THE ROLE OF CLASSROOM CONTEXT IN STUDENT SELF-REGULATED LEARNING: AN EXPLORATORY CASE STUDY IN A SIXTH-GRADE MATHEMATICS CLASSROOM

DISSERTATION

Presented in Partial Fulfillment of the Requirements for
the Degree Doctor of Philosophy in the Graduate School of The Ohio State University

By
İffet Elif Yetkin, M.A.

*****

The Ohio State University
2006

Dissertation Committee:
Professor, Stephen J. Pape, Adviser
Professor, Heather Davis
Professor, Anita Woolfolk Hoy

Approved by

__________________________
Adviser
College of Education
Copyright
İffet Elif Yetkin
2006
ABSTRACT

The purpose of this qualitative case study was (a) to investigate the nature of the classroom practices (i.e., tasks and activities; instructional and motivational structures) that hold potential for impacting student self-efficacy and strategic learning in one sixth-grade mathematics classroom and (b) to explore the ways in which individual students’ participation in these classroom practices potentially relates to their self-efficacy and strategic learning. The analytical tools and research incorporate concepts and principles drawn from sociocultural and social cognitive perspectives.

In this embedded case-study, in addition to examining one particular classroom as a case, three students with different levels of mathematics achievement and self-regulatory competence were selected purposively for in-depth analysis. Data were gathered through a survey instrument, videotaped classroom observations, interviews with focal students, and student journals. The survey instrument was administered in January and April of the school year to assess the focal students’ self-efficacy and strategy use in relation to each other and to other students in the class. Videotaped observations of classroom context and focal students were conducted from January to March. Data drawn from these observations were analyzed by using two analytical tools: three sources of efficacy (i.e., mastery experiences, vicarious experiences, and verbal persuasion) and three factors related to the transition from other- to self-regulation (i.e.,
developing understanding, building competence, and exercising strategic learning). Focal
students’ self-efficacy and strategic behaviors within the context of the specific
mathematical tasks were examined through problem-solving sessions and semi-structured
interviews at the beginning and end of the study. These data were analyzed to understand
focal students’ strategic behaviors in terms of analyzing the tasks, selecting,
implementing, and evaluating problem-specific strategies, as well as monitoring and
evaluating problem solutions. Data collected through student journals were used to
triangulate these data sources.

Analysis of classroom observations revealed that several aspects of classroom
practices observed in this sixth-grade mathematics classroom have potential to support
student self-efficacy. Students were given opportunities to experience success by
engaging with the tasks and activities through multiple representations during
collaborative as well as individual learning activities. They were also given opportunities
to challenge themselves through homework assignments that may foster a sense of
accomplishment beyond mastering basic skills. Peer modeling provided opportunities for
vicarious experiences. Furthermore, teacher recognition of student ideas and strategic
efforts conveyed to students sincere and realistic information regarding their capabilities
and progress. Most of these classroom practices also hold potential for impacting
students’ transitions from other- to self-regulation as related to strategic learning. While
tasks and activities created contexts for students’ active participation, the teacher
provided support for students’ understanding and competence through several
instructional practices such as peer modeling and joint learning activities. Teacher
facilitation of classroom discourse played a significant role in structuring these activities to enhance self-efficacy and strategic learning.

Findings from within and across case analysis showed that each focal student engaged with and interacted within the classroom context differently. Their classroom practices showed differences in terms of the ways they (a) participated in classroom activities, (b) experienced success or failure, (c) engaged with strategic learning activities, (d) received teacher recognition, (e) participated in peer modeling activities, and (f) took control over challenge. These differences brought about diverse opportunities and challenges for each student, which may have affected his or her development of self-efficacy and strategic learning in distinctive ways. Analyzing students’ self-efficacy and strategic learning in relation to their classroom practices across three cases supports this argument. Furthermore, these analyses support the argument that students’ participation in classroom practices, in part, is the result of complex interactions including their self-efficacy beliefs and strategic knowledge.
Dedicated to my family:

Mom, Dad, and Özgiş
ACKNOWLEDGMENTS

Working on this project has been extensive and difficult but I was so lucky to have wonderful people around me who made this experience also exciting, enlightening, and fun. Without their support and encouragement I would never have been able to finish this work.

I feel blessed to be under the guidance of such a great dissertation committee: Dr. Stephen Pape, Dr. Heather Davis, and Dr. Anita Woolfolk Hoy. I have always been inspired by their sincerity, intelligence, and grace.

