CHAPTER II

REVIEW OF RELATED LITERATURE

2.0.0 INTRODUCTION

Prior to designing this study, a review of the literature was conducted to ensure that the study was based on a sound philosophical foundation and other previously conducted research. This chapter provides information from the current literature beginning with a brief introduction to self-regulation, followed by sections that address self-efficacy and its relationship to self-regulation, a more in-depth discussion of self-regulation, instructional models, and concluding statements that summarize how the literature informed the present study.

2.1.0 SELF REGULATION

Self-regulation is defined in several ways by various researchers. Zimmerman(1986) defines self-regulated learning strategies as the "actions directed at acquiring information or skills that involve agency, purpose (goals), and instrumentality self-perceptions by a learner (p. 615)" for the purposes of a study he conducted with 80 high school students, 40 from the high achievement track and 40 from the low achievement track. Fourteen categories of self-regulation strategies were identified from interviews with the students. Use of the strategies predicted with 93% accuracy the academic track of the students, thereby indicating that higher achieving students use a greater variety of self-regulated learning strategies and with greater consistency than lower achieving students.

Zimmerman (2002) defines self-regulation as "self-generated thoughts, feelings, and behaviors that are oriented to attaining goals." He states, "self-regulation of learning involves more than detailed knowledge of a skill; it involves the self-awareness, self-motivation, and behavioral skill to implement that knowledge appropriately." He explains that self-regulation is a collection of skills that include specific, reachable goal setting, strategy adoption, self-monitoring, restructuring behaviors to meet goals, time management, self-evaluation, task ownership and adapting for the future (Zimmerman, 2002).

Zimmerman (1986) refers to 14 categories of self-regulated learning strategies that have been identified as contributing to academic achievement. The categories are

identified as follows: 1. self-evaluation; 2. organizing and transforming; 3. goal-setting and planning; 4. seeking information; 5. keeping records and monitoring; 6.environmental structuring; 7. self-consequences; 8. rehearsing and memorizing; seeking social assistance from 9. Peers, 10. Teachers and 11. adults; and reviewing records such as 12. tests, 13. notes, and 14. textbooks. Zimmerman also recognized learning behaviors that were initiated by someone other than the student, but did not include them as self-regulating strategies.

Self-regulating strategies are divided into three phases of a cyclical process. Forethought is the first phase. This phase includes task analysis, goal setting, planning and self-motivation. The second phase is the performance phase. This phase includes self-control and self-observation. This is the operational phase of completing a task. The third and final phase is the self-reflection phase. In this phase, students self-evaluate their efforts and develop a sense of satisfaction at their accomplishment. The final stage provides the motivation and impetus to tackle another task and so it is the basis for the forethought phase (Zimmerman, 2002). It is this stage that is enhanced by explicit instruction in self-regulated learning strategies. Students who have strategies that they have used to successfully complete previous tasks, will also have the confidence to approach future tasks with a better understanding of their capabilities and limitations. It is the self-awareness of one's abilities that increases self-efficacy. Since the phases are cyclical, however, explicit instruction on strategies for other phases wills ultimately impacts the whole process of self-regulation. Further Zimmerman (2002) concludes by stating, "Recent research shows that self-regulatory processes are teachable and can lead to increases in students' motivation and achievement (p. 69)."

Research indicates that attempts to teach problem-solving heuristics to mathematics students based on Polya's method has not achieved the positive results expected. It seems that developing and successfully utilizing problem-solving strategies is both problem and solver specific. In numerous studies, teaching heuristics has not produced measurable differences when compared to control groups that did not receive specialized problem-solving instruction (Schoenfeld, 1985). However, teaching students to use heuristics as generalized strategies for problem-solving is different from teaching self-regulated learning strategies. The heuristics that are taught to students are generally thought processes, whereas self-regulated learning strategies are taught as learning behaviors, which are not situation or task specific.

