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Self-regulatory training for helping students with special needs to learn mathematics

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SELF-REGULATORY TRAINING FOR HELPING STUDENTS WITH SPECIAL NEEDS TO LEARN MATHEMATICS

by

Yanrong Kang

An Abstract

Of a thesis submitted in partial fulfillment of the
requirements for the Doctor of Philosophy degree
in Psychological and Quantitative Foundations (Educational Psychology) in
the Graduate College of
The University of Iowa

July 2010

Thesis Supervisor: Associate Professor Joyce Moore

ABSTRACT

Previous research suggests that self-regulation interventions are effective in improving students' self-regulatory skill and school performance in a wide variety of educational domains. Inspired by social cognitive theory (Schunk & Zimmerman, 1997) and goal setting theory (Locke & Latham, 1990), I designed, implemented, and examined the beneficial impact of a two-part intervention to teacher effective self-regulation (i.e., goal setting and self-reflection) of 62 high school students with special needs (40 males, 22 females) during in-class math instruction. Results indicate that the two-part intervention led to high self-efficacy judgments and to better math performance compared to students with special needs who were randomly assigned into a delayed-treatment control group. Students in the intervention group also perceived the math instruction they received more positively. Results also show that, after participating in the intervention, all participants students with special needs increased their variety of self-regulatory strategies, and attributed their performance to more controllable (e.g., effort, strategy) causes. The gains in self-regulatory strategies and adaptive attributions, while significant in their own right, helped students experience a significant gain in their post-intervention math performance as well.

Abstract Approved: _____

Thesis Supervisor

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Title and Department

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Date

SELF-REGULATORY TRAINING FOR HELPING STUDENTS WITH SPECIAL NEEDS TO LEARN MATHEMATICS

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Graduate College
The University of Iowa
Iowa City, Iowa

CERTIFICATE OF APPROVAL

PH.D. THESIS

This is to certify that the Ph.D. thesis of

Yanrong Kang

has been approved by the Examining Committee
for the thesis requirement for the Doctor of Philosophy
degree in Psychological and Quantitative Foundations
(Educational Psychology) at the July 2010 graduation.

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CHAPTER I

INTRODUCTION

Despite available federal funding and educator efforts, students with special needs tend to show lower school performance across subjects (e.g., reading, writing, mathematics and science) than their peers without disabilities (IDEA, 2004). They also tend to experience more problems in transitioning to higher educator or to workforce placement (Swanson & Saez, 2003). Researchers believe the low proficiency of students with special needs in regulating their cognition, motivation, and behaviors in learning activities may be a critical factor in explaining their unsatisfactory school performance and problems in transitioning to higher education or to workforce placement (Wagner, 2005). Thanks to the efforts of forerunners in self-regulation research (Boekaerts, Pintrich, & Zeidner, 2000), sophisticated models of self-regulation have been developed and applied in a wide variety of education-related domains (Zimmerman, 1990a). However, most studies focused on traditional groups of students (i.e., typically developing students), and relatively few examined whether self-regulatory processes could impact the functioning of students with special needs. In this study, inspired by social-cognitive theory (Bandura, 1986), goal-setting theory (Locke & Latham, 1990), and the educational applications of self-regulated learning (Zimmerman, 1990b), students with special needs and low mathematics performance from special education resource rooms at three Midwest high schools were taught two self-regulation skills (i.e., goal-setting and self-evaluation) through teacher modeling.

Students with special needs, compared with their normally developing peers, are generally less effective self-regulated learners (Zimmerman, 2000a). People suspect that

neurological (Borkowski & Thorpe, 1994), social roots and educational environments are possible causes of this disadvantage in self-regulated learning (Zimmerman, 2000). Problematic neurological development might account for the challenges students with special needs face in focusing, recalling, and memorizing, which are crucial for effective self-regulation. In addition, parents of many students with special needs do not model sufficient self-regulatory behaviors, which are necessary for children to observe before developing self-regulatory skills. Public school educators may also "drop the ball" by failing to model and support self-regulatory learning and practices in class, due to the fact that supporting self-regulatory skills are usually not addressed in traditional teacher preparation programs.

Self-Regulation and Students with Special Needs

The social cognitive approach views self-regulatory processes as three cyclical phases, which are forethought, performance or volitional control, and self-reflection processes (Zimmerman, 1994). Forethought involves processes that precede and influence individuals' efforts to act on tasks. Performance or volitional control refers to processes that happen during the performance of a task and includes the adjustment of attention and action. Self-reflection takes place after performance and involves how individuals evaluate and judge their experience. These self-reflection processes cyclically affect the forethought and performance processes in terms of attention and action on future tasks.

Since self-regulation is a cyclical, iterative three-phase process, it is interesting to investigate in which phases students with special needs need particular assistance. Studies have suggested many students with special needs are challenged with goal setting in the

forethought phase (e.g., they don't plan or set goals before writing a passage) and performance (e.g., they write incomplete stories) (MacArthur & Graham, 1987). Some researchers posit students with special needs have difficulty with self-reflection, the third phase of cyclical self-regulatory process (Pintrich & Blazevski, 2004). Despite the instructional and learning potential of self-reflection, few studies have investigated self-reflection among students with special needs. I will address the importance of both forethought and self-reflection phases, and the subprocesses within each phase as well. How to support students' capacities in the two phases will be discussed later.

Self-regulatory interventions have been found to be effective with academic performance enhancement as well as behavior management for students with special educational needs in reading and writing (Sawyer, Graham & Harris, 1992). Compared with reading and writing, mathematics is a relatively neglected subject by both self-regulatory researchers and special education researchers. Among limited self-regulatory research in this subject of mathematics with students with special needs, a meta-analysis of mathematics intervention with elementary school children with special educational needs (Kroesbergen & Van Luit, 2003) reveals that self-instruction, one self-regulatory practice, is the most effective method for teaching math problem solving, and direct instruction is most effective for teaching basic skills. This dissertation study investigated the effects of two interventions on self-regulation in mathematic class for students with special needs.

Math Instruction

Students with mathematics difficulties are consistently underserved in public schools when compared with the amount of attention and support their peers with reading

disabilities receive, despite the finding that the cumulative incidence of learning difficulties in math through age 19 ranged from 6% to 14% (Rivera, 1997). Recent studies report math learning of five to ten percent of students in grades K-12 is impacted by learning disabilities (Fuchs & Fuchs, 2002; Garnett, 1998; Geary, 2001, 2004; Mazzocoo & Thompson, 2005). This percentage is similar to the estimated prevalence of students with reading difficulties. However, compared with the great amount of research attention drawn on reading, the amount of intervention studies on mathematics for students with special needs, including those with learning disabilities, are significantly insufficient (The U.S. Department of Education). This scarcity might be attributable to some historical influences and the impact of federal legislations (e.g., No Child Left Behind). For example, despite efforts of NCLB in encouraging effective teaching practices in reading, mathematics and science, departments of educations in many states and local school districts tend to focus on reading and language arts, rather than mathematics. Mastropieri et al. found a decrease in math studies with students with learning disabilities (Mastropieri et al., 1998, 2004), and this decrease is suspected to have resulted from the recent increased emphasis on reading and phonological processes of LD (e.g., Bradley, Danielson, & Hallahan, 2002; Snow, Burns, & Griffin, 1998). Although reading difficulties are sometimes related to students' difficulties with mathematics, a substantial number of students with LD exhibit problems in math alone (Scruggs & Masteropieri, 2003).

In addition, "poor achievement in mathematics actually may worsen as children progress through school due to the uniqueness of mathematics development" (Montague, 2007, p.75). Although it is not hard to understand why most studies on mathematics

interventions with students with special needs are concentrated with the domain of basic math skills—it is a large domain and crucial for the development of students' later math skills, studies on problem solving and other skills beyond basic calculation are underrepresented (Kroesbergen & Van luit, 2003; Miller et al., 1998). Obviously, there is an urgent need for more research on mathematics instruction and intervention for students with special needs in middle and secondary levels. Even among good-quality studies on mathematics instruction for students with special needs, many of them were more of episodic nature and did not offer solution to raise students' performance in the long run.

In addition to the limited studies on mathematics learning for students with learning disabilities, the range of topics those mathematics interventions address tends to be limited to basic computation rather than higher level skills which requires analysis and problem solving. A recent review indicated 65% of the mathematics studies with LD students addressed learning of basic computation skills (Mastropieri, Scruggs, & Chung, 1998). However, National Council of Teachers of Mathematics (NCTM, 2000)'s recent standards highlight the deficiencies in association of such a narrow focus by calling for more problems of varying structures, "problems that require analysis of the unknown, problems that provide insufficient or incorrect data, and problems that can be solved in more than one way or that have more than one correct answer (Mastropieri et al., 2004, p.333)," highlights the deficiencies in association of such a narrow focus. Several recent studies involve algebra learning with students with special needs possibly indicating a trend towards the study of higher level math learning (Mastropieri, Scruggs, & Chung, 1998). Along with this route, the present research investigated the math learning (e.g.,

fractions) among high school students with special needs and therefore contributed to the limited amount of research.

Although the nature of mathematical learning needs to be further investigated (Montague, 2007), mathematics is viewed as a cognitively demanding subject that requires learners to master a variety of skills and strategies in a complex and often burdensome process of self-regulated learning. Research findings indicate cognitive mechanisms, especially memory and monitoring processes, affect mathematical learning from an early age (Swanson & Jerman, 2006). A significant number of students with special needs, especially learning disabilities, face challenges in mathematics learning, particularly problem solving and self-regulated learning (Montague & Applegate, 1993a, 1993b; Swanson & Jerman), which is compromised by their difficulties with recalling and monitoring of information and the generalization of skills from one learning situation to another (Spear-Swerling, 2005). The self-regulatory challenges students with special needs face in mathematical learning can be attributed to their limited repertoire of strategies, immature metacognitive abilities, low motivation, and difficulty in monitoring their academic performance by spontaneously detecting and correcting errors (Montague, 2007; Swanson & Jerman, 2006).

Students with special needs are characteristically poor self-regulators and thus need explicit instruction to support their acquisition and use of self-regulatory strategies to succeed in the domain of mathematical learning. The most frequently studied self-regulatory strategy is self-monitoring, which refers to constant efforts in keeping track of on-going progress (Montague, 2007). Self-monitoring can take place in a variety of forms. For instance, elementary students were taught how to record the specific self-

monitoring objectives and were cued by a taped tone to record results for the number of problems completed when they were working on problems (DiGangi, Maag and Reid, 1993). In Dunlap and Dunlap's study (1989), students with learning disabilities were taught to use an individualized self-monitoring checklist, including items such as "*I passed the 0, crossed out the first number to the left of the 0 and made it one less*," while working out subtraction problems. Most self-regulatory studies chose elementary level or college level students and just a small proportion of those studies have been conducted at middle and secondary levels (Konrad et al., 2007).

Significance of the Current Study

The theoretical contribution of this research lies in examining academic self-regulation by connecting the forethought phase (i.e., the first phase of self-regulation) and self-reflection (i.e., the third phase of self-regulation). Goal-setting, one of self-regulatory components which received most attention from researchers, has been studied exclusively (i.e., in isolation) rather than along with other components, such as self-reflection. Until now, only several aspects of self-regulation have been extensively investigated, such as self-monitoring, self-instruction, goal-setting and self-reinforcement (Harris, Reid, & Graham, 2004). Self-reflection has been largely neglected despite its instructional potential. Self-reflection prompts students to evaluate whether they have met their goals, informs them of reactions to take for improving subsequent performance, and helps them to adjust goals for future learning (Zimmerman, 2001). Theoretically, I see self-reflection, which possesses great instructional potential, may possibly strengthen the effects of goal setting more significantly than goal setting alone. Considering that self-reflection encourages learners to connect goals with their performance and implies great

instructional potential, this research combined self-reflection with goal setting to help students' learning. Studies on self-regulation have been criticized for examining single self-regulatory processes in isolation rather than as a whole (Schunk & Ertmer, 1999, 2000). This research is one of the early attempts in this promising direction.

Not only did this research investigate multiple self-regulatory processes, but also investigated the effects of the two processes separately. Among the limited number of researchers who examined the effects of the whole process of self-regulation, most made no efforts in determining relative contributions of various self-regulatory processes, instructional components, and other variables that may possibly be responsible for change on students' achievement and/or behavior (Sawyer, Graham & Harris, 1992; Zimmerman, 1998). Despite the potential contribution of component analysis, studies attempting to figure out effects of different intervention components remain rare.

This study may provide educators with a practical solution to incorporating instruction on self-regulatory skills. The intervention examined in the present study may allow educators to incorporate self-regulation within the scope and sequence of their curricula. The intervention program is also classroom-friendly because it is both brief to administer, and easy to use. This is important because educators typically lack training in supporting self-regulation and consequently feel reluctant to use their instructional time for this seemingly non-course-specific purpose.

Enhancing the Forethought Phase: Goal Setting

Goal setting refers to setting targets at a specific learning or performance outcome. The process of setting goals is crucial for learning because it determines students' motivation, persistence, choice of activities and strategies, and progress monitoring (King,

Harner & Brown, 2000; Schunk, 2001). Goal setting also sets the standards for individuals to evaluate their performance (Bandura, 1986). During the learning process, goals direct learners' attention to most relevant task features, guide them to take better procedures on solving problems, increase effort, and extend persistence during their pursuit of goals (Locke & Latham, 1990). Goals are extremely useful in helping learners to see the distance between current performance and the goal they aim at. When learners find themselves reaching (or at least making progress towards their goals), they feel more confident in their ability to conduct similar activities (i.e., self-efficacy) and become more motivated in pursuing similar goals (i.e., intrinsic motivation) (Schunk, 1995). When learners see a discrepancy between present performances and the goals previously set, they may increase their efforts, adjust strategies, seek assistance, or take other adaptive actions (Locke & Latham, 1990).

Despite of the advantages goals may serve, simply having a goal does not guarantee enhanced learning. Effective goals need be specific (rather than vague), proximal (instead of distant) and difficult (not too easy) to promote students' learning (Bandura, 1988; Locke & Latham, 1990; Locke, Shaw, Saari, & Latham, 1981). Goals that denote specific performance standards, are temporally close at hand, or are viewed as difficult enough to require significant expenditure of attention, effort, persistence and strategic planning, enhance performance better than goals that are general, temporally distant, or perceived as easy or too easy (Schunk, 1990).

Goal setting and self-motivating beliefs have impacts on each other. Some key self-motivating beliefs include self-efficacy, intrinsic motivation, and task value. Self-efficacy refers to individuals' beliefs about their capabilities to learn or perform at a

certain designated level. Learners with high self-efficacy beliefs about their performance tend to achieve significantly more than students with low self-efficacy beliefs (Zimmerman, Bandura & Martinez-Pons, 1992). Students who are intrinsically motivated in and personally value the given activities are likely to perform better than those who are not intrinsically interested. When learners find themselves making progress toward and/or reaching their goals, they feel more self-efficacious, become more intrinsically interested in the particular subject area, consider the subject to be more enjoyable, and value similar activities to a greater degree (Locke & Latham, 1990). Consequently, they may set more challenging goals for their subsequent learning (Bandura & Schunk, 1981).

Although numerous studies have been published on the effects of assigning goals to students, most studies do not typically include systematic instruction on issues such as the reasons for goal setting, teachers modeling of goal setting, or sufficient practice opportunities in independent goal setting (e.g., Graham, MacArthur, & Schwartz, 1995; Locke & Bryan, 1966; Locke, Frederick, Lee, & Bobko, 1984; Schunk, 1996). This dissertation addressed those issues and set a solid stage to investigate how goal setting influences not only performance but students' self-efficacy, intrinsic motivation, task evaluation and other measures.

Enhancing the Self-reflection Phase

Self-reflection constitutes the cornerstone of the third cyclical phase of self-regulation, which consists of two subprocesses: self-judgment and self-reaction (Zimmerman, 1994). Self-judgment refers to when learners compare their present performance with goals they set prior to acting on tasks and explain their performance with causes concerning the performance. Self-reaction refers to when learners take

corresponding actions or procedures based on the judgment made on their observation. Self-judgment and reaction do not automatically occur. Instead, they are contingent on the results of self-observation, learners' deliberate attention to their own behaviors (Bandura, 1986). No learners are able to make informed judgments without deliberate self-observation. When learners believe they have made sufficient progress with reference to their adopted standards (i.e., goals), they feel self-efficacious and feel more confident in their abilities to perform tasks. Next, they may continue to make efforts, concentrate on the tasks, and adjust their actions to meet demands of tasks. In their future learning, learners may set more challenging goals and plan their actions more thoughtfully. After experiencing successes in their learning and accumulating knowledge in some subject areas or activities, students may feel more satisfied with their performance, and may also apply more adaptive strategies to improve their learning (Zimmerman, 1994). Students with special needs, compared with their normally developing peers, often have difficulty monitoring their learning process in a timely manner. Even when they observe their behaviors well, they often fail to make proper judgments about their learning, attribute poor performance to lack of ability or other non-changeable entities, and take maladaptive actions. Consequently, students with special needs often suffer a lower level of intrinsic motivation and self-efficacy which contributes to their reluctance to initiate learning activities, set challenging goals, and persist in learning tasks.

Goals of the Present Research

This dissertation research pursued three purposes. First, it examines whether self-regulatory training in the combination of goal setting and self-reflection will enhance the

use of students with special needs' self-regulatory strategies and adaptive (rather than maladaptive) attributions. Second, it examines whether goal setting will enhance students with special needs' achievement, intrinsic motivation, self-efficacy, satisfaction with their performance, and their evaluation of the self-regulatory training embedded math instruction. Third, it examines whether self-reflection will enhance students with special needs' achievement, intrinsic motivation, self-efficacy, satisfaction with their performance, and their evaluation of the self-reflection embedded instruction.

Research Questions

Recognizing that students with special needs encounter difficulties with both goal setting and self-reflection, Study 1 utilizes an experimental intervention to promote goal setting capabilities among students with special needs, while Study 2 utilizes a similar experimental intervention to promote self-reflection capabilities among students with special needs.

