoring, self-evaluating, self-consequencing, environmental structuring, and help-seeking. Goal setting refers to what the student is trying to accomplish (Schunk, 1989). Two types of goals have been studied across different subject matters: process goals and product goals. *Process goals* are strategic methods that can help students master a task. *Product goals* are the desired outcomes of learning efforts. Researchers have shown that students who set strategic process goals and self-monitor their progress display higher skill acquisition than those who set product goals or do not self-monitor (Zimmerman & Cleary, 2000). Self-regulated learners also engage in *strategic planning*. They search and select appropriate strategies that they believe will enable them to accomplish their goals. Those strategies are domain-specific and in the case of testing may include: deeper processing of elaborative and organizational strategies (e.g., rewriting notes, selecting main ideas, and outlining the text to be learned); rehearsal strategies for basic memory tasks (e.g. using mnemonics to remember the key stages of a theory); and other test-taking strategies designed to reduce worrisome thoughts during testing situations. These strategies may be learned through social assistance from peers, family members, or teachers, or from information from nonsocial sources, such as books (Zimmerman, 2000). Research evidence indicates that the use of appropriate strategies is highly correlated with academic achievement in the classroom (Pintrich & DeGroot, 1990).

Self-regulated learners are also self-motivated. Zimmerman (2000) has proposed a number of sources of self-motivation. Two key sources are students' outcome expectations and self-efficacy beliefs. *Outcome expectations* refer to the results of learning efforts, such as praise from one's teachers or parents for a high grade on a test, whereas *self-efficacy* beliefs refer to one's capabilities to perform those learning efforts (Zimmerman, 2000). Empirical evidence has shown that self-efficacy perceptions are highly correlated with and predictive of learning outcomes (Pajares, 1996). Self-efficacy beliefs play a key role in students' selection and use of learning strategies and goals, self-monitoring, and self-evaluation. Specifically, in a reciprocal manner, learners' self-efficacy beliefs are strengthened when strategy use leads to goal accomplishment, thus encouraging continuous strategy use with other unfamiliar tasks (Zimmerman & Kitsantas, 1996). Highly self-efficacious individuals are more likely to get high grades, self-monitor accurately, self-evaluate their strategy outcomes, and persist in the face of difficulties than those who self-doubt their capabilities.

Effective learning is dependent upon self-awareness. The learner must question what she has accomplished successfully, what areas are in need of further work and/or adjustments, and which strategies have been productive or unproductive. Such evaluation facilitates planning and self-regulation of future endeavors (Zimmerman, 2000). Such evaluation also impacts student motivation. Formal teacher evaluations may lead to negative results for some learners, particularly in cases where pupils have a track record of less than satisfactory performance, the evaluations are public, or the pupils possess only extrinsic motivation. Conversely, positive results will accrue to other students, especially those with mastery goals (Eun, 2009).

Self-evaluation involves cognitive, motivational, and affective aspects. As pupils become better at monitoring and assessing their behaviors, they become more sophisticated and more accurate in their assessments (Paris & Cunningham, 1996). As pupils conduct self-assessments with pride, their perceptions of their abilities and efficacy levels increase (Zimmerman, 2000). Schunk and Ertmer (2000, p. 641) posited that "…providing students with a learning goal and progress feedback led to the highest self-efficacy, motivated strategy use, and achievement".

Self-monitoring is defined as the awareness students have of their comprehension and their task performance during or shortly after completing an academic task (Schraw, Kauffman, & Lehman, 2002). According to Zimmerman (1999), there are three forms of self-monitoring: monitoring associated with self-evaluation, strategy implementation, and efforts to adapt the strategy from outcomes. When desired outcomes are less than fully attained, students must see the need to modify or change their strategy repertoire. Self-monitoring is important because it provides students with a source of “internal” feedback regarding task performance (Winne, 1996). Further, without monitoring, it may be nearly impossible for students to control their cognitive systems. This may be one reason why self-monitoring has been identified as a critical factor in the development of self-regulation (Kauffman, 2004). Self-monitoring training can be effective in improving adaptive goal setting and learning. Several empirical studies have shown that students benefit from being taught self-monitoring skills (Malone & Mastropieri, 1992).

According to Coleman and Webber (2002), “self-monitoring is the process of having individuals record data regarding their own behavior for the purpose of changing its rate” (p. 103). By observing and recording their own behavior, students comprehend the material more thoroughly (Coleman & Webber, 2002). For example, Lan (1996) conducted a study on 72 graduate students in a distance learning program and found that students in the self-monitoring group performed better academically than those in the instructor monitoring and control groups. Coleman and Webber (2002) also pointed out that self-monitoring has consistently produced outcomes of improved academic performance and classroom behavior.

Monitoring activities can include tracking of attention while reading a text or learning from a lecture, self-testing through the use of questions about the material to check for understanding, and the use of test-taking strategies (e.g., predicting test score and adjusting time spent). These monitoring strategies alert the learner to breakdowns in attention or comprehension that can then be subjected to repair through the use of regulating strategies (Garcia & Pintrich, 1994).

There is evidence that asking students to make "confidence judgments" about their performance shortly after completing a task is one highly effective approach to encourage the use of existing self-monitoring skills (Kauffman, 2004). Confidence judgments invoke self-monitoring because they involve asking students to assess how certain they are that they have successfully accomplished a specified activity shortly after completing that activity.

This self-monitoring research suggests that active monitoring of one's progress is an important skill that students can use in a variety of academic settings. Further, students who self-monitor achieve at a higher level than do students who do not self-monitor (Azevedo, 2005). Finally, according to Schraw and colleagues (1998), self-monitoring may be a domain general skill that can be used more or less consistently across multiple academic domains.

One promising technique for fostering students' use of existing self-monitoring skills involves prompting students to engage in activities they are capable of but do not do independently. Typically, researchers interested in prompting will simply ask students to engage in a target activity (e.g., self-monitoring) and then see how students who were prompted respond as compared to those who are not prompted. Chi and colleagues (1989) found prompting to be an effective technique for encouraging students to use self-explanation strategies. Others have explored the influence of prompting on planning (Scadamalia & Brown, 1985), monitoring (Lin & Lehman, 1999), and evaluating performance (King, 1991). Generally, researchers have found that prompts, when used to help students gauge progress on their learning goals, can be a highly successful technique for knowledge integration and knowledge transfer (Kauffman et al, 2008). One of the chief purposes of *authentic assessment* is to foster in students more active monitoring and assessment of their own performance (Calfee, 1991). *Authentic assessment* is any type of assessment that requires students to demonstrate skills and competencies that realistically represent problems and situations likely to be encountered in daily life. Students are required to produce ideas, to integrate knowledge, and to complete tasks that have real-world applications. These aspects of learning are critical in encouraging students to become independent learners who maintain control over their own education.

Van Kraayenoord and Paris (!997) found that students who were able to discuss their performance with awareness of the psychological characteristics affecting the work quality were better able to identify reading strategies that would improve their comprehension, and overall learning. This finding suggests that the capability of evaluating one's own work is closely related to the ability to assess literacy strategies. These researchers also found that self-assessments of academic performance are related to feelings of success and enjoyment of reading and writing outside of the school environment.

Acquisition of Skills

Learners can acquire skills in a multitude of domains by endeavoring through four sequential levels (Zimmerman, 2000, 2002): observation, emulation, self-control, and self-regulation. The observation and emulation levels are enacted through social learning experiences that help learners to eventually reach competence at self-controlled and self-regulated levels (i.e., independent of outside support). An "observation" level of skill is attained when a learner watches a model demonstrate how a skill ought to be performed.

In addition to performing the skill, the model provides verbal descriptions and receives visible consequences, such as rewards. At the "emulation" level, the learner begins to enact some general characteristics of the skill. Developing learners receive social feedback to facilitate performance improvement and to maintain motivation.

At the level of "self-control", learners eventually attain "automaticity" in their performance from having practiced on their own. They compare their performance with criteria established from observing the model's behavioral skill set. Novices are motivated by feelings of satisfaction from the realization that they have begun to reach the skill levels displayed by the models they have observed.

At the level of "self-regulation", students are able to adapt their behavioral skills to changing internal and external conditions. They begin to shift the emphasis of their attention from process to product. They are now motivated by self-efficacy beliefs and intrinsic interest in the task.

Age Differences

It is important to consider developmental differences in the acquisition of SRL. To date, a body of research has developed addressing this issue. Some studies have indicated that independent strategy use improves as individuals get older (Waters & Andreassen, 1983). A literature review (Alexander, Carr, & Schwaneflugel, 1995) of studies conducted in the1970's and 1980's that examined developmental differences of metacognition in gifted children has contributed to our knowledge of this issue. These researchers used the following categories in examining the data: children's declarative metacognitive knowledge, their cognitive monitoring, and their regulation of strategy use.

Developmental changes in declarative knowledge were found between earlier and later elementary grades and between later elementary and earlier secondary school grades. With respect to *cognitive monitoring*, children begin to develop skills by age 4 or 5 (Cultice, Sommerville, & Wellman, 1983), but do not begin to actively utilize them until age 11 or 12 (Veenman & Spaans, 2005). Only a few studies examined cognitive monitoring, and they found that monitoring is even difficult for adults (Alexander et al, 1995). With regard to strategy use regulation, there were differences in the complexity of strategy usage from earlier to later elementary grades (Robinson & Kingsley, 1977). Alexander and colleagues (1995) also concluded that students appear to acquire math strategies during the early primary grades while text comprehension strategies are only used in later elementary school years.

More recently, additional research has examined younger students' self-regulation, finding that young children have the ability to and do engage in SRL (Perry, Phillips, & Dowler, 2004). There is empirical evidence for a developmental progression of children's effective strategy usage from kindergarten through elementary grades. The development of children's metacognition appears to proceed from about age 5 to age 16. Sophisticated strategy utilization progresses further during adolescence and early adulthood (Flavell & Miller, 1993).