My advisor and mentor, Dr. Stephen Pape: Without your constant guidance, patience, support, and encouragement, this project would not have been possible. You always made me feel that I was not alone during this long process. Thank you so much for working with me at each and every step of this study, providing critical and detailed feedback in a short time, and pushing me for excellence. Thanks for standing by me at times of difficulty and showing your confidence in me. I have learned so much about teaching, research, and professionalism from you. I will truly miss our enlightening conversations and I look forward to future collaboration.

Dr. Heather Davis: This study would not be in the current form without your insightful input. I am grateful for your help to narrow down the study in the first place. You saved my sanity by gently pointing out the difference between a dissertation and a
life’s work. I also want to thank you for your generous support. Through your constructive feedback, helpful suggestions, and challenging questions you made me think about the subject from different perspectives. Thanks for believing in me, encouraging me to present my study at conferences, and helped me grow professionally.

Dr. Anita Woolfolk Hoy: I cannot express how lucky I feel to have had an opportunity to work with you. I am grateful for your valuable suggestions and comments, which helped me organize and improve my initial ideas about this study. I have learned a great deal from your experience and insight. Thank you for your kindness, enthusiasm, and care. You have always been a role model for me.

Carrying out this research would not have been possible without the help of Mrs. T and the participating students. I will always be grateful for them. Mrs. T: Thank you so much for letting me be a part of your classroom with your warm and generous welcome. Working with you on this study was an exceptional opportunity and experience for me. Thanks for your good heart, friendly face, and positive attitude. I also cannot express enough my appreciation to the participating students: Thank you so much, for your time and cooperation.

I was also fortunate to be a member of two research groups focusing on educational psychology and self-regulated learning coordinated by my dissertation committee. I had a chance to meet great people during group meetings and share my ideas about the study. Members of research groups: Thank you so much for generously helping me to refine my ideas with your comments, suggestions, and feedback at several stages of my dissertation work. I also want to thank you for your time and energy for helping me review the transcriptions.
I was also lucky to have friends who have been a great support in all ways. Gönül: thanks for always being there for me. Thanks for listening to my ideas, providing suggestions, helping me collect data, and being a companion during long-lasting work at coffee houses. Yeşim and Nejla: thank you so much for generously sharing your thoughts and experience. Figen and Mustafa: thanks for all your support and insights about qualitative research. Şükrü: thanks for helping me with the data analysis. Zeynep, Nilüfer, Semra, Emine, Dinçer, Erdal, Taşkın, and Tolga: thank you for your friendship and support in many ways. Mark, Mary, Patty, Leta, Noel, Sandy, Lois, and Curtis: thanks for your friendly conversation that gave me the necessary relaxation from the dissertation. My lifelong friends in Turkey, Asuman and Özlem: thanks for all your love and support.

I will never find words enough to express my gratitude that I owe to my family. Mom and Dad: Without your love, unyielding encouragement, and prayers I would never be able to finish this work. You have always been role models for me to become a better person. My sister, Özge: thanks for numerous post-cards, e-mails, phone-calls showing your love and support. You’re the best sister ever! Ömer: Thank you for your endurance, loyalty, and support in many ways. Thanks for waiting for me in Turkey for two years. Each day I am thankful for the fateful star that brought us together. I could not have wished for better.

I am also grateful to the Turkish Ministry of Education, Dr. Lowry W. Harding, Janet Harris Harding, The Graduate School, and The Office of International Education at The Ohio State University for their financial support during my doctoral study. Needless to add, any errors and omissions found in the dissertation are entirely my responsibility, and I will be extremely grateful if they were pointed out to me.
VITA

November 17, 1976....................................................Born- Ankara, Turkey

1998............................................................................B.S. Mathematics Education,
Middle East Technical University,
Ankara, Turkey

2000 - 2001 ................................................................M.A. Integrated Teaching
and Learning, The Ohio State
University

2001 - present.............................................................PhD Student, The Ohio State
University

PUBLICATIONS

and self-regulated learning: A teaching experiment in a seventh-grade

mathematics teachers’ probability achievement, attitudes toward probability and
mathematics with respect to gender. *Hacettepe University, Journal of
Education*, 22, 21-28

olasılık kavramları ile ilgili yeterliliklerinin incelenmesi. *D.E.Ü. Buca Eğitim
Fakültesi Dergisi Özel Sayısı, 11*, 384-394.