Can teachers enhance the goal-setting and self-reflection capabilities of students with special needs during math instruction? The present research investigates whether teacher modeling and guiding of goal setting and self-reflection will enhance self-regulatory capabilities, attribution to their performance, and math performance among students with special needs in a variety of academic domains. To the extent that students with special needs can learn the self-regulatory processes of goal setting and self-reflection, the present study further asks to what extent these acquired self-regulatory strategies will enhance students' learning during mathematics in terms of achievement, intrinsic motivation, self-efficacy, satisfaction, and evaluation of the math instruction they receive.

Can teachers enhance math learning and related concepts during goal setting embedded math instruction among students with special needs? Specifically, Study 1 investigates whether teachers' modeling and guiding of goal setting will enhance students with special needs achievement (which is measured with accuracy, the number of problems answered correctly), intrinsic motivation and self-efficacy in solving fraction problems, satisfaction with their performance, and their evaluation of the math instruction they receive.

Can teachers enhance math learning and related concepts during self-reflection embedded math instruction among students with special needs? Specifically, Study 2 investigates whether teachers' modeling and guiding of self-reflection will enhance students with special needs achievement (which is measured with accuracy, the number of problems answered correctly), intrinsic motivation and self-efficacy in solving fraction problems, satisfaction with their performance, and their evaluation of the math instruction they receive.

CHAPTER II

REVIEW OF THE LITERATURE

Self-Regulation

Self-regulated Learning Models

Several perspectives on self-regulated learning are presented for comparison in Table 1, each of which either has emerged or has been developed significantly further in the last decade and is supported by empirical studies. The current research owes most to Zimmerman's social cognitive model of self-regulation, although the past research has benefited considerably from the other four theoretical views, i.e., Boekaerts' model of adaptable learning (1992, 1995, 1996a, 1996b), Borkowski's process-oriented model of metacognition (Borkowski & Muthukrishna, 1992; Borkowski, 1996; Borkowski & Burke, 1996; Borkowski et al., 2000), Pintrich's general framework for self-regulated learning (Printrich, 2000), and Winne's four-stage model of self-regulated learning (Winne & Hadwin, 1998).

Despite different orientations and trajectories, the five models of self-regulatory learning share several assumptions. First, learners actively construct their own meanings, goals, strategies based on information available from external environment and their own minds (i.e., the internal environment). Second, learners can potentially monitor, control and regulate certain aspects of their own cognitive, motivation, behaviors and some features of their environments. However, this potential is constrained by contextual factors, and biological, developmental and individual differences, which may impede or interfere with an individual's ability and efforts at regulation. Third, learners' evaluative comparisons are made against certain criteria, goals, or standards in order to decide

whether the learning process should continue as is or some changes are necessary. Last, learners mediate the complex interplay of their external environment, internal characteristics, and exercise self-regulatory strategies en-route to outcomes such as achievement and purpose (Pintrich, 2004; Puustinen & Pulkkinen, 2001).

Social Cognitive Theory

Models of self-regulated learning are theoretically rooted in social-cognitive theory, including the models summarized in Table 1. Among the five models, Zimmerman's social cognitive model of academic self-regulation (Zimmerman, 2000a, 2001) was grounded in Bandura's emphasis on the reciprocal nature of interactions between personal processes, behaviors and environmental factors (Bandura, 1977, 1986) (see Figure 1). The social cognitive model of self-regulated learning includes many self-processes such as metacognition, affects, and motivational beliefs such as self-efficacy (Zimmerman, 2002). Social cognitive theorists define self-regulated learning as learning in which learners are metacognitively, motivationally, and behaviorally active participants in their own learning process (Zimmerman, 1986). Based upon this definition, Zimmerman postulated the triadic perspective of self-regulated academic learning, including self-processes, behavioral influences, and environmental influences acting upon one another in a reciprocal manner (Puustinen & Pukkinen, 2001; Schunk, 1989; Zimmerman, 1989, 2000a). Each node of this triad is composed of several different factors or variables that are also believed to be reciprocally interdependent (Zimmerman & Martinez-Pons, 1992). One node of this triad involves personal influences, which includes factors such as achievement goals, self-efficacy, metacognition, and affects. A second node involves behavioral influences, which

includes factors such as self-monitoring, self-judgment, and self-reaction. The third node involves environmental influences, which includes factors such as academic outcomes (Zimmerman, 1989; Zimmerman and Martinez-Pons, 1992). These three determinants are separable as well as interdependent when influencing individuals' functioning (Zimmerman, 1990a, 1998).

First, personal variables in the social cognitive model include cognitive, affective and motivational factors. As for cognitive influences, individuals often have goals such as acquiring skill and knowledge, finishing work, or obtaining good grades, and are aware of the feedback loop between specific outcomes and their behaviors (Zimmerman & Martinez-Pons, 1992). Additionally, personal variables include individuals' knowledge, experience and strategies in various areas (e.g., learning strategies). As for affective influences, anxiety, excitement, nervousness, and depressed moods may either facilitate or impair learning processes. Among motivational influences, self-efficacy is one of the most crucial in academic learning. Self-efficacy refers to beliefs of personal capabilities for different levels of attainment in a particular task domain (Pajares, 2002, Zimmerman & Martinez-Pons, 1992). It is hypothesized to affect choices such as learning activities and amounts of efforts expend, and therefore play an important role in this triadic model of self-regulated learning (Bandura, 1997; Schunk, 1994; Zimmerman, 2002; Zimmerman & Martinez-Pons, 1992). In Study 1 of the proposed research, the cognitive aspects of self-regulation will be addressed by modeling and supporting students with special needs to set appropriate goals and establish the loop between feedback and their goals. During this research, intrinsic motivation (i.e., the enjoyment and interest students with special needs feel when solving math problems), self-efficacy (e.g., how capable

students with special needs feel about solving problems in fractions) and intrinsic motivation (in the subject area), will be investigated as dependent variables resulted from self-regulatory training.

The behavioral component in the model is also crucial for self-regulated learning. Behavioral processes include self-monitoring, self-judgment, and self-reaction (Schunk, 1989; Zimmerman, 1990b, 2002). Self-monitoring refers to an individual's deliberate attention to aspects of one's behavior (Bandura, 1987), self- judgment refers to comparing one's present performance with one's goal or goals, and self-reaction refers to students' evaluations of their progress in learning (Schunk, 1994). For example, if a student believes that he has made sufficient progress (self-evaluation) in solving ten addition problems (self-judgment), he might reward himself with a cookie (self-reaction) (McWhaw, 1997). The realization of his progress toward the goal then substantiates and enhances his self-efficacy in learning mathematics (i.e., influenced the personal process) and his parents or teachers may therefore change the structure of his learning environment to allow more self-regulation (i.e., affected the environmental factors). As this example shows, the behavioral node affects other processes within the triad. In Study 2 of the proposed research, the cognitive aspects of self-regulation will be addressed by modeling and supporting students with special needs on self-reflection (i.e., judging their performance to a preset standard, and determining which steps to take for performance improvement).

The environmental influences in the reciprocal triad impact on the quality and extent to which a learner can exercise self-regulated learning. For a student, environmental factors refer to factors such as school or classroom settings, teachers'

discipline and support, and instruction structures. For example, students in a quiet study place may focus more on writing an essay than in a noisy environment. In schools with a strictly structured curriculum, students may not exercise self-regulatory behaviors (e.g., reward him/herself with some activity of personal choice) as much as those in school with a more flexible arrangement. A good learning environment supports students' self-regulatory learning and behaviors, and allows personal, behavioral and environmental factors operate in an optimal fashion (Zimmerman, 1986). To be more specific, a good learning environments eliminates distractions or barrier to informed decision making, and allows and encourages learners to take control over their learning by providing tools/instruments/ supports to help them gauge and adjust their learning.

In the present research, the classroom teachers adapted their instructional procedures to facilitate students' with special needs developing of their self-regulatory strategies and skills in learning high school mathematics. In summary, the personal, behavioral and environmental influences within the social cognitive model are interdependent on one another in this reciprocal triad.

The Cyclical Nature of Self-regulated Learning

From a social cognitive perspective, self-regulatory processes and accompanying beliefs fall into three cyclical phases: forethought, performance or volitional control, and self-reflection (Zimmerman, 2000a). A brief description of these three phases of self-regulated learning is necessary for understanding of the variables examined in this study. The three phases and subprocesses of self-regulation are presented in Figure 2.

The first phase, the forethought phase, refers to influential processes and beliefs that precede efforts to learn and set the stage for such learning. Among those processes is

goal setting, which refers to establishing or deciding on specific outcomes of learning (Locke & Latham, 1990). Further, one influential belief in the forethought phase is self-efficacy, which refers to individuals' beliefs about their capabilities to learn or perform at a certain designated level. Research findings show that learners who are assigned goals or self set goals are more likely to perform better than students with no goals (Ames, 1992b). Additionally, students who hold high initial self-efficacy beliefs about their performance tend to achieve higher than students with lower self-efficacy beliefs (Zimmerman, Bandura, & Martinez-Pons, 1992). Students also tend to do a better job at activities with higher perceived task value than lower task values.

The second self-regulatory phase is performance or volitional control, which refers to processes that occur during learning efforts and affect concentration and performance. A key process that students perform during this phase is self-monitoring, which informs them, through various forms of record keeping, about their progress in the learning process. Self-monitoring is defined as occurring when a learner assesses whether a target behavior (conducted by him/herself) has happened and then records the results (Nelson, 1977; Nelson & Hayes, 1981). Self-monitoring practices are commonly categorized into self-monitoring of attention (SMA) and self-monitoring of performance (SMP) (Reid, 1996). SMA involves that learners self-assess whether they are paying attention and self-record the results. SMP involves learners self-assess some aspects of their academic performance and to self-record the results (Reid, 1993; Reid & Harris, 1989). Almost all published studies with a SMA component utilize a taped random cueing system which was developed by Hallahan and other researchers at the University of Virginia (e.g., Hallahan, Lloyed, Kosiewicz, Kaufffman, & Grave, 1979). Although

SMA was initiated earlier and are widely studied, studies involving SMP shows higher variability in SMP procedures, including productivity (e.g., the number of problems attempted), accuracy (e.g., the number of problems completed), or strategy use (e.g., whether steps in performing a strategy were conducted). Although self-monitoring is limited to key processes (e.g., attention in SMA) or outcomes (e.g., performance in SMP), Hallahan and Sapona (1983) suggest it may not be applicable to situations involving new learning. However, people need to consider this statement with caution since all empirical studies are conducted to examine self-monitoring with skills that have been acquired (Singer & Cauraugh, 1985). Studies on SMA and SMP indicate their instructional potential in increasing the rate or the number of academic responses (i.e., productivity). The effects of self-monitoring on accuracy are less clear.

The third and final self-regulatory phase is self-reflection, which is defined as the process that takes place after learning efforts, and influences a learner's reaction to that experience and the aspects of forethought phase. Self-reflective processes may take place at the outset of this phase in the form of self-judgment, which involves comparing one's achieved results with some standards or goals. Students with deficiency in self-judgment often do not compare their performance with appropriate goals (even when have standards or goals available), and rather evaluate their performance to that of other students (e.g., often not an effective benchmark), and therefore fail to fairly judge their performance. Subsequently, self-evaluations may lead students to attribute success or failure to one of the following factors, the strategy they used to learn a subject, their ability, or the amount of effort exerted to learn. Attributions of success or failure to strategy use are directly related to positive self-reactions (Zimmerman & Kitsantas, 1997)

which, due the cyclical nature of self-regulation, enhance aspects of the forethought phase, such as elevating students self-efficacy about the academic skill, motivating students to seek harder goals, and greater intrinsic interest in the task at hand (Dweck, 1988; Zimmerman, 1998; Zimmerman & Kitsantas, 1997).

The above discussion explains how the personal, behavioral and environmental influences impact on one another through the forethought phase, performance phase and self-reflection phase of self-regulation (Pintrich & Schunk, 2002; Schunk, 1990; Zimmerman, 2002). Before performing a task or activity, self-regulated learners set goals after evaluating previous performance and analyzing the task requirement. Their goals also reflect their self-efficacy and intrinsic motivation in the subject area. Next, self-regulated learners show sustained efforts towards attaining their goals. They also modify their actions and thoughts based on self-monitoring and evaluation of progress toward the goal (Zimmerman, 2002). At the same time, these self-evaluations of learning or progress, resulted from self-monitoring, affect students' satisfaction and attribution of their performance, efficacy beliefs, which in turn influence students' choice of activities, effort expended, task persistence (Bandura, 1997). In this manner the cycle of self-regulation continues with each factor exerting influence throughout the entire process.

Skillful vs. Less Skillful Self-regulated Learners

Within ideal self-regulated learners, their personal processes, behavioral and environmental influences operate and interplay in an optimal fashion (Zimmerman, 1989). However, this idealized self-regulation does not happen in reality, because no matter how good self-regulated learners are, they cannot have absolute control over the self-

regulatory learning process (Zimmerman, 1989). Skillful self-regulated learners, compared with their less skillful peers, are more proficient in the following aspects.

First, skillful and less skillful self-regulated learners differ in their repertoire and actual application of learning strategies. Learning strategies are defined as overt and covert actions and processes targeted at acquiring information or skills (Zimmerman, 1989, p.329), which help to optimize self-regulatory processes. Less skillful self-regulated learners are not as aware of what particular strategies affect learning outcomes, relate to their self-regulated peers. In other words, less self-regulated learners, often ignorant of the feedback loop, tend to have difficulty comprehending the causality between their behaviors and learning outcomes. Schunk (1994) has designated this feedback loop as students' attribution for the causes of their success or failure on specific academic tasks. He also posits that this feedback loop is related to students' beliefs that they have control over their learning environments.

Second, skillful self-regulated learners differ from their more passive or impulsive counterparts in their self-efficacy perceptions of skill and performance. Less skillful self-regulated learners are less likely to believe they are incapable of succeeding at tasks, and are consequently less committed to academic goals (Zimmerman, 2002). They are also less willing to employ strategies to achieve academic goals. According to the social cognitive model, people's willingness or motivation to employ strategies is based on their self-efficacy beliefs. As discussed earlier, self-efficacy refers to students' beliefs that they can perform well in a particular task domain (Zimmerman & Martinez-Pons, 1992). Self-efficacy is often measured by asking students to rate their likelihood of solving specific problems in certain domains (Zimmerman, 1990a). Social cognitive perspective states

that students' perception of self-efficacy is the key to motivating their efforts to learn (Bandura, 1997, Zimmerman, 2002, Zimmerman & Martinez-Pons, 1992). High perceptions of self-efficacy lead people to exert a high level of efforts especially in the face of obstacles or hardships (Bandura, 1990). In the next section, I explain briefly how individuals learn, acquire and exercise their self-regulatory skills.

Acquisition and Mastery of Self-regulation

From the social cognitive perspective, learners acquire self-regulatory skills and strategies following the four sequential steps: observation, emulation, self-control, and self-regulation (Schunk & Zimmerman, 1997; Zimmerman, 2000a, 2002). The first step, observation, allows learners to observe of how a skill should be performed, such as when an aspiring writer discriminates the main elements of a metaphor (i.e., two things connected by a comparative phrase, such as "*He ate like a horse*."). After learners have a clear image of how to perform the skill, they enact the model(s)'s performance. One primary way that students develop self-regulatory skill is through the observation and imitation of proficient models (Zimmerman, 2000a). Learning through observation occurs when students watch, observe, imitate, and begin to reproduce self-regulatory skills displayed by a proficient model. With the step of self-control, learners can perform the skill or strategy even in novel situations, not just familiar situations. Then, self-regulated learners can adjust the skill or strategy to satisfy the contextual demands.

Observational learning is the process through when information is obtained from watching models' actions, hearing their descriptions, and discerning their consequences. An observer's motivation at this level is enhanced vicariously by the status and perceived expertise of the model. In the present research, observing self-regulatory strategies

demonstrated by classroom teachers, who are experts in mathematics, was presumed to increase students' goal-setting and self-reflection practices.

At the second level, emulation, novices learn to enact a model's performance. Learners have achieved this level of competence when they can emulate the general form of a model's skills, such as when they can apply a model's procedure to set a goal. An example might be, a student set his goal for Wednesday's worksheet performance as "*I plan to answer eight out of 15 problems correctly*" with teachers' reminding or support. Emulative experiences provide aspiring learners with behavioral and often social feedback to refine their performance and to develop self-regulative standards that are essential for higher levels of learning.

At the third or self-control level, students learn from self-directed practice to achieve automaticity in their behavioral technique, such as when a student automatically and independently sets a goal for his worksheet performance when received the worksheet from his teacher. Automaticity in technique is attained most readily when learners focus on the process of enacting the skill (e.g., the goal setting process itself) or strategy rather than on its outcomes (e.g., having a goal ready on the worksheet). Primary sources of motivation at this level are self-satisfaction reactions stemming from matching or surpassing a model's strategic process standards.

At the final sequential level of a social cognitive model of self-regulation, students learn to adapt their performance to changes in internal and external conditions. To accomplish this, they must shift their attention from modeled processes to performance outcomes. For example, aspiring writers can increase the effectiveness of their prose by monitoring which procedures have the most impact on the effectiveness

and efficacy of problem solution. Two primary sources of motivation at this level are self-efficacy beliefs (the degree to which a performance feels capable of performing a particular task) and intrinsic interest in working with fractions.

In the present research, math teachers modeled both strategies (i.e., goal setting, self-reflection) through verbal description and actual actions daily over the course of seven consecutive school days. While doing so, teachers also provided guided practice and encouraged independent practice of the two strategies. In the research, a combination of observation and emulation was used primarily since it was reported as an effective method in fostering self-regulatory practices in developing learners (especially in developing the skills for revising strategies and improving text structure in writers with learning disabilities) (Braaksma, Rijlaarsdam, van den Bergh, & van Hout-Wolters, 2004; Englert, 1992; Graham, Harris, Troia, 2002; Harris & Graham, 1992; Schunk & Zimmerman, 1997; Zimmerman & Kitsantas, 2002). This combination approach of both observation and guided emulation is more effective than the direct teaching method in supporting college students in a sentence-combining task (Zimmerman & Kitsantas, 2002) and in enhancing planning and rereading strategies in eighth grade writers (Braaksma et al., 2004).