Conclusion

The preceding sections represent a review of how research efforts have examined and fostered SRL. Direct strategy instruction, metacognitive discussions, and peer tutoring may all be effective in promoting an increase in students' productive usage of learning strategies. SRL seems more likely in classroom environments in which students are afforded opportunities to be challenged, to be self-reflective on their progress, and to assume responsibility for and to experience pride in their accomplishments. Teachers must be able to convey to students important information about strategies: what they are, how to use them, and when to apply them. They need to design open-ended instructional activities, provide support, and give feedback to student questions and concerns. Projects, portfolios, and authentic performance assessments motivate students to provide opportunities for SRL.

This meta-analysis will rigorously examine intervention studies with the aim of suggesting which types of training are most effective in promoting SRL in college students. Such information will provide more specific assistance to researchers, and to instructors who share in the belief of the value of SRL.

Questions and Hypotheses

Previous meta-analyses (Dignath & Buttner 2008; Hattie et al, 1996) have yielded both clear conclusions as well as questions needing further investigation. This dissertation attempts to test these conclusions for their validity at the college level and to address the unanswered questions. Dignath and Buttner (2008) conducted two meta-analyses, one for primary schools and one for secondary schools. My study extends those results from the primary and secondary school level to a collegiate level.

Several findings from these previous meta-analyses have direct bearing on the major research questions and hypotheses examined in this dissertation study. First, for both the primary and the secondary levels, effect sizes were higher when training was conducted by researchers. My study examines whether this differential impact holds true in the college level interventions.

A second important issue concerns the following question: Which type of strategy instruction has the greatest impact on student outcomes? Hattie and colleagues (1996) found that interventions in which students were taught cognitive strategies (e.g., mnemonic devices or graphic organizers) had the strongest effect on performance and a moderate effect on their affect. Programs that trained a combination of metacognitive, cognitive, and motivation strategies were more highly effective for affect than for performance. The Dignath studies also examined the impact of type of instructed strategy on student outcomes. In the primary school studies, they found higher effect sizes for academic performance outcomes if the intervention was based on social-cognitive theory and if it included instruction of metacognitive and motivation strategies. In the secondary school studies, effect sizes were higher if the intervention focused on motivation strategies than on cognitive strategies, and higher effect sizes for those promoting cognitive rather than metacognitive strategies. My study examines with specificity the relations between the training of different types of strategies and the various student outcomes outlined in our coding categories.

The Dignath (2008, p.30) analyses only included studies if they lasted for at least one week, “to distinguish between interventions and one-time experiments”. My study includes interventions of any length, and examines the impact of intervention length on dependent outcomes.

"Weighted averaged effect sizes did not differ significantly between primary and secondary levels when considering the overall measure for all dependent variables or for all academic performance measures together" (Dignath & Buttner, 2008, p. 30). There were some specific differences, however. Effect sizes for math were higher at the primary level, while reading/writing effect sizes were higher at the secondary level. Dignath and Buttner suggest that "older students, who have automated the process of reading and writing, still have free capacity for metacognitive processes, and can therefore benefit more from strategy training in this context" (p. 33). Zimmerman (1990) has likewise suggested that older students learn in a more strategic way. Butler (2002) has posited that metacognitive reflection improves effectiveness of intervention programs for older students.

Overall, the interventions included in these previous meta-analyses (Dignath & Buttner, 2008) indicate that interventions included in the study were effective in facilitating self-regulatory skills and usage in students at both levels. Mean effect sizes ranged from between .60 and .90, which is "very high for interventions in educational settings" (Dignath & Buttner, 2008, p. 37). Following a meta-synthesis conducted by Sipe and Curlette (1997) on 103 meta-analyses that investigated the effects of educational interventions, published from 1984 to 1993, an unweighted effect size of .38 was suggested as a benchmark of effectiveness. Given the above research background and findings, a number of specific hypotheses will be tested in this dissertation study.

1. The first hypothesis is that college level interventions designed to promote the acquisition of self-regulatory skills among college students will be effective.
2. The second hypothesis is that interventions conducted by researchers will produce larger effect sizes than those conducted by instructors. Research findings have been quite conclusive with respect to this variable thus far.
3. The third hypothesis is that interventions of greater length will produce larger effect sizes than those of shorter duration. This hypothesis is not suggesting that those of shorter duration will not have impact, but only that effect sizes will be relatively lower than those with training periods of longer duration.
4. The fourth hypothesis is that those interventions that include instruction in more than one strategy type (i.e., cognitive, metacognitive, motivation) will yield higher effect sizes than those focusing upon only one strategy type.

There are also a number of research questions which will be examined, although previous research results have been so mixed and inconclusive that specific outcomes will not be hypothesized. My study will examine relative effect sizes and possible differences stemming from the following: academic subject serving as the context for the training, the theoretical model used as a basis, and the instruments utilized to assess outcomes. The underlying model reflected in the above notions is that interventions will have significant impact upon important mediating variables (i.e., self-efficacy levels, strategy repertoire, motivation, metacognition), and that the changes in these variables will lead to enhanced academic performance outcomes.

The implications for educators are clear. Research is quite conclusive that effective usage of self-regulatory skills by students results in improved academic performance outcomes. What is less clear are the most effective ways in which to train students to acquire and consistently utilize self-regulation as an integral component of their learning approaches and processes. This meta-analysis contributes to the knowledge base informing researchers and instructors in the design and implementation of future intervention programs.

Chapter 3

METHODS

This chapter will convey the meta-analytic methodology for assessing the effects of training in self-regulated learning (SRL). First, I will describe the study sample in terms of the literature search and eligibility requirements. Next to be described are variables coded from the studies, such as outcome variables and potential moderating variables. Then, I will describe the coding of the instructional strategies and their theoretical origins. This will be followed with a discussion of context categories related to the intervention along with categories for coding types of assessment instruments. After comparing and combining the results, I will describe the calculation of the effect sizes. Next is a description of random effects models, heterogeneity, and how moderator effects will be analyzed. Finally, I will discuss the potential educational implications of this meta-analytic study of SRL.

Study Sample – Literature Search

To obtain the study sample, literature research was conducted using the following computerized databases: *Academic Search Premier, ERIC, MAS Ultra-School Edition, Professional Devel. Collection, Psyc. Articles, Psyc Books, Psyc Critiques, Psyc Info, Teacher Reference Center,* and *Dissertation Abstracts.* The search field was defined by use of the following terms as keywords: *self-regulated learning, study skills, learning strategies, self-regulatory strategies, self-regulatory skills, metacognition, self-*

motivation, study habits, self-monitoring, goal-setting, self-control, self-determination, self-management, and *college students.*

Study Sample – Eligibility Criteria

Studies were included in the analysis only if they adhered to several parameters.

1. Studies must be directed toward the training of self-regulated learning in colleges and universities. Such training may be embedded in existing course content, provided as a separate class such as study skills or supplemental instruction (academic support program offering free, regularly scheduled study sessions for difficult classes), or implemented in a college laboratory setting. Venues included classrooms, learning centers, or laboratory settings on campus.
2. Studies must aim toward fostering self-regulatory learning: "the impact of students' self-generated thoughts, feelings, and actions serving to strive for their own goals" (Dignath and Buttner, 2008, p. 3). They must include one or more components of self-regulation: cognitive, metacognitive, or motivation strategies. Interventions without such instruction (such as indirect approaches using cooperative learning only) were excluded. Training may be embedded into classroom instruction, may be provided as part of a separate class (e.g., at a learning center on campus), or may be provided by researchers in a laboratory setting.

3. Computer-mediated (CT) training environments were included if they adhered to the parameters outlined in this section. Lou et al. (2001) posit that learning in CT environments may involve different characteristics and contexts, and hence learning may be quite different when CT is present. These researchers also indicate that characteristics inherent in CT instruction might mediate the effects of self-regulated learning instruction. Sivin-Kachala and Bialo (1994) suggest that within CT instruction, training programs are too different with respect to underlying learning theories, instructional control, or other characteristics to be taken together as one mediating factor in the meta-analysis. To the best of my knowledge based on the literature search conducted, these hypotheses have not been examined through individual studies or meta-analytic review. This meta-analysis examines possible differences and similarities between CT instruction and non-CT instruction and their respective influences on student outcomes. The reality is that this kind of training increasingly takes place (Boekaerts & Corno, 2005), and to exclude such studies would render any conclusions less meaningful to educators involved in this type of instruction, which has become so prevalent in our institutions.
4. Studies included have conformed to specific study designs. Studies must have control group designs, and they must present sufficient descriptive data to calculate effect sizes. A study must adhere to fidelity of treatment for experimental and control groups. If there is any evidence of control group exposure to treatment simultaneous to experimental group

treatment, a study was excluded form the analysis. Effect sizes will be compared between studies utilizing just one training session and those with multiple training sessions.

5. Studies published from 1983 to 2008 have been included. This time span was selected because research in SRL was really beginning to occur at a more rapid pace and in a more defined manner in the early 1980's, and reviewing this time period represents a comprehensive examination of the studies conducted until the present time. Moderator analysis also becomes more meaningful with a relatively large number of studies to examine.

Variables Coded from the Studies

Table 1 provides a summary of all variables: independent, moderator, and outcome variables**.** Variables have been categorized as follows: general information, characteristics of the treatment, characteristics of the sample, type of outcome, quality of the assessment instrument, characteristics of the study design, and method of analysis and variables (including effect sizes if reported).

1. General information includes: names of the authors, publication year, and name of the journal.
2. Characteristics of the treatment include: the theoretical model upon which the study is based, the components of the training, the length of the training, and how the program was implemented.

3. Characteristics of the sample include: the sample size and distinguishing characteristics of the students (e.g., 2 or 4 year college, etc.), and academic subject (s).
4. Type of outcome includes: the specific dependent measure (e.g., academic achievement, strategy use, etc.) and the specific assessment instrument (e.g., achievement test, task, etc.). Academic achievements may be measured by course or examination grades, etc. Strategy use has been specified according to the specific strategy (s) assessed.
5. The nature of the assessment instrument has been categorized as follows: standardized, self-developed with empirical basis, or self-developed without empirical support. This categorization was contingent upon the specificity and quality of the evidence provided regarding the validity and reliability of the instruments.
6. The nature of the study design includes its defining characteristics, such as: control group design, pre- and post- measures, the length of instruction, and follow-up measures such as qualitative methodologies (e.g., interviews).

