Developmental and Gender Differences in Elementary Students' Self-Regulation, Self-Efficacy, and Sources of Self-Efficacy in Mathematics: An Exploratory Study

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by

Christina Lau
Bachelor of Arts
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Director: Anastasia Kitsantas, Professor
College of Education and Human Development

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George Mason University
Fairfax, VA

DEDICATION

I dedicate this thesis work to my family. Mom and Dad, you have inspired my educational journey and showed me that good things come from hard work, dedication, and patience. I am forever thankful for your love and support throughout the process. Judy and Thomas, your words of encouragement and advice have motivated me to pursue deeper goals in life.

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ABSTRACT

DEVELOPMENTAL AND GENDER DIFFERENCES IN ELEMENTARY STUDENTS' SELF-REGULATION, SELF-EFFICACY, AND SOURCES OF SELF-EFFICACY IN MATHEMATICS: AN EXPLORATORY STUDY

Christina LauM.S.

George Mason University, 2015

Thesis Director: Dr. Anastasia Kitsantas

The purpose of this study is to examine the developmental differences of elementary students' self-regulation, self-efficacy, and sources of self-efficacy, and to assess whether these variables differ as a function of gender across grade levels. Participants in this study included 442 third-, fourth-, and fifth-grade students from U.S. International Baccalaureate schools. Self-report measures were used to assess students' self-regulation (i.e., Perceived Responsibility for Learning Scale), self-efficacy, and sources of self-efficacy in mathematics. The results of this exploratory study showed that mastery experiences, vicarious experiences, social persuasions, and physiological states accounted for a significant amount of variance in students' mathematics self-efficacy. Social persuasions were the strongest predictor of mathematics self-efficacy. Boys reported stronger perceived responsibility, mastery experiences, social persuasions, and physiological states than did girls. Mastery experiences were the strongest indicator of

mathematics self-efficacy for girls. Limitations and implications for future research and practice are discussed.

CHAPTER ONE

Since the beginning of public education in the United States, educators have struggled with individual differences in student learning. Some students grasp concepts easily and are highly motivated and engaged in their learning, whereas others struggle to make sense of information and often lack interest in specific tasks (Zimmerman, 2002). During the 19th century, student's poor performance in school was believed to be due to lack of intelligence. In the 20th century, new psychological perspectives emerged and research on individual differences in academic learning began to gain widespread attention. Research provided educators with ways to accommodate students' individual differences in the classroom, including grouping students according to ability, fostering practical skills, and matching student performance on standardized tests with instructional treatment (Cronbach, 1957; Zimmerman, 2002). Despite these efforts, the reasons for students' success or lack of success in school remained unclear. Finally during the late 1970s, research on students' individual differences in learning emerged, suggesting that performance may be due largely to self-processes such as self-regulation and self-efficacy (Bandura, 1997; Zimmerman, 2002).

When looking at ways to encourage success in school, researchers have found that students who engage in self-regulated learning processes such as goal setting, planning, self-monitoring, and self-reflection tend to exhibit greater levels of achievement, motivation, and engagement in learning (Schunk & Zimmerman, 1998; Zimmerman 1989, 2000). Social cognitive theory purports that, "children can be described as self-regulated learners to the degree that they are metacognitively, motivationally, and behaviorally engaged in their own learning" (Zimmerman, 1989, p. 4). In general, metacognition refers to *knowledge about cognition* and *regulation or control of cognition* (Brown, 1987). Metacognitive processes involve a student's ability to set goals, make adjustments to their strategies, monitor their progress towards achieving their goals, and evaluate their performance (Zimmerman, 1989). Motivation is defined as a process whereby goal-oriented behaviors are initiated, directed, and sustained (Pintrich & Schunk, 2002). Motivation entails goals that provide drive and energy towards action and includes processes such as self-efficacy for learning, which refers to beliefs that students hold about their ability to perform and execute a specific learning task, these in turn, influence their level of engagement in learning and helps determine what they do with the knowledge and skills they possess (Bandura, 1997). Behavioral self-regulation involves a student's ability to regulate their behavior and attention towards reaching their desired goal. To successfully self-regulate one's own learning, a student must possess some degree of metacognitive awareness, motivation to engage in the specific task, and ability to control and adapt one's own behavior and actions. Therefore, these beliefs and abilities are fundamental for students to become self-regulated learners (Zimmerman, 2000).

Fostering the development of self-regulated learning behaviors can benefit students by empowering them to take responsibility and ownership over the learning process (Schunk & Ertmer, 2000). As students progress through school, they are faced with increasing demands such as completing homework, studying, extracurricular activities, and self-organization. Therefore, it is essential for students to adopt self-regulated learning strategies (e.g., goal setting, planning, self-monitoring, strategy use, self-reflection) early during their academic schooling in order to become successful learners (Zimmerman, 2000). Highly regulated students are successful in school partly because they set learning goals, monitor their academic progress, develop realistic self-efficacy beliefs for learning, and establish a productive learning environment (Zimmerman & Schunk, 2011). Additionally, adopting self-regulated strategies can benefit students by fostering study skills, independence, and positive academic attitudes (Cooper & Valentine, 2001).

Statement of the Problem

To date, research on self-processes such as self-regulation and self-efficacy has primarily focused on middle school, high school, and college students (e.g., Kitsantas, 2002; Pintrich & De Groot, 1990; Usher & Pajares, 2008; Zimmerman & Martinez-Pons, 1990). Far less is known about the development of elementary school students' self-regulation and self-efficacy (Joët, Usher, & Bressoux, 2011). A review of the literature reveals that only a handful of studies have investigated how students self-regulate their learning in the elementary years (Bembenutty, Clearly, & Kitsantas, 2013; Zimmerman & Schunk, 2011). In a meta-analysis by Dignath, Buettner, and Langfeldt (2008), the

authors found that only 48 intervention studies, conducted in elementary school settings, have examined some aspect of self-regulated learning. Furthermore, fewer studies have explored students' self-regulation in terms of their perceptions of responsibility for academic learning (e.g., Cooper & Valentine, 2001; Zimmerman & Kitsantas, 2005). In addition to addressing this gap in the literature, this study also sought to study the processes underlying students' self-efficacy in mathematics. The primary objective of this study is to examine the developmental and gender differences in self-regulation, self-efficacy, and sources of self-efficacy in upper elementary students.

Research is clear that primary education teachers can help cultivate self-regulatory strategies and instill positive self-efficacy beliefs in young children (Pajares, 2008; Zimmerman & Martinez-Pons, 1986). In order to develop ways to effectively integrate self-regulation in school, it is necessary to better understand the processes underlying students' development of self-regulation and self-efficacy.

Significance of the Study

This study is significant because it explores the development of self-regulation, self-efficacy, and the sources of self-efficacy in upper elementary students, grades 3 to 5, and whether these variables differ as a function of gender across grade levels. The context for this study is the International Baccalaureate (IB) Primary Years Programme (PYP), which is designed for students ranging from ages 3 to 12 years old. The IB PYP is one of three programmes offered by the IB organization, including the Middle Years Programme (MYP) and the Diploma Programme (DP). The IB PYP curriculum focuses on incorporating interdisciplinary themes into instruction, which provide the framework

for teachers to engage student learning. The IB organization is unique because IB teachers are trained to develop inquiry and to challenge students that encourage critical thinking from a global perspective.

Studies have shown positive outcomes of students enrolled in the IB program. Data collected in a 2003 student survey indicated that high school seniors within the IB DP have higher SAT scores, college acceptance rates, and college grade point averages compared to general education students (IBO, 2005). However, few studies have examined the value that the IB PYP provides in supporting students' education. Thus, the current study is significant because it may contribute to an understanding of how an IB PYP context affects the development of students' self-regulation skills, self-efficacy, and sources of self-efficacy. In particular, mathematics was selected as the subject of focus in this study because of its importance and prevalence in the school curriculum. Mathematics is considered to be one of the most difficult tasks elementary students encounter because it requires the application of skills, knowledge, and strategies to solve mathematics problems (de Corte, Verchaffel, & Op't Eynde, 2000). By investigating self-regulation, self-efficacy, and the sources of self-efficacy in the domain of mathematics, the results of this study may provide insight regarding implementation of classroom interventions for elementary students for researchers and teachers. The findings of this study may further help to inform understanding of the emerging behaviors young students possess in regulating their mathematics competence and how primary teachers can best foster the development of self-regulation and self-efficacy.

Research Questions

This study seeks to better understand the development of self-regulation, self-efficacy, and the sources of self-efficacy in upper elementary school students (grades 3 to 5). A student's ability to self-regulate their learning involves processes whereby they set goals for their learning, maintain active engagement and self-efficacy, monitor and evaluate their progress, reflect on their learning, and employ strategies to achieve their goals. This study explored young children's self-regulated learning, self-efficacy, and sources of self-efficacy by focusing on the following research questions:

RQ#1. What are the developmental differences in elementary students' self-regulation, self-efficacy, and sources of self-efficacy in mathematics?

RQ#2. Are there gender differences in self-regulation, self-efficacy, and sources of self-efficacy in mathematics across grade level (grades 3 to 5)?

Definition of Terms

For the purpose of this study, the following terms and definitions will be used. These terms were selected to help the reader understand the research from the field of educational psychology.

Self-regulated learning. Social cognitive theory maintains that "students can be described as self-regulated to the degree that they are metacognitively, motivationally, and behaviorally active participants in their own learning" (Zimmerman, 1989, p. 329). Self-regulation includes three key processes: forethought, performance, and self-reflection. Forethought processes includes goal setting, planning, and self-motivational beliefs. Performance processes includes behaviors such as self-monitoring, self-control,

attention focusing, and self-observation. Self-reflection processes include self-evaluation, causal attribution, and self-satisfaction (Zimmerman, 2000). Adopting self-regulated strategies can benefit students by fostering study skills, independence, and positive academic attitudes.

Perceived responsibility for learning. Perception of responsibility for academic learning is an element of self-regulation that encourages students to become more independent learners. In this study, perceived responsibility focused on students' willingness to accept responsibility for their own academic functioning.

Self-efficacy. Self-efficacy is a context-specific term that refers to "people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances" (Bandura, 1986, p. 391). In this study, the term refers to students' self-efficacy of their ability to solve mathematics problems.

Sources of self-efficacy. According to Bandura (1997), there are four sources underlying students' self-efficacy: mastery experience, vicarious experience, social persuasions, and physiological states. Mastery experience focuses on one's personal experience with success or failure in the past. Vicarious experience entails observing the actions and experiences of others, such as peers, classmates, and adults. Social persuasions involve obtaining evaluative feedback from others such as teachers, parents, and peers. Students also interpret their academic competence by their physiological states such as stress, anxiety, fatigue, and mood.

International Baccalaureate Primary Years Programme (IB PYP). The IB PYP context focuses on incorporating interdisciplinary themes into instruction, which

provide the framework for teachers to engage student learning. The IB organization is unique because IB teachers are trained to develop inquiry and to challenge students, which is conducive to the development of students' self-regulated learning.

CHAPTER TWO

In this chapter, the literature relevant to an examination of students' academic self-regulation, self-efficacy, the sources of self-efficacy, and the gender and grade-level influences that may have some bearing on these factors will be reviewed.

Conceptual Framework

The conceptual framework for this study is based on Bandura's social cognitive theory, which explains that people's behavior, personal factors, and their environment interact to influence the processes of their development (see Figure 1, p. 10). According to social cognitive theory, self-regulated learning is determined through the interaction of personal processes, environment, and behavioral events. For example, solving a multiplication problem such as "5 x 2 = ?" is assumed to be influenced not only by student's personal beliefs about their ability, but also by environmental (e.g., encouragement from a teacher) and behavioral (e.g., staying focused on solving the problem) factors. Personal attributes involve internal factors such as metacognition and motivation. Metacognitive processes include a student's ability to set goals, monitor progress, adjust strategies, and evaluate performances (Zimmerman, 1989). Motivation includes processes such as self-efficacy for learning, outcome expectancy, and interest (Schunk & Zimmerman, 2008). Environmental factors involve social interactions with adults and peers as well as the physical surroundings that are conducive to self-regulated

learning. Behavioral factors involve a student's ability to regulate his behavior and attention towards achieving the desired goal (Bandura, 1986). Thus, the social cognitive perspective purports that any exploration of self-regulation must involve these three key influences.