Students with Special Needs and Self-regulation

The present paper chose to focus on students with mild to moderate disabilities, especially learning disabilities, and the challenges they face with effective self-regulation. Learning disabilities refers to "a disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, which disorder may manifest itself in an imperfect ability to listen, think, speak, read, write,

spell, or do mathematical calculations," as stated in United States Code (20 U.S.C. §1401 [30]) (IDEA, 2004). This term includes such conditions such as perceptual disabilities, brain injury, minimal brain dysfunction, dyslexia, and developmental aphasia. This term does not include "learning problems that are primarily the result of visual, hearing, or motor disability, of mental retardation, of emotional disturbance, or of environmental, cultural, or economic disadvantage" (IDEA, 2004).

Students with special needs, especially those with learning disabilities (LD), compared with their regular education peers, generally are less effective with self-regulating processes, which is suspected of having a neurological basis (Borkowski & Thorpe, 1994) and social roots (Zimmerman, 2000a). First, their problematic neurological development might be responsible for the difficulties students with special needs experience in focusing, recalling, reading and other cognitive components crucial for effective self-regulation. Students with special needs often demonstrate problems with attention, impulsivity, memory or other aspects of information processing, as well as significant academic difficulties (Wong, Harris, Graham, & Butler, 2003). Second, students with special needs often grow up in low-income homes and communities where self-regulatory models, which are crucial for their development of self-regulatory skills (Brody & Ge, 2001), are insufficient (or even non-existent). Parental processes significantly impacts on children's development and demonstration of self-regulatory skills (Brody & Ge, 2001). In addition, children's attention to classroom instruction is related to whether parents give instructions in an understandable manner at home (Stright, Neitzel, Sears, & Hoke-Sinex, 2001). As a result, students with special needs, who often are already at a disadvantage before reach school age, may need to have good self-

regulatory models in school in order to become better self-regulators. Unfortunately, educators usually focus more on teaching academic skills rather than helping students with self-regulatory learning. It is understandable since legal mandates concerning students with special needs demand more access to the general curriculum (IDEA, 2004) and participation in state and district assessment (NCLB, 2001). However, as a result, special education teachers do not address self-regulatory skills as much as needed, due to their broad range of roles and responsibilities, and the heavy emphasis on academic skills instruction. Third, special educators report that they do not receive sufficient training in supporting self-regulation. The tradition and history of special education is teacher-directed, which often fails to provide students with special needs with specific and appropriate models, and more chances to practice self-regulation. In reality, educators with good intentions may think that they have no choice but to focus on providing various behavioral intervention programs and heavy academic instruction.

Interventions with self-regulatory components have shown considerable success with students with special needs in many areas. Evidence also indicates a broad variety of student populations could benefit from self-regulatory training, such as learning disabilities (e.g., Graham & Harris, 2003; Reid, 1996), behavior disorders (e.g., Nelson, Smith, Young, & Dodd, 1991; Smith & Sugai, 2000), and mental retardation (e.g., Cole & Gardner, 1984). Self-regulatory training is useful not only in decreasing maladaptive or increasing positive target behaviors (Kern, Ringdahl, Hilt, & Sterling-Turner, 2001), but also in producing meaningful improvements in college students' academic productivity and accuracy (Reid, Trout & Schartz, 2005).

Since self-regulation is a cyclical three-phase process, it is reasonable to investigate in which phases students with special needs, especially those with LD, need particular assistance. Some researchers claim students with special needs generally have difficulty with self-reflection, the third phase of cyclical self-regulatory process (Pintrich & Blazevski, 2004). However, studies have suggested students with special needs, as an extremely heterogeneous group, also have difficulty with goal setting (i.e., forethought (e.g., they don't plan or set goals before writing a passage) and performance (e.g., they write incomplete stories) (MacArthur & Graham, 1987).

Challenges Students with Special Needs Face

The obstacles students with special needs often face with goal setting during learning are summarized as follows. When learning mathematics, students with special needs constantly fail to analyze tasks effectively and to set appropriate task standards or criteria, which determine the direction for further learning activities (Butler, 1994; Butler & Winne, 1995; Dweck, 1986). In terms of operation, appropriate goals set by students ideally address the outcomes they would like to achieve and the standards they would use for choosing and applying learning strategies. Additionally, in the self-evaluation stage, students compare some aspects of their performance and standards, judge the results of their learning activities, examine their progress, and adapt their strategies and efforts, based on their interpretation of task requirements. Unfortunately, students with learning disabilities often have difficulties with interpreting task demands accurately. First, many students with special needs do not understand how crucial it is to interpret task demands (Butler, 1994, 1998). Second, even with those students who understand its importance and try to analyze task demands, they are often confused by task demands and tend to

interpret tasks wrongly, usually resulted from lack of concrete strategies for task interpretation (Baker & Brown, 1984; Campione, Brown, & Connell, 1988; Jacobs & Paris, 1987). Third, students with special needs often have problems with self-directing learning activities based on the task requirements they interpret. Therefore, in order to promote self-regulatory learning of students with special needs, researchers and educators need to assist them in constructing adequate task comprehension, to understand the importance of tasks analysis, and to acquire and apply concrete strategies for interpreting task requirements.

The difficulties discussed above are what students as a whole often face in learning. For students with special needs, those problems are more devastating. A typical classroom is not an ideal situation for study since it is not free of distraction. In other words, different goals and objects often compete for students' attention. As the dual processing self-regulation model describes (Boebaert & Cornor, 2005), students in a classroom constantly consciously and subconsciously make decisions about choosing either learning goals or goals unrelated to learning (e.g., goals for being popular among peers, goals for obtaining others' attention) . Students who have established refined and manageable learning goals are more likely to invest and maintain efforts in learning, instead of getting off track (Locke & Latham, 1990). Students with special needs frequently approach classroom tasks with characteristics that threaten the pursuit of establishing and maintaining learning goals (e.g., low motivation, high anxiety, stereotypic or repetitive behaviors, negative peer interaction, destructive and aggressive behaviors, and non-compliance) (e.g., Fidura, Lindsey, Walker, 1987; Oliver, Murphy, & Corbett, 1987; Walker, 1993).

To date, school interventions focus on helping students to cope with the negative affect they experience with stressors rather than supporting students to set and achieve learning goals (Boekaerts & Cornor, 2005). This over emphasis on negative affect is understandable since students with special needs often experience more chronic internal and external stressors, and meet greater obstacles in reaching their learning goals, and as a result experience more negative affect. However, a focus on coping with negative affect may not create the most effective intervention. In fact, students with special needs, especial learning disabilities, tend to make their first and primary appraisal of the class situation in terms of its relevance to their well-being, not in terms of relevance to the learning process (Frijda & Mesquita, 1995). In other words, students often do even set goals related to learning, and those who set learning goals often choose inappropriate ones (e.g., too general, not manageable, or too challenging), which do not help promote, or even inhibit or interfere with, the learning process. Those students without appropriate learning often suffer from the impacts of emotions, especially negative emotions, and as a result, their ongoing learning activities are frequently interrupted, because those students make sure "events that caused the interruption is evaluated and one's coping potential is considered in relation to the potential threat to well being" (Boekaerts & Cornor, 2005, p. 205). Moreover, not only do students with special needs experience negative emotions, but also they have more chronic internal and external stressors to manage. For example, they may face more and greater obstacles en-route to their learning goals due to greater difficulties with issues such as focusing and memorizing. To override both internal and external difficulties, students with special needs, especially learning disabilities, need a higher sense of academic self-efficacy to successfully engage in academic tasks.

Unfortunately, studies on high school and college students revealed that even typically developing youth have a difficult time focusing on academic tasks when other non-academic interesting options are available (Zimmerman & Bandura, 1994; Zimmerman, Bandura, & Martinez-Pons, 1992). Researchers suggest that educators need to help student register more interest and self-efficacy in academic pursuits. Previous research (Zimmerman & Bandura, 1994; Corno, 1989) suggests students need to be taught strategies to motivate themselves during learning in the face of attractive alternatives and obstacles. A possible solution is to collaborate with students on the self-regulated learning process and to help students gain a greater sense of ownership of their learning. In this research, attempts were made when class teachers scaffolded students' development of self-regulatory skills and strategies (i.e., goal setting and self-reflection).

Goal Setting Theory

One of the most thoroughly examined self-regulated learning strategies (or processes) is goal setting, which refers to deciding in advance of one's performance upon specific outcomes (Locke & Latham, 1990). Goal-setting is essential to learning because it affects how learners exert efforts, persist over time, or adjust their behaviors to achieve optimal outcomes (King, Harner & Brown, 2000). Goals also direct students' attention to relevant task features, actions to be taken, and procedures to be performed. Goals help a student to concentrate on the given tasks, choose and use appropriate strategies and resources, monitor progress, avoid distractions, and demonstrate better performance (Schunk, 2001).

When students work on tasks, they evaluate their performance with respect to their goals, and the results of self-evaluation impact their motivation and self-efficacy.

When they perceive progress, their self-efficacy is strengthened and motivation is sustained. When they see a discrepancy between present performance and the current goal, they may increase their efforts, adjust strategies, seek assistance or conduct other adaptive behaviors. Students' self-efficacy is enhanced when they attain or progress towards their goals.

Although students may benefit from goal setting in many ways, simply having a goal does not automatically help students' learning. In fact, effective goals are determined by the three properties: specificity, proximicity, and difficulty (Locke, Shaw, Saari, & Latham, 1981). Goals that denote specific performance standards, are temporally close at hand, and are viewed as difficult but attainable, enhance performance better than goals that are general, temporally distant, or perceived as very easy or very difficult (Schunk, 1990).

Specificity

Studies in various domains indicate that goals that incorporate specific performance standards (e.g., answer nine out of ten problems correctly on a worksheet) are more effective in enhancing self-regulation and activating learning behaviors than vague goals (e.g., do your best on the worksheet) (Bandura, 1997; Boekaerts, Pintrich, & Zeidner, 2000; Locke & Latham, 1990). Specific goals boost performance because they specify precisely what the learner is supposed to do and accomplish during the learning activity, the amount of efforts required for success. Specific goals improve self-efficacy by providing a clear standard against which to determine progress, and indicate the amount of satisfaction anticipated. Specific goals make it easy for learners to monitor

their progress toward the goals. For example, a specific goal of "*Finish the 20 additions questions on page 5*" is more effective than a general one of "*Do your best*."

Proximity

Goal proximity refers to temporal aspects of goals (Lock & Latham, 1990). Depending on how far goals project into the future, goals can be classified into two categories: proximal and distant goals. Proximal, short-term and reachable goals (e.g., "*Memorize the multiplication chart by tomorrow's class*") lead to higher motivation and improved self-regulation than distant and long-term goals which can only be achieved in the far future (e.g., "*Finish the algebra workbook by the end of the year*") (Bandura, 1997; Boekaerts, et al., 2000; Locke & Latham, 1990). Proximal goals boost self-efficacy because they allow frequent and unambiguous self-monitoring and self-evaluation of progress. Compared with proximal goals, distant goal are difficult to use when gauging goal progress and, in turn, do little to promote self-efficacy (Schunk, 1995). Individuals, particularly young learners and novices, benefit more from having proximal goals. However, it is important to note that a distant goal may function as well as proximal goals if it is divided into a series of proximal goals (Locke & Latham, 1990).

Difficulty

Difficulty refers to how challenging a goal is to an individual. Goals that an individual perceives as easy to attain do not motivate learners (Johnson & Graham, 1990). In general, difficult goals demands learners expend greater effort to attain than less difficult ones. However, learners are unlikely to attempt goals they view as too difficult or impossible to attain. On the other hand, learners, when facing difficult goals, may

initially feel unsure whether they can reach them, but working towards and attaining them boosts self-efficacy (Schunk, 1990).

Self-set vs. Assigned Goals

Some studies investigating the effects of self-set goals show that allowing learners to set their own goals enhances motivation and self-regulation, possibly due to higher level of commitment related to self-set goals (Schunk, 1995). Other studies do not support the conclusion by showing that assigned goals are as effective as self-set goals (Locke & Latham, 1990). Schunk (2001) explained, when learners accept the legitimacy of assigned goals and commit themselves to attaining them, the benefits of assigned goals can be as strong as their self set goals. Furthermore, Zimmerman (2000b) hypothesized that self-set goals would produce higher self-efficacy and better self-regulated performance than assigned goals, only when learners have mastered how set appropriate and realistic goals. Interventions to develop students' goal setting skill have shown positive impact on academic performance. For instance, research with secondary students indicated that those who met with a teacher once a week to discuss goals for the next week and evaluate progress toward previously set goals significantly outperformed other secondary students who were assigned in conference-only and control conditions (Gaa, 1973, 1979). In Study 1 of this research, the classroom teachers introduced the importance of goal setting and demonstrated goal setting procedures to students. Then, students were instructed and supported in setting their own goals. Those same intervention effects have been found with college students, as college student who set goals and recorded their progresses gained significantly higher grades than their control group peers (Morgan, 1987).

Learning Goals vs. Performance Goals.

Researchers have investigated the differences between mastery or learning goals, which involve learning skills or strategies, and ego or performance goals, which focus on performing well to avoid appearing incompetent (Dweck, 1999). There is still debate about whether performance and learning goals exert the same powerful effects on enhancing motivation, self-efficacy and self-regulation (Schunk, 1995). In addition, other studies show that performance goals are as effective as progress goals with respect to achievement. Studies published in the 1980s typically employed proximal goals in the form of some expected performance, such as number of problems to be solved (Bandura & Schunk, 1981), employee productivity standards (Bandura & Wood, 1989), or expected course grades (Zimmerman, Bandura, & Martinez-Pons, 1992). More recent studies report mastery-oriented goals are positively related to persistency (Ames, 1992; Dweck, 1989; Meece & Holt, 1993), achievement outcomes (McNeil & Alibali, 2000; Morgan, 1987; Schunk, 1996;), and the deep processing of course materials (Elliott, McGregor & Gable, 1999).

In Study 1 of this research, performance goals were introduced, modeled by the classroom teachers, and then students practiced setting appropriate performance goals. In addition, goals will be set as specific (i.e., number of math problems answered correctly on each worksheet) and proximal (i.e., needs to be reached in one class period).

Self-Regulated Learning, Goal Setting and Self-Efficacy

Bandura (1986, 1997) discussed two principle factors he thought contributed to positive self-efficacy beliefs among learners. One of the most important factors is previous masterful behavioral history. Research shows when learners continuously

experience success in enacting certain coping behaviors, their sense of mastery and satisfaction are enhanced, as well as the belief that similar behaviors can be mastered easily in the future (Stipek & Hoffman, 1980). In this research, self-regulatory interventions of goal setting and self-reflection were hypothesized to increase students' efforts, become aware of their masterful behaviors and also improve the math performance of students with special needs. Therefore, students' self-efficacy level was believed to be lifted due to the continued realization of masterful behaviors.

Events that occur during the goal-setting and during goal-striving process affect changes in learners' self-efficacy beliefs. Self-efficacy is enhanced when people find they are making progress toward their goals because they feel more competent and are in charge of their learning (Bandura, 1986). They also become more motivated to stay on task and continue to work because they perceive their goals as more attainable (Locke & Latham, 1990). When people attain their goals, they experience satisfaction and an increase in self-efficacy. However, this increase on self-efficacy does not happen automatically; it involves conscious (or sometimes subconscious) appraisal of both personal and situational contributions (e.g., perceived ability, expended effort, task difficulty, teacher or peer assistance, previous patterns of successes or failures) (Schunk, 1990), which are connected by goal setting and consequently evaluation of whether goals are achieved or not. When people are informed of whether they have reached the preset performance standards (i.e., goals), changes on their self-efficacy and learning performance are likely to happen. Previous studies suggest students who received specific and difficult goals in various subject areas (e.g., reading comprehension, writing) judged their self-efficacy higher than those who did not receive goals (Graham & Harris,

1989a, 1989b; Schunk & Rice, 1989). According to goal setting theory (Locke & Latham, 1990), goal progress feedback informs individuals about how to attain their goals and motivates them to work on the task by denoting progress and conveying that goals are attainable. Self-efficacy theory postulates that goal progress feedback, as a persuasive form of self efficacy information, raises self-efficacy by suggesting that individuals are competent and can continue to learn (Bandura, 1986).

Teachers can help students develop an effective behavioral history by offering students timely positive feedback about the skillfulness of their coping behaviors. Positive feedback informs self-efficacy and helps students adopt goals that are more challenging, yet attainable (Zimmerman & Kitsantas, 1997). In both Study 1 and Study 2 of this research, feedback on whether goals had been met were initially given to students by the teacher, and then decided by the students with special needs themselves (i.e., students with special needs counted the number of problems they had answered correctly, recorded these numbers, and then compared these numbers with their previously set goals). In addition, the classroom teachers taught, supported and reinforced students' learning of self-regulatory strategies (i.e., goal setting and self-reflection) which allowed students to feel more control over their learning process. With goal setting and self-reflection, students received more feedback about their learning and skill development, and therefore may enhance their self-efficacy.

The second factor is observational or modeled learning. Learners may raise their self-efficacy by witnessing other people (i.e., teachers or peers) perform effectively on a task, although the effects of such changes in self-efficacy may decrease after learners fail to perform the task as effectively as the previously seen models (Schunk & Zimmerman,

1997). In this research, classroom teachers provided sufficient models for learners to observe their self-regulatory practices, and it was hypothesized that students' self-efficacy could be increased in this way. In summary, personal behavioral history and observational learning serve as the foundation of the efficacy beliefs that contribute to better achievement (Paris, Byrnes, & Paris, 2001).

Not only is self-efficacy impacted by goal setting and self-reflection, it also influences learners' goal setting before they perform on tasks. Self-efficacy refers to individuals' beliefs about their capabilities to learn or perform tasks at a designated level (Bandura, 1986). It functions as a key self-motivating entity underlying the processes of goal setting. It influences the activities people choose, amount of effort they exert, and the length of their persistence (Schunk & Swartz, 1993). Learners with high self-efficacy about learning, compared with those with low self-efficacy, choose to engage in more challenging tasks, select effective strategies, expend more effort, and persist longer when they face obstacles (Schunk, 1991; Zimmerman, 1989). When learners with high self-efficacy need to set goals, they set more difficult goals than their lower self-efficacious peers. Low self-efficacious learners tend to avoid tasks, and seem reluctant to set goals, especially challenging ones.