Table 1

Summary of All Variables Included in Meta-Analyses

Independent Variables	Moderator Variables	Outcome Variables
1. College-level training programs to promote student acquisition of self-regulatory skills	1.Intervention Components a. type of instructional strategy b. theoretical model as basis for study	1. Academic achievement 2. Strategy use/ application 3. Self-efficacy 4. Motivation
	2. Intervention Context-Related Factors a. academic subject b. mode of implementation c. duration d. group work integration e. sample characteristics	

Outcome Variables

The coding scheme utilizes guidelines posited by Lipsey and Wilson (2000) and Dignath and Buttner (2008), and contains the information presented in the preceding section above. Appendix A (Study-Level Coding Form) and Appendix B (Effect Size Level Coding Form) outline the categories used to code each primary study. As suggested by Lipsey and Wilson (2000), the types of assessment instruments used to evaluate interventions have been placed into three categories: knowledge related to the academic subject, the application of acquired skills and/or strategies, and questionnaire to assess self-efficacy.

Potential Moderating Variables

The variables that will be tested as potential moderating variables have been placed into three categories: components of the intervention, intervention context-related factors (e.g., who delivered the training), and study design related factors. Examples of intervention components are type of instructed strategy and theoretical background. Examples of training context-related factors are: academic subject, length of intervention (hours and number of training sessions), and integration of group work. An example of study design-related factors is the assessment instrument.

Type of Instructional Strategy

Boekaerts (1999) has suggested that training can focus on three different types of SRL strategies: cognitive strategies, metacognitive strategies, and motivation strategies.

1. Cognitive strategies are content-specific. For example, in reading there would be text comprehension strategies and in math there would be problem-solving strategies. Cognitive strategies may be categorized (Weinstein & Mayer, 1986) into the following categories: repetition strategies, elaboration strategies, organizational strategies, and

problem-solving strategies. Repetition strategies improve the chances that information will be transferred to long-term memory, although they are not sufficient for deep processing. Elaboration strategies help the learner incorporate new information. Organizational strategies help the learner to consolidate information in order to be processed and stored more efficiently. Problem solving strategies help the learner to break a problem into smaller bits for easier solution (Mayer & Wittrock, 1996). In addition, domain-specific competencies also play a role (Klieme et al, 2001).

2. Metacognitive strategies can help the learner control, monitor, and regulate cognitive activities (Papaleontiou-Louca, 2003). Metacognition refers to a level of thinking that involves active control over the process of thinking that is used in learning situations. Metacognitive skills include: planning the way to approach a learning task, monitoring comprehension, and evaluating the progress towards the completion of a learning task. Metacognition facilitates self-reflection and strategy usage. After the learning phase has occurred, the results are assessed against criteria of effectiveness (Brown et al, 1983).

3. Motivation strategies play a crucial role in that they influence the initiation and maintenance of learning behaviors. Their effects have been shown in numerous studies (Schmitz, 2001). How learners explain success or failure (i.e., attributions) significantly influences learning behaviors. Their attribution influences motivation, emotional control, and self-efficacy (Bandura, 1986). Students with high self-efficacy beliefs tend to more frequently use cognitive and metacognitive strategies (Pintrich, 1999).

According to Kuhl's action control theory (Kuhl, 1987), the discrepancy between motivation and performance may be due to the "state-orientation" of a learner, focusing her metacognitive activity on controlling cognition to facilitate analysis of some past, present, or future state. Action-oriented learners concentrate on cognitive activities, which assist the arousal of goal-directed action tendencies (Kuhl, 1987).

The learner should be encouraged to request feedback and to discuss her learning. Strategic learners look for feedback after completing a task so that they may make conclusions about how to improve their learning (Butler & Winne, 1995).

Theoretical Background

The theoretical background refers to the underlying model upon which the intervention is based. Models have been placed into three categories: those focusing primarily on metacognition (e.g., Flavell's), social-cognitive models (e.g., Zimmerman's), and motivational models (e.g., Kuhl's). If no single determination was appropriate, models were classified as integrations of two or three of the models and coded as such.

Intervention Context-Related Factors

Factors that are directly related to the intervention include: the academic subject, the mode of implementation, the length of the intervention, and whether group work was incorporated.

1. The academic subject was placed into the following subject-specific categories: study skills, math, business, engineering, psychology, foreign languages, sciences, information technology, education, English, history, and reading/writing.

2. Interventions have been conducted either by teachers or researchers and have been coded into one of the two categories.
3. The duration of the intervention has been recorded in two modes: the number of sessions and the amount of hours. Both have been included in the analyses as a continuous variable.
4. The inclusion of group work was coded as: 1 for integration or 0 for no integration. Since the focus of this meta-analysis is the instruction of SRL, no distinction has been made between differing types of group work (e.g., cooperative vs. collaborative).

Type of Assessment Instrument

The type of assessment instruments used to evaluate student outcomes has been coded. Coding was expressed according to the following categories: the measurement of academic achievement by means of knowledge tests or course grades; the application of cognitive or metacognitive strategies by problem-solving, think aloud, simulation tasks, questionnaires, or interviews; the measurement of self-efficacy through questionnaires or interviews. In addition, instruments have been coded into 2 categories: those which are standardized and those which are not standardized. Studies which utilize both types, when measuring multiple outcomes, have been coded as “both”.

Comparing and Combining Results – Calculating Effect Sizes

First, the findings of the primary studies have been transformed into a numerical scale to enable proper comparisons (Lipsey & Wilson, 2000). The research findings reported in the primary studies often involve different measures of dependent variables and yield results that are not comparable across studies even though they deal with the same construct. To combine such findings in a meta-analysis, it is necessary to use an effect size statistic that standardizes the values from the original measures in some manner that makes them comparable. Mean values, standard deviations, *F* values, and sample sizes have been derived from each study so as to be able to compute effect sizes for each outcome. Standardized effect size (Hedge's g) was calculated by dividing the difference between the treatment and control group means with the pooled standard deviation of the two groups, corrected for small sample sizes (Hedges, 1981).

The quantitative outcome variables have been divided into the categories outlined above. Effect size estimates have been calculated for each outcome variable of which the study reported sufficient information to allow computations.

Calculating a Mean Effect Size

In order to describe the distribution of the effect sizes, weighted averaged effect sizes for every outcome category have been calculated. Since effect sizes are based on different samples of differing sizes, every effect size was weighted to avoid situations in which smaller samples with greater sampling error contribute as much to the mean effect size as larger samples (Hedges & Olkin, 1985). A mean weighted effect size has been calculated based on the principle that the greater the sample size of the study, the greater weight that will be given to the effect size of the study (Lipsey & Wilson, 1996). The mean effect size was consequently computed by weighting each effect size by the inverse of its variance.

By calculating average effect sizes, the statistical independence of the data must be upheld. However, most of the studies included in this analysis have assessed the multiple components of self-regulated learning by means of multiple outcome variables, which has lead to several different effect sizes per study. To address this issue, effect sizes involving the same construct have been averaged (Rosenthal, 2001), and those involving different constructs have been assigned to different meta-analyses (Hunter & Schmidt, 1990). The effect size distribution was analyzed for each such construct using one effect size from each study for each construct (Lipsey & Wilson, 2001).

In the case of studies comparing more than one treatment group with a control group, the data from the different treatment groups will be collapsed to yield a combined mean and standard deviation. Then the effect size for the control group versus this merged group will be computed (Borenstein et al, 2009).

Random Effects Models

Since this meta-analysis is reviewing a number of studies conducted by researchers operating independently, it is unlikely that all the studies are functionally equivalent (Borenstein et al, 2009). Differences between the studies have been taken into account by applying a random effects model. This model allows a variance in both the estimated and the true effect between the individual studies. Unless only minimal between-study variation is found, studies show that random effects models outperform fixed effects models concerning the trueness of results due to substantial differences in standard error estimation (Brockwell & Gordon, 2001). Hence, fixed effects models risk producing high Type 1 error rates if effect sizes are heterogeneous (Higgins & Thompson, 2004).

Heterogeneity

Heterogeneity in effect sizes was anticipated in this meta-analysis. This refers to the variation in the *true* effect sizes. But such variation really consists of both "true" heterogeneity and random, or within-study, error. Thus there is a need to isolate the true "between studies variation" from the observed variation. The key question is: What proportion of the observed variance reflects real difference in effect size? (Borenstein et al, 2009).

I squared has been used to ascertain the proportion of the observed variance that is real. If *I squared* is close to zero, there is little or no need to explain anything. If *I squared* is large, there is a need to conduct a subgroup analysis or meta-regression to try to explain the reasons for the variance.

A clear and substantive presentation of heterogeneity requires a measure of the magnitude and a measure of uncertainty (Borenstein et al, 2009). Magnitude can be expressed by the degree of true variation on the scale of the effect measure (*tau squared*) or the degree of inconsistency (*I squared*), or both.

Analyzing Moderator Effects

Moderator effects have also been analyzed using a random effects model.

Differences among effect sizes might be related to different study characteristics. To analyze the impact of study characteristics on the variability of the effect size distributions, an analogy to analysis of variance (for categorical variables) and meta-analytic regressions (for continuous variables) has been computed, with the potential moderating study characteristics as an independent variable. The factors which might enhance the training effectiveness have been grouped into 3 clusters: training context-related features, treatment content-related factors, and those related to the study design.