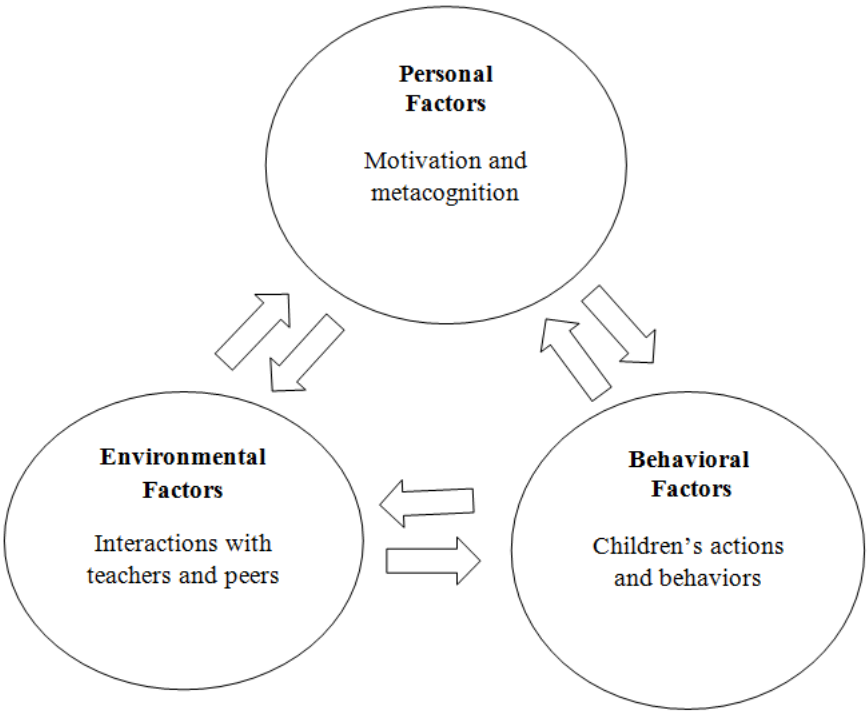

Figure 1. The triadic model demonstrates how the interaction between personal, environmental, and behavioral attributes inform a child's engagement in self-regulation (Bandura, 1986).

Social cognitive research is seeking to understand how self-processes such as self-regulation and self-efficacy influence human functioning and behavior (Bandura, 1997; Zimmerman, 2008). Understanding the processes underlying self-regulation and self-

efficacy are essential to understanding how individuals learn and develop through interactions with people in a variety of contexts (Bandura, 1986; Zimmerman, 1989).

Self-Regulation

According to the social cognitive perspective (Zimmerman, 2002), there are three sequential phases of self-regulation in which students engage when performing an academic task: forethought, performance, and self-reflection (see Figure 2, p. 13).

The forethought phase is characterized by processes that occur before doing a learning task or activity and comprises task analysis and self-motivational beliefs. This phase involves taking self-initiative and self-direction and consists of task analysis processes such as goal setting and strategic planning (e.g., selecting a strategy to guide one's cognition during the course of action). These processes entail setting process goals (i.e., focus on the steps and procedures for doing the task) and product goals (i.e., focus on the performance outcomes). Moreover, self-motivational beliefs underlie the forethought processes of goal setting and strategic planning (Zimmerman, 2000). Specifically, students' willingness to engage and persist in learning depends on self-motivational beliefs such as self-efficacy for learning (i.e., beliefs about one's ability), outcome expectations (i.e., beliefs about the expected outcome), intrinsic interest, and goal orientation (i.e., reasons for learning) (Schunk & Usher, 2013).These processes are thought to influence students' subsequent effort and persistence during engagement of a task (Schunk & Pajares, 2009). For example, a student who has a high level of confidence (self-efficacy) in his or her ability is more likely to be motivated to persist on a difficult task and exhibit greater effort than would a student with low self-efficacy (Cleary &

Zimmerman, 2001). They also show interest in the task or value and tend to adopt a specific learning goal orientation. Students' goal orientation is commonly categorized as either mastery or performance based. Students with a mastery goal orientation engage in learning because they believe learning is meaningful and desire to gain the required skills for learning. In contrast, students with a performance goal orientation focus on the actual outcomes (e.g., grades) and are less interested in the process of learning. Research on goal orientation has shown mastery goal orientation to be influential to students' motivation (Elliot & Dweck, 2005).

The performance phase involves processes that occur while doing a learning task or activity and includes two main categories: self-control and self-observation. In this phase, the student is employing strategies set forth in the forethought phase, monitoring progress, and adjusting those strategies while working towards achieving their goal. Highly self-regulated learners engage in self-control processes such as self-instruction, focusing attention, and applying task strategies as a means to keep themselves motivated to improve and engaged in the task. In addition to these processes, self-regulated learners are successful because they often manage time better, structure the learning environment, and seek help (Wolters, 2003). During self-observation, students focus on aspects of their performance and outcomes by engaging in processes such as self-recording and self-experimentation.

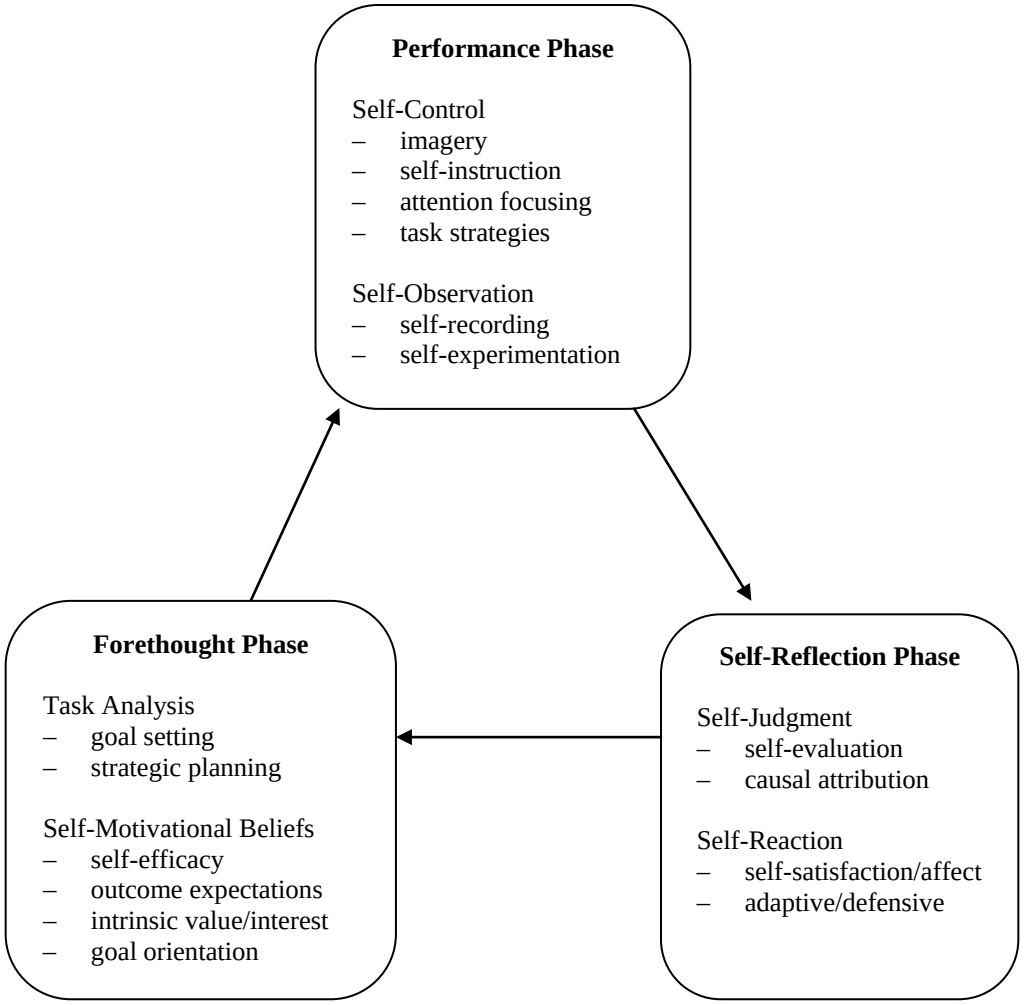

Figure 2. Zimmerman's three-phase model of academic self-regulation. Adapted from "*Motivating Self-Regulated Problem Solvers*" in J. E. Davidson and Robert Sternberg (Eds.), *The Nature of Problem Solving*, by B. J. Zimmerman and M. Campillo, 2003, New York, NY: Cambridge University Press.

The third phase, self-reflection, entails processes that occur after completion of a learning task or activity and includes two main categories: self-judgment and self-reaction. Self-judgment requires students to evaluate their performance and make causal attributions (i.e., judgments about causes of outcomes) for the outcomes, such as

explaining the causes of a poor test results either by one's limited ability in knowledge about the topic or insufficient effort. Students reflect on their performance by comparing it to their goals to determine progress (Schunk & Usher, 2013). The belief that students are making progress is certainly influential in strengthening self-efficacy and motivation (Schunk & Pajares, 2009). Students who attribute their progress to strategy use or effort are more likely to feel self-efficacious and to persist with future tasks, whereas those who attribute outcome to uncontrollable factors (e.g., luck, help from teacher) should experience a lesser degree of self-efficacy (Schunk & Ushcr, 2013). Self-reaction involves feeling satisfied with the results and responding in a defensive or adaptive way. If students perceive that they are making adequate progress towards reaching their goal, they are likely to feel satisfied and motivated to continue. The assessments students make about their performance (i.e., self-reflection) help to determine if they will continue on the task or return to the forethought phase to devise a new strategy, thus creating a feedback loop.

Examining the influences of forethought, performance, and self-reflection phase processes on self-regulation of elementary students is pivotal because these self-regulatory processes form the basis on which students begin to regulate their learning. There is evidence to support the various self-regulatory processes and the cyclical nature of this three phase model with regard to athletic tasks (Cleary & Zimmerman, 2001; Kitsantas & Zimmerman, 1998, 2002). There is additional research on students' self-regulation in academics. DiBenedetto and Zimmerman (2010) examined students' self-regulatory processes, comparing performance in science among high, average, and low

achieving students. Self-regulation was assessed using a method called a microanalysis, a semi-structured interview approach that asks specific questions pertaining to the processes within the three phases as students engage in a task (Cleary, 2011; Zimmerman, 2008). The researchers asked 51 11th grade science students, 17 in each of three achievement levels (high, average, and low) microanalytic questions as they read and studied a passage on tornados, and then immediately upon completion of a test. As hypothesized, the findings showed that high achieving students engaged in more self-regulatory processes (i.e., strategic planning, metacognitive monitoring, self-evaluative standards), spent more time studying, and received higher test scores than average and low achieving students.

Similar results have also been found with respect to students' test preparation and performance in a college level course. Kitsantas (2002) examined the effect of self-regulatory processes (e.g., goal setting, planning, self-monitoring, help seeking, self-evaluation) on test preparation and performance of 62 college students enrolled in an undergraduate psychology course. Students were interviewed individually about the strategies they used to prepare for an upcoming test as well as the strategies they used during and after test taking. Following the completion of the test, the researcher classified students into two groups (high or low achieving) on the basis of their test performance. Thirty-two students were identified as high test performers and 30 students were labeled as low test performers. As expected, high test scorers exhibited more self-regulatory processes while studying for an exam, taking a test, and after receiving their test results than low test scorers. Significant differences in self-regulatory processes were found in

goal setting and planning, organizing and transforming notes, and help seeking. Additionally, high test performers were more likely to engage in self-monitoring and keeping track of records (e.g., maintaining a daily record of study progress), self-consequencing (e.g., rewarding oneself for completing a study session), and environmental structuring (e.g., finding a quiet place to study).