Zimmerman (2000) states that low levels of self-regulation are related to poor achievement in all aspects of life. He uses examples other than education, such as personal health care, to illustrate the point. He states that social learning experiences, or the lack thereof, contribute to the acquisition of self-regulation strategies. He states that individuals who have low levels of self-regulation grew up in "homes or communities where they (self-regulation strategies) are not taught, modeled, or rewarded." This makes it important to include explicit self-regulated learning strategy instruction as a component of a complete instructional program.

Hagen and Weinstein (2000) states, "The more students can take responsibility for their own learning, the more likely they are to attribute success to their own efforts. If students believe that their efforts will make a difference in what and how much they learn, then they are more likely to expend higher levels of effort in their studies."This is an extremely potent statement about the power of taking ownership of one's own learning, which further supports the potential benefits of providing explicit self-regulated learning strategy instruction to students as an integrated component of their regular mathematics instruction.

Howard-Rose and Winne (1993) express the concern that they attempted to isolate elements of self-regulated learning that occur dynamically in instructional situations that develop instantaneously during classroom interaction and students' engagement with learning tasks. They mention that previous researchers have failed to measure the individual components of self-regulated learning because the previous models have been one-dimensional. They attempt with their study to create a multi-level dimensional model that recognizes the complexity and interaction of the components.

The study participants were 33 twelfth-grade students from two senior high schools located in a medium-sized metropolitan area. All participants were volunteers from an original pool of 180 students. The study sample was heterogeneous based on performance (GPA), cognitive ability (Raven's Progressive Matrices), and socioeconomic background (Howard-Rose &Winne, 1993). Students were asked to complete tasks. The tasks were designed to favor the self-regulated learning components. Students completed a survey, The Academic Attribution Scale, to address the source of their success or failure at completing the tasks. The Academic Self-Concept Scale was administered to assess self-efficacy. The SRL (Self-Regulated Learning)Rating Scale was also administered. The Meta cognitive Questionnaire was

administered to collect data on the cognitive processes students used to complete the tasks. Students were trained to record their cognitive activity while completing the tasks through a processing called "tracing." Students were scored on the tasks using a pre-test/post-test matrix. Finally students were videotaped while they worked on the tasks. The video tapes were analyzed for data related to the components of self-regulated learning (Howard18Rose &Winne, 1993).

Based on statistical analyses, triangulation and aggregation methods, the data were unreliable. There did not appear to be any consistent relationships among the data sources for the various components of self-regulated learning. In other words, the researchers were unable to isolate and quantify the specific components of self-regulated learning (Howard-Rose &Winne, 1993). The researchers did not identify how to isolate components of self-regulated learning, but they did eliminate at least one method that other researchers will not have to try and they shed light on the intricacy and multifaceted nature of the construct.

2.1.1 SELF-EFFICACY AND RELATIONSHIP TO SELF-REGULATION

The theoretical framework for using self-regulated learning strategies is based on Bandura's theory of self-efficacy. He defines self-efficacy as "a judgment of one's capability to accomplish a certain level of performance (Bandura, 1986, p. 391)." Further he explains that one's belief in one's own abilities has an effect on the choices one makes. For example, people tend to avoid situations they believe require capabilities beyond the ones they possess. Similarly, people are more willing to engage in tasks that they feel they will be able to complete successfully. This willingness to engage in an activity contributes to the individual's competency with respect to the skills required to complete the activity. According to Bandura, a person's belief in how likely he/she is to be successful at a task has an influence on the level of effort the individual is willing to expend. An individual is more likely to put forth greater effort and persist toward the completion of the task if the person feels he/she is capable of successfully completing the task (1986). These ideas have implications for how students should be supported in their efforts to learn new skills and concepts and the importance of providing explicit self-regulated learning strategy instruction.

Bandura's theory of self-efficacy is rooted in social-cognitive theory, which holds that behavioral, environmental and personal factors interact to determine and

define human actions (Schunk & Zimmerman, 1997). Bandura includes both social constructionist elements that address how cognitive development occurs and it also includes elements of self-determination theory, which addresses motivational factors (Schunk& Zimmerman, 1997; Sullivan, 1998).