Chapter 4 – Results

Descriptive Analyses of the Studies

The full texts of eighty-nine primary studies were examined for potential inclusion in this meta-analysis. Thirty-four studies were excluded for the following reasons: fourteen did not include a control group, seven did not provide sufficient statistics from which to calculate effect sizes, seven did not involve the direct training of strategies, and six did not utilize outcome variables selected for this meta-analysis. After excluding these studies which did not meet eligibility criteria, the literature search resulted in 55 studies in which an intervention group was compared against a control group. These intervention studies utilized a total sample consisting of 6,669 students. Ninety-three effect sizes were computed for the primary studies and grouped within the three outcome categories (i.e., academic achievement, strategy use, and self-efficacy). Forty-two effect sizes were related to academic achievement, 31 effect sizes were related to strategy use, and 20 effect sizes were concerned with self-efficacy.

Forty studies compared one treatment group with one control group. Eleven studies compared two treatment groups with a control group, and four studies compared three treatment groups with a control group.

Comprehensive Meta-Analysis Version 2 software (Borenstein, Hedges, Higgins, & Rothstein, 2005) was used to conduct all statistical analyses.

Frequencies of Intervention Characteristics

Table 2 provides a summary of the primary study characteristics and effect sizes. Forty-seven percent of the studies were based on a social-cognitive theoretical model (26 studies), twenty-seven percent of studies were based on an integrated model (15 studies), and twenty-six percent of studies were based on a metacognitive model (14 studies). Thirty-six interventions trained students in multiple strategies, sixteen programs trained metacognitive strategies exclusively, and three programs trained cognitive strategies exclusively. Fifty-three percent of the studies were conducted by researchers and forty-seven percent by instructors. The academic subjects within which the training was embedded are represented by the following numbers of studies: Study Skills (15), Psychology (7), Math (6), Science (5), Reading/Writing (4), Education (2), English (2), Information Technology (6), Accounting (1), Foreign Language (1), History (1), Business (1), Sociology (1), and Nursing (1). The number of training sessions per intervention ranged from one session to thirty-two sessions and from one hour to forty hours. Only 23 studies included clear and precise information regarding the length of intervention in numbers of sessions and 29 studies reported precisely the number of hours of training. Eleven percent of the studies incorporated group work and 89% did not do so. Thirty-five percent of the studies utilized computer mediated instruction (CT) and sixty-five percent did not integrate this process. Twenty-eight studies (51%) randomized subjects into experimental and control groups. Thirteen studies (24%) randomized intact classes into experimental and control groups. Eight studies (15%) used matching to form groups, and six studies (10%) did not use randomization or matching. Thirty percent of the studies utilized assessment instruments which were standardized, fifty percent used non-standardized assessment instruments, and twenty percent used both types of instruments (i.e., when measuring multiple outcomes). Forty-one studies (75%) were conducted at four year universities, 7 studies (12.5%) were conducted at 2 year institutions, and 7 studies (12.5%) did not specify the nature of the institution.

Table 2

Summary of Primary Study and Effect Size Characteristics

Variables	*n = 55 studies*
Theoretical Background	Metacognitive: 14 Social-cognitive: 26 Integrated: 15
Instruction of Cognitive Strategies	3
Instruction of Metacognitive Strategies	16
Instruction of Multiple Strategies	36
Delivery Mode	Instructors: 26 Researchers: 29
Content Area	Study Skills: 15 Psychology: 7 Math: 6 Information Technology: 6 Science: 5 Reading/Writing: 4 Others: 12
Assessment Instrument	Standardized: 20 Non-standardized: 16 Both: 19
Computer-mediated Instruction	Yes: 19 No: 36
Type of Institution	Four-year: 41 Two-year: 7 Unknown: 7
Randomization	of individuals: 28 of groups: 13 matching: 8 non-randomized/matched: 6

Hypotheses Tested and Major Research Questions

Hypothesis One

The first hypothesis is that college level interventions designed to promote the acquisition of self-regulatory skills among college students will be effective. In order to test this hypothesis, a total of 93 effect-size estimates were calculated. From these, the overall weighted average effect size was 0.335 (S.E. = 0.049; 95% CI = 0.240, 0.431). A well respected set of parameters from which to evaluate the magnitude of effect sizes was presented by Cohen (1977, 1988) in his book on statistical power. He suggested, based on his review of a wide spectrum of behavioral science research, the following measuring points for standardized mean difference effect sizes: Small (0.20), Medium (0.50), and Large (0.80). According to these numbers, the overall mean effect size for this meta-analysis should be viewed as between small and medium, confirming this hypothesis.

The averaged effect sizes for the different outcome categories were calculated and were as follows: academic achievement was 0.266 (S.E. = 0.058; 95% CI = 0.152, 0.379), self-efficacy was 0.373 (S.E. = 0.108; 95% CI = 0.161, 0.585), and strategy use was 0.280 (S.E. = 0.073; 95% CI = 0.136, 0.424). Students' self-efficacy levels appear to have been enhanced by these interventions to a greater extent than academic performance and strategy use.

Heterogeneity of effects was evaluated in several ways. The chi-square statistic was used to test the hypothesis that one hundred percent of the heterogeneity was due solely to sampling error (Rothstein & Richardson, 2008). In order to compute this statistic (Q), we compute the deviation of each effect size from the mean, square it, weight this by the inverse variance for that study, and sum these values over all studies to yield the weighted sum of squares (WSS), or Q. The Q value was significant (Q = 180.557, p < .001); this value indicates that the heterogeneity was higher than that which would be anticipated strictly from sampling error.

Next, the *I squared* statistic was used, where Q is the chi-square statistic and *df* is its degree of freedom (Rothstein & Richardson, 2008). *I squared* is computed as the ratio of excess dispersion to total dispersion. The *I squared* statistic suggested that 70% of the total variance is due to between-study variance, and not due to sampling error. *Tau squared* is an estimated value of between studies variation. To yield this estimate, we start with the difference (Q-*df*), which represents the dispersion in true effects on a standardized scale. "We divide by a quantity (C) which has the effect of putting the measure back into its original metric and also of making it an average, rather than a sum, of squared deviations" (Borenstein et al, 2008, p. 137). The value of *Tau squared* was calculated to be .082. *Tau* is an estimate of the standard deviation of the true effect sizes. The estimate of *Tau* is simply the square root of *Tau-squared*. The value of *Tau* was calculated to be .286. Since these statistics suggested that moderators are possibly impacting heterogeneity, moderator analyses were additionally conducted.

Hypothesis Two

The second hypothesis is that interventions conducted by researchers will produce larger effect sizes than those conducted by instructors. This hypothesis was not supported by the findings: mean effect size for those studies conducted by researchers was 0.366 (S.E. = 0.080; 95%CI = 0.201, 0.512) and it was 0.316 (S.E. = 0.059; 95%CI =

0.204, 0.437) when training programs were implemented by instructors. When compared to the overall values indicated above, the values for *Tau squared* (.127, .051) and for *Tau* (.356, .226) indicated that this moderator explained little of the between-studies variation. These results are not consistent with the results found in the meta-analyses conducted by Hattie et al (1996) and those conducted by Dignath and Buttner (2008).

Effects sizes differed somewhat depending on outcome categories. When the outcome was strategy usage, the mean effect size was 0.294 (S.E. = .086; 95%CI = 0.127, 0.462) when the intervention was conducted by researchers and 0.256 (S.E. = .160; 95%CI = -0.056, 0.569) when conducted by instructors. When the outcome was academic achievement, the mean effect size was 0.213 (S.E. = .122; 95%CI = -0.025, 0.452) when the program was implemented by researchers and 0.304 (S.E. = .063; 95%CI = 0.181, 0.428) when conducted by instructors. When the outcome was self-efficacy, the mean effect size was 0.518 (S.E. = .243; 95%CI = 0.051, 1.002) when conducted by researchers and 0.254 (S.E. = .081; 95%CI = 0.097, 0.415) when conducted by instructors. The only outcome that was higher when instructors conducted the training was academic achievement. Hattie and colleagues also reported a larger mean effect size only for the outcome of academic achievement (.055) for interventions conducted by instructors.

Hypothesis Three

A large proportion of the primary studies did not provide explicit information regarding the number of sessions (42% of studies) and/or the length of sessions (53% of studies). Therefore, although this moderator was evaluated, it could not be analyzed with a proper degree of precision. Mean effect sizes were calculated after the number and length of sessions were categorized into the ranges presented in Table 3 and Table 4. From an examination of the data from both tables, it seems apparent that those training programs of shorter duration actually yielded larger effect sizes.

I examined the effect size for strategy use outcomes specifically regarding intervention length, and the results are presented in Tables 5 and 6 below. Studies of longer duration do appear to produce larger effect sizes for this outcome only.

Since duration may also be viewed as a continuous moderator, meta-regressions were conducted to assess this as a potential predictor in the meta-analytic model. The first analysis utilized duration measured in number of sessions, and the value of *Q* was found to be insignificant (*Q* = 28.46; p = .29). The second analysis utilized duration measured in number of hours, and the value of *Q* was also found to be insignificant (*Q* = 35.48; p = .23). Based on these results, this third hypothesis was not confirmed.

Table 3

Mean Effects Sizes for Duration of Interventions in Hours

Number of Studies	Number of Hours	Mean Effect Sizes
13	1 to 4	0.410 (S.E. = .13; CI = .14, .68)
6	5 to 13	0.548 (S.E. = .19; CI = .16, .94)
7	14 and above	0.374 (S.E. = .13; CI = .13, .63)
29	not reported	0.270 (S.E. = .05; CI = .18, .38)

Table 4

Mean Effect Sizes for Duration of Interventions in Sessions

Number of Studies	Number of Sessions	Mean Effect Sizes
15	1 to 4	0.424 (S.E. = .12; CI = .18, .67)
11	5 to 10	0.431 (S.E. = .09; CI = .25, .62)
6	11 and above	0.211 (S.E. = .09; CI = .04, .39)
23	not reported	0.283 (S.E. = .07; CI = .15, .42)

Table 5

Mean Effect Sizes for Strategy Use for Duration of Interventions in Sessions

Number of Studies	Number of Sessions	Mean Effect Sizes
8	5 and above	0.55 (S.E. = .09; CI = .36, .73)
9	1 to 4	0.28 (S.E. = .13; CI = .03, .53)
10	not reported	0.09 (S.E. = .11; CI = -.12, .30)

Table 6

Mean Effect Sizes for Strategy Use for Duration of Interventions in Hours

Number of Studies	Number of Hours	Mean Effect Sizes
7	5 and above	0.59 (S.E. = .11; CI = .38, .79)
8	1 to 4	0.23 (S.E. = .13; CI = -.02, .47)
12	not reported	0.16 (S.E. = .10; CI = -.05, .36)

Hypothesis Four

The fourth hypothesis is that those interventions that include instruction in more than one strategy type (i.e., cognitive, metacognitive, motivation) will yield higher effect sizes than those focusing upon only one strategy type.