Previous research has addressed the processes by which different achieving high school and college students engage in forethought, performance, and self-reflection. However, research on self-regulatory functioning of younger students has been limited (e.g., Beghetto & Baxter, 2012; Kitsantas, Steen, & Huie, 2009). Additionally, most of the current literature that has studied self-regulation of elementary students has only focused on aspects of self-regulation (e.g., self-efficacy, task strategies, attribution, goal orientation). To better understand the processes underlying younger students' self-regulation in learning, it is pertinent to study the processes within each of the three phases of self-regulation. Although this study did not address this issue, it would be interesting to examine the role of these processes in students' academic learning. However, this study focused on students' willingness to accept responsibility for their academic functioning, which is considered an element of academic self-regulation. As students progress in school, the role of responsibility for learning and completing homework should be more in the hands of the students. Hence, this study seeks to explore whether young students become more independent learners as they progress in elementary school.

Developmental studies on self-regulation. Research has shown the developmental difference of self-regulation in promoting learning and school

achievement across grade levels (Eme, Puustinen, & Coutelet, 2006; Pajares & Cheong, 2003; Zimmerman & Martinez-Pons, 1990). In general, research supports the notion that the sophistication of students' self-regulatory functioning will increase over broad developmental periods (e.g., middle school to high school) as they accumulate experience and knowledge about learning strategies. In a qualitative study with 5th, 8th, and 11th grade students, Zimmerman and Martinez-Pons (1990) examined grade-level differences for 14 self-regulatory learning strategies (i.e., self-evaluating; organizing and transforming; goal-setting and planning; seeking information; keeping records and self-monitoring, environmental structuring; self-consequating; rehearsing and memorizing; seeking assistance; reviewing materials). The sample included students from gifted and general education schools and contained an equal number of students from each of the three grade levels (30 fifth-graders, 30 eighth-graders, 30 eleventh-graders). During the one-on-one structured interview, each student was asked to describe the strategies they use in different learning contexts (i.e., in classroom situations, when completing mathematics assignments, when completing writing assignments, when checking English or science homework, when preparing for a test, when taking a test, when feeling low motivation to complete homework, and when studying at home). Upon completing the interview, students were administered two self-efficacy scales: verbal comprehension and math problem solving. For the verbal self-efficacy scale, students rated on a scale from 0 to 100 their confidence level in defining the word correctly. For the math self-efficacy scale, students rated their confidence level in solving various mathematics problems (e.g., simple arithmetic, algebra, probability, statistics). Each scale contained 10 items of

increasing difficulty. The findings revealed that 11th grade students displayed greater, more adaptive use of self-regulation strategies and self-efficacy beliefs than 8th grade students, who in turn surpassed 5th graders. These findings suggest that highly regulated students are not only confident in their ability to learn and achieve their goal, but also use strategies to improve their learning.

Prior studies have focused on the developmental differences of students in regards to self-regulatory functioning in academics (e.g., Cleary & Chen, 2009; Eme et al., 2006; Pajares & Cheong, 2003; Rosário, Núñez, Valle, González-Pienda, & Lourenço, 2013); however, those studies only focused on certain aspects of self-regulation (e.g., goal orientation, self-efficacy, task interest, motivation). Pajares and Cheong (2003) examined from a developmental perspective the achievement goal orientations in writing of 1,266 students ranging from grades 4 through 11. Students in their study were from three different public schools located in the Southern and Northeastern United States. Students completed surveys for each of the variables studied (i.e., mastery goals, performance-approach goals, performance-avoid goals, self-efficacy, self-concept, self-efficacy for self-regulation, task value, anxiety). The findings revealed that mastery goal orientation (i.e., focusing on mastering the learning material) in writing decreased as students progressed from elementary school to middle school and increased in high school; performance goal orientation (i.e., focusing on outcomes) decreased from elementary school to middle school and then stabilized. The authors found that at each level of schooling, students with higher self-efficacy, self-concept, and self-efficacy for self-regulation reported stronger mastery goals than did students with lower self-efficacy.

These findings suggest that developing a mastery goal orientation is particularly conducive to learning and serve an adaptive motivational function.

Recently, studies have focused on examining motivation and self-regulation of students in the middle school years (Cleary & Chen, 2009; Rosário et al., 2013), a distinct developmental period whereby students take on greater academic, social, and personal demands. In particular evidence has shown a decrease in motivation as students in middle advanced from one grade level to the next. Cleary and Chen (2009) found that students reported less frequent use of self-regulatory strategies, task interest, perceived usefulness as they advanced from 6th to 7th grades. Similarly, Rosário et al. (2013) found that self-regulatory strategy use and self-efficacy for using self-regulation strategies decreased from 7th to 9th grades.

While there is research examining the developmental differences of students' motivation and self-regulation, few studies have specifically focused on the development of upper elementary students' self-regulation. Eme et al. (2006) examined the developmental differences in reading monitoring of French students (N = 150) in 3rd and 5th grades by using an open-ended questionnaire that assessed students' skills, goals, and strategies (e.g., picturing the story in one's mind, re-read sentences) related to reading. Overall, the findings showed that knowledge about skills, goals, and strategies for reading increased slightly with grade, with knowledge of goals having the most substantial progress. Moreover, analysis of students' meta-knowledge about evaluation in reading revealed that few students explicitly provided elaborate knowledge (e.g., main idea comprehension) about reading tasks, goals, and skills and seldom provided specific

reading goals and strategies. These findings highlight important insight on young children's monitoring ability given that it is a critical determinant in expert-reading development.

Self-regulation and academic achievement. Research demonstrates that the use of self-regulatory processes relate to academic achievement, specifically that differences in self-regulatory processes exist among students of different achievement levels. Pintrich and De Groot (1990) studied motivational orientation and self-regulated learning of seventh and eighth grade students studying science and English. The authors focused on the relationships among motivation, self-regulated learning, and student performance. The sample included 173 students of varied achievement levels from eight science and seven English classrooms. Students responded to the Motivated Strategies for Learning Questionnaire (MSLQ), a self-report measure, self-efficacy, intrinsic value, test anxiety, self-regulation, and use of learning strategies. As predicted, self-efficacy and intrinsic value were positively correlated with cognitive strategy use (e.g., rehearsal, elaboration, and organizational strategies), and self-regulation. Further, self-regulation and self-efficacy were two of the best predictors of academic performance. Students with higher grades were more likely to report the use of self-regulatory strategies than low-achieving students. Also, students with higher self-efficacy and intrinsic value were more likely to report using cognitive strategies than low-achieving students in both science and English.

Furthermore, numerous studies have found that high-achieving students, especially those in the gifted program, exhibit greater self-regulation general education students (DiBenedetto & Zimmerman, 2010; Zimmerman & Martinez-Pons, 1990).

Shaunessy, Suldo, Hardesty, and Shaffer (2006) examined the psychosocial (i.e., psychopathology) and school functioning (i.e., self-efficacy, school climate, in-school behavior) of 122 gifted and high-achieving students enrolled in the IB program and 176 general education students in a public high school in the Southeastern United States. Students in this study were in 9th through 12th grades and came from a single public school that houses both an IB high school and general education high school. Eligibility for the IB program is highly selective and based on students having a grade point average of 3.0 or higher on a scale of 4.0. Students enrolled in the gifted program were required to meet the state criteria for intellectually gifted students, which include referral by teacher, parent, or adult; passing score on a teacher checklist of characteristics of gifted children; and obtaining an intelligence quotient of 130 or higher on an intelligence test. Students who were not part of the gifted program but served in the IB program were described as high achieving students. A comparison of IB and non-IB students showed that IB students reported more confidence in their academic abilities, held more desirable perceptions of school climate, and achieved higher grade point averages than general education students. Moreover, IB students reported fewer psychopathology symptoms (e.g., delinquent and aggressive behavior) than general education students. Furthermore, gifted and high achieving IB students were similar in terms of school and psychological functioning.

More recently, research has examined the role of self-regulated learning strategies in predicting achievement of elementary school students. For example, Kitsantas et al. (2009) studied self-regulated learning strategies and goal orientation as predictors of the

achievement of 81 fifth grade students. The researchers hypothesized that prior achievement, self-regulatory strategy use, and mastery goal orientation would predict students' Grade Point Average (GPA) and Standards of Learning (SOLs) scores in the domains of language arts, mathematics, social studies, and science. The sample was primarily Caucasians with an equal representation by gender. Students in the sample completed two self-report instruments: The Motivated Strategies for Learning Questionnaire (MSLQ) and the Patterns for Adaptive Learning Scale (PALS). The MSLQ contains two scales: the Motivation Scale and the Self-Regulated Learning Strategy Scale. For their study, the researchers selected to use only the Self-Regulated Learning Strategy Scale to examine the different learning strategies (i.e., cognitive and metacognitive strategies) in which students engaged. The PALs assesses motivation by measuring mastery and performance goal orientations. Achievement was assessed using students' GPA, as well as a longitudinal examination of changes in students' SOL scores from third grade to fifth grade. The findings revealed that prior achievement and use of self-regulation strategies accounted for a significant amount of variance in students' academic performance. Consistent with prior research, self-regulated strategies was the only variable to predict GPA across all subject areas (mathematics, science, language arts, and social studies). This finding suggests that developing self-regulated strategies is important for students to become successful learners across various academic domains.

Adopting self-regulated strategies should theoretically help promote academic learning. Researchers have documented that utilizing self-regulation in homework enhances students' development as independent learners with better study skills, more

positive attitudes toward learning, and greater responsibility for completing assignments (Cooper, Lindsay, Nye, & Greathouse, 1998; Cooper & Valentine, 2001). More recently, Zimmerman and Kitsantas (2005) developed a scale of perceived responsibility for learning, which assessed students' self-regulation by asking students to rate whether the student or teacher was more responsibility for various academic tasks. This scale was designed to better understand students' display of academic responsibility and was utilized to investigate the meditational role of perceived responsibility beliefs between homework practices and academic achievement. Self-efficacy was also examined to study its meditational role in homework and achievement in girls (N = 179). In addition to finding strong internal consistency reliability for this scale (α = .90), the researchers found a significant path relationship between homework and achievement via girls' self-efficacy and perceived responsibility beliefs. Self-efficacy and perceived responsibility also independently contributed to girls' GPA. The findings with this newly developed scale are indeed insightful; however a limitation of the study was the generalization of the findings being limited to girls attending a parochial school. Hence, this study seeks to utilize this scale to explore further the gender differences in students' perception of responsibility for academic learning.

Self-regulation and gender differences. Researchers have also attempted to study gender differences in students' engagement of self-regulatory processes. Females display greater self-regulation than do males, as females tend to employ goal-setting, environmental structuring, self-monitoring, record keeping, and help seeking more often than males (Zimmerman & Martinez-Pons, 1990). Similarly, meta-analytical studies have

shown that females exhibit greater motivation and ability to regulate their behaviors than males (Cross, Copping, & Campbell, 2011; Else-Quest, Hyde, Goldsmith, & Van Hulle, 2006; Silverman, 2003). Silverman (2003), for example, analyzed 33 delay of gratification studies and found a slight advantage in delay ability attributes favoring females in their self-control and knowledge of strategies for delaying gratification (e.g., not thinking about the tempting object). The ability to delay gratification (e.g., postpone immediate gratification for a larger reward later) involves one's ability to control emotional arousal and resist temptation during a task. It is important to note that females were almost twice as likely as males to delay gratification when a continuous rather than dichotomous scale was used. This finding suggests that females are likely to exhibit greater self-control when they are presented with several choices rather than only two.

