Improving Student Mathematics Achievement through Self Regulation and Goal Setting

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Abstract: As middle school students' mathematic scores decline in comparison to other countries, researchers have found self-regulation to be a tool to improve students' mathematics achievement. The following is an action research project conducted in a middle school where result showed an increase in students' mathematics achievement.

Middle school students' mathematics achievement is of great concern to policy makers and educators. Compared to other countries, the United States trails behind in middle school students' mathematics achievement. Many factors contribute to this difference such as parental involvement, students' self-efficacy, teaching structure, and students' self-regulated learning (Slavin, Lake, & Groff, 2009). As middle school students' mathematic scores decline in comparison to other countries, researchers have found self-regulation to be a possible remedy for improving students' mathematics achievement.

The purpose of action research is to increase student achievement, as defined by results in teacher-generated tests in mathematics, and to help students become mangers of their own learning. In accordance with research findings, it is the hypothesis of this action research project that the implementation of self-regulation and goal setting will enhance student mathematics achievement, as measured by teacher generated exams. This study was guided by the following question: Can the implementation of self-regulation through goal setting improve student mathematics achievement?

Theoretical Foundation

Social Cognitive theory views students' behavior and learning as a continuous interaction (reciprocal causation) between personal, behavioral, and environmental factors (Bandura, 1989). Personal factors that can influence students' learning are their self-efficacy, emotions, knowledge, and goals. Behavioral factors are the actions that students take or fail to take. Environmental factors are the students' physical environment (Zimmerman, 1989).

According to Bandura (1989), self-regulation provides students a foundation for purposeful action by allowing them to have control over their thoughts, feelings, and factors that affect their learning. In addition, self-regulation provides students with a system that can help them control external factors that influence them (Bandura, 1989). Self-regulation, from a social cognitive perspective, is an internal process that influences what actions (behavior) will be taken (Ziimmerman, 1989). As students learn to self regulate, they begin not only how to control the way they think but also how to manipulate their behaviors and environment for the benefit of their learning.

Literature Review

The middle school years are a critical time for growing adolescents. It is during this time that young people deal with changes in their body, learn new abilities, and form positive social relationships (Meece, 2003). One of the major issues of education is students' decreasing motivation, self-esteem, and achievement, especially during the transition to middle school. Many attribute the decrease to instructional practices, insensitivity to students' needs, and several

Medina, E. (2011). Improving student mathematics achievement through self regulation and goal setting. In M. S. Plakhotnik, S. M. Nielsen, & D. M. Pane (Eds.), *Proceedings of the Tenth Annual College of Education & GSN Research Conference* (pp. 147-153). Miami: Florida International University. http://coeweb.fiu.edu/research_conference/

other issues (Dembo & Eaton, 2000; Meece, 2003). For many students, the transition to middle school can be an overwhelming event. Elementary schools are typically supportive student-centered, mastery-based orientations. On the other hand, middle schools are performance-focused with an increase in expectations of academic achievement, teacher-centered instruction, and high-stakes testing (Cleary & Chen, 2009).

Although changes in schools can improve student motivation, one major dilemma is that adolescents often believe that they are not responsible for their achievement (Dembo & Eaton, 2000). Unfortunately, middle school students fail to realize the importance mathematics achievement has on their lives and their country. Mathematics achievement of middle school students is of great concern to policy makers and educators, for it is believed that secondary mathematics achievement is a key predictor of the nation's economic potential and competitive strength for the future (Slavin, Lake, & Groff, 2009).

Finally, many middle school students seem to be unaware of their actions and the damaging effects their behaviors have on their academic growth. They lack a sense of responsibility for their learning and attribute that responsibility to their parents and teachers.

Self-Regulation

Research has found that a key source of underachievement is students' lack of ability to control their behaviors and motivation (Dembo & Eaton, 2000). Many middle school students lack the ability to set goals and priorities, control their emotions, and assume responsibility for their actions. Research has been conducted on innovative ways to teach students to assume responsibility for their academic achievement. Many researchers have found self-regulation to be helpful (Clearly & Zimmerman, 2004; Dembo & Eaton, 2000; Dignath & Buettner, 2008; Zimmerman, 1998, 2000).