Only three studies trained exclusively in cognitive strategy usage. The mean effect size for those studies was 0.656 (S.E. = .419; 95%CI = -0.165, 1.478). Sixteen studies trained exclusively in metacognitive strategies, and the mean effect size was 0.287 (S.E. = .080; 95%CI = 0.141, 0.452). No studies trained exclusively in motivation strategies. When strategies from two or three categories were focused upon (36 studies), the mean effect size was 0.329 (S.E. = .060; 95% CI = 0.210, 0.447). Since so few studies trained exclusively in cognitive strategies, it was only feasible to compare metacognitive strategy instruction with multiple strategy instruction. In the case of this comparison, the results do not support the hypothesis. *Tau-squared* and *Tau* were not reduced at all in this analysis, indicating that this variable did not explain any of the heterogeneity. In addition, it should be noted that 65% of the studies conducted multiple strategy instruction, perhaps reflecting a realization by researchers of the importance of this type of comprehensive training.

In sum, hypothesis one was confirmed by the results of these analyses; hypotheses two, three, and four were not supported by the data. It should be noted that power to detect moderator effects was low, since the sample size within groups was smaller than the total sample size (Borenstein et al, 2007). Low power may have contributed to the lack of support for these hypotheses. Each of these four hypotheses will be discussed in greater detail in Chapter 5.

Relationships between Moderators and Effect Sizes

In addition to the hypotheses proposed prior to this analysis, there were a number of research questions that were identified as having significant importance to the status of research in this area of college level interventions. The first part of this analysis will be confirmatory in nature, in that variables will be examined which have received attention by researchers conducting the prior meta-analyses (Hattie et al, 1996; Dignath & Buttner, 2008). The second section will be more exploratory in nature, looking at variables not receiving the same level of attention by previous researchers.

Confirmatory Moderator Analysis

Theoretical Basis

The theoretical basis of the study was social-cognitive in 26 of the studies, and the overall mean effect size was 0.421 (S.E. = .07; 95%CI = 0.295, 0.548). The basis was metacognitive in 14 studies, and the mean effect size was 0.302 (S.E. = .119; 95%CI = 0.077, 0.545). No studies were based purely on motivational theory, although in a few studies this theoretical basis was incorporated along with one or both of the other theoretical bases. When there was an integration of two or three of these theoretical backgrounds (15 studies), the mean effect size was 0.216 (S.E. = .081; 95%CI = 0.057, 0.376). *Tau-squared* values (.058, .150, .058) and *Tau* values (.241, .387, .241), however, indicated that this variable explained little of the between studies variation.

Two conclusions may be drawn from these results. First, it appears that many researchers have identified social cognitive theory has having the most to offer in terms of the development of these types of training programs. Second, those studies based on this theoretical foundation appear to yield the largest effect sizes, although the difference in effect sizes is small. These results will be discussed further in Chapter 5.

Content Area

Table 7 summarizes the mean effect sizes found when the interventions were conducted within different content areas.

Table 7

Summary of Effect Sizes related to Respective Content Areas

Number of Studies	Content Area	Mean Effect Size
1	Business	0.572 (S.E. =.21; CI = -.79, -.05)
2	Education	-0.124 (S.E. = .22; CI = -.56, .31)
2	English	0.586 (S.E. = .16; CI = .28, .89)
1	Foreign Languages	0.160 (S.E. = .15; CI = -.14, .46)
1	History	-0.237 (S.E. = .34; CI = -.90, .43)
6	Information Technology	0.212 (S.E. = .15; CI = -.09, .51)
6	Math	0.265 (S.E. = .12; CI = .03, .50)
7	Psychology	0.480 (S.E. = .16; CI = .17, .79)
4	Reading/Writing	0.463 (S.E. = .21; CI = .05, .84)
5	Science	0.306 (S.E. = .15; CI = .02, .59)
15	Study Skills	0.398 (S.E. = .07; CI = .27, .53)

An interesting point to note is that two of the 3 studies with negative effect sizes (Education and History) used computer software training alone, with no human training component. Training in the third study was conducted by a student, not a researcher or instructor.

For purposes of analysis, individual academic subjects were distributed into three categories. Table 8 summarizes mean effect sizes for these respective categories of academic content.

Table 8

Summary of Effect Sizes related to Academic Content Categories

Number of Studies	Content Categories	Mean Effect Size
23	English/Study Skills/Reading/Writing	0.42 (S.E. = .04)
11	History/Psychology/Sociology/Education	0.23 (S.E. = .14)
22	All Other Content Areas	0.23 (S.E. = .08)

When compared to the overall values, the values of *Tau-squared* (.058, .150, .058) and *Tau* (.241, .387, .241) were not reduced enough by this moderator to account for much of the heterogeneity

Group Work Integration

Only four studies integrated group work, so it was not feasible to conduct an analysis on this moderator variable.

Exploratory Moderator Analysis

CT Instruction

When CT instruction was an instructional design component (35% of studies), the mean effect size was 0.239 (S.E. = .089; 95%CI = 0.065, 0.413). For those studies (65% of studies) not including this component the mean effect size was 0.384 (S.E. = .056; 95%CI = 0.275, 0.495). The values of *Tau-squared* (.066, .100) and *Tau* (.256, .316), however, indicated that this variable explained little of the between-studies variation.

Assessment Instrument

Twenty studies utilized an assessment instrument which was standardized, while 16 studies used a non-standardized instrument (e.g., course grades, instructor-developed tests, etc.). Nineteen studies which assessed multiple outcomes utilized both standardized and non-standardized instruments. Examples of standardized instruments utilized in the primary studies are: the Learning and Study Strategies Inventory (LASSI), the Motivated Strategies for Learning Questionnaire (MSLQ), the Degree of Reading Power (DRP) test, and the Fennama-Sherman Mathematics Attitudes Scale. The mean effect sizes associated with each are as follows: standardized was equal to 0.295 (S.E. = .098; 95%CI = 0.110, 0.494), non-standardized was equal to 0.507 (S.E. = .075; 95%CI = 0.360, 0.654), and for those including both it was equal to 0.235 (S.E. = .075; 95%CI = 0.088, 0.381). The values of *Tau-squared* (.071, .044, .126) and *Tau* (.267, .209, .356), however, indicated that instrument type explained little of the between-studies variation.

The nature of the assessment instrument was further analyzed according to the outcome category being measured. Table 9 summarizes mean effect sizes for each outcome category for each type of assessment instrument.

Table 9

Summary of Effect Sizes for Outcome Category by Assessment Instrument

Outcome Category	Assessment Instrument Type	Mean Effect Size
Strategy Use	Standardized	0.320 (S.E. = .203)
	Non-standardized	0.535 (S.E. = .131)
	Both instrument types	0.200 (S.E. = .098)
Academic Achievement	Standardized	0.167 (S.E. = .087)
	Non-standardized	0.494 (S.E. = .089)
	Both instrument types	0.135 (S.E. = .093)
Self-efficacy	Standardized	0.453 (S.E. = .254)
	Non-standardized	0.209 (S.E. = .214)
	Both instrument types	0.325 (S.E. = .093)

For the outcome categories of strategy use and academic achievement, those studies employing non-standardized assessment instruments found higher effect sizes. When self-efficacy was being measured, effect sizes were higher when the instrument was standardized.

Type of College/University

Forty-one studies conducted research at four year institutions, seven studies were conducted at two year institutions, and seven studies were implemented at institutions which were not clearly specified by the researchers. The mean effect size at four year institutions was 0.315 (S.E. = .052; 95%CI = 0.217, 0.420), the effect size at 2 year colleges was 0.148 (S.E. = .144; 95%CI = -0.135, 0.431), and it was 0.611 (S.E. = .116; 95%CI = 0.385, 0.838) at those institutions of unknown nature. The values of *Tau-squared* (.103, .061, .050) and of *Tau* (.320, .248, .224), however, indicated that this moderator explained little of the between-studies variation.

Randomization of Subjects

Twenty-eight studies randomly assigned students into experimental and control groups. The mean effect size for those studies was 0.366 (S.E. = .083; 95%CI = 0.204, 0.529). Thirteen studies used groups (generally intact classes) as the unit of randomization, and the mean effect size for those studies was 0.227 (S.E. = .100; 95%CI = 0.030, 0.424). Eight studies used some form of matching of subjects, and the mean effect size for those studies was 0.317 (S.E. = .075; 95%CI = 0.170, 0.464). Lastly, six studies used intact classes without any random assignment, and the mean effect size for those studies was 0.429 (S.E. = .095; 95%CI = 0.241, 0.612). Scher and colleagues (2006) found that nonrandomized studies produced higher effect sizes than randomized studies, which suggests that the former may be upwardly biased.

Publication Bias

An analysis was performed to determine if effect size differed significantly in published studies as compared to unpublished dissertation studies. There were forty-two unpublished dissertation studies yielding a mean effect size of 0.218 (CI = 0.123, 0.313). The mean effect size for the thirteen published studies was 0.680 (CI = 0.535, 0.824). These results are in line with the expectation that the effects reported in published studies are generally larger than those reported in unpublished studies (Lipsey & Wilson, 2001).