Social constructivists fall into two groups. First are those who base their beliefs on Piaget's work. They believe that human learning is an internal function that addresses the disequilibrium created within the individual when confronted with a conflict between experiences and what one believes he/she knows (Sullivan, 1998). In the second camp are those who base their beliefs on Vygotsky's theory, which maintains that learning occurs as the result of human interaction in social settings (Sullivan, 1998).

Bandura's use of social cognitive theory is compatible with both perspectives (Martin, 2004, Schunk& Zimmerman, 1997; Sullivan, 1998). Schunk and Zimmerman(1997) describe a process for self-regulation development that begins with social interaction and modeling and eventually becomes an internal set of processes that are revised and monitored based on an individual's interaction with new experiences and tasks. They suggest that Vygostky's theory explains cognitive features of self-regulation and Piaget's theory explains the self-motivation component that is inherent in those who are successfully able to self-regulate their own learning. In other words social cognitive theory as Bandura uses it to support his theory of self-efficacy blends social learning behaviors (Vygotsky) with motivational factors and personal monitoring (Piaget) to explain how self-regulating behaviors combine to increase self-efficacy (Harrison, Rainer, Hochwarter, &Thompson, 1997). According to Bandura's theory of self-efficacy, as students take control of their own learning and engage in behaviors that they self-evaluate as beneficial, their understanding of their own ability to successfully accomplish future tasks increases and this thereby increases self-efficacy (Bandura,1986).

Self-efficacy is determined by four factors. The first factor which may contribute to self-efficacy is previous success. If one is successful at completing a task, he/she develops a greater confidence that he/she can successfully complete future tasks (Bandura, 1986); i.e. success breeds success. The second factor that may contribute to self-efficacy is vicarious experience. If an individual observes someone, who he/she perceives to be similarly capable, complete a task then the individual believes that he/she is also capable of completing the task (Bandura, 1986); i.e. if he

can do it, so can I. Verbal persuasion is another factor that contributes to self-efficacy. If an individual is told that they are capable of completing a task by someone they trust they may decide that they are indeed capable. The influence of this factor is ultimately limited by the success one has when the task is attempted (Bandura, 1986). It does speak, however, to the power a teacher may have to motivate students to attempt new skills or problems. Finally, the general psychological state of the individual influences his/her self-efficacy. If the individual is highly stressed or agitated about attempting a new task, he/she may not feel as though he/she can successfully complete the task whereas under less stressful conditions, he/she may feel better about the situation in general (Bandura, 1986).

Zimmerman (1990) has also studied the effects and influence of self-efficacy. Most of his work seems to have been conducted with very young children, but in one particular study he explored fifth, eighth and eleventh grade students' abilities to use self-regulated learning and estimate their mathematical efficacy. He found that students' self-efficacy increased with age. High school students' self-efficacy was greater than middle school students', which was greater than the elementary school students. This seems contradictory to studies which indicate that students' mathematical confidence decreases with age. It is important to note that confidence to complete a task may be low, but by being able to accurately predict one's inability to successfully complete the task, self-efficacy is high. Self-efficacy is a measure of one's ability to accurately predict their capability; it is not the same as one's confidence level.

Zimmerman (1990) found that students who more actively engaged in self-regulated learning strategies also had higher levels of self-efficacy than other students. It may be that students who are more actively engaged in the pursuit of learning are more aware of their strengths and limitations and thus their self-efficacy increases as their active involvement in learning increases. He provides an overview of the underlying beliefs and assumptions of self-regulated learning theory. He states, "Self-regulated learning theorists view students as meta-cognitively, motivationally, and behaviorally active participants in their own learning process (Zimmerman, 1986, p. 308)." The meta-cognitive component recognizes student behaviors such as planning, organizing, self-instructing, self-monitoring and self-evaluating during the learning process. The motivational component examines the level at which students perceive them as competent, capable, and independent learners. The behavioral aspect of self-

regulation refers to students' abilities to recognize, select, and design appropriate learning strategies and environments (Zimmerman, 1986).