Self-regulation is defined as "the degree to which students are metacognitively, motivationally, and behaviorally active participants in their own learning process (Zimmerman, 2008, p.167). The definition focuses on students proactively using specific processes, such as goal setting, strategic planning, and self monitoring to improve their academic achievement. Self-regulation stresses the importance of self-awareness during a task, monitoring one's progress, and finding new strategies if the original ones did not lead to success (Lizarraga, Ugarte, Cardelle-Elawar, Iriarte, & Baquedano, 2003). Self-regulated learning can be defined as the students' self-generated thoughts, feelings, and actions taken to attain their learning goals (Zimmerman, 2001).

To maximize the efficiency of self-regulation, students may choose among a variety of self-regulation strategies (Cleary & Chen, 2009). Self-regulation strategies are techniques aimed at obtaining knowledge and skills (Nota, Soresi & Zimmerman, 2004). Commonly used academic self-regulation strategies have been identified as organizing information; goal-setting and planning; looking for information; providing self-monitoring, self-evaluation, and self-consequences; asking for help from a peer, teacher, or adult; rearranging the physical environment; and reviewing tests, notes, and texts (Garcia & Pintrich, 1994; Zimmerman & Martinez-Pons, 1986).

Following the social cognitive perspective, self-regulation strategies fall into three categories: personal, behavioral and environmental. Personal strategies consist of how the student manages information. This can include the student taking notes, summarizing, making chapter outlines, and monitoring themselves. The student may also set up goals and plan how they are going to accomplish them. Behavioral strategies consist of what behaviors or actions the student is going to take. For example, if a student determines that a factor that is affecting

their learning is not paying attention in class, they may take on a behavioral strategy such as being more attentive. Finally, environmental strategies include the student seeking help or making adjustments to his or her physical study environment (Garcia & Pintrich, 1994).

If one of the goals of education is to turn out students who are competent enough to educate themselves and manage their lives, then students need to learn how to regulate and monitor themselves. Students should be able to adjust strategies and determine what is and is not working for them (Dembo & Eaton, 2000). Finally, a shift from a teacher-directed to student-managed learning environment needs to occur. As students set goals and monitor their progress, they will learn how to adjust strategies and make corrections in their learning progress (Dembo & Eaton, 2000).

Goal Setting

Goal setting takes place when a person sets a goal, or an objective, and aims his or her actions toward the attainment of the goal (Locke & Latham, 2002; Schunk, 2001). Goals have an effect on student motivation, learning, self-efficacy, and self-evaluation (Bandura, 1997; Schunk, 1995), all of which enhance self-regulation, but enhancement is not automatic (Schunk, 2001). Five key principles of goal setting have been previously mentioned, but the goal properties of specificity, proximity, and difficulty are crucial for enhancement of self-regulation (Schunk, 2001). Specificity refers to goals being clear and specific to a standard. Goals that are specific raise performance because they are specific to the amount of effort needed to accomplish the task. Furthermore, specificity enhances self-regulation and self-evaluation (Locke & Latham, 1990). Proximity refers to the time frame set for the goal to be attained. Student self-regulation is increased when the deadline has been placed at a nearer rather than further date (Locke & Latham, 1990). Last, goals that are either too easy or too difficult for the student to achieve do not enhance self-regulation (Schunk, 1995). Goals must be challenging, yet attainable (Yearta, Maitlis, & Briner, 1995).