Outlier/Sensitivity Analysis

I performed outlier analyses by reviewing forest plots (Appendixes D and E) of the effect sizes and confidence intervals at both the study level and for the additional moderator analyses. Nine of the primary studies were selected as possible outliers because of their extremely large effect sizes and due to the fact that their confidence intervals did not overlap the intervals for the other studies.

I then performed a sensitivity analysis. If these nine studies were excluded in the calculations, the overall mean effect size would decrease slightly from 0.335 to 0.304.

The two most extreme outliers were examined to determine if there were any study design characteristics which might account for such disparate impact. The study with the largest effect size and confidence interval in the positive direction was very focused in terms of both type of training and the outcomes assessed. The students were helped to acquire writing revision skill through the influences of modeling and social feedback, with close personal attention provided. The study with the lowest effect size involved no training by researchers, instructors, or peer models. An existing accounting software program was modified to include learning strategies and prompts to increase learners' metacognitive skills. In fact, all three of the studies with the lowest effect sizes were computer-mediated, with no inclusion of training by researchers, instructors, or peers. It should be noted that in 35% of the studies this approach was incorporated, with a much lower mean effect size (0.24) when compared to those studies not using this approach (0.38). This higher effect size of 0.38 is much closer to the mean effect size of 0.45 reported in the analysis by Hattie and colleagues. This variable may have been one of the factors lowering the overall mean effect size for all studies to 0.335.

Chapter 5 – Summary, Conclusions, and Recommendations

Hypotheses

Hypothesis One

The first hypothesis is that college level interventions designed to promote the acquisition of self-regulatory skills among college students will be effective. The overall weighted average was found to be 0.335, which falls between the small to medium range of effect sizes (i.e., small = 0.20, medium = 0.50) according to Cohen (1977, 1988).

A mean of 0.335 may also be compared against effect sizes found in other meta-analyses in education. Hattie (1987, 1992) outlined a measurement procedure for ascertaining the typical effect of most interventions in education. Based on a synthesis of 304 meta-analyses, based on more than 40,567 studies, he found that an effect size of 0.40 was the typical effect size in educational interventions. A meta-analysis conducted by Sipe and Curlette (1997) on 103 meta-analyses investigated the effects of educational interventions from 1984 to 1993. They suggested an unweighted effect size of 0.38 as a benchmark of effectiveness.

Hattie and colleagues' (1996) own meta-analysis of self-regulatory interventions examined 270 effect sizes from 51 studies and found an average effect size of 0.45 for those interventions. The meta-analysis by Dignath and colleagues (2008) found a mean effect size of 0.69.

By any one of these comparative measures, the mean effect size of 0.335 found in this dissertation study is lower than anticipated. This result appears to confirm the findings of the previous meta-analyses conducted by Hattie and colleagues (1996), who found higher effect sizes for primary and lower secondary school students than for older levels or university students. They also found higher effect sizes for interventions among younger rather than older primary school students. Dignath and Buttner (2008) found virtually comparable effect sizes for primary schools (0.68) and secondary schools (0.71).

We need to consider possible reasons for these lower effect sizes among the college student population. Hattie and colleagues (1996) have suggested that this might be the result of a "ceiling effect". Theoretically, college students have already developed more efficient learning approaches than those of younger ages, and so it becomes more difficult to raise their skill and performance levels. "Why should high-performing students see the need to change their study skills, attributions, or other factors moderating their performance?"(Hattie et al, 1996, p. 127). But this notion is based on the assumption that college students have mean scores toward the upper boundary of the scale, but the means of the actual distribution do not reveal this. Another possible factor is simply chronological age. It may be that for most individuals, willingness to change decreases with age and experience. The possibility also exists, of course, that the training programs themselves were deficient in one or more components essential to effectiveness.

Hypothesis Two

There was no significant difference in mean effect sizes for interventions conducted by researchers when compared to teachers. This result is inconsistent with the findings of both previous meta-analyses (Hattie et al, 1996; Dignath & Buttner, 2008), in which researcher delivered programs yielded higher effect sizes across all outcomes.

The central finding in these previous analyses is troubling. Both research teams noted that the level of implementation by school teachers in primary and secondary schools continues to lag behind that of researchers. It is critically important that relevant research results be implemented by teachers (De Corte, 2000). Researchers and educators must work diligently to close this persisting gap.

According to Waeytens et al. (2002), teachers lack knowledge about the concept of self-regulated learning. Observation studies have shown that teachers spend only a minimal amount of time on strategy teaching (Hamman et al, 2000). They often lack knowledge and skills regarding what strategies to use and when and how to use these strategies (Putnam & Borko, 2000; Randi & Corno, 2000). When implementing a training program to foster self-regulated learning by regular classroom instructors, it seems that extensive teacher training would be a necessary requisite.

In addition, studies show that teachers' beliefs do not easily change (Spillane et al, 2002). Yerrick et al (1997) describe how teachers assimilate new notions into their existing belief systems and use new language to describe their teaching without changing their daily teaching practices.

The finding that the mean effect size for those interventions conducted by college instructors in this meta-analysis is not significantly lower than for those conducted by researchers is a positive indicator. Perhaps the training provided to instructors in these studies was truly effective in facilitating successful program implementation. Unfortunately, in most of the primary studies, not enough information was provided to the reader in order to determine the nature of this component of teacher training. It is critically important for future researchers to examine this study design characteristic.

Hypothesis Three

The third hypothesis is that interventions of greater length will produce larger effect sizes than those of shorter duration. Tables 3 and 4 in Chapter 4 summarize the effect sizes associated with training programs of differing lengths. The trend that may be gleaned from that data suggests that the interventions of shorter duration, as measured by both number of sessions and hours of training, produced larger effect sizes than those of longer duration. Therefore, this hypothesis was not confirmed by the results.

The results of the meta-analysis by Hattie and colleagues (1996) indicated mixed results. For programs of one to two day duration, the mean effect size was 0.58. For those of three to four days, the effect size was 0.28, and for those lasting 4 to 30 days, the effect size was 0.76. The researchers did not provide data of session lengths in hours, however, so their results are limited in scope and precision.

Dignath and Buttner (2008) found that the longer interventions (as measured in numbers of sessions) produced higher effect sizes for both elementary and secondary schools. They theorize that students' strategy use becomes more automated and sophisticated over time, and that providing students with opportunities to practice strategy use will foster transfer to real learning contexts. In other words, learners need time to adopt strategies into their learning behaviors.

I examined the effect sizes for strategy use outcomes based upon intervention length in my study. The results are listed in Table 5 and Table 6 in the previous chapter. Interestingly, studies of longer duration produced larger effect sizes, a finding which is consistent with Dignath and Buttner's ideas about longer practice having greater impact upon students' strategy use. However, due to the number of primary studies not providing information on duration, it is not possible to adequately test the statistical significance of these results.

Hypothesis Four

The fourth hypothesis is that those interventions that include instruction in more than one strategy type (i.e., cognitive, metacognitive, motivation) will yield higher effect sizes than those focusing upon only one strategy type. As indicated in the previous chapter, the data did not support this hypothesis.

Confirmatory Moderator Analysis

Theoretical Background

Forty-seven percent of the primary studies were based on a social-cognitive theoretical background. This may be indicative of a trend among researchers, recognizing the ability of this theoretical basis to comprehensively examine and explain student learning behavior at all age levels. As indicated in the previous chapter, the effect size of 0.421 for interventions based on this model was larger than the effect sizes for metacognitive or integrated models, but moderator analysis indicated that this moderator did not account for much of the between-studies variation.

Content Area

Fifteen studies (27%) were embedded in the area of study skills. The mean effect size for these interventions is 0.398. Since all other content areas were represented by less than eight studies, these disciplines were additionally grouped into three categories: Language Arts/Study Skills, Social Sciences, and Other. Effect sizes for each category in order are: 0.42, 0.23, and 0.23.

It is apparent that studies utilizing Language Arts/Study Skills have yielded the largest effect sizes, although the values of *Tau-squared* (.068, .138, .062) and of *Tau* (.260, .372, .248) indicate that this variable accounted for little of the between-studies variation. The findings of the meta-analysis by Dignath and Buttner (2008) related to content area were significant. In their secondary school analyses, they compared effect sizes for language arts with those embedded in mathematics, and found larger effect sizes in language arts than in mathematics. Their explanation of these results appears reasonable and compelling. Research on the development of metacognition has revealed that, especially in the context of reading and writing, secondary students perform better than elementary students (Alexander et al, 1998). "Older students who have automated the processes of reading and writing still have free capacity for metacognitive processes, and can therefore benefit more from strategy training in this context" (Dignath & Buttner, 2008, p.254). Alexander (1995) found that students already learn math strategies during the early primary school years but they only start applying text comprehension strategies in the higher grades.

Research on the relationship between academic content and student achievement beliefs has been limited (Wolters & Pintrich, 1998). Wigfield (1994) reported a negative progression of students' achievement beliefs as they get older, which appears to be deeper and more pervasive in the area of mathematics than in other disciplines. Also, students value mathematics more highly in elementary school, whereas older students value language arts to a greater degree (Wigfield, 1994). Those academic disciplines in which students have higher achievement beliefs might be more fertile ground for training programs.

Group Work Integration

Only six studies incorporated group work into the training program. The mean effect size for those studies is 0.531, and the mean effect size for those studies not incorporating group work is 0.313.

There is a substantial body of research showing the positive impact of cooperative learning on students' performance, strategy use, and motivation (Guthrie et al, 1998).

But in the studies included in this meta-analysis, very little information was provided about the implementation of group work. Since group work was not the main topic of these interventions, insufficient information exists about the manner in which this type of learning was introduced during the training programs. Therefore, it is not reasonable to reach any meaningful conclusions about this moderator variable from this analysis.

Exploratory Moderator Analysis

CT Instruction

When CT instruction was an instructional design component (35% of studies), the mean effect size (0.239) was lower than for those studies (65% of studies) not including this component (0.384), but this variable accounted for little of the between-studies variation.