However, there is also some debate on whether self-regulatory training and goal setting could enhance self-efficacy for students with special needs. Sawyer et al. (1992) reported self-regulatory strategy development and goal setting conditions did not result in differences in self-efficacy of upper elementary students with learning disabilities. Sawyer et al. noted that "students with LD began with relatively high pretest self-efficacy scores, despite their relatively poor pretest writing performance" (1992, p.350). This

phenomenon may be explained in the following way. Students with low achievement may not be able to evaluate their learning as accurate as their normally achieving peers, and tend to overestimate their abilities, sometimes dramatically so. As Alvarex and Adelman found (1986), even when students with learning disabilities are able to make accurate self-evaluative judgments, they continuously make overly positive self-evaluations, despite efforts to counter them. Bandura and Schunk (1981) also described such overestimation especially among learning of young ages and learning with learning difficulties as well as Sawyer et al. (1992). Based on the information above, it is ambiguous whether the causal relationship between self-regulatory training and self-efficacy exists for students with special needs in this research. This ambiguity, however, is not rooted in a doubt that goal setting and goal progress enhance learners' self-efficacy but, rather, in the expectation that the initial (pre-test) self-efficacy beliefs held by students with special needs will be miscalibrated as unrealistically high prior to the goal setting intervention and manipulation.

Self-Reflection: Self-Judgment and Self-Reaction

The last phase of self-regulation (also called post action phase) is self-reflection, which consists of two categories of processes closely related to self-observation: self-judgment and self-reaction. Self-judgment refers to comparing present performance with one's goal and making causal attributions concerning the results. Self-judgment may produce various results and consequences depending on types of standards employed (i.e., normative vs. absolute), goal characteristics (i.e., specificity, proximity and difficulty), importance of goal attainment, and performance attributions. Both self-judgment and self-reaction rely on sensitive and proximal self-observation. Without effective self-

observation, it is impossible for learners to make good judgments and therefore take useful reactions.

Self-observation refers to learners' deliberate attention to their own behaviors (Bandura, 1986). Learners have to know what and how they do in order to regulate their actions and behaviors. Schunk suggested action and behaviors can be assessed on dimensions such as quantity, quantity, quality, rate, and originality (1989). Learners' knowledge on their learning can function to improve their studying. For instance, students with special needs often do not realize the subtle progress they make across days and weeks; students with less desirable study habits often are surprised to know how much time they waste on nonacademic activities. Even for the most capable learners, self-observation often take the form of self-recording (i.e., self-monitoring) due to the fact that memory capacity is limited. Self-reporting on learning instances, behavioral instances, or educational instances with entities such as time, place, and duration of occurrence could help the quality of self-observation (Mace, Befiore, & Shea, 1989). Two properties are crucial for effective self-observation: regularity and proximity (Bandura, 1986). Regularity refers to observing instances frequently, not intermittently. Proximity refers to observing instances in time, not long after they occur.

In Study 2, self-observation was aided by self-recording which took place in the form of referring to participants' own practice work sheets. Students observe their own performance by reviewing the number of questions they have attempted to answer, and that of questions they have answered correctly. As discussed previously, students with special needs often have difficulty with attention, motivation and memory. Compared with their typically developing peers, they are less likely to observe themselves

accurately without the assistance of external aids (e.g., their practice work sheets). The self-observation occurs at the end of the 15-min guided/independent practice block and meets the criteria of regularity (once per 15 minutes) and proximity (reviewing their own performance for the last 15 minutes).

As for self-judgment, I have to discuss standards learners use for judging their performance. There are two types of standards of absolute standards and normative standards. Absolute standards are fixed and independent of others' performance, such as "*Finish reading Chapter 1 by next Monday*;" whereas normative standards depend on performance by others "*Score higher than Julia on the 2nd math quiz this semester*." Standards are informative to learners since as they are often used to compare with one's performance to reveal their progress. The importance of goal attainment also affects self-judgment. Learners are more likely to make judgments of goal progress when they value the given goals. Self-judgments are less likely to happen when learners view the given goals as unimportant and irrelevant to them. Attribution, or perceived causes of outcomes, affects learners' achievement beliefs and behaviors (Weiner, 1985). Achievement outcomes often are attributed to such causes as ability, effort, task difficulty, luck and situational factors (e.g., teacher or peer assistance) (Frieze, 1980; Weiner, 1979). Learners take into account their attributions of outcomes when judging whether the progress towards their goals is adequate or not.

Self-reactions to goal progress have emotional consequences (i.e., satisfaction or dissatisfaction) that help motivate learning behaviors (Bandura, 1986). When learners believe the goal progress is acceptable, they continue to strive toward their goals without changing their learning behaviors. At the same time, they experience the anticipated

satisfaction, hold higher self-efficacy and become more motivated. When learners are dissatisfied with their goal progress, they may take actions depending on their attribution and other factors. If they believe they are capable of attaining their goals, they may not decrease motivation and instead, work on what they think they need to improve. In this research, students who were not satisfied with their performance needed to explain what had caused their unsatisfactory performance and decide on an action plan to improve their performance. Students who were satisfied with their performance needed to figure out what had contributed to their satisfactory performance and keep doing what had caused their good performance.

Mathematics Instructions and Interventions for Students with Learning Disabilities

In the last three decades, numerous studies have been published on many aspects of mathematics learning of student with special needs, especially those learning disabilities, including behavioral, cognitive, metacognitive interventions, and some interventions with multiple components (e.g., peer tutoring intervention with strategy instruction, cooperative learning intervention with computer-assisted instruction) (Kroesbergen & Van Lui, 2003). The interventions published, overall, have been effective in raising students' school performance. It seems there is a trend towards incorporating computers, manipulatives and strategy training within instructional formats. The present research follows this trend and embeds self-regulatory strategy training within school class instruction.

In addition to the limited studies on mathematics learning for students with learning disabilities, the range of topics those mathematics interventions address is also limited to basic computation rather than higher level skills which requires analysis and

problem solving. A recent review indicated 65% of the mathematics studies with LD students addressed learning of basic computation skills (Mastropieri, Scruggs, & Chung, 1998). However, National Council of Teachers of Mathematics (NCTM)' emphasis on problems of varying structures (2000) and "problems that require analysis of the unknown, problems that provide insufficient or incorrect data, and problems that can be solved in more than one way or that have more than one correct answer (Mastropieri et al., 2004, p.333)," highlights the problems in addressing such a narrow focus. .

Compared with Mastropieri et al.'s 1998 review, their 2004 review identified a significantly smaller number of studies on mathematics instruction and intervention. Mastropieri et al. (2004) suggests this unfortunate phenomenon may be a consequence of the recently increased emphasis on reading and phonological processes in identification and treatment of learning disabilities (e.g., Bradley et al., 2002; Snow et al., 1998). There is an urgent need for more research on mathematics for students with LD because a substantially large number of students with LD exhibit significant difficulties in mathematics alone and not all of their difficulties are related to or resulted from deficient reading skills (Scruggs & Masteropieri, 2003). In fact, some research reported the cumulative incidence of learning difficulties in mathematics through age 19 ranges from 6% to 14% (Mayo Clinic, 2005).

Masteropieri et al. (2004) showed that recent NCTM-based math curriculums (e.g., Enhanced Anchored Instruction) often failed to lead to more positive effects than traditional instructions did. Nevertheless, the published studies show that students in experimental conditions always performed at least as well as controls. Although there can many factors (e.g., teachers' familiarity with traditional instruction) that are possibly

accountable for this finding, it may suggest the need to develop versatile and universal self-regulatory strategies to incorporate into many mathematics curricula used by different teachers in many classrooms.

CHAPTER III

HYPOTHESES

In this research which involves self-regulatory interventions on goal setting and self-reflection for high-school students with special needs who receive specialized mathematics instruction, the following hypotheses were examined. The hypotheses are grouped into three clusters with the first cluster (Hypotheses 1-4) relating to students' overall development of self-regulatory strategies and attributions across both studies, the second cluster (Hypotheses 5-9) relating to the hypothesized benefits from the goal-setting intervention in Study 1, and the third cluster (Hypotheses 10-14) relating to the hypothesized benefits of the self-reflection intervention in Study 2.

Hypotheses Relating to the Development of Self-Regulatory Strategies (Studies 1 and 2)

Students completed two administrations of the Self-Regulated Learning Interview Schedule (SRLIS)—once prior to Study 1 and a second time 2 to 5 weeks after the conclusion of Study 2. Comparing students' scores across the two SRLIS administrations, it was hypothesized that participants would show an increase in their frequency and variety of self-regulatory strategies used after participating in the combination of goal setting and self-reflection interventions. Comparing students' score across the two Attribution Scale administrations, it was hypothesized that participants would show an increase in their attribution to controllable causes (i.e., strategy use, efforts and practice) after participating in the combination of goal setting and self-reflection interventions. The reason that all participants were expected to show increased self-regulatory strategies and controllable attributions—rather than just those participants in the experimental groups of Studies 1 and 2—was that participants in the control groups of both studies received a

delayed treatment exposure to the experimental interventions. Hence, by the end of Study 2, all participants had received both interventions.

The Self-Regulated Learning Interview Schedule generates two measures on learners' use of self-regulatory strategies. First, strategy use (SU) refers to the number of different self-regulatory strategies used by each participant. Second, strategy frequency (SF) is measured with the number of times that each strategy is mentioned by a student.

Hypothesis 1. The participants' second SRLIS scores will show a significant increase in their self-regulatory strategy use (SU) compared with their first SRLIS scores.

Hypothesis 2. The participants' second SRLIS scores will show a significant increase in their self-regulatory strategy frequency (SF) compared with their first SRLIS scores.

Hypothesis 3. The participants' second Attribution Scale administration scores will show a significant increase in their scores for controllable attributions than their first Attribution Scale administration scores.

Hypothesis 4. The participants will show a significant increase in their second math performance scores compared with their first second math performance scores.

Hypotheses Relating to the Goal-Setting Intervention (Study 1)

In Study 1, which consisted of a self-regulatory intervention involving goal setting, the following hypotheses were examined.

Hypothesis 5. The experimental group receiving the goal setting intervention would improve more than the control group on the post-intervention assessment of their accuracy of the math performance test (i.e., number of problems answered correctly).

Hypothesis 6. The experimental group would show higher post-intervention levels of self-efficacy in solving math problems than would the control group.

Hypothesis 7. The experimental group would show higher post-intervention levels of intrinsic motivation toward solving math problems than would the control group.

Hypothesis 8. The experimental group would show higher post-intervention levels of satisfaction in their math performance (i.e., understanding math concepts and solving math problems) than would the control group.

Hypothesis 9. The experimental group would evaluate the quality of the math instruction they received more positively on their post-intervention assessment than would the control group.

Hypotheses Relating to the Self-Reflection Intervention (Study 2)

In Study 2, which consisted of a self-regulatory intervention involving self-reflection, the following hypotheses were examined.

Hypothesis 10. The experimental group receiving the self-reflection intervention would improve more than the control group on the post-intervention assessment of their accuracy of the math performance test (i.e., number of problems answered correctly).

Hypothesis 11. The experimental group would show higher levels of post-intervention intrinsic motivation toward solving math problems than would the control group.

Hypothesis 12. The experimental group would show higher levels of post-intervention satisfaction in their math performance (i.e., understanding math concepts and solving math problems) than would the control group.

Hypothesis 13. The experimental group would show higher levels of post-intervention self-efficacy toward solving math problems than would the control the control group.

Hypothesis 14. The experimental group would evaluate the quality of the math instruction they received more positively on the post-intervention assessment than would the control group.

CHAPTER IV

METHOD

Participants

Seventy-five high school students with special needs in five special education resource classes in the Midwest were recruited for the present research. Sixty-two high school students (40 males and 22 females) completed the both interventions on goal setting and self-reflection and were included in the data analysis. Among the sixty-two participants, 64% percent of the participants were European American, 32% African American, and 4% Hispanic. The racial composition of the participants was roughly the same as the student body in the three participating school districts. Among participants, male students were twice more than female students included in the study relative to what was expected from the existing gender distribution within the school districts. This characteristic of the study's sample is not problematic, however, because male students are typically overrepresented in students with special needs (Wehmeyer & Schwartz, 2001). Sixty-four percent of participants received free or reduced lunch. These sixty-two students ranged in age from 15.1 to 19.8 years, with an average age of 17.2 years.

Description of Participants

All students with special needs participating in this study met the following criteria: (1) identification as eligible individuals (EI) to receive special educations by their local school district in Iowa; (2) description in students' school files suggesting difficulties in learning (e.g., the performance summary and problems inhibiting them from making progress, accommodation methods); (3) students' standardized math scores (e.g., the Iowa Test of Educational Development) were at least one standard deviation

below the average; (4) students receive math instruction with accommodations. Unlike almost all of the previously published articles, participants' disability types and intelligence scores are not reported due to lack of intelligence testing results in participants' school files. School districts in the state of Iowa have adopted Iowa's response to intervention (RtI) model which utilizes a non-categorical designation for all students with special needs identified as eligible individuals (EI). Iowa state legislation requires students with special needs are not labeled with different categories (e.g., learning disabilities, emotional behavioral disturbance). That explains the difficulty I face in describing specific disabilities types the participants had in the present research. In addition, standardized cognitive ability test and achievement tests are no longer required for determining students' eligibility for special education, as mandated by the Iowa Department of Education.

Participant Attrition

Initially, seventy-five high school students with special needs in five special education resource classes in the Midwest were recruited for the present research. However, 62 students (i.e., 83% of the recruited sample) completed the research and whose data were included in data analysis for testing hypotheses.

Considering the typical attendance issue for students with special needs and the duration of this research, the issue of attrition was addressed with the following procedures. First, to be included in data analysis, participants needed to receive at least six school days (out of a possible 10) of each intervention. The rationale behind the six-day standard was that the intervention and the instruction that participants missed in one day could be compensated easily since teachers typically reviewed the previous day's

lesson and intervention. Second, participants who missed the post-assessment(s) of dependent measures (e.g., mathematics achievement test, the intrinsic motivation scale) for any reason were allowed to take the post-assessment one day later. Therefore, the use of the six-day standards ensured the data and results reflected intervention effects rather than difference in amount of instruction participants received. Third, participants who missed the pre-assessment(s) of dependent measures for any reason were not allowed to take the pre-assessment, and were excluded from data analysis. This decision was made based on students' special needs. Students with special needs tend to feel frustrated when presented with novel and unfamiliar assessments. In my research situation, participants could manage their frustration when taking the pre-assessment(s) in a group or with the rest of the class, but taking pre-assessment(s) alone was too overwhelming.

The descriptive statistics on pre-intervention dependent measures on the final participants (N=62) and the students who "dropped out" (N=13) from the present research were presented in Table 7. One-way ANOVAs were conducted to investigate whether the participants who completed the study differ from those who "dropped out" on the pre-intervention assessment of dependent measures (e.g., math performance, self-efficacy, and intrinsic motivation). The following findings were generated. The math performance of these two groups differed significantly, $F(1, 73) = 11.59$ ($p < .05$). The math self-efficacy scores of these two groups differed significantly, $F(1, 71) = 11.59$ ($p < .05$). The satisfaction with math performance scores of these two groups differed significantly, $F(1, 73) = 6.37$ ($p < .05$). The intrinsic motivation toward math learning did not differ significantly, $F(1, 71) = 2.70$ ($p > .05$). The evaluation of math instruction received of these two groups did not differ significantly, $F(1, 72) = 1.88$ ($p > .05$).

Although it might be surprising to see the math performance of the "drop-outs" was significantly higher than "completers," the discrepancy could be explained by the fact that some participants who made sufficient progress switched their placement from resource room math class to general education math class after their spring Individualized Education Plan (IEP) meetings. The "drop-outs" showed lower self-efficacy in math learning than did the "completers" before the interventions. The "drop-outs" also tended to view the math instruction they received more negatively than the "completers." "Drop-outs" and "completers" had comparable levels of intrinsic motivation towards math learning and satisfaction with their math performance.

Although the difference between "drop-outs" and "completers" were statistically significant, I would not conclude that the final sample was biased or not reprehensive of the special needs population. Instead, I think the differences reflected more of the dynamic nature of special education placement. In addition, the small sample size ($N \leq 13$) of the "drop-outs" group might keep the ANOVA tests from being considered valid and powerful.

Curriculum and Instruction

Class Instruction and Intervention: A typical 55-minute math class started with progress monitoring (10 minutes), followed by teacher lecture (or teacher directed instruction, 30 minutes), and concluded with guided/independent practice (15 minutes). The self-regulatory intervention took place during the guided/independent practice (i.e., the last 15 minutes in class) (see Table 2).

Research Design

This research investigated whether self-regulatory training in goal setting (i.e., Study 1) and self-reflection (i.e., Study 2) would enhance students' with special needs effective use of self-regulatory strategies and change attributed causes of their math performance. Before Study1, all the participants were individually interviewed with the Self-Regulated Learning Interview Schedule (SRLIS) which was designed to reveal students' academic self-regulatory strategy use in many domains. Then, all the participants experienced two consecutive self-regulatory interventions with Study 1 and Study 2. Next, all the participants were individually interviewed again using the SRLIS. The results of these two SRLIS administrations were compared to show whether the two self-regulatory interventions (i.e., goal setting and self-reflection) enhanced students' with special needs strategy use (SU) and strategy frequency (SF). Appendix A outlines the design of my research with two studied included.

Study 1

Prior to the intervention of goal setting, all participants took a math performance test and completed several measures which are discussed in the methodology section. Following this pre-intervention assessment, participants in each class were then randomly assigned into either the treatment group or a delayed-treatment control group. Both groups received math instruction from the same math teachers each day for seven consecutive school days. Appendix B outlines the design of my study 1.