FIELDS OF STUDY

Major Field: Education
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>TABLE OF CONTENTS</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abstract</td>
<td>ii</td>
</tr>
<tr>
<td>Dedication</td>
<td>v</td>
</tr>
<tr>
<td>Acknowledgments</td>
<td>vi</td>
</tr>
<tr>
<td>Vita</td>
<td>ix</td>
</tr>
<tr>
<td>List of Tables</td>
<td>xiv</td>
</tr>
<tr>
<td>List of Figures</td>
<td>xv</td>
</tr>
</tbody>
</table>

## CHAPTERS

1. INTRODUCTION ................................................................................................... 1  
   Background of the Study .................................................................................. 1  
   Historical Trends in Theory and Research on SRL ........................................ 3  
   Statement of the Problem .............................................................................. 6  
   Theoretical Framework ................................................................................... 9  
   Purpose of the Study ..................................................................................... 13  
   Research Questions ......................................................................................... 14  
   Significance of the Study ............................................................................ 15  
   Limitations, Delimitations, and Assumptions............................................. 16  
   Definition of Terms ....................................................................................... 17  

2: THEORETICAL RATIONALE AND REVIEW OF LITERATURE .......................... 19  
   Introduction .................................................................................................... 19  
   SRL from a Social Cognitive Perspective ..................................................... 20  
      Human Agency in Triadic Reciprocal Causation ..................................... 20  
      Enactive and Vicarious Learning ............................................................... 21  
      Cyclical Phases, Key Processes and Associated Beliefs ......................... 22  
         Forethought ............................................................................................. 23  
         Performance control .............................................................................. 25  
         Self-reflection ....................................................................................... 26  
   Summary ........................................................................................................... 27  
   SRL from a Sociocultural Perspective ............................................................ 28  
   Shared and Mediated Agency ......................................................................... 29  
   SRL as a Socialization Process ..................................................................... 29  
      Intersubjectivity, ZPD, and scaffolding .................................................. 31  
   Summary ........................................................................................................... 34  

x
Self-Regulated Learning Research ............................................................................ 34
  Self-Efficacy .................................................................................................. 35
  Strategy Use ................................................................................................. 40
  Summary ........................................................................................................ 47
Classroom Context and SRL Research ...................................................................... 47
  Instructional Models ...................................................................................... 50
    Reciprocal teaching ............................................................................. 50
    Strategic content learning .................................................................. 51
    Instructional practices in mathematics ............................................... 52
  Summary ........................................................................................................ 57

3: METHODOLOGY ................................................................................................ 58
Restatement of the Purpose and Research Questions ................................................ 58
Research Perspective ................................................................................................. 59
  Participants and Context of the Study ............................................................ 61
    Selection of focal students ........................................................................ 63
Gaining Entry and the Researcher’s Role .................................................................. 65
Data Sources and Collection Procedure ................................................................... 66
  Mathematics Self-Efficacy and Strategy Questionnaire .............................. 69
  Videotaped Classroom Observations ........................................................... 70
  Focal Student Interviews ............................................................................ 72
  Journal Writing .............................................................................................. 73
Data Analysis ............................................................................................................. 74
  Analyzing Classroom Observations ........................................................... 75
  Analyzing Focal Students’ Self-Efficacy and Strategic Learning .......... 77
  Cross-Case Analysis ...................................................................................... 78
  Presentation of Data Sources ......................................................................... 79
Establishing Trustworthiness ..................................................................................... 80

4. DATA ANALYSIS ................................................................................................ 83
The Nature of Classroom Practices ........................................................................... 83
  The Nature of Tasks and Activities ............................................................ 84
    Daily class activities .............................................................................. 85
    The nature of tasks .................................................................................. 86
    Control over challenge ........................................................................... 89
Teacher Instructional Support

Communicating classroom goals
Negotiating meaning
Assisting peer modeling
Supporting the development of strategic knowledge
Fostering joint learning activities

Teacher Motivational Support

Analysis of Focal Students’ SRL and Classroom Practices

Focal Student #1: Alice
Evidence of self-efficacy
Evidence of strategic behavior
Participation in classroom practices

Focal Student #2: Kyle
Evidence of self-efficacy
Evidence of strategic behavior
Participation in classroom practices

Focal Student #3: Mike
Evidence of self-efficacy
Evidence of strategic behavior
Participation in classroom practices

Cross-Case Analysis

Self-Efficacy
Strategic Behavior
Classroom Practices and SRL
Participation structure
Experiencing mastery
Engagement with strategic learning activities
Teacher recognition
Modeling successful performance
Control over challenge

5. CONCLUSIONS
Supporting Students’ Strategic Learning
Supporting Students’ Self-Efficacy
Implications for Theory and Practice
Recommendations for Future Research

xii
APPENDICES
Appendix A: Oral script, informed consent form, and human subjects approval form. .............................................................. 181
Appendix B: Mean scores, standard deviations, and quartiles ................... 188
Appendix C: Mathematics self-efficacy and strategy questionnaire ............ 190
Appendix D: Categories for classroom observations .................................. 195
Appendix E: Interview protocols ............................................................. 198
Appendix F: Journal prompts ................................................................. 204
Appendix G: Categories for analysis of classroom context ......................... 206
Appendix H: Categories for analysis of focal students ............................... 209
Appendix I: Comparison of focal students’ self-efficacy ............................ 212
Appendix J: Comparison of focal students’ strategic efforts ....................... 214
Appendix K: Comparison of focal students’ classroom practices ................. 217