Self-Regulated Learning through Goal Setting

Zimmerman (1998) describes self-regulation through goal setting as a continuous cyclical activity that consists of three phases: forethought, performance, and self-reflection. The forethought phase is the process that occurs before learning effort; the performance phase is the process occurring during the learning effort; and the self-reflection phase is the phase after the learning effort is complete. Goals are entailed across all three phases of self-regulation. During the forethought phase, students set goals and plan strategies to reach the goal. During the performance phase, students perform goal-directed actions and monitor their progress. Finally, during the self-reflection phase, students evaluate their progress toward the goal and adjust strategies, if necessary, to ensure attainment of the goal (Schunk, 2001). Researchers have found that student mathematics achievement has a positive correlation to self-regulated learning (Clearly, Platten, & Nelson, 2008; Clearly & Zimmerman, 2004; Dignath & Buettner, 2008; Vrugt & Oort, 2008; Zimmerman, 2001) and student goal-setting (Hsieh, Cho, Liu, & Schallert, 2008; Meece, 2003; Okun, Fairholme, Karoly, Ruehlman, & Newton, 2006; Wolters, 2004; Zimmerman, & Kitsantas, 1997).

Method

Design

This study used a time-series, quasi-experimental design. Students were observed for five weeks prior to the introduction of self-regulation through goal-setting. During this time, the teacher recorded each individual student's math assessment scores, based on a teacher-generated test. After self-regulation through goal-setting was introduced and implemented, the students

were observed for another five weeks. During this time, the teacher also recorded each individual student's math assessment scores, based on a teacher-generated test. At the end of the research, the average scores for the five weeks before and after the implementation were compared. Academic achievement, in this action research, will be linked to students' weekly scores on teacher-generated tests.

Participants

The setting in which the action research took place was in a small middle school in Miami named RMS. In the 2010-2011 school year, RMS had a total enrollment of 800 students, comprised of 85% Hispanic, 10% White, 3% African American, 1% Asian and 1% Native American or Multiracial. During the 2010-2011 school year, RMS also employed 45 teachers and 3 administrators. RMS fosters students in grades 6-8, enforces a uniform policy, and 75% of the students receive free or reduced lunch. In addition, the school is eligible for participation in state and federal Title I programs.

The study was conducted in a regular mathematics class with 34 eighth-grade students, aged 13 to 14 years. Of the participants, 53% were female, and 47% were male. In addition, 97% of the participants were Hispanic and 3% African American.

Procedure

This study was conducted in three phases over a total of 12 weeks.

Phase 1 (Observation Period-5 weeks)

Phase 1 of the study began on the 2nd week of school and lasted until the 6th week of school. The first phase was five weeks long. This phase was an observation period for the teacher; she observed her students' behaviors and test scores. During this phase, class proceeded as normal. Students received home work, class work assignments, and a weekly assessment. During this phase, students took weekly exams, five altogether for the phase, based on the subject matter being taught by the teacher. During phase 1, the teacher recorded the students' weekly test scores and observed if the students' scores were improving, declining, or remaining constant. In addition, she averaged all student test scores to attain an average weekly exam score. At the end of the first phase, the teacher averaged each of the students' five phase 1 test scores. Then, she averaged all students' scores, which provided a phase 1 class average score.

Phase 2 (Explanation Period-2 weeks)

Following the completion of the first phase, the study entered into an explanation period. During this phase, the teacher shared the weekly test scores for the past five weeks with the students. In addition, during this explanation period, the teacher explained the definition and purpose of self-regulation and goal-setting. The teacher explained to the students the purpose and impact of goals, based on research findings. Each student was then provided with a self-regulation folder which contained charts, a graph, and goal setting/strategic planning/self-reflection sheets. The students were then given their test scores for the past five weeks and were asked to place these scores on the chart provided and graph them as a line graph. The students were able to visually see how they had been performing for the past five weeks. After the students had seen their progress, the teacher encouraged the students to reflect on their progress and to think of factors in their life that were affecting their grades. The teacher spent the next two weeks helping students identifying factors affecting their learning and setting up achievable goals and strategies to help them accomplish their goals. For example, one student identified that one of the reasons she was doing so poorly in mathematics is that she was easily distracted or not paying attention in class. For one of her goal helping strategies, she wrote "not getting

distracted." The student then decided that she would not sit near her friends, not talk during class presentation time, and go to sleep early so she would not be sleepy during class.