Over the course of seven consecutive school days, participants in the treatment participated in the goal setting intervention during the last 15 minutes of class (i.e., practice time). Participants in the control group also worked with the same math

problems during the practice time but did not receive the intervention. To teach the goal setting process, the teacher asked each student to set a goal for the number of problems to answer correctly per worksheet. There were 15 practice problems on each worksheet per day over the course of seven consecutive school days. The control group received regular instruction on worksheets with no goal setting intervention. After seven school days, all participants were re-tested using the same math test and related measures completed initially. On Day 1, with the treatment group, the teacher introduced the importance of goal setting and modeled how to set goals. From Day 1 through Day 4, the teacher modeled how to set one or two good goals per class session. From Day 1 through Day 7, the students set their own goals independently when they felt ready. Over the seven consecutive school days, the teacher's support was always available if requested. During the allotted practice time, the control group worked on their typically assigned practices worksheets with no goal setting intervention. Appendix C outlines the instructional procedures from Day 1 through Day 7. Teachers kept giving students feedback on the goals they wrote on their worksheets. For example, there was a student who was very slow at answering questions (e.g., low processing speed or fine motor problems) and he typically was able to answer three to four problems. He often felt frustrated when asked to work on worksheets and therefore initially set a goal of zero. In this situation, the teacher stepped in and convinced the student that five or six might be a better goal for him.

Study 2

Since self-reflection requires students to reflect on their learning by comparing with their pre-set goals, the first step of Study 2 provided delayed treatment to

participants in the control group of Study 1 on goal setting for seven consecutive school days (see shaded cells in Appendix B). That is, after seven days only participants in the treatment group received the goal-setting intervention, but after 14 days all participants in both conditions received the goal-setting intervention.

Next, participants were randomly re-assigned into either a treatment group or a delayed-treatment control group. Over the course of seven consecutive school days, participants in the treatment group participated in the self-reflection intervention during the practice time. To teach the self-reflection process, the teacher asked each student to judge whether he or she had met the accuracy goal, what explained his or her meeting or not meeting the goal, and what actions he or she might take to maintain or improve performance in the future. The control group received regular instruction on worksheets (just as was done during the goal setting intervention). After this self-reflection intervention, all participants completed the same math performance test and other measures they had completed earlier in Study 2. Appendix D outlines the design of my study 2.

More details on the instructional procedures utilized in Study 2 are presented in Appendix E. On Day 1, with the treatment group, the teacher introduced the importance of self-reflection and demonstrated how to self-reflect with the self-reflection form provided. From Day 1 to Day 4, the teacher continuously modeled how to use the self-reflection form. From Day 1 to Day 7, the students made use of the self-reflection form by judging their performance, figuring out the cause of their satisfactory or dissatisfactory performance, and deciding what to do to maintain or improve their performance. Over the seven consecutive school days, the teacher's support was always

available if requested. Teachers kept giving students feedback on the reflection options they wrote on their worksheets. For example, there was a student who chose all options or none options when they believed none option explained their success or failure in meeting their goals. In this situation, the teacher needed to step in and explain the connotation of each option to the students. If no option applied, the students needed to be prompted to write down their own explanation about their performance outcomes. During the allotted practice time, the control group worked on their typically assigned practices with self-reflection intervention.

Measures

Self-regulatory Learning Interview Scale (SRLIS)

The Self-regulated Learning Interview Schedule (SRLIS) (Zimmerman & Martinez-Pons, 1986, 1988, 1990) was used to assess participants' self-regulatory learning practices with eight learning contexts (see Appendix F). This instrument has been used by Zimmerman and Martinez-Pons in their 1986 and1988 studies which supported the SRLIS is a reliable and valid measurement on self-regulation. For each context, participants indicated the methods they typically used to accomplish the task at hand. Students' responses were then classified into 14 categories of self-regulated strategies and one "other" category (see Appendix K).

The SRLIS generates two measures: strategy use (SU) and strategy frequency (SF). Strategy use (SU) refers to the number of different self-regulatory strategies each participant uses. Based on Zimmerman and Martinez-Ponz's scoring system, each strategy was recorded as only once no matter how many times it was mentioned by a participant. The SU scores participants could possibly obtain range from zero to 14.

Strategy frequency (SF) refers to the number of times in total that all self-regulatory strategies are mentioned. Each self-regulatory strategy was recorded on the number of times it was mentioned by a participant during the eight learning contexts. Then, the occurrences of the all 14 strategies mentioned by each participant were summed up, and the number of times a strategy mentioned was taken into consideration. The lower limit for participants' SU scores is zero (i.e., no self-regulatory strategies were mentioned) and there is no upper limit for the SF scores.

This SRLIS was administered by an experienced interviewer who was unaware of students' group condition (see Appendix L for interview procedures). Every interview was audio recorded verbatim and then transcribed into protocols. The SRLIS interview protocols were analyzed by a trained coder. To assess reliability, two coders independently coded approximately 20 percent of the protocols. Both coders were trained previously to reach an 80 percent level of agreement (Withall, 1949). Two trained coders coded the data separately, and disagreements were resolved through discussion. In this research, the interrater reliability is .93 for SU, and .84 for SF. The high interrater reliability for SU was achieved mainly due to the intensive training raters had received and the thorough disagreement resolution sessions.

Attributions Scale

The Attribution Scale was adapted and expanded from Zimmerman and Kitsantas' attribution interview scale (1997) to reveal students' attribution of failure and success on math problem solving. The Attribution Scale was used successfully by Zimmerman and Kitsantas who reported acceptable levels of reliability and validity. The Attribution Scale was adapted and expanded from Zimmerman and Kitsantas' This scale used four orally

presented, open-ended questions that asked students to indicate why they thought they had done poorly on some math problems and why they had done well on others. The questions included "*Why do you think you missed this problem?*" "*Why do you think you answered the problem right?*" "*What can you do to keep doing well?*" and "*What can you do to improve your performance?*" (See Appendix G for details)

Students' answers were audio recorded, then transcribed and grouped by coders into one or more of seven categories: strategy use (e.g., goal setting, self-reflection), efforts, ability, practice, external assistance (e.g., teacher's instruction, peer's help), "*I don't know*" or other. A student received one point for any one of the controllable causes (i.e., strategy use, efforts and practice) no matter how many times it was mentioned and zero for any less controllable causes (i.e., ability, external assistance, and other). The attribution scores ranged from 0 to 12. Two trained coders coded the data separately, and disagreements were resolved through discussion. Interrater reliability was .95. The interrater reliability was achieved due to the intensive training raters had received and the thorough disagreement resolution sessions.

Mathematics Performance Measure

This mathematics performance test consists of 15 mathematics problems based on the high school mathematics curriculum used in the classrooms (see Appendix H for a sample measure). This measure was developed by the primary investigator and participating teachers, which reflects both the curricula in use and the research interest. The 15 problems were used to assess participants' understanding of math concepts and problem solving skills, and reflected students' mathematics achievement. Students were asked to attempt as many problems as they could, although they were allowed to skip

problems they didn't know how to answer. Students worked on the problems independently without assistance from teachers. This test generated an accuracy score for each student with the number of problems (out of 15) he (or she) answered correctly.

Self-efficacy Scale on Solving Math Problems

An adapted Mathematics Self-efficacy Scale (Nielsen & Moore, 2003) was used to measure participants' expressed confidence in math learning (see Appendix J for a sample scale). Each item used a 1-7 scale, ranged from 1 (*Not at all confident*) to 7 (*Very confident*).

In this scale, students' self-perceptions in working with specific math tasks were measured. It is distinguished from domain-specific assessment of students' self-perceptions in working in the subject of mathematics in general (Pajares & Graham, 1999). Bandura postulates the specificity of tasks and the correspondence between the task and the entity of interest could increase prediction of self-efficacy on academic outcomes. In addition, Seegers and Boekaets' study suggested task specific assessments on self-efficacy enhance prediction than broader assessments (1996).

The first item (i.e., work with fractions) was borrowed from a previously validated questionnaire (Mathematics Self-efficacy Scale, Nielsen & Moore, 2003). The original questionnaire covered nine mathematical domains, and this item (i.e., work with fractions) was chosen because it matched the research interest of the current investigation. The remaining eight items were written specifically for the present investigation. In creating the new items, the investigator followed procedures outlined by Bandura and Schunk (1981) and the format used by Nielsen and Moore (2003). Except the first item (i.e., *Work with fractions*), other items were supplemented with visual aids (e.g., *Write*

the fraction represented by the shaded part in the figure) and specific examples (e.g., *two thirds and one fourth were used to compare fractions*) to accommodate participants' needs of seeing concrete examples to assist their comprehension. Participants are instructed to provide honest answers to each item on the basis of how they feel at the time of instrument administration, and not on the basis of how they wish they felt or how they may feel at the end of the mathematics class. The nine-item scale showed high internal consistency, Cronbach's alpha= .87. The test-retest reliability was .90. This high test-retest reliability was one of the most unexpected findings in the research. The high test-retest reliability could be partially explained by a unique administration practice. The researchers were able to re-administer this measure to obtain test-retest data in the study hall period, right after participants' math class when the first administration of this measure was conducted. The short intervals between the two administrations accounted somewhat for this high reliability.

Intrinsic Motivation Scale

An Intrinsic Motivation Scale (Reeve, Nix & Ham, 2003) was used to assess participants' intrinsic motivation in math learning with a 1-7 point scale, ranged from 1 *(Not at all true*) to 7 (*Very much true*). Some adaptations were made to the original scale to fit the purpose of my research, such as substituting "the puzzle" in each scale item with "solving fraction problems" (see Appendix I). In this research, intrinsic motivation was operationally defined as participants' self-reported level of interest and enjoyment of working with math problems fractions. Three items (i.e., item 3, item 4, and item 5) (e.g., "*Solving fraction problems is interesting*") were used to assess interest; the other three

items (item1, item2, item6) (e.g., "*Solving fraction problems is fun*") were used to assess enjoyment. This six-item scale showed high internal consistency, alpha = .92.

Satisfaction Scale

A one-item Satisfaction Scale was used to assess each participant's satisfaction with his (her) daily math worksheet performance on a 1-7 point scale, ranged from 1(*Not at all satisfied*) to 7 (*Very satisfied*). The item was as follows: "*How satisfied are you with today's performance?*" This scale was adapted from the satisfaction scale used by Kitsantas and Zimmerman in their 1998 study. The test-retest reliability was .92.

Evaluation of Instruction Measure

A one-item Instructional Evaluation Scale was used to assess how positively a participant perceived the mathematics instruction received during that particular 50-minute class period with a 1-7 point scale, ranged from 1 (*Not at all good*) to 7 (*Very good*). The item was as follows: "*How do I rate today's instruction*?" The test-retest reliability was .83.

Treatment Fidelity

To ensure consistent implementation of the interventions, the following procedures were employed. First, the participating teachers strictly followed standard scripts (see Appendix M and Appendix N) when introducing and modeling goal setting and self-reflection. In fact, the participating teacher practiced using the scripts until they could be performed without error prior to the start of the research. To standardize the intervention procedure, participants in Study 2 use a standard self-reflection report (see Appendix O) to facilitate their reflection practices.

The primary investigator also checked the accurate delivery of intervention information. She observed 80 percent of the lessons and used a card system to remind the teacher with time management. This procedure ensured that the instructional routines were identical across school days and the amount of time allotted for to self-regulatory interventions was constant among cooperating teachers.

With regards to assessment issues, some practices were designed and applied to help participants understand numerical scales on self-efficacy, motivation and other dependent measures (see Appendix P for more information).

CHAPTER V

RESULTS

In this research, results were analyzed with both a *t*-test and an analysis of covariance (ANCOVA). The first cluster of hypotheses (Hypotheses 1-4) was tested with a paired-samples *t*-test, which were used to examine within-group pre-post comparisons. ANCOVA was used for the rest of analyses (Hypotheses 5-14) with pre-intervention scores on the dependent measure serving as the covariate, post-intervention scores serving as the dependent or outcome measure, and experimental group (treatment vs. control) serving as the independent variable. Results are reported for both studies, with the results for Study 1 (i.e., goal-setting intervention) reported first, and results for Study 2 (i.e., self-reflection intervention) reported second (Tables 3 and 4).

The rationale that both *t*-tests and ANCOVAs were used was: *t*-tests for the statistical tests that didn't include independent variables, and ANCOVAs were for tests that included the independent variables. The second and third clusters of hypotheses were tested with a repeated measures analysis of co-variance using participants' pretest scores as the covariate to test if the interventions increase participants' scores on the dependent measures. ANCOVA was preferred over *t*-tests because of the potential small sample size that leaves open the possibility that the two groups of participants were not highly comparable at the start of the study despite the use of random assignment to conditions. The first cluster of hypotheses demanded comparisons between participants' pre- and post-intervention scores, so paired samples *t*-test was chosen since having comparable groups was no longer a concern.

Results about the First Cluster of Hypotheses 1 - 4 (Study 1 and 2)

In total, twenty-nine high school students with special needs and low math performance were included in the data analysis involving the first cluster of hypotheses 1-4. The ending of this study coincided with the end of 2009 school year and many participants were unable to be tested and interviewed due to their exam schedules (i.e., many participants needed extended time for end-of-year exam and schools used their open hours and/or study hall time which I planned to use for this research). Table 3 shows the descriptive statistics for the pre- and post-intervention dependent measures.

The descriptive statistics for participants' pre-intervention and post-intervention SU scores appear in Table 3. A paired-samples *t*-test was conducted to compare participants' strategy usage (SU) scores. There was a significant increase from the pre-intervention variety scores ($M = 7.75$, $SD = 2.37$) to the post-intervention variety scores ($M = 8.96$, $SD = 2.15$): $t\ (27) = 2.15$, $p < .05$. These results suggest that the combination of goal setting and self-reflection interventions had an enhancing effect on the variety of self-regulatory strategies students with special needs use (Hypothesis 1 was supported).

The descriptive statistics for participants' pre-intervention and post-intervention SF scores appear in Table 3. A paired-samples *t*-test was conducted to compare participants' strategy frequency (SF) scores. There was not a significant increase from the pre-intervention frequency scores ($M = 14.36$, $SD = 6.44$) to the post-intervention frequency scores ($M = 16.82$, $SD = 4.64$): $t\ (27) = 1.71$, $p > .05$. These results suggest that the combination of goal setting and self-reflection interventions did not have a significant enhancing effect on the frequency of self-regulatory strategies students with special needs use in learning contexts (Hypothesis 2 was rejected).

The descriptive statistics for participants' pre-intervention and post-intervention controllable attribution scores appear in Table 3. A paired-samples *t*-test was conducted to compare participants' adaptive (i.e., controllable) attributions for their math performance. There was a significant increase from the pre-intervention adaptive attribution scores ($M = 2.86$, $SD = 1.69$) to the post-intervention adaptive attribution scores ($M = 4.43$, $SD = 3.59$): $t\ (27) = 2.84$, $p < .05$. These results suggest that the combination of goal setting and self-reflection interventions had a significant effect on increasing the adaptive (more controllable) attributions students with special needs tended to make (Hypothesis 3 was supported).

The descriptive statistics for participants' pre-intervention and post-intervention math performance scores appear in Table 3. A paired-samples *t*-test was conducted to compare the students' pre-intervention and post-intervention math performance. There was a significant increase from the pre-intervention math performance scores ($M = 11.79$, $SD = 1.29$) to the post-intervention math performance scores ($M = 14.93$, $SD = 2.02$): $t\ (27) = 4.46$, $p < .05$. These results suggest that the combination of goal setting and self-reflection interventions has a significant effect on enhancing the math performance scores displayed by students with special needs (Hypothesis 4 was supported).

Results about the Second Cluster of Hypotheses 5 - 14 (Study 1 and 2)

Math Performance

The descriptive statistics for participants' pre-intervention and post-intervention math performance scores in Study 1 broken down by experimental condition appear in Table 4. In Study 1, participants who participated in the goal-setting intervention scored higher on accuracy than did participants who did not participate in the goal-setting intervention (*Ms*, 11.28 vs. 13.50; $F(1, 59) = 13.35$, $MSE = 79.21$, $p < .01$, Partial $\eta^2 = .18$) (Hypothesis 5 was supported).

The descriptive statistics for participants' pre-intervention and post-intervention math performance scores in Study 2 broken down by experimental condition appear in Table 5. In Study 2, participants who participated in the self-reflection intervention scored higher on accuracy than did participants who did not participate in the self-reflection intervention (Ms, 8.00 vs. 9.29; $F(1, 59) = 9.36$, $MSE = 8.96$, $p < .01$, Partial $\eta^2 = .14$) (Hypothesis 10 was supported).

Math Self-efficacy

The descriptive statistics for participants' pre-intervention and post-intervention math self-efficacy scores in Study 1 broken down by experimental condition appear in Table 4. In Study 1, participants who participated in the goal-setting intervention scored higher on the self-efficacy scale than participants who did not participate in the goal-setting intervention (*Ms*, 41.16 vs. 51.54; $F(1, 55) = 12.21$, $MSE = 127.09$, $p < .01$, Partial $\eta^2 = .18$) (Hypothesis 6 was supported).

The descriptive statistics for participants' pre-intervention and post-intervention math self-efficacy scores in Study 2 broken down by experimental condition appear in

Table 5. In Study 2, participants who participated in the self-reflection intervention score higher on the self-efficacy scale than did participants who did not participate in the self-reflection intervention (*Ms*, 50.04 vs. 59.08; $F(1, 49) = 4.27$, $MSE = 139.63$, $p < .05$, Partial $\eta^2 = .08$) (Hypothesis 11 was supported).

Intrinsic Motivation for Math

The descriptive statistics for participants' pre-intervention and post-intervention math intrinsic motivation scores in Study 1 broken down by experimental condition appear in Table 4. In Study 1, participants who participated in the goal-setting intervention did not score higher on the intrinsic motivation scale than participants who did not participate in the goal-setting intervention (*Ms*, 20.71 vs. 26.00; $F(1, 49) = 2.00$, $MSE = 34.25$, $p > .05$, Partial $\eta^2 = .04$) (Hypothesis 7 was rejected).

The descriptive statistics for participants' pre-intervention and post-intervention math intrinsic motivation scores in Study 2 broken down by experimental condition appear in Table 5. In Study 2, participants who participated in the self-reflection intervention scored higher on the intrinsic motivation scale than did participants who did not participate in the self-reflection intervention (*Ms*, 18.00 vs. 24.92; $F(1, 53) = 7.17$, $MSE = 52.19$, $p < .01$, Partial $\eta^2 = .12$) (Hypothesis 12 was supported).