Other researchers have found a gender gap favoring girls in their behavioral and emotional regulation. For example, preschool girls are better at regulating emotional expressions (e.g., the expression of frustration) than boys (Cole, 1986; Davis, 1995; Sarni, 1984). In a series of studies with U.S. eighth graders, Duckworth and Seligman (2006) examined the role of self-discipline on students' academic performance and assessed whether it differed by gender. Self-discipline was defined in their study as "the ability to suppress prepotent responses in the service of a higher goal and that such a choice is not automatic but rather requires conscious effort" (p. 199). Thus, the ability to discipline oneself involves self-control and attention (e.g., choosing homework over playing video games; paying attention in class rather than daydreaming; and persisting on a long-term project despite frustration and boredom). Several hypotheses were tested in

two studies by Duckworth and Seligman: (1) Adolescent girls earn higher grades in mathematics (Algebra I and Algebra II), English, and social studies than boys; (2) Females obtain higher grades on school report cards than scores on standardized achievement tests; (3) Standardized achievement test under predict girls' report card grades; (4) Girls are more self-disciplined than boys; (5) Self-discipline is a better predictor of school report card grades than of standardized achievement tests; and (6) Self-discipline is mediated by the relationship between report card grades and gender, even when controlling for achievement test scores. In a study of 140 eighth grade students (78 girls, 62 boys) from ethnically diverse backgrounds attending a magnet public school, Duckworth and Seligman (2006) distributed a battery of self-discipline measures including student self-reports (The Impulsivity subscale, the Brief Self-Control Scale, and Delay of Gratification Questionnaire) and teacher and parent questionnaires (The Self-Control Rating Scale). The Delay of Gratification Questionnaire asked students to report on 27 hypothetical tasks with response choices between smaller, immediate rewards and larger, delayed rewards (e.g., "Would you prefer $55 today or $75 in 61 days?"). Achievement was assessed using students' final report card grades for mathematics, English, and social studies classes and scores on standardized achievement tests (mathematics, language arts, and reading). As hypothesized, girls earned significantly higher final grades in all academic subjects than did boys. Self-reports from students, teachers, and parents indicated that girls were more self-disciplined than boys; these gender differences were greatest based on teacher ratings of students' self-discipline (d = .78) and smallest for parent ratings (d = .32). These findings were further

supported when the study was replicated by the researchers in a second study (Duckworth & Seligman, 2006), which included eighth grade students (N = 164; 89 girls, 75 boys) from the same school one year following the first study. In addition to replicating study one, the researchers included an aptitude measure (IQ test) to determine its impact. Contrary to their prediction that girls and boys would do equally well on the IQ test, the findings showed that boys outperformed girls on IQ tests. Although this study does not examine gender differences in achievement, the findings from Duckworth and Seligman's study raise question about mental ability differentiated by gender that necessitates greater scrutiny.

Recent research has found similar results showing that girls outperform boys in achievement and behavior regulation. In Germany, Weis, Heikamp, and Trommsdorff (2013) examined whether gender differences in school achievement (German and mathematics) can be explained by self-regulation (behavior and emotion regulation). The study included a small sample of fifth grade students (N = 53; 34 girls, 19 boys) from 22 different fifth grade classes in seven different schools. Behavior regulation was assessed by teachers' ratings of their students' behavior in relation to academics. Emotion regulation was assessed by student self-reports about coping strategies (i.e., problem and emotion-oriented strategies) when they have difficulties doing homework. Students indicated how often they use problem-oriented strategies (e.g., "I try to think of different ways to solve it") and emotion-oriented strategies (e.g., "I tell myself it doesn't matter") to cope with their emotions. School achievement was assessed using both grades and standardized testing in reading, writing, and mathematics. As hypothesized, the findings

were consistent with previous studies showing girls retain better behavioral regulation than boys (Duckworth & Seligman, 2006; Zimmerman & Martinez-Pons, 1990). For emotion regulation, there were no significant gender effects.

While there is evidence for gender differences in behavioral regulation favoring girls, there is some literature that suggests that girls and boys do not differ in certain aspects of self-regulation (DiBenedetto & Zimmerman, 2010; Pintrich & De Groot, 1990). For example, Pintrich and De Groot (1990), found no gender differences in students' cognitive strategy use (i.e., rehearsal, elaboration, and organizational strategies), metacognitive strategies (i.e., planning, skimming, and monitoring), and intrinsic interest for learning in science and English classes. However, these researchers and others (Joët et al., 2011; Pajares, Johnson, & Usher, 2007) have found that boys and girls differ in self-efficacy across context. For example, boys typically report higher self-efficacy in mathematics (Joët et al., 2011) and science, whereas girls report higher self-efficacy in writing (Pajares et al., 2007). Others have found no significant gender differences (Kiran & Sungur, 2012; Usher & Pajares, 2006).

In a Swiss study, Krebs and Roebers (2010) examined metacognitive monitoring and control processes involved in students' test-taking behavior. As previously discussed, monitoring and control of cognition constitute key aspects within the theoretical framework of self-regulated learning. The authors investigated students' ability to strategically regulate their test performance by adequately considering the outcomes of their monitoring (e.g., which of the choices is most likely to be correct?) and regulating their answers through control processes (e.g., crossing out answers that would have been

incorrect). The sample contained a total of 107 students from third (N = 54) and fifth (N = 53) grades. Students in the study were shown a short educational film about how sugar was produced, followed by 26 questions containing answerable and unanswerable items relating to the film; rated their confidence-level in each question, and were then given the option to withdraw answers (i.e., cross out answers they thought were incorrect). Students' ability to monitor their test performance was based on monitoring for accuracy of their confidence in their answers (i.e., lower confidence judgments should be given for incorrect answers and higher confidence for correct answers). Controlling for behavior in test-taking was assessed by whether the student crossed-out answers they thought were incorrect (e.g., unanswerable items). As expected, the findings indicated that older students are better at metacognitively differentiating between correct and incorrect answers than younger students, thus allowing them to effectively monitor and control their test-taking behaviors. This finding suggests that engaging in self-regulatory strategies such as monitoring is beneficial in test performance. However, these self-regulatory strategies did not differ by gender.

Whether gender differences exist in students' ability to self-regulate their learning remains unclear. Overall, the literature suggests that in certain aspects of self-regulation, there may be gender differences. For example, girls may be better at regulating their behavior and emotions than boys. Understanding which of these self-regulatory processes differ by gender is essential for facilitating students' efforts to become self-regulated learners. Particularly, attention to students' self-efficacy is needed, given its importance in facilitating their self-regulation in learning.

Self-Efficacy

Self-efficacy refers to beliefs that students hold about their ability to perform and execute a learning task under specified conditions. The beliefs that students hold about themselves and about their academic competence influences their academic performance and level of engagement in learning and helps determine what they do with the knowledge and skills they possess (Bandura, 1997). For example, students who attribute success to controllable factors (e.g., hard work, effort, studying) demonstrate greater academic achievement whereas students who attribute outcome to external factors (e.g., luck) tend to earn lower achievements (Bandura, 1997). In a study examining self-efficacy and mathematics achievement of nine year old students from Japan (N = 8,220) and the United States (N = 10,070), House (2006) found that students who attributed mathematics success to hard work and studying at home tended to earn higher test scores in mathematics. Moreover, students who reported enjoying mathematics and stressed the importance of memorizing the textbook or notes also tended to earn high mathematics scores. In contrast, students who believed that success in mathematics is innate and attributed success to good luck tended to earn lower mathematics scores.

Sources of Self-Efficacy

Bandura (1997) hypothesized that self-efficacy beliefs are developed as students interpret information from four sources. The first and most powerful source has to do with one's own personal experience, or *mastery experience*. Students interpret and evaluate information about their academic competence when they complete an academic task. Personal experience with success or failure will influence one's perception about the

ability to perform tasks. A student who has done well on previous mathematics tests will have positive beliefs about his ability in mathematics, thus raising his confidence to accomplish other related mathematics tasks. A student who has done poorly or failed to produce the desired outcome will have negative beliefs about his ability in mathematics and lower confidence to successfully accomplish related tasks (Bandura, 1997).

The second source of self-efficacy beliefs comes from the *vicarious experience* of observing the actions and experiences of others, such as peers, classmates, and adults. Seeing a classmate experience success from a challenging situation may empower fellow students that they too can achieve success. Models serve an important role in the development of self-efficacy when students doubt their own ability or have limited experience with the task at hand. Such students can benefit from having a model demonstrate coping strategies such as trying different ways to solve a mathematics problem (Bandura, 1997). Research has shown that models serve a more influential role during the transitional periods from elementary to middle school, during which time young students become more aware of information eliciting social comparisons (Eccles, Midgley, & Adler, 1984).

The third source of self-efficacy comes from *social persuasions* and evaluative feedback from teachers, parents, and peers. Supportive messages encourage students to bolster students' confidence in their academic capabilities (Bandura, 1997). Students who are not yet skilled at making accurate self-appraisals often rely on others to provide feedback (Usher & Pajares, 2008). Younger students, in particular, depend on feedback from others and may be most susceptible to what others tell them (Bandura, 1997).

The fourth and final source of one's competence comes from *physiological states* such as stress, anxiety, fatigue, and mood. Students interpret their physiological states as an indicator of their academic competence by evaluating their performances (Bandura, 1997). While emotional reactions to school-related tasks can provide cues to one's outcome for success or failure, severe emotional states can interfere with one's perception of self-efficacy. For example, too much anxiety can lead to avoidance of the task or negative thoughts about doing it.

Thus, according to Bandura's four sources of self-efficacy and prior research, students' past experiences alone are not enough to establish their beliefs about their academic ability. Rather, social cognitive theory maintains that students evaluate their past performances together with personal and environmental factors to form their self-efficacy beliefs. The four sources of self-efficacy play an important role in the development of students' self-efficacy beliefs.

Examining these four sources of self-efficacy on students' academic performance has been the focus of much study in recent years (see Usher & Pajares, 2008, for a review). Mastery experience has been found to be a powerful predictor of self-efficacy across academic domains (e.g., Lopez & Lent, 1992; Usher & Pajares, 2006). Previous findings for the other hypothesized sources have been less clear in predicting self-efficacy. For vicarious experience, some researchers have reported that it independently predicts self-efficacy (Matsui, Matsui, & Ohnishi, 1990), while others have reported no such relationship (Kiran & Sungur, 2012; Lent, Lopez, & Bieschke, 1991; Lopez & Lent, 1992; Joët et al., 2011; Pajares et al., 2007). For social persuasions, researchers have

found that it predicts self-efficacy of elementary and middle school students (Joët et al., 2011; Klassen, 2004; Usher & Pajares, 2006). Researchers have reported that physiological states predict self-efficacy (Lopez & Lent, 1992; Matsui et al., 1990), while others researchers have not reported such influence (Lent et al., 1991).

Research on the sources of self-efficacy in younger students has been even more unclear, while few studies having examined the influence of elementary students' efficacy beliefs in academics (Usher & Pajares, 2008). Pajares et al. (2007), for example, examined the role of the four sources of self-efficacy on 1,256 elementary, middle, and high school students' writing self-efficacy beliefs. The sample contained primarily middle class students enrolled in Grades 4 to 11, with 296 elementary students (grades 4 and 5), 497 middle school students (grades 6, 7, and 8), and 463 high school students (grades 9, 10, and 11). The sources of self-efficacy were assessed using the *Sources of Self-Efficacy Scale* adapted from those used by Lent and colleagues (Lent et al., 1991; Lent et al., 1996). This scale comprises 28 items rated on a 6-point Likert scale reflecting whether students found a particular statement true or false (e.g., "when I come across a tough writing assignment, I work on it until I complete it"). Writing self-efficacy was assessed using a 10 item scale that asked about students' beliefs of their ability on various composition, grammar, usage, and mechanical skills appropriate to their grade level. The items in this scale ranged in difficulty from basic (e.g., "write simple sentences with good grammar") to more ambitious items (e.g., "write a well-organized and well-sequenced paper that has a good introduction, body, and conclusion"). Students' writing competence was also assessed by teacher ratings of their students' ability relative to other students in

that grade level. Consistent with findings from other researchers (e.g., Britner & Pajares, 2006), Pajares et al. (2007) found that all four sources correlated with self-efficacy and with each other. Furthermore, mastery experience was the greatest predictor of self-efficacy for students across all grade levels (grades 4 to 11). Differences by school grade level showed that elementary students reported stronger self-efficacy, mastery experience, social persuasions, and vicarious experience than did students in middle or high school. They also found that physiological indices predicted self-efficacy for elementary and middle school students, but not for high school students, who were greater influenced by social persuasions. This finding suggests that socialization experiences may have a greater role in students' development of self-efficacy as they get older.