Pajares (1997) has conducted a number of studies related to the influence of self-efficacy and mathematics performance. In one such study he wanted to determine if the type of mathematical assessment would influence students' self-efficacy judgments. Three hundred twenty-seven middle school students were presented with both a multiple choice assessment and an open-ended performance assessment of similar mathematics problems. Even though students performed better on the multiple-choice test, there was not a significant difference in their self-efficacy judgments. However, the findings did indicate that the higher performing students are better at identifying their level of self-efficacy than lower performing students.

In another study, Pajares (1995) tested different levels of self-efficacy. Working with 391 college students enrolled in different universities, he found that students' mathematical self-efficacy for completing specific mathematics problems was more reliable than their general confidence to perform mathematical tasks or their predictions of earning high grades in mathematics-related courses. The findings of this study differ to some extent from previous studies, which had indicated that students' mathematical confidence was a strong indicator of problem-solving ability. The findings confirmed Bandura's theory that there are different ways of assessing self-efficacy (Bandura, 1986).Pajares (1995) asserts that self-efficacy is more accurately related to specific tasks than to global views of generalized situations. As a result students could confidently predict their capability to complete specific problems, but were less able to accurately predict their capability to complete all mathematics problems of a particular type or to earn a high grade in a class. However, students generally are very aware of their capabilities, which is why teachers and counselors are advised to seriously consider students' self-efficacy in the same way they consider test scores when making course placement decisions.

Pajares and Miller (1994) address the flaws in a number of studies that have previously attempted to determine if self-efficacy and self-concept are predictors of students' problem-solving performance. They based their study on Bandura's social cognitive theories of self-efficacy, which defines self-efficacy as "people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances (p. 193)."

A study conducted by Pajares and Miller (1994) found that "self-efficacy had stronger direct effects on (mathematics problem-solving) performance than did any of the(other) variables (p. 198)" examined in the study, such as mathematics self-concept, perceived usefulness of mathematics, prior mathematics experience, and gender. Several aspects of the study supported Bandura's theories. First, the overall findings indicate the power of self-efficacy. Second, most students' overestimated the level of their performance. That is also consistent with social cognitive theory.

Pajares (2002) states that Bandura's social cognitive theory of human functioning is the framework for both self-efficacy and self-regulated learning. Pajares explains self-efficacy by stating, "Individuals engage in behavior, interpret the results of their actions, use these interpretations to create and develop beliefs about their capability to engage in subsequent behaviors in similar tasks and activities, and behave in concert with the beliefs created (Pajares, 2002, p. 116)." In the same journal, Zimmerman (2002) explains, "the self-motivated quality of self-regulated learners depends on several underlying beliefs, including perceived efficacy and intrinsic interest (p.66)." One of the most crucial of these beliefs is the students' knowledge of their capabilities to successfully complete a task or activity, which is the essence of self-efficacy beliefs (Pajares, 2002). This is a compelling argument to substantiate the value of self-efficacy as a driving force for the use of self-regulated learning strategies.

Pajares (2002) refers to a number of studies that indicate that gender may be a factor in students' self-efficacy and use of self-regulated learning strategies. However, the differences vary by subject and grade span. He addresses several reasons why gender may appear to be a greater influence than it actually is. First he mentions that there is not a statistical difference between the self-efficacy of students with similar academic capabilities. He also indicates that differences seem to align to societal expectations that boys do well in mathematics and Mathematics and that girls do better in language arts. Pajares hypothesizes that the methods used for measuring self-efficacy may also create differences among genders. Finally he mentions that boys and girls seem to respond to questions about self-confidence and capability differently. Girls tend to be more humble while boys tend to overestimate, exaggerate or brag (Pajares, 2002).