Satisfaction with Math Performance

The descriptive statistics for participants' pre-intervention and post-intervention math satisfaction scores in Study 1 broken down by experimental condition appear in Table 4. In Study 1, participants who participated in the goal-setting intervention scored higher on the satisfaction scale than did participants who did not participate in the goal-

setting intervention (*Ms*, 4.03 vs. 5.00; $F(1, 51) = 5.09$, $MSE = 3.19$, $p < .05$, Partial $\eta^2 = .09$) (Hypothesis 8 was supported).

The descriptive statistics for participants' pre-intervention and post-intervention math satisfaction scores in Study 2 broken down by experimental condition appear in Table 5. In Study 2, participants who participated in the self-reflection intervention do not score higher on this scale than did participants who did not participate in the self-reflection intervention (*Ms*, 4.85 vs. 5.46; $F(1, 55) = 1.80$, $MSE = 3.10$, $p > .05$, Partial $\eta^2 = .03$) (Hypothesis 13 was rejected).

Satisfaction for Math Instruction

The descriptive statistics for participants' pre-intervention and post-intervention math instruction evaluation scores in Study 1 broken down by experimental condition appear in Table 4. In Study 1, participants who participated in the goal-setting intervention scored higher on the satisfaction for math instruction scale than did participants who did not participate in the goal-setting intervention (*Ms*, 4.47 vs. 5.55; $F(1, 51) = 4.35$, $MSE = 2.50$, $p < .05$, Partial $\eta^2 = .08$) (Hypothesis 9 was supported).

The descriptive statistics for participants' pre-intervention and post-intervention math instruction evaluation scores in Study 2 broken down by experimental condition appear in Table 5. In Study 2, participants who participated in the self-reflection intervention scored higher on the satisfaction for math instruction this scale than did participants who did not participate in the self-reflection intervention (*Ms*, 4.23 vs. 5.50; $F(1, 41) = 22.05$, $MSE = 2.03$, $p < .01$, Partial $\eta^2 = .30$) (Hypothesis 14 was supported).

Correlation Analysis

Table 6 shows the pre-intervention correlation matrix, for the five dependent measures of student math performance, math self-efficacy, intrinsic motivation for math, satisfaction with math performance and students' evaluation of math instruction. As shown in the table, students' math performance and their self-efficacy in learning math intercorrelated positively and significantly, $r(61) = .39$, $p < .01$. Students' self-efficacy in learning math correlated positively and significantly with the rest of the dependent measures: students' intrinsic motivation in learning math, $r(61) = .46$, $p < .01$, students' satisfaction with their own math performance, $r(61) = .39$, $p < .01$, and their evaluation on the quality of math instruction they had received, $r(61) = .39$, $p < .01$. And, students' intrinsic motivation to learning math correlated positively and significantly with their satisfaction with their performance, $r(61) = .34$, $p < .01$, and their evaluation on the quality of math instruction they had received, $r(61) = .44$, $p < .01$. Additionally, students' satisfaction with performance also correlated positively and significantly with their evaluation of math instruction they received, $r(61) = .47$, $p < .01$.

Therefore, the correlation table for post-intervention dependent measures is not available because when the dependent variables were measured the last time, the control group in Study 2 had not received the delayed treatment on self-reflection. It doesn't make too much sense to present a correlation matrix with this confounding effect.

The zero-order correlation between math performance and students' self-efficacy in math learning reported in Table 6 was significant and positive [$r(61) = .39$, $p < .01$]. The zero-order correlation between students' self-efficacy in math learning and their intrinsic motivation to learn math reported in Table 6 was significant and positive [$r(61)$

= .46, $p < .01$]. The zero-order correlation between students' self-efficacy in math learning and their satisfaction with their math performance reported in Table 6 was significant and positive [$r(61) = .39$, $p < .01$]. The zero-order correlation between students' intrinsic motivation to learn math and their satisfaction with their math performance reported in Table 6 was significant and positive [$r(61) = .34$, $p < .01$]. The zero-order correlation between students' intrinsic motivation to learn math and their evaluation on the quality of math instruction they had received reported in Table 7 was significant and positive [$r(61) = .44$, $p < .01$]. The zero-order correlation between students' satisfaction with their math performance and their evaluation on the quality of math instruction they had received reported in Table 8 was significant and positive [$r(61) = .47$, $p < .01$].

CHAPTER VI

DISCUSSION AND CONCLUSION

The results of this present research regarding the first cluster of hypotheses showed that after high school students with special needs participated in the combination of two interventions to increase their self-regulation (i.e., goal-setting and self-reflection), they increased the variety of their self-regulatory strategies significantly. Increased strategy knowledge and usage were evident in that participants were more able not only to use teacher-taught self-regulatory strategies (i.e., goal setting and self-reflection) during problem solving, but also to come up with more self-regulatory strategies (e.g., seeking assistance) (as shown in the learning contexts the second administration of SRLIS) on their own. Students with special needs, are often described as "overwhelmed, disorganized and frustrated in learning situations (p. 186, Vaidya, 1999)" and lack strategies which are executive in nature and supports effective learning.

One possible interpretation of these results is, after participating in goal setting and self-reflection interventions, students with special needs became aware of the need of executing strategies such as planning, monitoring and evaluating (although monitoring was not explicitly modeled in this research); then beginning to imagine and envision the future with reference to performing in one and multiple situations. In other words, participants were more aware of how actions (or procedures) they took could impact their learning due to constant planning (i.e., goal setting) and evaluating (i.e., self-reflection), so they simultaneously explored effective strategies which could help them achieve more (which explains the increased variety of self-regulatory strategies they applied at the second administration of SRLIS). This research adds on to the accumulating evidence

that self-regulatory training could help students, even students with special needs, become independent, effective learners.

Furthermore, the results show, after participating the goal setting and self-reflection interventions, participants explained their performance outcomes with more adaptive causes (e.g., effort, strategy and practice) rather than maladaptive ones (since they saw how their own actions influenced the performance results). Among challenges students with special needs face in learning, one of the most notorious one is why they think they succeed or fail at learning (Valas, 2001). Based on their history of academic problems and failures, many of them may believe they are just incapable to learn (Cullen, 1985), or that school work is just too difficult. Even if they succeed at a task, they believe it is due to pure luck rather than effort that was put forth—when their academic underachievement lasts for long, students who perceive themselves as incompetent choose to make attributions that are consistent with this view (i.e., low ability). This research helped participants to understand the relationship between their efforts on a task (or strategies they used) and the achievement outcomes, and offered opportunities of re-examination (with the intervention which took place daily). The development of a sense of an external locus of control (i.e., attributing success and failures to controllable rather than uncontrollable causes) leads students with special needs toward a self-improving direction.

Another main purpose of this study was to analyze the impact of goal-setting and self-reflection on students with special needs' math performance and self-motivating beliefs (e.g., self-efficacy) through the lens of change in teacher-led classroom practice. In addition to the apparent demonstration that students' math performance benefited from

the interventions of goal setting and self-reflection, more specifically, I sought to demonstrate that self-motivating beliefs, as an indicator of psychological adjustment to the instructional procedure in math class, are sensitive to perceived changes in the classroom procedure involving opportunities of students' self-regulating of math learning.

What distinguishes the intervention research from many others with students with special nights is high level of treatment fidelity with relative ease. The participating teachers practiced the scripts provided until they could say them without error before each class. Although it appeared time-consuming, the teachers reported the rehearsal of scripts was "easy" due to the following factors. First, the primary research went over the scripts with teacher and was able to translate them into a language teachers desired to use. The intervention used only materials that were already integrated into the curriculum (worksheets) and basically consisted on teacher instructions and student prompts. Second, since the interventions were integrated into math worksheet time which was just fifteen minutes, the script time was approximately two to three minutes on average. Additionally, most scripts were repetitive in nature and therefore didn't demand much memorization time. For example, throughout the goal-setting intervention, teachers used almost identical scripts many times (initially targeted at the treatment group, and later on at individual students who need extra support). Therefore, this study provides educators with a practical solution to incorporating instruction on self-regulatory skills. Since these interventions were not task specific, teachers can incorporate self-regulation within the scope and sequence of their curricula, without a huge expenditure of their prep time. After this research was concluded, the teachers who were involved did not view their lack

training in supporting self-regulation as a problem as some studies suggested (Diaz-Greenberg, Thousand, Cardelle-Elawar & Nevin, 2000).

Despite the two interventions were embedded in math instruction, results show participants' increased self-regulatory strategies transferred to other settings, such as history learning (reflected by the eight learning contexts). This transferring effect, which was still significant two weeks after the interventions were concluded, demonstrates the long-lasting potential of these interventions in transforming students into more effective learns and successful citizens. The participating teachers also expressed interest in participating in some follow-up self-regulatory intervention research because they noticed students' improved performance and increased interest in learning. These findings meet my expectation that even educators without much training can easily use these interventions to support students' self-regulatory practices while teaching content.

The methodological contribution of this research was random assignment I was able to implement. Despite the important role single-subject research plays in developing evidence-based practice in special education (Horner, et. al., 2005), group designs, especially ransomed assigned, are more rigorous methods for comparing effects of instructional approaches (Schumaker & Deshler, 2003). Most single-subject studies, comparing pre- and post-intervention data, do not fit this purpose. Single subject investigations and group design studies often reveal different results due to the fact that single subject studies allow and encourage more intensive individualized instruction while the instruction focused by group designs are often more general, less intensive, and target at more students (e.g., a whole natural class). The random assignment design was achieved thanks to the inclusion and co-teaching movement. Due to the large numbers of

students in each class (for special education classes), both the instructional strategist (i.e., special education teacher) and regular education teachers were assigned in each math class. Consequently, it made it easy to run both control and treatment groups at the same time—students also were used to working in groups and shown no curiosity in the other group was doing (once being told they would get the same treatment later).

Under the influence of response-to-intervention (RtI), mainstream movements, and the shortage of special education teachers (CFTL, 2004), special educators serve a larger number of students. Naturally, these special educators, along with general education professionals, may find studies with group designs more informative for their instruction. The scale of this research was larger than that of many studies on students with special needs. Historically, more single subject designs have been used with students with special needs than group designs due to the nature of special education. For instance, there are usually a few students present in a resource room during a class period and the resource room time is often the only time they are available for participation in intervention studies (Schumaker & Deshler, 2003).

Besides its large scale, the effects of this research were broader in scope and assessed over a longer duration. One issue that makes group designs problematic (less prevalent) is that of school attendance for students with special needs. Students may miss school for physician's appointments and physical problems, and therefore attrition is a huge limitation. Previous group designs are typically used with interventions which are comparatively short in duration (e.g., one intervention period). Therefore, with a duration of four weeks (20 school days), the current research is appealing since interventions with long duration may be more useful to educators and practitioners.

Limitations of the Present Research

Along with the contributions this research made to the knowledge base of intervention studies on students with special needs, I need to admit the following limitations of this study. First, the attendance issue with students with special needs reduced the number of participants in this research. Attendance issues (e.g., doctor appointments, adolescence pregnancy, family emergencies) have been recognized by educators and researchers as factors which probably cause the poor school performance of students with special needs. In this data analysis of this research, I used only participants who successfully completed most of the interventions in the treatment group. In the control group, I also included students who attended school the same number of days during the same period. In other words, my sample was probably biased because only students who better school attendance and therefore consequently benefited more from interventions were taken into consideration. Analyses for the study were limited to data from approximately 60 students in two groups for comparison. This lack of power was a possible hindrance in the studying the hypotheses in question. In additions, data based on 60 participants may have been a factor in the lack of significance for the some correlation among dependent measures.

Second, among all participants in this resarch, some with lower reading levels and less satisfactory study habits were excluded from data analysis. Despite the training and monitoring teachers and researchers provided to students on understanding and filling out questionnaires, some participants purposefully or accidently omitted some questionnaire items, or even a whole questionnaire. The data analysis reflected this by decreased Ns.

Third, I could not identify specific disabilities of participants due to the state mandated non-categorical special education model in Iowa, which probably limits the possible generalization of this research. On the other hand, special education has been transforming from a disability-based model to a need-based model, and my research may attract attention from classroom teachers and elicit more replication, considering that teachers have started serving a more heterogeneous student body in their classrooms, including students without and with special needs, with and without disability labels.

Future Prospects

The present research also informs of possible directions in restructuring teacher education and revitalizing programs for learning to teach. Most teacher education programs prepare teachers by providing research-based content knowledge (Fenstermacher, 1993), which is emphasized by the current U.S. department of Education (USDOE). According to the USDOE (2002), the No Child Left Behind (NCLB) definition of a "highly qualified teacher" focuses on content knowledge. To be more specific, most teacher education programs emphasize the acquisition of content knowledge and application of theories, rather than pedagogical practices, not to mention supporting students to become self-regulated learners who feel ownership of their learning process (Darling-Hammon, 1996; Fessler, 1995). This research helps educators with pedagogy and teaching practicum, whose importance has been made explicit in the Individuals with Disabilities Education Improvement Act (IDEIA) of 2004.

A direction I would like to go is to enhance pre-service teachers' lesson planning with self-regulatory trainings. In Ohio and most states, lesson plans are required to be standards-based—teachers need to address state benchmark standards in the lesson plans

they write on a daily basis. As a university supervisor, I find many of pre-service teachers have difficulty in aligning their lesson objectives (which are based on state mandated standard) with both standards and pre- and post-assessments (see Appendix S and Appendix T for two sample lesson plans by one of my pre-service teachers). For instance, the standard the pre-service teacher chose was "Print capital and lowercase letters, correctly spacing the letters. Place punctuation marks at the end of sentences," but her lesson objective was written as "At the end of the lesson the students should be able to write a sentence about George Washington," which did not reflect the standard of interest at all. In addition, the pre-assessment (i.e., "Questioning") and the post-assessment (i.e., "Collect and review student work for proper capitalization and spacing of letters" did not tell how she would judge whether her students were able to write a sentence with correct capitalization, spacing and punctuation. Furthermore, I also self-regulatory trainings will help them to compare the objectives with the students' performance (measured by post-assessments) and reflect more insightfully on what they could do enhance their students' learning next time they teach. I find pre-service teachers tend to leave the reflection section on their lessons plan blank or make superficial statements such as "I think I need to slow down a bit," rather than to connect their teaching practices to students' learning, and therefore adjust their teaching with an goal of helping students master the lesson objectives. I believe a self-regulatory training with goal setting and self-reflection incooperated would help pre-service teachers to write better quality lesson plan and consequently improve their teaching.

Future efforts should be made to help teachers understand the importance of self-regulation is essential for students with special needs. Since educators will need

evidence-based instructional strategies to promote and support improvements in student self-regulated skills, future research should systematically replicate and extend these and other strategies which have found to be effective with learning of students with special needs. Since additional training may not always be available or realistic for pre-service and in-service teachers, continuous efforts may need to be directed toward designing intervention programs or instructional strategies which can be readily learning by educators with minimal support.

Another direction researchers can head towards is to teach parents self-regulatory practices so they can function as good models for their children to learn self-regulation. As I discussed in the Introduction and Literature Review sections, parents of students with special needs often fail to provide effective self-regulatory models to their children, and consequently reduce their children the chances of observing and emulating self-regulatory practice at the first place. If researchers tackle the social roots of poor self-regulation and work on changing family environments into self-regulation nurturing ones, students, especially those with special needs, would benefit greatly from early and continuous exposure to self-regulatory models, and therefore become more effective learners at school and later on in their lives.

Table 1. Comparisons of Five Self-Regulated Learning Models

Author	SRL process		
	Preparatory phase	Performance phase	Appraisal phase
Boekaerts	Identification, interpretation, primary and secondary appraisal, goal setting	Goal striving	Performance feedback
Borkowski	Task analysis, strategy selection	Strategy use, strategy revision, strategy monitoring	Performance feedback
Pintrich	Forethought, planning, activation	Monitoring, control	Reaction and reflection
Winne	Task definition, goal setting, planning	Applying tactics and strategies	Adapting metacognition
Zimmerman	Forethought (task analysis, self-motivation)	Performance (self-control, self-observation)	Self-reflection (self-judgment, self-reaction)

Note. Adapted from "Models of self-regulated learning: a review," by M. Puustinen and L. Pulkkinen, *Scandinavian Journal of Educational Research*, *45*, p. 281. Copyright 2001 by Taylor and Francis Group.

Table 2. Daily Instructional Procedures

Progress Monitoring *(10 minutes)*	Whole Class	
Instruction/Lecture *(30 minutes)*		
	Experimental Group	**Control Group**
Guided/Independent Practice *(15 minutes)*	Intervention Goal Setting/Self-Reflection	No Intervention

Table 3. Descriptive Statistics for the Participants' Pre- and Post-Intervention Dependent Measures

	Strategy Use		Strategy Frequency		Attribution		Math Performance	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Pre-Intervention	7.75	2.37	14.36	6.44	2.86	1.69	11.79	1.29
Post-Intervention	8.96	2.15	16.82	4.64	4.43	3.59	14.93	2.03

Table 4. Study 1: Dependent Measure Means and SDs for Control and Experimental Groups

Dependent Measures	Groups			
	Control group		Experimental group	
	Pre-assessment	Post-assessment	Pre-assessment	Post-assessment
Math Performance	4.89 *(M)*	11.28	4.77	13.50
	4.10 *(SD)*	2.59	4.58	2.53
Self-efficacy	37.95 *(M)*	41.16	41.42	51.54
	13.03 *(SD)*	14.28	12.35	11.22
Intrinsic motivation	17.73 *(M)*	20.71	23.29	26.00
	8.09 *(SD)*	7.44	8.59	7.81
Self-satisfaction	5.34 *(M)*	4.03	5.08	5.00
	1.75 *(SD)*	1.88	1.59	1.84
Instruction Evaluation	4.92 *(M)*	4.47	5.17	5.55
	1.79 *(SD)*	1.74	1.79	1.88

Table 5. Study 2: Dependent Measure Means and SDs for Control and Experimental Groups

Dependent Measures	Groups			
	Control group		Experimental group	
	Pre-assessment	Post-assessment	Pre-assessment	Post-assessment
Math Performance	5.07 *(M)*	8.00	2.98	9.29
	3.51 *(SD)*	3.37	2.09	3.23
Self-efficacy	37.69 *(M)*	50.04	37.65	59.08
	13.86 *(SD)*	14.69	12.66	12.18
Intrinsic motivation	17.88 *(M)*	18.00	20.50	24.92
	10.65 *(SD)*	9.08	7.59	9.56
Self-satisfaction	3.85 *(M)*	4.85	3.67	5.46
	2.18 *(SD)*	1.97	1.17	1.41
Instruction Evaluation	4.97 *(M)*	4.23	4.04	5.50
	1.90 *(SD)*	1.98	1.55	1.67

Note: *N*=62

Table 6. Pre-intervention Correlation Matrix for the Five Dependent Measures

	1	2	3	4	5
1. Math Performance	1.00	0.39**	0.17	-0.07	-0.04
2. Self-Efficacy	--	1.00	0.46**	0.39**	0.39**
3. Intrinsic Motivation	--	--	1.00	0.34**	0.44**
4. Satisfaction	--	--	--	1.00	0.47**
5. Evaluation	--	--	--	--	1.00

Note: **. Correlation is significant at the 0.01 level (2-tailed).