More studies have recently focused on the sources of self-efficacy in younger students (e.g., Joët et al., 2011; Britner & Pajares, 2006). Britner and Pajares (2006) examined the influence of the sources of self-efficacy in predicting science self-efficacy of students in grades 5 to 8 (N = 319; 155 boys, 164 girls). Students in this study were from middle class families and were primarily White. Using the *Sources of Self-Efficacy Scale* adapted by Lent and colleagues to assess the four sources, science self-efficacy was assessed with five items that asked students to rate their confidence that they could earn either an A, B, C, or D in their science class. In addition, the study included other variables (e.g., self-concept, science anxiety, and self-efficacy for self-regulated learning) to see which were the greatest predictor of students' science grade. The findings revealed that self-efficacy was the most consistent predictor of students' achievement in science.

Mastery experience was the only source that significantly predicted science self-efficacy. Although the contributions of the other three sources were minor, all four sources were significantly related to each other and self-efficacy.

Extending this study of middle school students' sources of self-efficacy related to science, Kiran and Sungur (2012) studied 1,932 eighth grade students (1,013 boys, 906 girls) from 21 middle schools. Students were from middle to high socioeconomic class families. This study utilized the *Sources of Self-Efficacy Scale* and the MSLQ. With the exception of vicarious experience, all other sources of self-efficacy predicted students' science self-efficacy. Again, mastery experience was found to have the greatest predictive ability to students' self-efficacy beliefs.

With regard to the sources of self-efficacy in elementary school students, Joët et al. (2011) investigated the sources of self-efficacy and self-regulatory efficacy beliefs of French third grade elementary students (N = 395) from upper-middle class families in the areas of mathematics and French. Students completed self-report measures for both mathematics and French, which were administered separately over a 2-week interval period. Using hierarchical linear modeling, the study found that mastery experience, social persuasions, and physiological states were significantly related to self-efficacy and with achievement in both subject areas. Vicarious experience was the only source that did not significantly affect students' self-efficacy beliefs. For mathematics, the authors found that mastery experience and social persuasions predicted mathematics self-efficacy; while mastery experience, social persuasions, and physiological states predicted French self-efficacy.

Overall, the findings from these studies with elementary, middle, and high school students revealed many consistent findings about students' sources of self-efficacy. Mastery experience was found to be the greatest indicator of self-efficacy in various academic domains (Joët et al., 2011; Britner & Pajares, 2006), while vicarious experience had the least influence on self-efficacy (Joët et al., 2011; Kiran & Sungur, 2012). Consistent with Bandura's theory, many of the studies found that all four sources were related to self-efficacy, regardless of whether the findings were significant.

Sources of self-efficacy and gender differences. In addition to investigating the sources of academic self-efficacy, some researchers have attempted to explore whether male and female students differ in efficacy beliefs and sources of self-efficacy. Researchers have found no significant differences by gender with regard to the sources of self-efficacy for students in science, mathematics, and writing, regardless of age group (Britner & Pajares, 2006; Lent et al., 1991; Pajares et al., 2007). However, Usher and Pajares (2006) found gender differences in the domain-general academic self-efficacy beliefs of sixth-grade students. Their study investigated the sources of self-efficacy and self-regulatory efficacy beliefs of 263 (140 girls, 123 boys) entering middle school students (grade 6). The results indicated social persuasion to be the primary source of influence in girls, whereas mastery experience was the most powerful source for boys. Girls also had stronger vicarious experiences.

In a more recent study, Joët et al. (2011) examined whether the sources of self-efficacy and self-regulatory efficacy differ as a function of gender for third grade students in mathematics and French. The gender distribution of the sample in their study was

comparable in size (200 boys, 195 girls). In mathematics, they found that boys outperformed girls and reported higher self-efficacy, self-regulatory efficacy, mastery experience, social persuasions, and lower physiological states. For the subject of French, there were no gender differences for the sources of self-efficacy. Interestingly, girls outperformed boys on the French achievement test, but reported significantly lower self-efficacy.

Further evidence indicates that gender differences in the sources of self-efficacy may be a function of academic domain. For example, boys reported higher mastery experiences, social persuasions, and lower anxiety in areas of mathematics (Joët et al., 2011; Lent, Lopez, Brown, & Gore, 1996) and science (Britner & Pajares, 2006). Girls however reported stronger master experiences and lower anxiety in writing (Pajares et al., 2007). Further evidence shows that girls report more vicarious experience and social persuasions in mathematics (Lopez, Lent, Brown & Gore, 1997), writing (Pajares et al., 2007), and general academics (Usher & Pajares, 2006). Whether these gender differences exist in younger students is less clear. Therefore, the present study will focus on gender differences in the sources of self-efficacy among elementary students from various grade-levels (grades 3 to 5).

While a majority of research on self-regulation and the four sources of self-efficacy has been conducted with middle school, high school, and college students (e.g., Zimmerman & Martinez-Pons, 1990; Usher & Pajares, 2008), there remains a lack of research exploring how these self-processes influence human functioning and behavior in younger students. Little is known about the processes underlying elementary students'

self-regulation and self-efficacy in academics, especially in mathematics. Previous research reveals that there is much inconsistency in what sources have been found to relate to self-efficacy. Moreover, whether gender differences exist in the sources of self-efficacy and self-regulation in mathematics learning remains unclear.

Given these pivotal gaps in the literature, the present study is exploratory and thus seeks to explore self-regulation, self-efficacy, and the sources of self-efficacy among upper elementary students in grades 3, 4, and 5.

CHAPTER THREE

This study aimed to yield a richer understanding of upper elementary students' self-regulated learning, self-efficacy, and the sources of self-efficacy in mathematics. This chapter describes the methodology selected to address the research questions, including the participants, the setting, the measures, and the procedures for collecting and analyzing the data.

Participants

Student participants in this study were drawn from International Baccalaureate (IB) schools throughout the United States. All third, fourth, and fifth grade students enrolled in the IB PYP were invited to participate in this study (N = 501). Preliminary analysis of the data indicated outliers in student responses on specific items of the surveys. The sample size was reduced after deleting these students from the study. The final sample size for analysis was 442 third-(N = 154), fourth-(N = 145), and fifth-(N = 143) grade students enrolled in U.S IB schools. The sample comprised 235 girls (53.2%) and 207 boys (46.8%), with ages of students ranging from 8 to 12 years (M = 9.54, SD =1.15). The ethnic composition of students was: 57% Caucasian, 17% Hispanic, 9% multi-racial, 9% Asian, 7% African American, and 1% other. Participation was voluntary and no compensation was given. Data collection took place between the end of the 2013-2014 and middle of the 2014-2015 school years.

Setting

This study took place in IB schools across the United States. Consultation with the IB PYP coordinator at each school division and research department helped to obtain the sample. Students were recruited from 69 classes within 16 IB PYP schools across 11 states. The IB PYP program focuses on using interdisciplinary themes and incorporating global issues into the curriculum, which provide the framework for teachers to engage students and challenge them. Learning is centered on six interdisciplinary themes: who we are, where we are in place and time, how we express ourselves, how the world works, how we organize ourselves, and sharing the planet. An important aspect of the IB PYP curriculum is to develop students as inquirers, both in the classroom and in the world. This philosophy is influential to the development of students' self-regulation and self-efficacy beliefs.

Measures

Personal data questionnaire. A brief questionnaire was developed to obtain demographic information about the students (e.g., age, gender, grade, and ethnicity).

Sources of self-efficacy. The four sources of self-efficacy were measured using a 14-item scale developed by Lent, Lopez, and Bieschke (1991) and later adapted by Usher and Pajares (2006). The scale was modified to pertain to mathematics and reduced from a pool of 24-items. This scale contained four subscales: mastery experience (n = 3) (e.g., "I always do my best work in mathematics"), vicarious experience (n = 3) (e.g., "I admire people who are good at mathematics"), social persuasions (n = 4) (e.g., "People often tell me that I am a good mathematics student"), and physiological states (n = 3) (e.g., "I am

nervous when I work on mathematics"). Responses for the scale ranged from 1 (Not at all true) to 4 (Completely true). This scale has been shown to have good psychometric properties in a prior research study with elementary school students, with Cronbach alpha coefficients ranging from .61 to .89 (Joët et al., 2011). In this study sample, the Cronbach's alpha reliability coefficient for each of the four subscales of the sources of self-efficacy was: .67 for mastery experience, .65 for vicarious experience, .68 for social persuasions, and .67 for physiological states.

Mathematics self-efficacy. The 4-item measure used to assess students' self-efficacy in mathematics was adapted from Joët et al. (2011). A sample item was "I can solve math problems." Responses for the scale ranged from 1 (Not at all true) to 4 (Completely true). This scale has shown to have established Cronbach alpha reliability with elementary students (overall $\alpha = .87$; boys $\alpha = .83$; girls $\alpha = .86$) (Joët et al., 2011). The Cronbach's alpha reliability coefficient for the present study sample was .69.

Perceived Responsibility for Learning Scale (*PRLS*).The PRLS, developed by Zimmerman and Kitsantas (2005), is an 18-item scale that assesses students' perceptions of personal responsibility for learning, which is a measure of self-regulation. The respondents were asked to rate whether they perceived the student or the teacher being more responsible for various learning tasks or outcomes, such as motivation (e.g., not really trying in class) and deportment (e.g., not behaving in class). A sample item was "Who is more responsible for a student NOT finishing their homework?" Students responded to each item on a 5-point Likert scale: 1 (mainly the teacher), 2 (a little more the teacher), 3 (both the teacher and student the same), 4 (a little more the student), and 5

(mainly the student). Higher scores on this scale indicate a greater degree of responsibility for learning by the student.

For this study, the PRLS was adapted and included 12 of the original 18 items. The final scale contained 5-items which explained 50% of the variance. The remaining items were dropped due to low loadings and cross-loadings. Factor loadings ranged from .58 to .80. An exploratory principal component analysis yielded three factors, which together accounted for 51% of the variance.

Previous research using the PRLS has shown to have established a single factor structure and an alpha reliability coefficient of .90 (Zimmerman & Kitsantas, 2005). The Cronbach alpha reliability coefficient on the reduced scale in the present study sample was .74.

Procedures

This study used data collected from a larger multiphase study investigating elementary students' self-efficacy and self-regulatory development in Primary Years Programme (PYP) schools. IRB approval was obtained as part of the larger study (see Appendix A). Consultation with the IB research department helped to obtain the sample. The IB research office provided email address of IB PYP coordinators from schools in the United States that had been accredited by the IB organization for at least two years at the time of the survey. The school IB PYP coordinator was asked to contact and invite third, fourth, and fifth grade teachers at their schools to participate in the study. These teachers then contacted the parents of their students and informed them of the study. After collecting informed consent from the parent (see Appendix B), students completed

the assent form electronically (see Appendix C), then filled out a Personal Data Questionnaire (see Appendix D), and finally completed the surveys electronically either at home or at school. The surveys took approximately 20 minutes for students to complete.

Data Analysis

Descriptive statistics were calculated (i.e., means and standard deviations) for students' self-regulated learning, self-efficacy, and sources of self-efficacy in mathematics. Pearson's correlation analyses were conducted to assess relationships among the variables (i.e., perceived responsibility, self-efficacy, and sources of self-efficacy). Mean differences, one-way ANOVAs, and regressions were conducted to assess the developmental differences of the variables (i.e., perceived responsibility, self-efficacy, and sources of self-efficacy) in the study (RQ1). To address developmental differences, one-way ANOVAs were calculated among the variables (i.e., perceived responsibility, self-efficacy, and sources of self-efficacy). Regression analyses were conducted to determine the influence of the sources of self-efficacy in predicting mathematics self-efficacy. One-way ANOVAs were conducted to examine gender and grade level differences for all the variables (i.e., perceived responsibility, self-efficacy, and sources of self-efficacy) (RQ2).

CHAPTER FOUR

The overall aim of this study was to explore how self-regulated learning, self-efficacy, and the sources of self-efficacy are manifested in upper elementary school students (grades 3-5), and to examine whether they differ as a function of grade level and gender in mathematics. Since little research has been conducted on self-regulated learning, self-efficacy, and the sources of self-efficacy in the elementary years, this study was designed to be exploratory in nature.