2.1.2 EVIDENCE OF SRL IMPROVING LEARNING ACHIEVEMENT

Research has documented evidence that SRL builds learning accomplishmen t among students instructed in these meta-cognitive and behavior-related concepts. Utilizing a multidimensional scale created by Bandura and Wood (1989), Zimmerman, Bandura,and Martinez-Pons (1992) interviewed high school students to assess their perceived self-regulatory efficacy in not only academic achievement, but also other domains of functioning (Zimmerman & Martinez-Pons, 1988). The authors hypothesized that students perceived efficacy for using self-regulated learning strategies and achieving in academic courses would influence their personal goals and grade achievement (Zimmerman et al., 1992). The authors used two sub-scales from the Children's Multidimensional Self-Efficacy Scale (Bandura & Wood, 1989): self-efficacy for self-regulated learning and self-efficacy for academic achievement. The authors also assessed the grade goals of both students and their parents using rating scales developed by Locke and Bryan (1969). The resulting questionnaire was administered in the social studies classes of 102 participating students (Zimmermann et al., 1992).

Zimmerman et al.'s (1992) study found that students' personal goals played a key role in their grade attainment, thereby providing support for a social cognitive view of academic self-regulation. In accordance with prior research, the higher students' perceptions of their own self-efficacy, the higher the goals they set for themselves (Bandura & Wood, 1989). The influence of parents' goal-setting for students additionally influenced academic attainment, largely by fostering self-motivation. In other words, students who felt that their parents had high goals for their grades personally sought to attain those goals (Zimmerman et al., 1992).

In a related study, Zimmerman and Martinez-Pons (1988) asked teachers to rate their own perceptions of students' use of SRL strategies. Given on Likert scales, these teacher ratings were submitted to multivariate analyses along with the students' math and verbal scores on a standardized test. By combining teacher ratings with test scores, the researchers separated the students' achievement outcomes associated with their use of SRL strategies from students' general abilities. The authors confirmed that student interviews demonstrated a .70 correlation with SRL usage. According to the authors, this finding is indicative of students' use of SRL beyond their general

abilities. This further demonstrated that instruction in SRL provides a valuable contribution to student achievement (Zimmerman & Martinez-Pons, 1988).

During the 1990s, researchers demonstrated a desire for students to not only know what a strategy was, but also how and when to use the strategy, as well as how to teach the strategy to others. The goal was to render learning so self-regulated that students would be able help other classmates obtain knowledge of the concept. This strategy entailed three, important meta-cognitive (i.e., thinking about one's own thinking) aspects: declarative knowledge (what the strategy is), procedural knowledge (how the strategy operates), and conditional knowledge (what, when, and why a strategy should be applied) (Paris, Lipson, & Wixson, 1983). In this vein, SRL proved a valuable concept due to it semphasis of the "self" – in terms of the agent establishing learning goals (Paris & Winograd, 2003) – and its combination of cognitive strategies, meta-cognition, and motivation (behaviorally controlled) into one coherent construct. Researchers believed this approach to be consistent with Bandura's (1989) work on self-regulation, which included the three interrelated processes of self-observation, self-evaluation, and self-reaction.

One such researcher, Boekaerts (1996), described SRL as a learning episode with a goal-directed and context-specific pattern of behavior that unfolds over time until one of the following conditions is met: (1) the learning goal that organized the learning episode is attained, (2) the goal is partially accomplished, but this state of affairs is accepted by the learner, (3) the goal is re-appraised and determined unattainable, unattractive or irrelevant in the present context by the learner, or (4) another goal takes precedence for the learner. According to Boekaerts (1996), this definition distinguished learning opportunities from personal learning episodes and endorsed that some learning opportunities provided by the teacher might be interpreted by students as personal learning episodes, whereas others might be perceived as mere tasks or assignments. While Boekaerts' (1996) work was focused on the Netherlands, U.S. researchers were already producing parallel evidence of students achieving positive academic outcomes through SRL-infused curriculums (Paris &Winograd, 2003).