Phase 3 (Implementation-5 weeks)

The third phase began on the 9th week of school and ended on the 13th week of school. During this phase, the class continued as normal with the exception of the implementation of the self-regulation and goal-setting. During phase 3, students continued taking weekly exams for a total of five exams. During this phase, the students received their slef-regulation folders and previous weeks test scores at the beginning of each week. The students then placed their scores on their chart and graphed their results. The students then entered into the self-reflection stage of goal-setting. Students were asked to reflect on their actions or lack of actions in the previous week. The students were asked self-reflection questions, such as did they complete all their strategies, why or why not; what strategies were working for them and how they knew they were working; and what they would do different and what they would do the same. The students then chose a new goal for that week and chose goal-helping strategies and so forth. This cyclical method continued for the five weeks of the third phase. Just as during phase 1, the teacher recorded the students' weekly test scores and observed if the students' scores were improving, declining or remaining constant. In addition, she averaged all students' test scores to attain an average weekly exam score. At the end of the third phase, the teacher averaged each of the students' five phase 3 test scores. Then, she averaged all students' scores to achieve a phase 3 class average score.

Results

During phase 1, the class average weekly scores ranged from 63% to 79%. At the end of phase 1, the class had an average of 69.7% on weekly assessments, with 41% of the students averaging a below mastery level of 70% on their weekly assessments. During phase 3, the class average weekly scores ranged from 62% to 95%. At the end of phase 3, the class had an average of 81.4% on weekly assessments improving over 11% from phase 1. In addition, only 12% of students averaged a below mastery level of 70% on their weekly assessments compared to 41% in phase 1. Nearly 30% of the students improved their scores and began working at a mastery level of 70% or higher. On an individual student basis, 71% of students improved their average score on weekly assessments, while only 18% decreased, and 11% remained the same.

This study was guided by the question: "Can the implementation of self-regulation through goal-setting improve student mathematics achievement?" A paired t-test was used to test the hypothesis that students' mathematics achievement improved as a result of self-regulation and goal-setting (see Table 1).

The excel output gives the t critical one-tail value at 1.69236 at alpha = 0.05; therefore, the null hypothesis (H_0) was rejected. Therefore, it is the conclusion of this study that the two population means are statistically different and that students' mathematics achievement, as measured by teacher-made exams, were significantly gained after the introduction of self-regulation through goal-setting.

Conclusion

Research has shown that students who set goals and are self-regulated learners have higher achievement. The results of this study correlates with research findings. Result of this study show that the students significantly improved their mathematics achievement. Through the use of self-regulation, students learned to determine factors that affect their learning and effectively choose and adjust strategies to correct these factors.

Table 1

t-Test: Paired Two Sample for Means

	After	*Before*	*Paired Difference*	
Mean	81.38235	69.73529		
Variance	95.03119	277.049	Mean	11.64706
Observations	34	34	Standard Error	2.388655
Pearson Correlation	0.548772		Median	8
Hypothesized Mean Difference	0		Mode	24
Df	33		Standard Deviation	13.92813
t Stat	4.87599		Sample Variance	193.9929
P(T<=t) one-tail	1.33E-05		Kurtosis	-1.07904
t Critical one-tail	1.69236		Skewness	0.139775
P(T<=t) two-tail	2.66E-05		Range	51
t Critical two-tail	2.034515		Minimum	-14
			Maximum	37
			Sum	396
			Count	34
			Confidence Level(95.0%)	4.859755

Note: U_D = paired difference mean; H_0: $U_D = 0$; H_a: $U_D > 0$ where $U_D = U_{after} - U_{before}$

Based on the results of the action research project and on the findings of research, the implementation of self-regulation through goal-setting had a positive impact on students' mathematics achievement. As a result of the success of this project, self-regulation through goal-setting will be implemented at RMS as a mathematics department strategy to improve students' mathematics achievement.

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