This variable was not studied in the previous meta-analyses (Dignath & Buttner, 2008; Hattie et al, 1996) on training programs, so a comparison of results is not possible. It may be possible, as suggested by Dignath and Buttner (2008), that computer mediated instruction involves a distinctive process that should be properly studied on its own.

Assessment Instrument

As indicated in Chapter 4, effect sizes were highest in studies using non-standardized instruments, although moderator analysis found little between-studies variation accounted for by instrument type. The exception was for the outcome of self-efficacy assessment, where the effect size was highest when standardized instruments were utilized. However, in every instance where self-efficacy was measured, the assessment instrument was standardized, so it is not possible to isolate the distinctive impact of this moderator variable (i.e. standardization) upon effect size with regard to self-efficacy outcomes.

With respect to the outcome categories of academic achievement and strategy usage, the effect of instrument type is not clear. We may only speculate about several possibilities. Since non-standardized instruments have been developed by the researchers or teachers implementing a study, there may well be a higher level of subjectivity involved, and unwittingly the results may be more easily influenced by those administering the assessment. Ever since the *No Child Left Behind Act* has been in force, there have been allegations of teachers “teaching to the test”. Perhaps a process analogous to this alleged pattern may occur with regard to this moderator variable.

However, we should also consider the contrary interpretation: that the training in those studies utilizing non-standardized instruments was more focused and concentrated than in the studies utilizing standardized instruments. It may well be that this narrow focus and concentrated training is a more effective approach when attempting to influence college students’ performance, strategy usage, and self-efficacy levels.

Type of College/University

Seventy-five percent of the studies were conducted at four year institutions. This high proportion is probably due to two factors. First, many of the studies were conducted as dissertation studies, which only take place at institutions with degrees ranging from

Bachelor's to Doctoral degrees. Secondly, most two year colleges do not place as much emphasis on research as do four year institutions.

The mean effect size for the four year institutions was approximately twice as large as for two year institutions, but moderator analysis found that college type accounted for little of the between-studies variation. Since only seven studies were conducted at 2 year colleges, it is probable that low power affected this finding. We may only speculate as to the factors involved. Student drop-out rates at many two year colleges are very high, perhaps reflecting a lower academic commitment level among these student populations. And the proportion of students at 2 year colleges requiring developmental or remedial courses may be higher than the proportion at four year institutions.

Limitations of This Study

Before presenting conclusions and implications, there are several limitations in this study which must be mentioned.

First, studies of differing quality were taken into account together, giving equal weight to studies of relatively higher and lower quality. Although I excluded studies which did not meet my eligibility criteria, there were still differences in the methodological quality of the individual primary studies.

Moderator analysis was somewhat limited in some cases due to the lack of clear and precise information provided by researchers. This was especially true with respect to the following moderator variables: type of college/university (i.e., two or four year/ urban or suburban), duration of interventions, and the nature of group work when this component was included in the intervention.

A third limitation is that the moderators were confounded with each other. The overall mean effect size was the average of a number of heterogeneous effects, which was possibly produced by differences in the characteristics of the student participants as well as by differing intervention components.

A fourth limitation is that power to conduct moderator analyses was low, since the sample size within subgroups was (by definition) smaller than the total sample size. Consequently, low power may have affected the results of these analyses.

A fifth limitation is that attempts to examine individual student variables, such as gender and ethnicity, were not feasible due to the lack of information provided in primary studies.

Conclusions

It appears that interventions to help college students acquire self-regulated learning strategies can be effective in reaching their objectives. Although mean effect sizes for college level interventions were lower than those found for primary and secondary school levels, many of the training programs yielded small to medium effect sizes among the college students participating in the studies. Students' self-efficacy levels appear to have been enhanced to a greater extent than their academic performance or their use of strategies.

Researcher-directed interventions did not produce significantly larger effect sizes than those conducted by instructors, which is inconsistent with the direction of the findings in the meta-analyses conducted on primary and secondary school level studies. Perhaps this pattern is not inevitable, even though researchers understand the “why” and “how” of these training programs and are strongly committed to their successful implementation. If instructors receive comprehensive and effective training, they may well become highly motivated to conduct successful interventions to help college students become more self-regulated learners.

Interventions of longer duration did not yield higher effect sizes, contradicting the results found by Dignath and Buttner. In some cases, this may indicate that the intensity of the training may be more important than the quantity. In studies of shorter duration, the objective may well be more focused, and the training may be more highly concentrated. Students’ proficiency levels may be more highly influenced under such conditions.

Sixty-five percent of the interventions trained multiple categories of strategies. Perhaps researchers are becoming increasingly cognizant of the synergistic effect of training different strategy types together in the same program.

Forty-seven percent of the studies were based on social-cognitive theory. This may be indicative of a trend among researchers in their realization of the fruitfulness of this theoretical orientation in the formulation of interventions of this nature.

With respect to academic content, interventions embedded within the academic content areas of language arts/study skills yielded the largest effect sizes, although this moderator accounted for little of the between-studies variation.

Regarding computer-mediated (CT) instruction, the three studies with the lowest effect sizes utilized computer software programs exclusively to train students, with no actual person-to-person instruction. Overall, those studies utilizing CT instruction yielded lower effect sizes, although this variable accounted for little of the between-studies variation. These results indicate the need for additional research in this area of instruction.

The final conclusion is that the moderators examined in this meta-analysis do not account for much of the heterogeneity, which has obvious implications for future research.

Recommendations for Future Research

Future researchers formulating and implementing intervention studies are encouraged to use greater care in the information they provide to the readers of their studies. Their goal should be to provide all the information one would need to replicate the exact study. This applies to sample data, training program characteristics, etc.

The reader should be able to answer several questions after examining a study. In what manner were the instructors (who deliver the intervention) trained? In what specific ways did students receive strategy instruction? Over how many sessions was the intervention delivered? What was the exact time period of each session? Were subjects randomly placed into experimental and control groups? Was the institution a four year or 2 year college/university?

Future research is encouraged which incorporates group work into the study design. Much research has found that group work improves student outcomes when it is implemented with certain criteria in place (Johnson & Johnson, 2005; Johnson &

Johnson, 1990). But little research has been conducted on the specific impact of group work on helping students acquire self-regulated learning strategies.

Research is also needed in order to isolate the impact of computer-mediated training on the effectiveness of interventions. Studies should directly compare training programs equivalent in all respects except for computer usage to identify this variable's impact (if any).

Perhaps the greatest need going forward is in the area of helping college instructors to become committed to incorporating SRL into their instructional repertoire and on the most effective ways to do so. "Teachers are likely to keep and use new strategies and concepts if they receive coaching (either expert or peer) while they are trying the new ideas in the classrooms" (Showers et al, 1987, p. 80). Much research has demonstrated the requirement that for teachers to truly evolve professionally in the classroom, continued modeling and support are necessary (Veenman & Denessen, 2001; Showers et al, 1987). Future researchers are urged to incorporate such coaching of instructors into their SRL interventions for college students, and for students of all age groups.

Lastly, it must be reiterated that much of the heterogeneity was not accounted for or explained by the moderator variables examined in this meta-analysis. Future researchers are encouraged to consider other potential moderators that may have impact on the effectiveness of interventions designed to help college students become more self-regulated learners. Is it possible, for example, that certain interventions may be more effective with students requiring remediation than with more advanced students (or the reverse relationship)? Is there a relationship between effect size and the geographical location of the college (i.e., urban or suburban)? Is there a relationship between effect size and ethnicity or gender of students? Is there a relationship between years of teaching experience and effect size? Hopefully, additional research will begin to provide more conclusive answers to these and other potentially important questions.

Appendix A – Study-Level Coding Form

Bibliographic reference:

____
____
____

_ _ _ _ 1. Study ID number

______2. Publication year

_____ 3. Type of assignment to conditions
1 random after matching, stratification, blocking
2 random, simple
3 nonrandom
4 other____________
5 cannot tell

______4. Overall confidence of judgment on how subjects were assigned
1 very low (little basis)
2 low (guess)
3 moderate (weak inference)
4 high (strong inference)
5 very high (explicitly stated)

______5. Was the equivalence of groups tested at pretest?
1 yes
2 no

____6. Pretest differences, if tested
1 negligible differences, judged unimportant
2 some difference, judged of uncertain importance
3 some differences, judged important

_____7. Total sample size

_____8. Treatment group sample size

_____9. Control group sample size

____10. Who delivered the intervention?
1 researcher
2 instructors

____11. Academic subject
1 accounting
2 sciences
3 engineering
4 computer science (information technology)
5 psychology
6 math
7 study skills
8 foreign languages
9 history

____12. Type of strategy instructed
1 cognitive
2 metacognitive
3 motivation
4 integration of 2 or 3 of these

____13. Theoretical background
1 metacognition
2 social-cognitive
3 motivational
4 integration of 2 or 3 of these

___14. Group work
0 no integration
1 integration

____15. Type of assessment instrument
1 knowledge test
2 problem-solving, think aloud, simulation task, questionnaire, interview to assess application of strategies
3 questionnaire or interview to assess self-efficacy

____16. Assessment instrument
1 standardized
2 self-developed with empirical basis
3 self-developed without empirical support

____17. Number of treatment sessions

____18. Number of treatment hours

_____19. Nature of control group

1 receives nothing
2 treatment as usual, school setting
3 alternative treatment
4 cannot tell

_____20. CT instruction

1 yes
2 no

Appendix B – Effect Size Level Coding Form

_ _ _ _ 1. Study ID number

_ _ 2. Effect size sequence number

_______3. Effect size type
1 pretest comparison
2 posttest comparison
3 follow-up comparison

_______4. Category of outcome construct
1 self-efficacy
2 academic achievement
3 utilization of strategies

_______5. Type of data effect size based on
1 means and standard deviations
2 *t*-value or *F*- value
3 chi-square (*df* = 1)
4 frequencies or proportions
5 frequencies or proportions
6 other