A major contribution of Paris and Winograd's (2003) study was making SRL more teacher-friendly and classroom viable. To do this, their research illuminated the principles of SRL that could be converted into practice:

- Self-appraisal leads to a deeper understanding of learning. They suggested that both teachers and learners practice reflection as a first step toward changing one's approach to the task, if need be. This includes evaluation of what is known and what is yet to be acquired. This periodic monitoring of one's learning process is a useful habit due to its promotion of self-efficacy.
- Self-management of thinking, effort, and affect promotes flexible approaches to problem-solving that are adaptive, persistent, self-controlled, strategic, and goal-oriented.
- Self-regulation can be taught in diverse ways. SRL is flexible and adaptive; different kinds of strategies and motivation might be emphasized for different learners. SRL can be taught with explicit instruction, directed reflection, and meta-cognitive discussions.
- Self-regulation is woven into everyone's narrative experiences and identity. (Paris &Winograd, 2003)

Just prior to Paris and Winograd's (2003) study, Paris and Paris (2001) conducted a seminal study that recommended Project/Problem Based Learning (PBL) as a vehicle for SRL instruction. PBL focuses on student-designed inquiries regarding authentic problems in realistic environments and the use of many resources over extended time. With this structure, PBL allows for the concepts embedded in SRL to flourish among students who demonstrate motivation for learning (Paris & Paris, 2001, p. 94). Learning in this environment depends upon the assessment of both the product and the process. In other words, students must understand what is known, what requires additional effort, and what skills are needed in achieving the goals of the project/learning experience.

According to Paris and Paris (2001), self-assessment in PBL requires that students internalize standards so they can regulate their individual learning more effectively. This assessment depends on both internal and external factors, and encompasses all three domains of SRL – cognitive, motivational, and affective (Paris & Paris, 2001).Like Paris and Paris (2001), Hmelo (2004) conducted extensive work with the PBL concept and found that the model, when instructed correctly, required learners to use SRL to solve highly complex problems. One way that Paris and Paris (2001) helped individuals understands SRL as a concept was the use of metaphors.

One metaphor was that of acquisition: Learning new strategies and skills, and then applying those strategies/skills to content acquisition. According to Dabbagh and Kitsantas (2012), students' practice of SRL may be regarded as a skill (p. 3). The second metaphor was becoming more regulated (i.e., as students developed new competencies). As Paris and Paris (2001) promoted it, SRL was not obtained, so much as shaped and elaborated upon through participation in students' zones of proximal development. Zimmerman et al. (1992) would label this approach a Vygotskian view of SRL.

Paris and Paris (2001) also deviated from prior research by discussing how students become self-regulated. Researchers have noted that every student constructs his or her own theory of SRL; however, students' understanding of the process might be enhanced or encouraged in these three ways: 1) SRL can be induced from authentic or repeated experiences in school, 2) teachers may provide explicit instruction about SRL, and 3) SRL can be acquired through engagement in practices that require self-regulation (i.e., situations in which self-regulation is welded to the nature of the task). Regardless of the approach chosen, Paris and Paris (2001) argue, students of all ages could benefit from the practice of SRL's constructs, analyses, and discussions of learning strategies.

Perry et al. (2002) claimed that qualitative methodologies were responsible for the insights gained into younger students' utilization of SRL. In particular, researchers revealed how qualitative methods targeted issues that young children valued (learning to read and write), used language that young children understood (classroom language), and assessed SRL in the context of naturally occurring events in the young students' classrooms. For Perry and colleagues (2002), the objective was to identify features of classroom tasks, authority structures, and evaluation practices that were supportive of young children's development of independent and academically effective forms of reading and writing. To this end, they worked alongside teachers to design activities that contained the aforementioned features.