Descriptive Statistics

The descriptive statistics of the data were analyzed using SPSS 22.0. Table 1 provides the means and standard deviations of all measures in this study by gender and grade level. Boys reported greater perceived responsibility for learning, mastery experience, social persuasions, and physiological states, whereas girls reported greater vicarious experience and lower anxiety for mathematics. Boys and girls did not differ in mathematics self-efficacy. Differences by grade level revealed that older students reported stronger self-efficacy and mastery experience as well as perceived responsibility for learning than did younger students.

Table 1

Means and Standard Deviations for Variables in the Study by Gender and Grade Level

Variables	Gender				Grade Level					
	Males		Females		3rd		4th		5th	
	M	SD	M	SD	M	SD	M	SD	M	SD
Perceived Responsibility	4.42	.73	4.37	.75	4.24_a	.89	4.49_b	.69	4.45_b	.58
Self-Efficacy	3.15	.64	3.14	.60	3.08_a	.64	3.11	.60	3.25_b	.60
Mastery Experience	3.32	.66	3.25	.61	3.21_a	.63	3.24	.63	3.40_b	.63
Vicarious Experience	3.04	70	3.08	.64	3.02	.67	2.99	.69	3.17	.62
Social Persuasions	3.16	.64	3.13	.59	3.06	.63	3.15	.62	3.22	.59
Physiological States	2.98	.75	2.92	.74	2.90	.77	2.95	.75	3.00	.71

Note. Mean scores for self-efficacy and the sources of self-efficacy range from 1 (low) to 4 (high). Scores for perceived responsibility range from 1 (low) to 5 (high). Group means for a dependent variable (row) that are subscripted by different letters are statistically different ($\alpha = .05$) computed on an effect identified by one-way ANOVA.

Correlation analyses. Pearson correlation analyses were performed to examine the inter relationship among self-regulation, mathematics self-efficacy, and the sources of self-efficacy (see Table 2). There was a statistically significant positive correlation between students' perceived responsibility and self-efficacy ($r = .11$, $p < .05$). Perceived responsibility also significantly correlated with students' mastery experience ($r = .12$, $p <$

.05), vicarious experience (r = .10, p < .05), social persuasions (r = .12, p < .05), and physiological states (r = .14, p < .01).

Consistent with the tenets of Bandura's (1997) theory of self-efficacy and previous studies (Britner & Pajares, 2006; Usher & Pajares, 2008), each of the hypothesized sources of self-efficacy significantly correlated with mathematics self-efficacy (r = .66 - .77, p < .01) and with each other (r = .54 - .72, p < .01). The strongest correlation was between self-efficacy and social persuasions (r = .77, p < .01).

Table 2

Pearson Correlation Matrix among Self-Regulation, Self-Efficacy, and Sources of Self-Efficacy

	1	2	3	4	5	6
1. Perceived Responsibility	-					
2. Self-efficacy	.11*	-				
3. Mastery Experience	.12*	.69**	-			
4. Vicarious Experience	.10*	.73**	.61**	-		
5. Social Persuasions	.12*	.77**	.66**	.72**	-	
6. Physiological States	.14**	.66**	.54**	.69**	.71**	-

*p<.05
**p< .01

Comparative Analyses

One-way analyses of variances (ANOVAs) were conducted to test gender and grade level differences in self-regulation, mathematics self-efficacy, and the sources of self-efficacy (Table 3).

Gender differences. Boys (M = 4.42, SD = .73) reported slightly higher levels of perceived responsibility than did girls (M = 4.37, SD = .75), however the difference was not significant, $F(1, 440) = 0.60$, p = .44. Boys also reported stronger mastery experience (M = 3.32, SD = .66 for boys; M = 3.25, SD = .61 for girls), social persuasions (M = 3.16, SD = .64 for boys; M = 3.13, SD = .59 for girls), and physiological states (M = 2.98, SD = .75 for boys; M = 2.92, SD = .74 for girls) in mathematics than did girls, although the gender differences were not significant, $F(1, 434) = 1.23$, p = .27, $F(1, 437) = 0.31$, p = .58, $F(1, 436) = 0.80$, p = .37, respectively. For girls, mean differences indicated that mastery experience (M = 3.25, SD = .61) was the strongest influence on mathematics self-efficacy. There were no significant main effects with regards to self-efficacy ($F(1, 433) = 0.03$, p = .86) and vicarious experience ($F(1, 434) = 0.33$, p = .57) between boys and girls in the entire sample.

Grade level differences. Regarding grade level differences, there was significant grade level differences in perceived responsibility for the entire sample, $F(2, 439) = 5.15$, p = .01. The effect size (eta squared) for grade level was .02 and is considered small. Post hoc comparisons using Turkey tests indicated significant pairwise differences between third grade and the other two grade levels. Students who were at a higher grade level were more likely to report greater responsibility for their own learning. Mean differences in scores on the perceived responsibility scale were similar for fifth (M = 4.45, SD = .58) and fourth grade (M = 4.49, SD = .69) students. When compared to their younger peers, fifth and fourth graders reported greater responsibility for their learning than the third graders (M = 4.24, SD = .89). Interestingly, there were numerical differences in the

means at each grade level by gender. Further ANOVAs were conducted to examine if there were any gender differences by grade levels. For girls, students' perception of responsibility was stronger for fourth (M = 4.54, SD = .70) and fifth grades (M = 4.40, SD = .59) than third grade (M = 4.19, SD = .89), and this difference was significant, $F(2, 232) = 4.33$, p = .01. The effect size (eta squared) for grade level was .04 and is considered almost medium. Post hoc comparisons using Turkey tests indicated significant pairwise differences between girls in third and fourth grades.

There was also a significant main effect for self-efficacy for the entire sample, $F(2, 432) = 3.26$, p =.04. The effect size (eta squared) for grade level was .01 and is considered small. Mean differences showed that fifth graders (M = 3.25, SD = .60) reported higher self-efficacy than fourth (M = 3.11, SD = .60) and third graders (M = 3.08, SD = .64). Post hoc comparisons using Turkey tests indicated significant pairwise differences between the third and the fifth graders.

There was also a significant main effect for mastery experience for the entire sample, $F(2, 433) = 3.65$, p = .03. The effect size (eta squared) for grade level was .02 and is considered small. Mean differences revealed that fifth graders (M = 3.40, SD = .63) reported greater levels of mastery experience than fourth (M = 3.24, SD = .63) and third graders (M = 3.21, SD = .63). Post hoc comparisons using Turkey tests indicated significant pairwise differences between the third and the fifth graders. Mean differences revealed that vicarious experience, social persuasions, and physiological states increased slightly across grades for the entire sample, however the differences were not significant at the univariate level (see Table 3).

Table 3

Pairwise Comparisons

Source	Dependent variable	*df*	*F*	*p*	Eta-squared
Gender-full sample	Perceived responsibility	1	0.60	.44	.00
	Self-efficacy	1	0.03	.86	.00
	Mastery experience	1	1.23	.27	.00
	Vicarious experience	1	0.33	.57	.00
	Social persuasions	1	0.31	.58	.00
	Physiological states	1	0.80	.37	.00
Grade-full sample	Perceived responsibility	2	5.15	.01	.02
	Self-efficacy	2	3.26	.04	.01
	Mastery experience	2	3.65	.03	.02
	Vicarious experience	2	2.70	.07	.01
	Social persuasions	2	2.38	.09	.01
	Physiological states	2	0.61	.55	.00
Grade-Boys	Perceived responsibility	2	1.84	.16	.02
	Self-efficacy	2	2.52	.08	.02
	Mastery experience	2	1.54	.22	.02
	Vicarious experience	2	2.31	.10	.02
	Social persuasions	2	1.84	.16	.02
	Physiological states	2	2.03	.13	.02
Grade-Girls	Perceived responsibility	2	4.33	.01	.04
	Self-efficacy	2	2.30	.10	.02
	Mastery experience	2	2.87	.06	.02
	Vicarious experience	2	1.75	.18	.01
	Social persuasions	2	0.84	.43	.01
	Physiological states	2	0.38	.68	.00

Relationship between Mathematics Self-Efficacy and its Hypothesized Sources

To examine the relationship between mathematics self-efficacy and its sources, regression analyses were conducted to determine which source predicts self-efficacy and for each grade level (Table 4). The results revealed that 70% of the variance in students' mathematics self-efficacy was accounted for by mastery experience (β = .25), vicarious experience (β = .24), social persuasions (β = .38), and physiological states (β = .09) for the full sample ($F(4, 429) = 253.37$, $p < .0001$, $R^2 = .70$). More specifically, effects for social persuasions were the strongest, which accounted for greater unique variance than did the other sources.

For third graders, mastery experience (β = .26), vicarious experience (β = .33), and social persuasions (β = .33) predicted students' mathematics self-efficacy ($F(5, 147) = 68.23$, $p < .0001$, $R^2 = .70$), with vicarious experience and social persuasions being equally the strongest predictors of students' self-efficacy in third grade. For fourth graders, mastery experience (β = .21), social persuasions (β = .36), and physiological states (β = .26) significantly predicted mathematics self-efficacy ($F(5, 132) = 51.72$, $p < .0001$, $R^2 = .66$), with social persuasions being the strongest predictor of students' self-efficacy in fourth grade. For fifth graders, mastery experience (β = .31), vicarious experience (β =.28), and social persuasions (β = .48) predicted mathematics self-efficacy ($F(5, 137) = 94.08$, $p < .0001$, $R^2 = .77$), with social persuasions being the strongest predictor of students' self-efficacy in fifth grade.

Table 4

Regression Results Predicting Math Self-Efficacy of 3rd, 4th, and 5th Grade Students

	Full Sample (N = 442)			3rd Grade (N = 154)			4th Grade (N = 145)			5th Grade (N = 143)		
Variable	β	*t*	R^2	β	*t*	R^2	β	*t*	R^2	β	*t*	R^2
Mastery experience	.25	6.78***	.70	.26	3.99***	.70	.21	2.96**	.66	.31	5.57***	.77
Vicarious experience	.24	5.71***		.33	4.50***		.12	1.43		.28	4.25***	
Social persuasions	.38	8.50***		.33	4.08***		.36	4.35***		.48	6.70***	
Physiological states	.09	2.35*		.03	.50		.26	3.48**		-.07	-1.04	

Note. *$p < .05$, **$p < .01$, ***$p < .0001$

Summary of Findings

This exploratory study examined the developmental differences in elementary students' self-regulation, self-efficacy, and sources of self-efficacy in mathematics. It also examined whether these variables differed as a function of gender across grade level.

RQ#1 findings: What are the developmental differences in elementary students' self-regulation, self-efficacy, and sources of self-efficacy? The first research question addressed the developmental differences in self-regulation, self-efficacy, and the sources of self-efficacy in mathematics across third, fourth, and fifth grade students. Findings revealed that 70% of the variance in students' mathematics self-efficacy was accounted for by mastery experience, vicarious experience, social persuasions, and physiological states. Social persuasions were the strongest predictor of mathematics self-efficacy for the entire sample, especially for third, fourth, and fifth grade students. Mastery experience, vicarious experience, and social persuasions were significant in predicting mathematics self-efficacy for third graders. For fourth graders, mastery experience, social persuasions, and physiological states predicted mathematics self-efficacy. For fifth graders, mastery experience, vicarious experience, and social persuasions predicted mathematics self-efficacy. Students' self-efficacy in mathematics and perceived responsibility for learning both increased as they progressed through Grades 3, 4, and 5.

RQ#2 findings: Are there gender differences in self-regulation, self-efficacy, and sources of self-efficacy in mathematics across grade level (grades 3 to 5)? The second research question addressed whether self-regulation, self-efficacy, and the sources

of self-efficacy differed as a function of gender across grade levels. Findings related to grade level differences showed a significant main effect for girls' perceived responsibility. Boys reported slightly stronger perceived responsibility, mastery experience, social persuasions, and physiological states than girls; however these differences were not significant. For girls, mastery experience was the strongest indicator of mathematics self-efficacy. Overall, boys and girls did not differ in all the variables of the study (i.e., perceived responsibility, self-efficacy, mastery experience, vicarious experience, social persuasions, physiological states).