Table 7. Dependent Measure Means and SDs for Students Who Completed the Research and Those "Dropped Out"

Dependent Measure	"Completers"		"Drop-outs"	
	M	*SD*	*M*	*SD*
Math Performance	4.52	4.09	8.62	3.10
Self-efficacy	39.73	13.52	30.27	10.37
Intrinsic motivation	21.53	8.71	16.73	10.20
Self-satisfaction	5.02	1.69	3.69	1.84
Instruction Evaluation	5.08	1.80	4.33	1.30

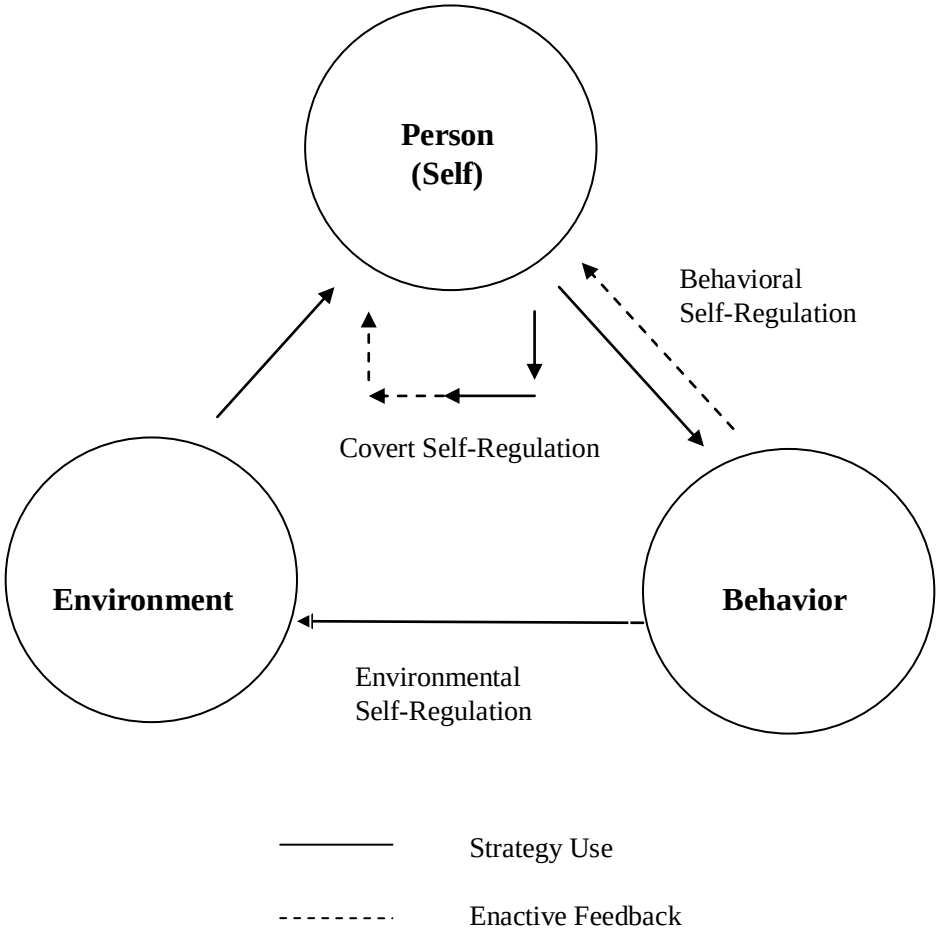


Figure 1. Self-regulation interaction between person, behavior and environment.

Source: From "A social cognitive view of self-regulated academic learning" by B. J. Zimmerman, 1989, Journal of Educational Psychology, 81, p.330. Copyright 1989 by the American Psychological Association.

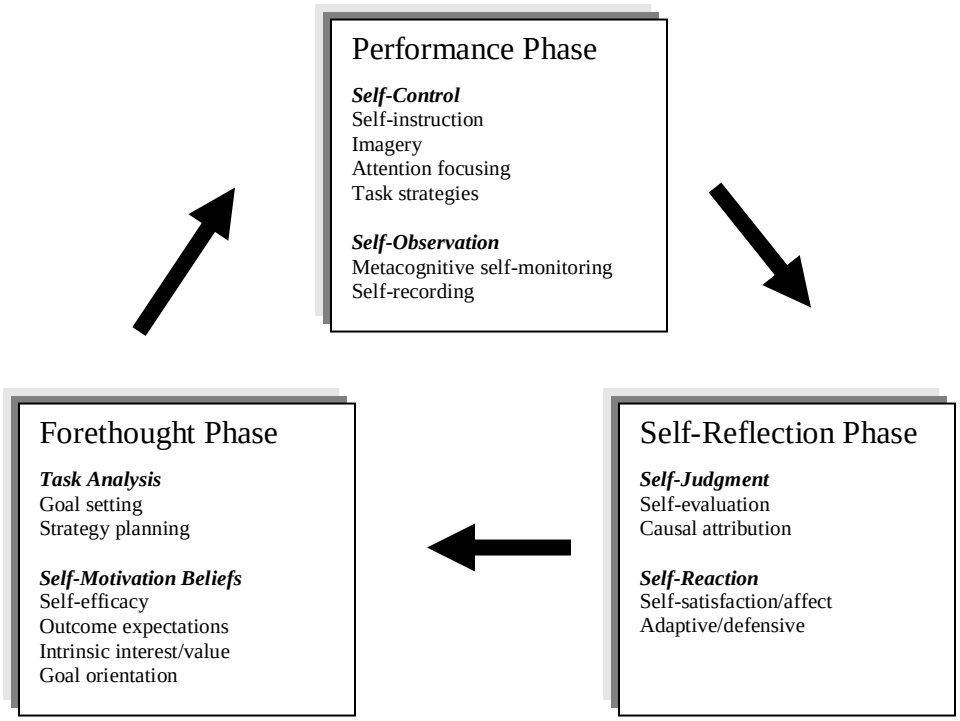
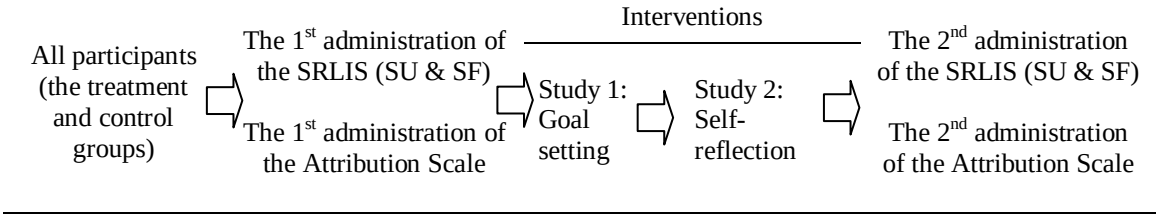


Figure 2. Phases and Subproceses of Self-Regulation.

Source: From "Motivating self-regulated problem solvers" by B. J. Zimmerman, & M. Campillo, 2003, *The psychology of problem solving* (Figure 8.1, p.239). J. E. Davidson & R. J. Sternberg (Eds.). New York: Cambridge University Press. Copyright 2003 by Cambridge University Press.

APPENDIX A
OUTLINE OF THE TWO-STUDY RESEARCH



APPENDIX B
OUTLINE OF STUDY 1 ON GOAL SETTING

	Assessment 1 of Dependent Variables	Intervention	Assessment 2 of Dependent Variables	Delayed treatment
Treatment Group	Achievement *Accuracy* Intrinsic motivation Self-efficacy Satisfaction Instruction evaluation	Goal Setting	Achievement *Accuracy* Intrinsic motivation Self-efficacy Satisfaction Instruction evaluation	---
Control Group		---		Goal Setting

APPENDIX C
INSTRUCTIONAL PROCEDURES ON DAY 1 THROUGH DAY 7 IN STUDY 1 ON GOAL SETTING

A Class Period *(55 minutes)*		
Progress Monitoring *(10 minutes)*	Whole Class	
Instruction/Lecture *(30 minutes)*	Whole Class	
Guided/Independent Practice *(15 minutes)*	Experimental Group	Control Group
Day 1	Practice + Goal Setting a. Introduce goal setting b. Teacher modeling c. Teacher assigned goals d. Feedback	Practice
Day 2	Practice + Goal Setting a. Revisit goal setting b. Teacher modeling c. Teacher assigned goals	Practice
Day 3	Practice + Goal Setting a. Teacher modeling b. Students self set goals c. Teacher support available d. Feedback	Practice
Day 4	Practice + Goal Setting a. Teacher modeling b. Students self set goals c. Teacher support available d. Feedback	Practice
Day 5	Practice + Goal Setting a. Teacher modeling b. Students self set goals c. Feedback	Practice
Day 6	Practice + Goal Setting a. Teacher modeling b. Students self set goals c. Feedback	Practice
Day 7	Practice + Goal Setting a. Teacher modeling (if needed) b. Students self set goals c. Feedback	Practice

APPENDIX D
OUTLINE OF STUDY 2 ON SELF-REFLECTION

	Assessment 1 of Dependent Variables	Intervention	Assessment 2 of Dependent Variables	Delayed treatment
Treatment Group	Achievement *Accuracy* Intrinsic motivation Self-efficacy Satisfaction Instruction evaluation	Self-Reflection	Achievement *Accuracy* Intrinsic motivation Self-efficacy Satisfaction Instruction evaluation	---
Control Group		---		Self-Reflection

APPENDIX E
INTRUCTIONAL PROCEDURES ON DAY 1 THROUGH DAY 7 IN STUDY 2 ON SELF-REFLECTION

A Class Period *(55 minutes)*		
Progress Monitoring *(10 minutes)*	Whole Class	
Instruction/Lecture *(30 minutes)*	Whole Class	
Guided/Independent Practice *(15 minutes)*	Experimental Group	Control Group
Day 1	Practice + Self-Reflection a. Introduce self-reflection b. Teacher modeling c. Feedback	Practice
Day 2	Practice + Self-Reflection a. Introduce self-reflection b. Teacher modeling c. Feedback	Practice
Day 3	Practice + Self-Reflection a. Teacher modeling b. Teacher support available c. Feedback	Practice
Day 4	Practice + Self-Reflection a. Introduce self-reflection b. Teacher modeling c. Teacher support available d. Feedback	Practice
Day 5	Practice + Self-Reflection a. Student self-reflect b. Teacher support available c. Feedback	Practice
Day 6	Practice + Self-Reflection a. Student self-reflect b. Teacher support available c. Feedback	Practice
Day 7	Practice + Self-Reflection a. Student self-reflect b. Teacher support available c. Feedback	Practice

APPENDIX F
THE SELF-REGULATED LEARNING INTERVIEW SCHEDULE

1. Assume your teacher is discussing with your class the history of the civil rights movement. Your teacher says that you will be tested on the topic the next day. Do you have a method that you would use to help you learn and remember the information being discussed?

   *What if you are having trouble understanding or remembering the information discussed in class?

2. Assume your teacher asks students in your class to write a short paper on a topic such as the history of your community or neighborhood. Your score on this paper will affect your report card grade. In such cases, do you have any particular method to help you plan and write your paper?

   *What if you are having difficulty with the topic?

3. Teachers usually expect much accuracy with students' math homework. Many of these assignments must be completed without the help of a teacher. Is there any particular method you use when you don't understand a math problem at home?

   *What if the assignment deals with a very difficult type of problem?

4. When completing homework assignments such as science reports or English grammar exercises, do you use a particular method for checking your work after it is finished?

   *What if it is a difficult assignment?

5. Most teachers give important tests at the end of marking periods, and these tests greatly affect report card grades. Do you have a particular method for preparing for these tests in English or history? What if you are preparing for an especially difficult test?

6. When taking a test in school, do you have a particular method for obtaining as many correct answers as possible?

   *What if it is a difficult test question?

7. Many times students have difficulty completing homework assignments because there are other, more interesting things they would rather do, such as watching TV, daydreaming, or talking to friends. Do you have any particular method for motivating yourself to complete your homework under these circumstances?

   *What if you are trying to meet a pressing deadline?

8. Some students find it easier if they can arrange the place where they study. Do you have a particular method for arranging the place where you study?

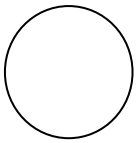
   *What if you are having difficulty concentrating on your school work?

** Follow-up questions. (Zimmerman & Martinez-Pons, 1990)*

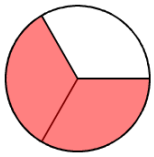
APPENDIX G
ATTRIBUTION INTERVIEW SCALE

Situation 1 Students are presented a question they answered correctly on the performance test.	Question 1 Why do you think you answered the question right?	Question 2 What can you do to keep doing well?
	A coder will categorize students' responses according to the following types: a. Strategy b. Effort c. Ability d. Practice e. "I don't know" f. External assistance g. Other	
Situation 2 Students are presented a question they answered incorrectly on the performance test (as well as their answers and the correct answers)	Question 1 Why do you think you missed the question?	Question 2 What can you do to improve your performance?
	A coder will categorize students' responses according to the following types: a. Strategy b. Effort c. Ability d. Practice e. "I don't know" f. External assistance g. Other	

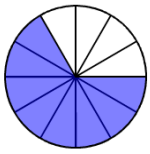
APPENDIX H
FIFTEEN-ITEM ACHIEVEMENT TEST
(SAMPLE: ON SOLVING FRACTION PROBLEMS)

1. Use the circle to the right to represent $\frac{3}{4}$ 

2. Write a fraction to represent the shaded portion of the circle $\frac{\square}{\square}$



3. Write a fraction to represent the shaded portion of the circle $\frac{\square}{\square}$

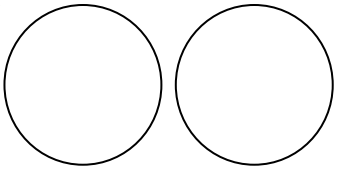


4. Fill in the blank so that the fractions are equivalent. $\frac{1}{3} = \frac{\square}{9}$

5. Reduce the fraction to its simplest form. $\frac{4}{16} = \frac{\square}{\square}$

6. Circle the larger of the two fractions. $\frac{1}{4}$ $\frac{3}{4}$

7. Circle the larger of the two fractions. $\frac{5}{12}$ $\frac{10}{11}$

8. Use the circle to the right to determine whether $\frac{3}{4}$ or $\frac{5}{6}$ is larger. Circle the larger answer. 

Write your answer to each fraction problem.

9. $\frac{2}{9} + \frac{2}{9} =$

10. $\frac{1}{5} + \frac{1}{2} =$

11. $\frac{5}{6} - \frac{1}{6} =$

12. $\frac{11}{12} - \frac{2}{3} =$

13. $\frac{3}{4} \times \frac{5}{6} =$

14. $\frac{2}{3} \times \frac{2}{5} =$

15. $\frac{5}{6} \div \frac{2}{3} =$

APPENDIX I
SELF-REPORT MEASURE OF INTRINSIC MOTIVATION

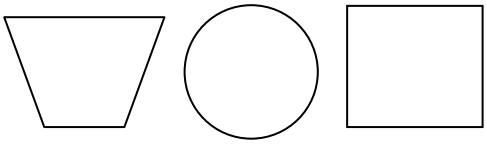
Please express your impression of fractions by using the following 6 items...

	Not at all True			Somewhat True			Very much True
1. Solving fraction problems is fun.	1	2	3	4	5	6	7
1. Solving fraction problems is an enjoyable activity.	1	2	3	4	5	6	7
2. Solving fraction problems held my constant and full attention.	1	2	3	4	5	6	7
3. Solving fraction problems stimulated my curiosity without interruption.	1	2	3	4	5	6	7
4. Solving fraction problems is very interesting.	1	2	3	4	5	6	7
5. Solving fraction problems is a pleasant, happy task to do.	1	2	3	4	5	6	7

APPENDIX J
SELF-DESIGNED: FRACTIONS SELF-EFFICACY SCALE

	Not at all Confident			Somewhat Confident			Very Confident
1. Work with fractions	1	2	3	4	5	6	7
2. Write the fraction represented by the shaded part in the figure	1	2	3	4	5	6	7

3. Draw lines to divide the following shape into thirds	1	2	3	4	5	6	7



4. Compare fractions, such as $\frac{1}{4}$ and $\frac{2}{3}$	1	2	3	4	5	6	7
5. Rewrite 4 as a fraction with 1 in the denominator $4 = \frac{?}{1}$	1	2	3	4	5	6	7
6. Add fractions, such as $\frac{1}{6} + \frac{1}{4} =$	1	2	3	4	5	6	7
7. Subtract fractions, such as $\frac{2}{3} - \frac{1}{6} =$	1	2	3	4	5	6	7
8. Multiply fractions, such as $\frac{2}{5} \times \frac{3}{8} =$	1	2	3	4	5	6	7
9. Divide fractions, such as $\frac{6}{7} \div \frac{2}{3} =$	1	2	3	4	5	6	7

APPENDIX K
SELF-REGULATED LEARNING STRATEGIES CODING SCHEME

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

APPENDIX L
SRLIS INTERVIEW PROCEDURES

Each participant was brought individually to a separate room in their school by the interviewer. The participant was seated across a table from the interviewer and informed that he or she would be asked some questions about his or her learning practices. The interviewer then administered the structured interview.