_______6. Page number where effect size found

_______7. Raw difference favors (i.e., shows more success for):
1 treatment group
2 neither (exactly equal)
3 control group
4 cannot tell or statistically insignificant report only

_______8a. Treatment group sample size
_______8b. Control group sample size

_______9a. Treatment group mean
_______9b. Control group mean
______10a. Treatment group standard deviation
______10b. Control group standard deviation

______11a. *n* of treatment group with a successful outcome
______11b. *n* of control group with a successful outcome
______12a. proportion of treatment group with a successful outcome
______12b. proportion of control group with a successful outcome

______13a. *t*-value
______13b. *F*-value (*df* for the numerator must = 1)
______13c. Chi-square value (*df* = 1)

______14. Effect size

APPENDIX C

Summary of Studies included in the Meta-analysis

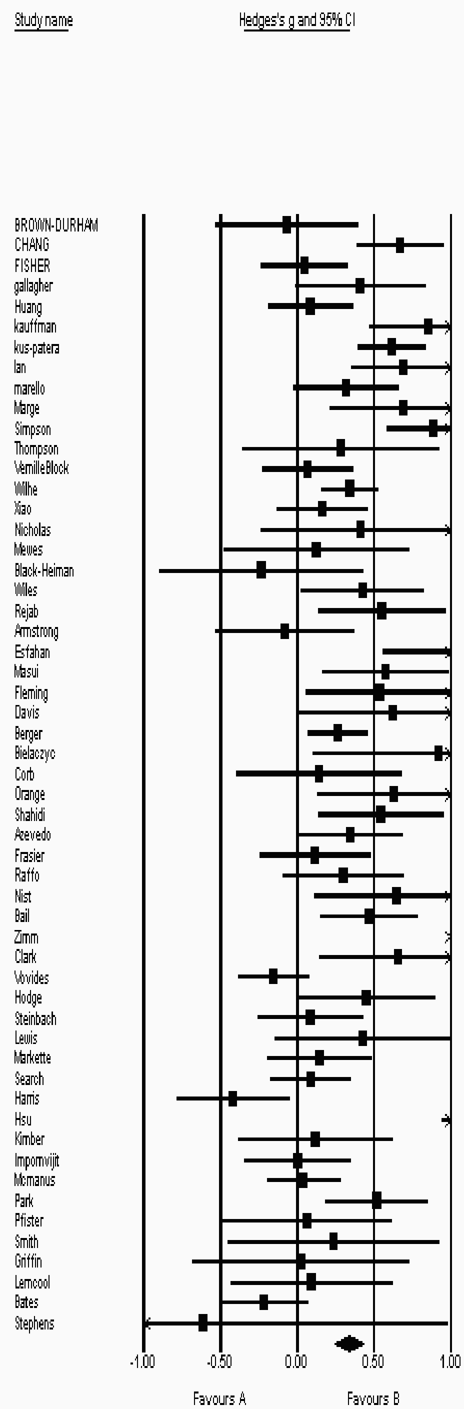
Authors	Year	Delivery Mode	Outcomes	N	Hedges'g	S.E.
Armstrong, A.M.	1998	researcher	self-efficacy	72	.411	.232
Azevedo, R.	2004	researcher	researcher	131	.344	.176
Bail, F.T.	2008	instructor	acad. ach.	157	.465	.161
Bates, C.	2006	unknown	acad. ach. strategy use	112	-.219	.148
Berger, D.	2003	instructor	academic ach.	741	.260	.100
Bielaczyc, K.M.	1995	researcher	strategy use	24	.918	.417
Black-Heiman, D.K.	1999	instructor	self-efficacy	34	-.237	.339
Brown-Durham, G.	2006	researcher	self-efficacy strategy use	34	-.070	.239
Chang, M.M.	2007	researcher	acad. ach. self-efficacy	99	.665	.145
Clark, E.	1991	instructor	acad. ach.	60	.653	.263
Corb, R.E.	1996	researcher	acad. ach.	51	.138	.276
Davis, D.M.	1998	instructor	self-efficacy	42	.618	.313
Fisher, J.E.	1998	instructor	all 3 outcomes	38	.044	.145
Fleming, V.M.	2002	instructor	acad. ach.	65	.536	.249
Frasier, R.A.	2006	instructor	self-efficacy	115	.114	.184
Gallagher, P.A.	2003	researcher	acad. ach., strategy use	50	.408	.217
Griffin, T.A.	202	researcher	strategy use	39	.023	.361
Harris, D.	1998	researcher	acad. ach.	58	-.420	.187

			strategy use			
Hodge, E.A.	1991	instructor	acad. ach.	78	.447	.228
Huang, T.	2008	researcher	all 3 outcomes	50	.083	.141
Hsu,	1999	researcher	acad. ach. self-efficacy	144	1.412	.241
Impornvijit, K.	2008	instructor	acad. ach. strategy use	81	.001	.179
Kauffman, D. Ge, X. Xie, K. Chen, C.	2008	instructor	strategy use	54	.851	.197
Kimber, C.	2009	researcher	acad. ach.	29	.117	.257
Lan, W.Y.	1996	researcher	acad. ach., strategy use strategy use	72	.688	.173
Lemcool, K.G.	2007	researcher	acad. ach. strategy use	26	.090	.268
Kus-Patera, S.	2003	researcher	all 3 outcomes	105	.612	.114
Lewis,	2006	researcher	self-efficacy	46	.425	.293
Marello, C.	1999	instructor	acad. ach. strategy use	88	.317	.176
Marge, J.	2001	researcher	strategy use	60	.685	.243
Markette,	1996	unknown	acad. ach. strategy use	75	.142	.173
Masui, C.	2005	instructor	acad. ach.	141	.572	.212
McManus, T.E.	1998	unknown	strategy use	119	.039	.122
Mewes, J.R.	2002	researcher	strategy use	40	.123	.310
Nicholas, K.R.	2002	researcher	self-efficacy	36	.411	.330

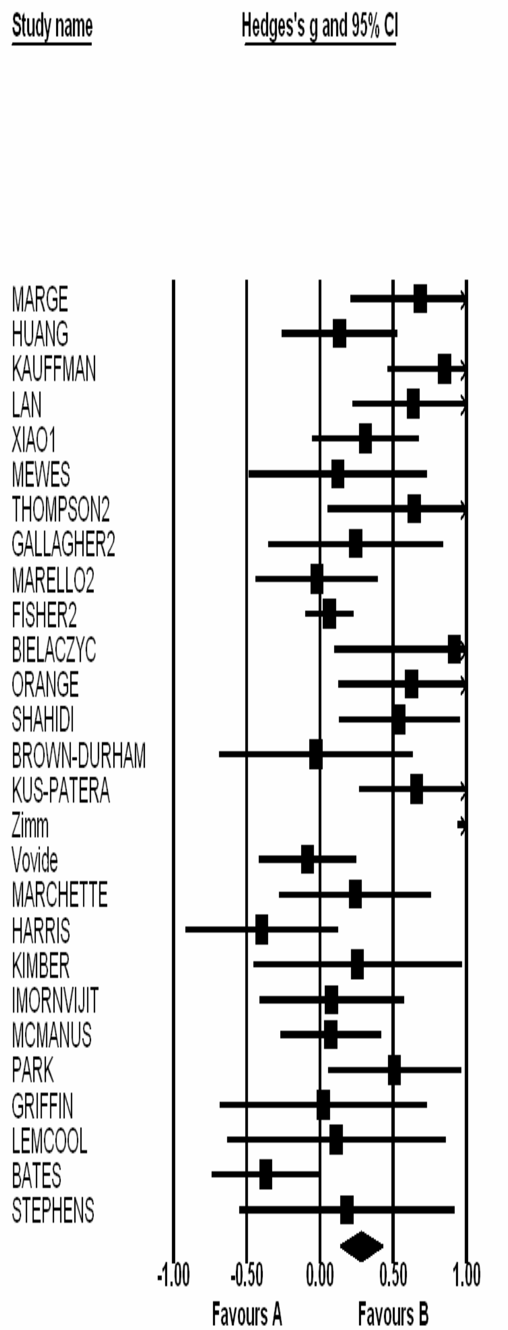
Nist Simpson	1990	researcher	acad. ach.	55	.644	.274
Orange, C.	1999	researcher	strategy use	63	.625	.255
Park, H.K.	2000	unknown	acad. ach. strategy use	156	.514	.170
Pfister, T.L.	2002	instructor	acad. ach. strategy use	76	.061	.281
Raffo, D.M.	2003	instructor	acad. ach.	96	.300	.202
Rajab, A.M.	2007	instructor	self-efficacy	18	.548	.212
Rezvan, S.A. Ahmadi, S.A. Abedi, M.R.	2006	researcher	acad. ach.	60	.572	.274
Search, S.P,	1996	instructor	acad. ach. self-efficacy	113	.085	.134
Shahidi, S.	2001	researcher	strategy use	110	.542	.210
Simpson,	1988	instructor	acad. ach.	60	.883	.155
Smith,	2002	researcher	self-efficacy	31	.233	.351
Steinbach,	2008	instructor	acad.ach.	130	.083	.176
Stephens,A.	2009	researcher	acad. ach. Strategy use	27	-.613	.810
Thompson, R.	2008	instructor	all 3 outcomes	45	.282	.327
Vernille Blocklin, K.M.	2008	instructor	acad. ach. self-efficacy	129	.067	.152
Vovides, Y.	2005	researcher	acad. ach. strategy use	137	-.156	.118
Wilhe, R.R.	2001	instructor	acad. ach. self-efficacy	141	.338	.095
Wiles, W.	1997	instructor	acad. ach.	98	.422	.205

Xiao, L.	2006	researcher	all 3 outcomes	117	.160	.152
Zimmerman, B. Kitsantas, A.	2002	researcher	self-efficacy strategy use	12	2.114	.486

Appendix D - Forest Plot for All Studies



Appendix E - Forest Plot for Strategy Use Studies



Meta Analysis

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