Overall, these findings provide some information worth considering about the development of self-regulation, self-efficacy, and the sources of self-efficacy in upper elementary school students studying mathematics. These results, the limitations of this study, and educational implications are discussed in depth in the following chapter.

CHAPTER FIVE

The purpose of this study was to explore: (1) the developmental differences of self-regulation, self-efficacy, and the four sources of self-efficacy in mathematics across third, fourth, and fifth grade elementary students, and (2) whether these variables differ as a function of gender and grade level. This chapter provides a discussion of the results in this study with the relevant literature of the field, reviews the limitations, and then concludes with implications for future research and practice.

Discussion of the Results

RQ#1: What are the developmental differences in elementary students' self-regulation, self-efficacy, and sources of self-efficacy in mathematics? Regression analyses revealed that mastery experience, vicarious experience, social persuasions, and physiological states independently predicted elementary students' mathematics self-efficacy. This finding is consistent with the tenets of social cognitive theory specifically Bandura's (1986) hypothesized sources of self-efficacy and confirm previous research findings (e.g., Usher & Pajares, 2006). Social persuasions accounted for the greatest proportion of the variance in students' mathematics self-efficacy. This was the case for the entire sample of students, as well as for third, fourth, and fifth grade students. Contrary to Bandura's notion that mastery experience is the most influential source of self-efficacy, this study found that emulation (i.e., demonstration of skill with directed

feedback and guidance) fostered the mathematics beliefs of elementary students in this particular group. This finding is not surprising given that practice solving mathematics problems and receiving guidance and feedback from a more experienced learner such as a teacher or classmate are essential components of self-regulatory development (Zimmerman, 2000). The effects of receiving feedback are particularly relevant in this context, as teachers and peers can play a powerful role in a student's development of self-efficacy. Classroom observations conducted subsequently to data collection within the larger study revealed that teachers encouraged students in the IB PYP to work collaboratively in groups, which allowed students the opportunity to share the wealth of knowledge, help one another, and practice what they have learned through observing the teacher solve a mathematics problem. Group work activities such as these are conducive to creating learning experiences that help students work towards mastery-based learning.

Vicarious experience also greatly predicted mathematics self-efficacy for the entire sample, especially for third and fifth graders. Some studies have found a significant relationship between vicarious experience and self-efficacy for specific groups of students, such as those with learning disabilities (Hampton, 1998) and of Indo-Canadian decent (Klassen, 2004). For example, Stevens, Olivárez, and Hamman, (2006) found that vicarious information had a greater influence on Hispanic students than Caucasian students. In another study, Usher and Pajares (2006) found that vicarious experience predicted reading self-efficacy beliefs of Grade 6 students across various reading ability levels (i.e., above level, on level, and below level). In a qualitative investigation of Grade 8 middle school students' sources of self-efficacy in mathematics, Usher (2009) found

that all students in the sample (N = 8) regardless of mathematics self-efficacy level relied on vicarious information to interpret their own mathematics capabilities. These previous research findings suggest that the extent of vicarious experience in forming students' self-efficacy beliefs may be influenced in part by context factors.

For the full sample, mastery experience and vicarious experience both predicted mathematics self-efficacy nearly equally. The predictive utility of physiological states was significant; however it was less powerful than the other three sources. These findings support previous research showing that mastery experience consistently predicts self-efficacy, and that physiological states is the least powerful indicator (e.g., Britner & Pajares, 2006; Joët et al., 2011; Usher & Pajares, 2006). Along with accomplishments, these findings suggest that influences from peers, parents, and teachers, as well as emotional and physiological well-being (e.g., anxiety, arousal, mood) are valuable for elementary students to interpret their beliefs about their mathematics capabilities.

Regression analyses revealed that there were developmental differences in the predictive utility of the various sources of self-efficacy on mathematics across students from each grade level. At the third and fifth grade levels, mastery experience, vicarious experience, and social persuasions were influential in creating students' mathematics self-efficacy beliefs. At the fourth grade level, mastery experience, social persuasions, and physiological states influenced mathematics self-efficacy beliefs. These findings suggest that varying sources of information are influential in creating elementary students' mathematics self-efficacy. Social persuasions accounted for the greatest predictor of mathematics self-efficacy for third, fourth, and fifth grade students, with

greater predictive utility in fifth grade. This finding suggests that receiving evaluative feedback plays a powerful role on the development of students' mathematics self-efficacy beliefs during elementary school years and becomes more potent as they progress through subsequent grade levels. Furthermore, the sources of self-efficacy accounted for greater amount of variance in mathematics self-efficacy among fifth grade students (R^2 = .77) than third (R^2 = .70) and fourth grade students (R^2 = .66). This finding indicates that the four sources of self-efficacy become more powerful indicators of students' beliefs of their mathematics capabilities as they progress through upper elementary school.

Regarding grade level differences for the entire sample, results from one-way ANOVAs revealed that there were mean differences in perceived responsibility, self-efficacy, and mastery experience across third, fourth, and fifth grades. Students reported stronger perceptions of responsibility for their own learning and greater confidence as they transitioned into higher grade levels in upper elementary school. Perceived responsibility for learning increased as students became older and more knowledgeable about mathematics concepts. This finding is consistent with previous findings suggesting that self-regulatory functioning increases as students develop greater depths of knowledge as they progress through school (e.g., Zimmerman & Martinez-Pons, 1990). The findings for self-efficacy are consistent with previous findings suggesting that children's self-efficacy increase as they learn and develop skills throughout the school years (Schunk & Pajares, 2002). The beliefs that children hold about themselves are linked to future behaviors such motivation, which are likely influential for career choices (Borkowki & Thorpe, 1994). A student who has a strong belief in his or her mathematics

ability is more likely to put forth the effort and persist on challenging tasks as well as consider mathematics as a career aspiration. This in turn, influences the personal responsibility he or she takes for learning and doing homework. Developing a positive sense of self is not only influenced by self-efficacy judgments, but also by attributions (i.e., reasons for one's success or failure). If a student attributes prior accomplishments for success and failure to uncontrollable factors such as luck, the student then is not likely to envision a future with much hope and will not feel confident about his or her mathematics abilities.

Mean differences indicated that vicarious experience, social persuasions, and physiological states increased slightly by grade level, however the differences were not significant. From a developmental perspective, the findings in this study overall are encouraging as they suggest positive development of self-regulation and mathematics self-efficacy in elementary students as they take on greater challenges in mathematics learning each school year.

RQ2: Are there gender differences in self-regulation, self-efficacy, and sources of self-efficacy in mathematics across grade level (grades 3 to 5)? One-way analyses of variance were conducted to examine the effects of gender on self-regulation, self-efficacy, and the sources of self-efficacy across third, fourth, and fifth grade students. The analyses revealed that boys and girls did not differ in any of the variables in the study (i.e., perceived responsibility, self-efficacy, mastery experience, vicarious experience, social persuasions, physiological states). For girls, there was a statistically significant difference in means for perceived responsibility between third and fifth grade

students. Mean differences showed that boys reported slightly greater perceived responsibility than did girls, however the difference was marginal. This finding is consistent with previous findings suggesting that boy and girls do not differ in self-regulation ability (DiBenedetto & Zimmerman, 2010; Pintrich & De Groot, 1990; Kiran & Sungur, 2012). Boys reported slightly stronger mastery experience, social persuasions, and physiological states than did girls. These findings are consistent with previous, which suggest that boys report stronger master experience in the area of mathematics (Lent et al., 1996). For girls, mastery experience was the strongest indicator of mathematics self-efficacy. However, it is important to note that contextual and demographic factors play a role in the interpretation of the findings. Thus, findings from previous studies have reported that students may rely on different sources of self-efficacy as a function of their gender, academic domain, and ethnic background (Usher, 2009). For example, researchers have found that girls report stronger social persuasions and vicarious experiences in mathematics (Lopez et al., 1997), but greater master experiences and lower anxiety in writing (Pajares et al., 2007).

Further one-way analyses of variance were conducted to examine if there were any gender differences by grade levels. Findings for mathematics self-efficacy were consistent with previous findings, suggesting that boys and girls report similar confidence in their mathematics abilities during the elementary years. However, differences begin to emerge following students' transition into middle school (Midgley, Feldlaufer, & Eccles, 1989; Pajares, 2005). These findings provide some information worth noting about the

developmental and gender differences in elementary students' self-regulation, self-efficacy, and sources of self-efficacy in mathematics.

Erikson (1968) suggested that young children's accumulated experiences in learning may be interpreted differently for boys and girls as they develop their sense of self. Erikson argued that boys generally tend to associate their sense of self in regards to their accomplishments in school, such as success or failure in solving mathematics problems. Girls on the other hand rely more on the satisfaction with relationships to help interpret their sense of identity than accomplishments. These findings may help interpret why boys' development of self-efficacy beliefs are strongly influenced by their academic accomplishments whereas girls relied on social interactions with classmates and teachers in their development of self-efficacy, in addition to academic accomplishments.

Limitations

According to social cognitive theory, Bandura (1986, 1997) purports the importance of evaluative feedback in the development of children's' beliefs about their capabilities. In this study, social persuasions were the strongest predictor of students' mathematics self-efficacy. This finding suggests that receiving feedback from teachers, parents, and peers may influence students' interpretation of their mathematics capabilities more so than do accomplishments, observation, and physiological arousal. When interpreting the findings, however, a few limitations of the current study must be considered. First, the psychometric quality of the sources of self-efficacy subscales in this study were modest, thus caution should be taken for drawing conclusions about the hypothesized source of self-efficacy. Particularly, previous research studies have reported

low to modest reliability coefficients for vicarious experience (e.g., Lent et al., 1991; Stevens et al., 2006; Usher & Pajares, 2008) and with Grade 3 elementary students (Joët et al., 2011). In a meta-analysis, Usher and Pajares (2008) purport that this inconsistency in reliability for the vicarious experience subscale may be likely due to the multidimensional nature of this variable. Peer and adult role models have remarkably different influences on students' perceptions and beliefs about their academic learning at different developmental stages (Harris, 1995; Pinker, 2002). Bandura (1997) contends that young children's self-efficacy beliefs are more likely to be influenced by peers (e.g., classmates) than adult (e.g., parents) role models. Hence, a third grade Hispanic female is more likely to compare herself to her female Hispanic classmate than to a Caucasian female student in the same grade. As such, students whom she perceives as similar to her according to age, gender, ethnicity, and/or ability will likely be the most influential in raising or lowering her self-efficacy beliefs. Findings of vicarious experience which only include items measuring adult or peer role models may provide an incomplete picture about the nature of this source. Nevertheless, researchers remain convinced that social models play a central role in developing ones sense of self (Bandura, 1997; Marsh et al., 2008).

A second limitation was that the study only collected data at one time point. Thus, this study was not able to take into account developmental changes of students' self-perceptions throughout the school year and between school years. As several researchers have noted (e.g., Cleary & Chen, 2009; Joët et al., 2011), it is important to take into account the evolving nature of students' self-perceptions as they grow and acquire new

experiences. Exploring this evolution over time will help to better understand the processes underlying self-regulation and self-efficacy and the role these play in students' academic learning and performance in school.

Third, the present study utilized only self-report data to examine students' perceptions and beliefs about their mathematics abilities. Qualitative investigations can provide a more in-depth understanding about the processes and techniques younger students use to evaluate their academic abilities (Pajares & Schunk, 2005; Usher, 2009; Zimmerman, 2008). Future studies should incorporate qualitative data to validate and obtain a deeper understanding about developmental differences and gender effects in elementary students' self-regulation, self-efficacy, and the sources of self-efficacy.

Implications for Future Research and Practice

The findings of this study suggest more research is needed to identify and understand the extent of elementary school students' self-regulation, self-efficacy, and sources of self-efficacy in mathematics and other subject areas. Particularly, investigating how these self-perceptions develop in younger students is needed. Though some studies have started to explore the processes underlying young children's self-regulation (e.g., Kitsantas et al., 2009) and self-efficacy (e.g., Joët et al., 2011), it will be beneficial to replicate or adapt these studies with elementary school students. Such information could provide insight for developing interventions that best support young students' perceptions and beliefs about mathematics learning.