This SRLIS was administered to all participants twice, the first time before the intervention, and the second time 2 to 5 weeks after the intervention has concluded. This SRLIS measure was used to investigate whether the training (in goal setting and self-reflection) had resulted in long-lasting changes of students' use of self-regulated learning strategies (the intervened strategies as well as non-intervened strategies) in different learning contexts.

As for each learning context, the interviewer asked each participant what methods they used to accomplish a particular task (Appendix F). If the participant did not provide answers, he or she would be asked, "What if you are having difficulty? Is there any particular method you use?" If the participant still had difficulty in offering any self-regulated learning strategies, the interviewer stopped questioning the participants about the certain learning context and moved on to the next context.

Individual strategies were identified for classification by category, and were not rated for appropriateness. Usually each strategy was described in one or two sentences; however, occasionally several sentences were used—particularly if the interviewer requested a better description. Previous studies using this SRLIS show students vary greatly in the number of strategies reported, ranging from none to as many as eight

strategies. The summarization and analysis of the SRLIS data in this research were discussed in Chapter V.

APPENDIX M
TEACHERS' SCRIPTS FOR GOAL SETTING INTRODUCTION

Day 1

What is a goal? (*Students' responses*) A goal is an objective for you to reach. It can be assigned by other people, and it may also be set by you yourself. What's your goal? (*Students' responses*).

We need to set goals in small increments, which means raise my goal little by little. We also need to specify how much time we use and how much efforts we expend. If you tell yourself, "I'm going to answer all the 20 questions right" and then sit around and wait for it to suddenly happen, you could be waiting all your life and end up not solving any of them. If you answer nine questions right today, ten questions right tomorrow, and increase the questions you answer correct per day by one, you may reach your ultimate goal "I'm going to answer all the 20 questions right" within one month. Therefore, **when you set a goal, it should be hard but not overwhelmingly hard**.

To set a good goal, we need to know what information I have. For example, I have a practice sheet answered by a student from another class. I blacked out his name so you guys do not know who I talked about. (*The teacher shows students the practice sheet*) Look, he tried eight questions, and answered seven right. Let's discuss what his goal should look like. (*The teacher looked at students and seems expect some creative ideas—which are unlikely to happen. The teacher starts to be more specific.*) He tried eight questions, right? (*Students: Yes…*☹) So how many questions he should try next time? (*Students' responses—eight, twenty, …*). Remember what we said before? **A good goal should be hard but not overwhelmingly hard**. What about eight questions? He tried eight already, so do you think it is hard enough? (*Students' responses: No*) So how about twenty? (*Students' responses: Too many! Too hard!*) So what's the reasonable number of questions should he try next time? Probably ten. (*Students' responses: #$%^$&^@#$**)

Next, he answered seven questions right. What's the reasonable number of questions should he answer right next time? Remember, **a good goal is hard but not overwhelmingly hard**. Let's look back. He tried eight questions, so we set the goal as ten. What's the difference between ten and eight? Two. So tomorrow, this student needs to try two more questions. Now, he answered seven questions right? Does he need to make progress? Yes. So what's the reasonable number of questions should he answer right next time. Probably nine. (*Students' responses: #$%^$&^@#$**) What's the difference between nine and seven? Two.

You get it. See we set goals for this student by adding two to the number of questions he attempted, and adding two to the number of questions he answered right. Now, let's help yourselves to set some GOOD goals, **which are hard but not overwhelmingly hard**. Look at your practice sheet. Out of 20 questions, how many did you try to answer? (*Students' answers*) Let's add two to this number. This number is the goal for you to reach next time. It means you need to try this number of questions next

time. Next, how many questions did you answer right? (*Students' answers*) Let's add two to this number. This number is the goal for you to reach next time. It means you need to answer this number of questions next time.

Now, write down your goals on the bottom of your practice sheet. Let's check if you have had the right goals. (*The teacher checked around to ensure students have had the right goals*) Next, I will hand out another practice sheet to each of you and you are expected to write the goal on the upper side of this practice. A sample is presented below. You don't need to worry about the shaded questions until I tell you. (Students start working on the practice).

--

After students finish the practice which consists of 20 questions, students are asked to switch their practice sheet with their neighbors. Then the teacher will go through the answers to all the questions and students are asked to count how many questions their neighbor tried and got right, then compare with the written down goals. If their performance is the same or higher than the goals set, students circle *Yes* for *Met this goal?* If their performance is lower than the goals set, students circle *No* for *Met this goal?*

Then, students get their own practice sheets with the feedback column filled out by their neighbors. Then, students are directed to record their performance (# of questions answered right) and come up with appropriate goals for the next time.

Worksheet Sample

Student Name: _____ Date:

_____

Goals			Feedback (Filled out by students with the teacher's help)	
How many problems do you plan to answer right today?	_____/15	Met this goal?	Yes	No
How many problems do you answered right today?	_____/15	Met this goal?	Yes	No

Problem 1

Problem 2

APPENDIX N
TEACHERS' SCRIPT USED FOR SELF-REFLECTION

Day 1

What is self-reflection? (*Students' responses*) Self-reflection refers to a four step procedure that students judge whether their performance has reached their goals or not. Students also need to figure out why they did well, or less well than expected, and then come up with possible ways to improve their performance. To summarize, to self-reflect, students need to do the following things (*the teacher writes the following three steps on the blackboard*):

Evaluate whether your performance is good enough or not,
Think about why you did well or less well,
Plan on what to do to improve your performance in the future.

Self-reflection is a three step procedure which includes (*the teacher points to the three steps written on the blackboard*) you evaluate whether your performance is good enough, think about why you did well or less well, and plan on what to do to improve your performance in the future. What is self-reflection? (*Students' responses*)

How can we apply self-reflection in our studies? (*Students' responses: &^%$&^%$&^☹*) In order to help you to conduct self-reflection, I have this Student Report on Self-reflection (Appendix J) for you so you don't miss any of the three steps. (*The teacher hands out copies of the Student Report Measure of Self-Reflection to each student*)

What is the first step of self-reflection? (*Students' responses*). Look at Question 1 on your sheet, it asks you whether you met the goal you set for yourself. This question reflects your evaluation of your own performance. Based on your performance and its discrepancy with the goal, you can select Yes or No. (*The teacher hands out students' practice sheet which shows their accuracy and productivity goals as well as their actual performance*). Now, choose Yes or No by circling the option you select. Does anyone remember why we do Question 1? (*Students' responses: &^%$&^%$&^☹*) Yes, it reflects the first step of self-reflection which is evaluating whether your performance is good enough or not.

What's the second step of self-reflection? (*Students' responses*). Look at Question 2 on your sheet, it asks you why you think you missed some questions. This question requires you to think about why you did less well. What's the second step of self-reflection? (*Students' responses*) (*The teacher reads the first four options and asks students to write any other causes of their less satisfactory performance in option e*).

What's the third step of self-reflection? (*Students' responses*). Look at Question 3 on your sheet, it asks you what must change for you to get the questions right. This question requires you to plan on what to do to improve your performance in the future. What's the third step of self-reflection? (*Students' responses*) (*The teacher reads the first*

four options and asks students to write any other actions they consider to take in order to improve their performance in option e).

In question 3 and 4, the last two steps of self-reflection will be practiced again. However, the difference from what we have done is question 3 asks you why you think you answered some questions right. What is the first step of self-reflection? (*Students' responses*). This question requires you to think about why you did well. What's the second step of self-reflection? (*Students' responses*) (*The teacher reads the first four options and asks students to write any other causes of their satisfactory performance in option e*).

What's the third step of self-reflection? (*Students' responses*). Look at Question 3 on your sheet, it asks you what you need to keep doing to maintain and improve your learning. This question requires you to plan on what to do to improve your performance in the future. What's the third step of self-reflection? (*Students' responses*) (*The teacher reads the first four options and asks students to write any other actions they consider to take in order to improve their performance in option e*).

APPENDIX O
STUDENT REPORT MEASURE ON SELF-REFLECTION

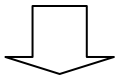
Directions:

I'm interested in finding out what you think about your learning experience. There is no right or wrong answer to any of the questions. I only want to find out what you really think and hope that you will answer the best that you can. It is important that you answer on your own. Remember, this is not a test. Please wait for my direction before you answer. I will read each question and option to you when you proceed. Please follow my pace and do not go too fast.

Please answer the following questions by circling the options of your choice (you can select more than one options if necessary).

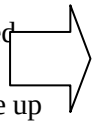
1. Did you meet the goal you set for yourself?

Yes No



2. Why do you think you missed some questions?

a. I did not pay attention. I got distracted.
b. I did not try hard. I was lazy.
c. I did not use good strategies. I used bad ones.
d. I did not persist on the task. I gave up easily.
e. Other. Please specify _____ _____.

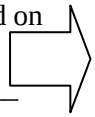


3. What must change for you to do to get them right?

a. I need to pay more attention.
b. I need to try harder.
c. I need to use good strategies taught by my teachers or other people.
d. I need to stay on task and continue to work.
e. Other. Please specify _____ _____.

4. Why do you think you answered some questions correctly?

a. I did not get distracted. I paid attention.
b. I was not lazy. I tried hard.
c. I did not use bad strategies. I used good ones.
d. I did not give up easily. I persisted on the task.
e. Other. Please specify _____ _____.



a. What do you need to keep doing to maintain and improve your learning?

a. I need to pay more attention.
b. I need to try harder.
c. I need to use good strategies taught by my teachers or other people.
d. I need to stay on task and continue to work.
e. Other. Please specify _____ _____.

APPENDIX P
PRACTICE TO HELP STUDENTS UNDERSTAND UNIPOLAR FORCED RESPONSE SCALES

Practice to help participants understand numerical scales will be used in the current research. Since students with LD often need concrete examples to assist their learning, participants will be shown a practice example to familiarize with the following assessment tools (e.g., self-efficacy scale, self-satisfaction scale). In the classroom, the teacher will ask students to judge the volume of water on a 7-point scaled transparent plastic bottle. In this concrete way, students will learn how to use numerical scale to convey the strength of their dependent measures (e.g., self-efficacy, self-satisfaction).

APPENDIX Q
A SAMPEL TRANSCRIPTION OF AN SRLIS ADMINISTRATION

Nathan, West High, 1st Interview, March 30th

Assume your teacher is discussing with your class the history of the civil rights movement. Your teacher says that you will be tested on the topic the next day. Do you have a method that you would use to help you learn and remember the information being discussed?

I don't. ***get to know the topic before I pass it.

Assume your teacher asks students in your class to write a short paper on a topic such as the history of your community or neighborhood. Your score on this paper will affect your report card grade. In such cases, do you have any particular method to help you plan and write your paper?

Yes, I will write down ideas (5). And put them on a paper.

Teachers usually expect much accuracy with students' math homework. Many of these assignments must be completed without the help of a teacher. Is there any particular method you use when you don't understand a math problem at home?

Ask my mom(11). Figure it out on a piece of paper.

When completing homework assignments such as science reports or English grammar exercises, do you use a particular method for checking your work after it is finished?

I would look over it, look over the homework. And I check it when I'm done.(1)

Most teachers give important tests at the end of marking periods, and these tests greatly affect report card grades. Do you have a particular method for preparing for these tests in English or history?

I would study for the test and look over materials. (15)

What if you are preparing for a very hard test?

Hmm, I will, I will do, try my best. (15)

When taking a test in school, do you have a particular method for obtaining as many correct answers as possible?

Yes, sometimes, sometimes possible, sometimes not possible.

How?

The worksheets in class. I look over them before I take the test. (12)

Many times students have difficulty completing homework assignments because there are other, more interesting things they would rather do, such as watching TV, daydreaming, or talking to friends. Do you have any particular method for motivating yourself to complete your homework under these circumstances?

Do homework when I get back from school. And, like, don't go to computers or watch TV, or talk to friends. Just do it when I get home. (6)

Some students find it easier if they can arrange the place where they study. Do you have a particular method for arranging the place where you study?

I would study in a quiet place. (6)

APPENDIX R
SRLIS CODING SCHEME

Student Name: Nathan Coder: _____

Interview: (Please choose one) 1st 2nd

Categories of strategies	Definitions	Frequency
1. Self-evaluation	Statements indicating student-initiated evaluations of the quality or progress of their work, e.g., "I check over my work to make sure I did it right."	1
2. Organizing and transforming	Statements indicating student-initiated overt or covert rearrangement of instructional materials to improve learning, e.g., "I make an outline before I write my paper."	
3. Goal setting and planning	Statements indicating student setting of educational goals or subgoals and planning for sequencing, timing and completing activities related to those goals, e.g., "First, I start studying two weeks before exams, and I pace myself."	
4. Seeking information	Statements indicating student-initiated efforts to secure further task information from nonsocial sources when undertaking an assignment, e.g., "Before beginning to writing the paper, I go to the library to get as much information as possible concerning the topic."	
5. Keeping records and monitoring	Statements indicating student-initiated efforts to record events or results, e.g., "I took notes of the class discussion." "I kept a list of the words I got wrong."	1
6. Environmental structuring	Statements indicating student-initiated efforts to select or arrange the physical setting to make learning easier, e.g., "I isolate myself from anything that distracts me." "I turned off the radio so I can concentrate on what I am doing."	2
7. Self-consequences	Statements indicating student arrangement or imagination of rewords or punishment for success to failure, e.g., "If I do well on a test, I treat myself to a movie."	
8. Rehearsing and memorizing	Statements indicating student-initiated efforts to memorize material by overt or covert practice, e.g., "In preparing for a math test, I keep writing the formula down until I remember it."	
9. Seeking social assistance from peers	Statements indicating student-initiated efforts to solicit help from peers, e.g., "If I have problems with math assignments, I ask a friend to help."	
10. Seeking assistance from teachers		
11. Seeking assistance from adults other than teachers		1
12. Reviewing records by rereading tests	Statements indicating student-initiated efforts to reread tests, e.g., "When preparing for a test, I review my previous tests."	1
13. Reviewing records by rereading notes		

14. Reviewing records by rereading textbooks		
15. Other	Statements indicating learning behavior that is initiated by other persons such as teachers or parents, and all unclear verbal responses, e.g., “I just do what the teacher says.”	2

APPENDIX S
A LESSON PLAN BY A STUDENT TEACHER

Teacher Candidate: MC Day(s)/Date(s): Monday, February 22, 2010 Cooperating Teacher Initials: Grade Level: Kindergarten Subject Area(s): Math Approx. Time for Lesson(s): 25 minutes

Lesson Plan Format

Type of Lesson: _X__ Small Group

***Materials & Resources for Teacher**	***Materials & Resources for Students**
Picture of George Washington Book: *A Picture Book of George Washington* Quarter money sign	Recording sheet Pencil Quarter Premeasured string for necklace

Lesson Summary:

The students will be doing more exploration of presidents (George Washington) by doing a quarter flip and also a quarter craft.

Ohio Connections:

Standard: Data Analysis and Probability Standard
Benchmark: Data Collection
Grade-Level Indicators: Gather and sort data in response to questions posed by teacher and students; e.g., how many sisters and brothers, what color shoes.

Interdisciplinary Connections:

Social studies- History: Heritage: Recognize state and federal holidays and explain their significance.

Lesson Objective(s)	**Pre Assessment**	**Post Assessment & Scoring Guidelines**
By the end of the lesson the students will be able to chart data collected to answer a question.	Questions about data collection process.	Observation of student work time

Key Vocabulary:

George Washington, experiment, heads, tails, equal, even, odd, more, less

Instructional Procedures:

I. Introduction
   1. Have the students come to the front rug read *A Picture Book of George Washington*.
   2. Ask the students what coin George Washington is on.
   3. Do the money poem with the quarter added in.

II. Procedures
   1. Have the students get a large quarter printout. Talk about the parts of a quarter color and cut the quarter out.
   2. Once the quarter is glued hole punch the quarter and tie the string.
   3. Do the new money dance (dime and quarter)
   4. Have the students do the quarter flip. They should make a tally on the recording sheet each flip.

5. Conclusion
   1. Have the students bring their tally sheets to the front rug to share.
   2. Talk about heads, tails, more and less again.
   3. Have student put the tally sheet in their seat covers.

Differentiated Instruction Support(s):

Extension:

Homework Options & Home Connections:

N/A

APPENDIX T
A LESSON PLAN BY A STUDENT TEACHER

Teacher Candidate: MC Day(s)/Date(s): Monday, February 22, 2010 Cooperating Teacher Initials: Grade Level: Kindergarten Subject Area(s): Language Arts Approx. Time for Lesson(s): 25 minutes

Lesson Plan Format

Type of Lesson: ___X__ Large Group/Whole Class

***Materials & Resources for Teacher**	***Materials & Resources for Students**
ELMO Lined paper Marker	Lined paper Pencil Crayons

Lesson Summary:

The students will do a guided writing activity about George Washington using information learned from books read to the class.

Ohio Connections:

Standard: Writing Conventions
Benchmark: Handwriting and Punctuation and Capitalization
Grade-Level Indicators: Print capital and lowercase letters, correctly spacing the letters. Place punctuation marks at the end of sentences.

Interdisciplinary Connections:

Social Studies

Lesson Objective(s)	**Pre Assessment**	**Post Assessment & Scoring Guidelines**
At the end of the lesson the students should be	Questioning.	Collect and review student work for proper capitalization

able to write a sentence about George Washington.		and spacing of letters.

Key Vocabulary:

Capital letter, and punctuation.

Instructional Procedures:

I. Introduction
1. Read the story My Book about George Washington.
2. Make a word bank for writing.
3. Distribute writing paper.

II. Procedure
1. Have students dictate the sentence to be written.
2. Ask the students what the first letter needs (capital), ask what else needs capitalized (proper nouns), and how to end a sentence.
3. Circulate the room and check progress of students writing and have students correct any errors they have made.

III. Conclusion
1. Have the students draw a picture to go with the sentence.
2. Have students put papers on the back table when done and then read books quietly on the front rug.

Differentiated Instruction Support(s):

Shadow write for students who are not using proper spacing.

Extension:

N/A

Homework Options & Home Connections:

Lesson Reflection:

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