Perry et al. (2002) conducted a five-year longitudinal study in which they observed literacy activities in five 2nd grade and 3rd grade classrooms from 1998 to 2002.The classrooms were selected from a larger pool of classrooms in a suburban school district in British Columbia. The observations took the form of running weekly records for six months during reading and writing time. Based on researchers' observations, three of the classrooms were categorized as high-SRL classrooms.

Teachers in these classes engaged students in complex, open-ended literacy activities, offering them choices and opportunities regarding their level of challenge in completing tasks, as well as self- and peer-evaluation opportunities (Perry et al., 2002). In contrast, the two low-SRL classrooms featured students who engaged in simple, closed activities that often focused on specific, isolated skills. Student choice was extremely limited in the last two classrooms; the teacher controlled the difficulty level and evaluation criteria, which were typically the same for all students. Teacher support typically targeted procedural task completion; as a result, the non-SRL classrooms offered few opportunities for students to participate in SRL-like curricula (Perry et al., 2002).

After collecting, coding, and analyzing the running records, Perry et al. (2002) derived five overarching categories that reflected SRL in these classrooms: (1) choices,(2) opportunities to control challenges, (3) the opportunity to evaluate their own and others' learning, (4) instrumental support, and (5) feedback and evaluation that were nonthreatening and mastery oriented. The authors additionally looked at teachers' speech and actions to determine which aspect of self-regulation they promoted and why. While the focus of the study was on teachers' engagement in SRL, the researchers uncovered evident benefits to the students (Perry et al., 2002).

From their study, Perry et al. (2002) concluded that young children do utilize SRL in classrooms where they can engage in complex, open-ended activities, make choices that impact learning, control challenges, and evaluate themselves and others. Furthermore, the field observations revealed that teachers can provide support or scaffolding for students through questioning, clarifying, correcting, elaborating and modeling. Students in these classrooms were also allowed to support one another through brainstorming and sharing problem-solving strategies.

Lastly, Perry et al. (2002) asserted that, by embedding assessments and evaluation into the classroom's ongoing activities, teachers created nonthreatening and intrinsically motivating learning contexts. In these classrooms, students demonstrated attitudes and actions that were aligned with independent, academically effective learners' meta-cognition, intrinsic motivation, and strategic action. Perry et al.'s (2002) work continues to be a seminal example of not only SRL's existence as a concept, but its practical ability to advance academic achievement for students as young as primary school.

Perry et al.'s (2002) findings were substantiated and expounded upon by later studies. In a meta-analysis of SRL studies, Dignath, Buettner, and Langfeldt (2008) found that SRL could not only be taught to primary-aged students, but that primary students appeared to benefit most from strategy instruction based upon socio-cognitive theories. In another study, Lombaerts et al. (2009) conducted field testing to develop and refine an instrument aimed at measuring primary teachers' beliefs regarding the use of SRL instruction/strategies in the classroom. This study reestablished a known constraint present in SRL instruction: the difficulty of accurately measuring belief systems. The authors determined that their instrument, the Self-Regulated Learning Teachers' Beliefs(SRLTB) scale, was valid and reliable; however, they noted that the SRLTB items required more specific revision in order to tease out teachers' beliefs regarding SRL from teachers' general education beliefs. For example, teachers who adhere to constructivist type curriculums might more naturally embrace SRL, while those who lean more toward behaviorist educational philosophies might find fault with SRL instruction (Lombaertset al., 2009).

Looking to explore the concept of SRL from an empirical lens, Loyens et al.(2008) compared various SRL studies to assess the quantitative state of the research. These researchers reiterated that the "self" aspect was the crucial piece in the SRL concept, but went further by highlighting that self-generating and self-monitoring learning issues are beneficial for students' academic achievement. Self-reflection is equally crucial for self-regulation: Indeed, highly driven students often and accurately performing self-assessment. These findings further validated that SRL depends on the learner, and particularly the actions that he or she initiates and undertakes (Loyens et al.,2008).