The findings of this study indicated social persuasions to be the most powerful source of mathematics self-efficacy for elementary students in this sample. However, the

reliability of the items measuring this source was relatively modest, along with the other sources of self-efficacy. Similarly, other researchers have found low to modest reliabilities and inconsistent findings, especially with vicarious experience in predicting self-efficacy. Future research should address this issue by developing a measure that accurately captures vicarious experiences among students. Lent et al. (1996) suggested that items assessing vicarious experience should be divided into sub-categories so that the influence of peer and adult role models can be evaluated separately. This may help to better understand the nature of vicarious experience and to document the relationship between this source and self-efficacy.

Though the findings indicated all four sources of self-efficacy predicted mathematics self-efficacy for the entire sample, the contributions of each source in students' development of self-efficacy differed by grade level. To foster positive development of self-efficacy, parents and IB PYP teachers should construct learning environments that are favorable for children's development. Bandura, Barbaranelli, Caprara, and Pastorelli (1996) found that parents who have a high sense of efficacy are more likely to construct favorable environments for their children. These students come to school prepared and are motivated to learn (Bandura, 1997). However, students hold different beliefs about their capabilities as they enter new learning situations in school. To strengthen students' self-efficacy, Schunk (1989) identified a range of strategies that teachers can use in the classroom. These include (a) goals and feedback, (b) rewards, (c) self-instruction for verbalization of strategies, and (d) participant modeling. When solving mathematics problems, teachers can enhance students with low self-efficacy by

giving them feedback that their success was due to effort. Giving students positive feedback conveyed that effort was responsible for success and that they were developing skills necessary for success. These messages may encourage the student to continue to perform well with hard work. Students develop their skills as they learn strategies, in turn increasing self-efficacy (Alderman, 2008). Another strategy for enhancing self-efficacy is by observing and emulating role models through vicarious experience, which is the second most powerful source of self-efficacy as purported by Bandura (1997). The findings in this study revealed that social persuasions played a central role in how elementary students established their self-efficacy beliefs in mathematics. IB PYP teachers should continue to promote students' social persuasions. In the classroom, teachers should create learning experiences such as practicing with mathematics problems that help students work towards mastery-based learning and provide positive feedback to help enhance students' confidence in mathematics. Given that peers serve as better models than do adults in increasing self-efficacy for young children, IB PYP teachers should encourage students to demonstrate to the class how they solved a mathematics problem and acknowledge mistakes. As observed in the IB PYP classrooms, teachers should continue group work activities as it provides students opportunities to work closely among their peers and to teach one another. An interesting aspect for future research could be to explore further the role of the IB PYP program on students' development of self-regulation, self-efficacy, and the sources of self-efficacy. The IB curriculum and philosophy may provide a foundation for self-regulation and self-efficacy

and understanding these developments in IB PYP students may help teachers to better foster students' confidence and self-regulation strategies in mathematics.

Appendix A

IRB Confirmation Form

GEORGE MASON UNIVERSITY

Office of Research Integrity and Assurance

Research Hall, 4400 Univeristy Drive, MS 6D5, Fairfax, Virginia 22030
Phone: 703-993-5445; Fax: 703-993-9590

DATE:	February 17, 2014
TO:	Anastasia Kitsantas
FROM:	George Mason University IRB
Project Title:	[477541-2] Supporting Student Project-based Learning through Self-Regulation Learning
Reference:	8587
SUBMISSION TYPE:	Continuing Review/Progress Report
ACTION:	APPROVED
APPROVAL DATE:	February 17, 2014
EXPIRATION DATE:	February 16, 2015
REVIEW TYPE:	Expedited Review
REVIEW TYPE:	Expedited review category #7

Thank you for your submission of Continuing Review/Progress Report materials for this project. The George Mason University IRB has APPROVED your submission. This submission has received Expedited Review based on applicable federal regulations.

Please remember that all research must be conducted as described in the submitted materials.

Please remember that informed consent is a process beginning with a description of the project and insurance of participant understanding followed by a signed consent form. Informed consent must continue throughout the project via a dialogue between the researcher and research participant. Federal regulations require that each participant receives a copy of the consent document.

Please note that any revision to previously approved materials must be approved by the IRB prior to initiation. Please use the appropriate revision forms for this procedure.

All UNANTICIPATED PROBLEMS involving risks to subjects or others and SERIOUS and UNEXPECTED adverse events must be reported promptly to the Office of Research Integrity & Assurance (ORIA). Please use the appropriate reporting forms for this procedure. All FDA and sponsor reporting requirements should also be followed (if applicable).

All NON-COMPLIANCE issues or COMPLAINTS regarding this project must be reported promptly to the ORIA.

The anniversary date of this study is February 16, 2015. This project requires continuing review by this committee on an annual basis. You may not collect date beyond this date without prior IRB approval. A continuing review form must be completed and submitted to the ORIA at least 30 days prior to the anniversary date or upon completion of this project. Prior to the anniversary date, the ORIA will send you a reminder regarding continuing review procedures.

Please note that all research records must be retained for a minimum of three years, or as described in your submission, after the completion of the project.

If you have any questions, please contact Karen Motsinger at 703-993-4208 or kmotsing@gmu.edu. Please include your project title and reference number in all correspondence with this committee.

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within George Mason University IRB's records.

Appendix B

Parental Consent Form

Characteristics and Context of Primary Years Program (PYP) Students' Self-Efficacy and Self-Regulatory Development

RESEARCH PROCEDURES
This research is being conducted to examine instructional contexts and practices of PYP classrooms that encourage student self-regulation and impact student self-efficacy beliefs. As part of this research, we are administering surveys to students to assess self-regulatory practices and academic motivational beliefs. If you agree to allow your child to participate, your child will be asked to complete a survey consisting of multiple measures estimated to take 20-30 minutes to complete.

RISKS
There are no foreseeable risks to you or your child for participating in this research.

BENEFITS
There are no benefits to your child as a participant other than to further the research on student self-regulated learning in PYP classrooms.

CONFIDENTIALITY
The data in this study will be confidential (no one else will be able to identify your child's identity). To keep it this way, your child's identity will be identified by numbers only. No names will appear on collected data. Through the use of an identification key, only the researcher will be able to link each interview to your child's identity.

PARTICIPATION
Your child's participation is voluntary, and your child may withdraw at any time and for any reason. If your child decides not to participate or if your child withdraws from the study, there is no penalty or loss of benefits to which you or your child are otherwise entitled. There are no costs to you or any other party.

CONTACT
This research is being conducted Drs. Anastasia Kitsantas and Angela Miller at George Mason University. Dr. Kitsantas may be reached at 703-993-2688 for questions or to report a research-related problem. You may contact the George Mason University Office

of Research Integrity & Assurance at 703-993-4121 if you have questions or comments regarding your rights as a participant in the research.

This research has been reviewed according to George Mason University procedures governing your child's participation in this research and has been approved.

CONSENT
I have read this form and agree for my child to participate in this study.

_____ _____

Name Date

_____

Signature

Appendix C

Student Consent Form

Characteristics and Context of Primary Years Program (PYP) Students' Self-Efficacy and Self-Regulatory Development

RESEARCH PROCEDURES: WHAT WE ARE DOING
The reason for this research is to see what schools can do to help all students like you become better learners. If you would like to help with this study, you will be asked to fill out a survey about your beliefs and actions towards learning in school.

RISKS: WHAT COULD HAPPEN TO YOU
There are no risks for taking part in this study.

BENEFITS: WHAT'S IN IT FOR YOU
There are no rewards or money paid for being in this study.

CONFIDENTIALITY: WHAT WILL HAPPEN TO YOUR INFORMATION
The information that the researcher collects from you will be kept private. The data in this study will be confidential (no one but the researcher will know that this is what you think). To keep it this way, you will be identified by numbers only.

PARTICIPATION: YOU HAVE A CHOICE
You don't have to fill out the survey if you don't want to. If you change your mind after you start and want to stop that is OK. I will not get mad and nothing will happen to you.

CONTACT: WHO TO CALL IF YOU HAVE QUESTIONS
My name is Dr. Kitsantas, and I am teaching at George Mason University. You can call me at this phone number 703-993-2688 if you have any questions about this study. The George Mason University Office of Research Integrity & Assurance knows all about my research and said that it was OK for me to do it. You can call them at 703-993-4121 if you have any questions about being a part of this research.

ASSENT
I have read this form and I agree to help with this study.

_____ _____

Name Date

_____

Signature

Appendix D

Personal Data Questionnaire

1. What is your teacher's name? _____

2. What is the full name of your school?

   _____

3. How old are you? _____

4. What grade are you in school?
   3rd □ 4th□ 5th□

5. What is your gender?
   Male □ Female □

6. What is your ethnicity?
   African American □ Asian □ Hispanic □ Multi-Racial □ White □ Other □

7. Which of the statements below is most like you? Please choose one.
   School is easy for me and I usually do very well. □
   School is sometimes hard but I usually do okay.□
   School is hard and I usually do not do well.□
8. Which of the statements below is most like you? Please choose one.
   Math is easy for me and I usually do very well.□
   Math is sometimes hard but I usually do okay.□
   Math is hard and I usually do not do well.□

9. When math homework is assigned for this class, how much do you usually complete?
   Never assigned
   None of it
   Some of it
   Most of it
   All

Appendix E

Sources of Mathematics Self-Efficacy

(Lent et al., 1991; adapted by Usher & Pajares, 2006)

Read each statement carefully and choose the response that best describes you.

	1 Not at all true	**2 Sometimes true**	**3 Mostly true**	**4 Completely true**
Mastery Experience				
1. I have always been good at math.	1	2	3	4
2. I always do my best work in math.	1	2	3	4
3. Compared to the other students, I am a good math student.	1	2	3	4
Vicarious Experience				
4. Most of my friends are good at math.	1	2	3	4
5. I admire people who are good at math.	1	2	3	4
6. The people that I would like to be like are people who like math.	1	2	3	4
Social Persuasions				
7. My teacher tells me that I am good at math.	1	2	3	4
8. The other students in my class think that I am good at math.	1	2	3	4
9. My family thinks that I am good at math.	1	2	3	4
10. People often tell me that I am a good math student.	1	2	3	4
Physiological States				
11. I am nervous when I work on math.	1	2	3	4
12. Math work doesn't scare me.	1	2	3	4
13. I can't think clearly when I do math.	1	2	3	4

Appendix F

Mathematics Self-Efficacy
(Adapted from Joët, Usher, & Bressoux, 2011)

Read each statement carefully and choose the response that best describes you.

	1 Not at all true	**2 Sometimes true**	**3 Mostly true**	**4 Completely true**
1. I can add two three-digit numbers.	1	2	3	4
2. I know how to write numbers in digits and in words.	1	2	3	4
3. I can solve math problems.	1	2	3	4
4. I can get good grades in math.	1	2	3	4

Appendix G

Perceived Responsibility for Learning Scale (*PRLS*)
(adapted from Zimmerman & Kitsantas, 2005)

Is a <u>student</u> OR <u>teacher</u> MORE RESPONSIBLE for the following things stated below?

Use the following five-point scale below.

	THE TEACHER			**THE STUDENT**	
Who is more RESPONSIBLE for a student...	**1 Mainly the teacher**	**2 A little more the teacher**	**3 Both the teacher and student the same**	**4 A little more the student**	**5 Mainly the student**
1. Who is more responsible for a student NOT finishing their homework?	○	○	○	○	○
2. Who is more responsible for a student NOT participating in class?	○	○	○	○	○
3. Who is more responsible for a student NOT really trying in class?	○	○	○	○	○
4. Who is more responsible for a student NOT behaving in class?	○	○	○	○	○
5. Who is more responsible for a student focusing in class?	○	○	○	○	○

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BIOGRAPHY

Christina Lau graduated from Lake Braddock Secondary School, Burke, Virginia, in 2010. She received her Bachelor of Arts in Psychology from George Mason University in 2014 and graduated with honors. She completed a senior honor thesis examining differences among elementary students' self-regulation in mathematics.