Building on Zimmerman et al.'s (1992) work, Coutinho (2008) assessed the relationship between self-efficacy and meta-cognition among college students, seeking to understand how these variables related to students' performance as measured by their grade point averages. Like Zimmerman et al. (1992), Coutinho (2008) found that self-efficacy reflected a person's perceived ability to attain a desired outcome by taking necessary steps.

2.1.3 EDUCATING STUDENTS THROUGH SELF-REGULATION OF LEARNING

Professor Zimmerman has educated his students by using his social learning model of development of self-regulation competence. Self-regulation has been defined by Dr. Zimmerman as learners' beliefs about their capability to engage in appropriate actions, thoughts, feelings, and behaviors in order to pursue valuable academic goals, while self-monitoring and self-reflecting on their progress toward goal-completion (Zimmerman, 2000). As doctoral students, we have set for ourselves the goal of earning the doctorate degree, and all of the possible career activities associated with this high level of accomplishment. We must be confident, or self-efficacious in our ability to learn the tools necessary to perform in our courses, as junior researchers, and as defenders of our work. This growing process is embedded in the doctoral program, when you are a student of Professor Zimmerman's.

The development into a self-regulated individual involves four levels: observation, emulative, self-control, and self-regulation (Schunk& Zimmerman, 1997). Observation is based on Bandura's (1986) social cognitive theory which suggests that through observation, we can learn to do things we would not have been able to do before observing the behavior performed by others. The emulative level is when the learner begins to try the behavior on his or her own, but imitates exactly the way the model or professor has done. The difference between the first two levels is that in the first level the student is observing while in the second level, the student is using motoric, rather than just cognitive processes as he or she tries to imitate the behavior that was observed (Schunk & Zimmerman, 1997). The third level of development into a self-regulated educator involves self-control. At this level the student internalizes what has been Barry observed but will still be dependent on the professor's model of the behavior. The final level of self-regulation occurs in the student when he or she is able to adapt the behavior as needed independent of the professor, using one's own internal sources to guide behavior. These levels and the ways in which Professor Zimmerman used them are essential to understanding the impact of him as an educator and the role of self-regulated learning for all future students who will attempt to follow in his footsteps.

2.1.4 MATHEMATICAL PROBLEM SOLVING AND SRL

Zimmerman and Kitsantas (1999) have argued that self-regulated learners are able to set goals, plan a course of action, select appropriate strategies, self-monitor, and self-evaluate their learning, as well as reflect upon their goal accomplishments. They are also intrinsically motivated to learn and report high self-efficacy for learning and, performance. Additionally, according to English and Kitsantas (2013), numerous research studies have found that students' self-regulation is highly predictive of student academic performance (Zimmerman, 2002; Zimmerman &Kitsantas, 1999). On the contrary, esearchers have found that students' inability to self-regulate their learning behavior is equally related to academic learning difficulties and low motivation (Zimmerman & Schunk, 2001). Other authors (i.e., English & Kitsantas, 2013; Hmelo, 2004) have also discussed SRL as an essential skill in a Project-Based Learning (PBL) environment, which is defined as "a systematic teaching method that engages students in learning knowledge and skills through an extended inquiry process structured around complex, authentic (real-life) questions and carefully designed products and tasks" (Larmer, Ross,&Mergendoller, 2009).

Many studies have documented a gradual shift toward teachers intentionally supporting the constructs of SRL, which entails encouraging students' ownership of work and creating a classroom climate that supports students' planning and execution of their work. Perry et al.'s (2002) five-year case study of elementary classrooms, for instance, found that students demonstrated higher levels of SRL behaviors when teaching practices were more supportive of SRL pedagogy. Similarly, Lawanto et al. (2013) conducted an exploratory SRL study involving 27 students in grades 9-12 who were working on an engineering design project. The project was similar to PBL (Hmelo, 2004) in that students received design problems that their project had to solve/overcome. According to Lawanto et al. (2013), the higher-scoring SRL students showed a greater completion rate for planning and constructing their engineering project than the lower-scoring students, the latter of who often had great plans that they struggled to execute.