LIST OF REFERENCES ......................................................................................... 220
### LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>24</td>
</tr>
<tr>
<td>3.1</td>
<td>66</td>
</tr>
<tr>
<td>3.2</td>
<td>67</td>
</tr>
<tr>
<td>4.1</td>
<td>87</td>
</tr>
<tr>
<td>4.2</td>
<td>88</td>
</tr>
<tr>
<td>4.3</td>
<td>92</td>
</tr>
<tr>
<td>4.4</td>
<td>113</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phases and areas for regulation</td>
<td>24</td>
</tr>
<tr>
<td>Time schedule for the data collection procedures</td>
<td>66</td>
</tr>
<tr>
<td>Data sources and collection procedure</td>
<td>67</td>
</tr>
<tr>
<td>Expected task product by task purpose</td>
<td>87</td>
</tr>
<tr>
<td>Student participation structure with respect to purpose of the tasks</td>
<td>88</td>
</tr>
<tr>
<td>Teacher instructional support</td>
<td>92</td>
</tr>
<tr>
<td>Teacher motivational support</td>
<td>113</td>
</tr>
</tbody>
</table>
LIST OF FIGURES

Figure                                                                 Page
5.1  Forms of teacher support and their potential to impact self-efficacy and strategic
learning .................................................................................................................................................. 166
CHAPTER 1

INTRODUCTION

Background of the Study

During the last 20 years, the conception of what it means to learn mathematics has shifted from being defined as the passive and decontextualized acquisition of concepts and procedures to being defined as the active construction of meaning, which results from the connecting of new ideas to previous understandings (Lampert, 1990; Romberg & Kaput, 1999; Schoenfeld, 1992). Earlier perspectives on mathematics education have mainly focused on mathematics content, which was considered to be a sequential, static body of facts, procedures, and concepts. For a long time, these perspectives have determined the content and pedagogy of school curricula. The specific objectives that students needed to master were stated and the teachers’ role was to explain facts and concepts, and to demonstrate rules and procedures. Parallel with these notions, students were expected to memorize concepts and practice procedures until they mastered them.

Beginning with the work of Piaget and developmental theorists, the focus in mathematics education shifted from mathematics content to how students learn mathematics effectively. Current perspectives describe school mathematics as “dynamic, constructed, and reconstructed through an ongoing process of sense making by the
learner” (Heaton, 2000, p.4). Similarly, the learning of mathematics is viewed as a human activity, which requires learners to represent and communicate mathematical ideas, interpret the mathematical representations of others, build connections between ideas, use reasoning skills, and solve problems (Heaton, 2000; Romberg & Kaput, 1999). This notion of learning mathematics gained increasing currency through the efforts of the National Council of Teachers of Mathematics (NCTM) and the National Research Council (NRC), after 1980s in the United States.

The vision of school mathematics, articulated in reform documents in the US (e.g., Kilpatrick, 2001, NCTM, 1989, 2000; NRC, 1990), offers a set of expectations for change in teaching school mathematics. In particular, achieving “mathematical proficiency” that requires an integrated attainment of conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and productive disposition (Kilpatrick, 2001), calls for teachers and students to take on different roles, than what they are used to. A teacher is required to be a role model, a facilitator, and a coach, rather than one who conveys information. The current reform movement also implies that students are to be autonomous learners and supports school mathematics programs in creating self-regulated learners. Students build deeper understanding of more mathematical content when they can take control over their learning, by defining their own goals, monitoring their progress, evaluating and reflecting on their thinking, being confident in their abilities, and being willing to persevere when faced with difficulties (NCTM, 2000). However, these are not easy tasks to achieve for many students, and this calls for educational researchers to address “how students become masters of their own learning process” (Zimmerman, 2001, p.1).
The concept of self-regulated learning (SRL) serves as a comprehensive framework for understanding the processes that play a role in students being active agents of their own learning. Although researchers differ in their perspectives on self-regulation, there is some consensus among them that it involves cognitive, affective, motivational, and behavioral components that enable individuals to adjust their goals and actions to achieve desired results, in accordance with changing environments (Zeidner, Boekaerts, & Pintrich, 2000). When applying this concept to academic learning, SRL refers to academically effective forms of learning, through which learners set goals, and monitor, control, and regulate their cognition, motivation, and behavior, and reflect on their learning processes, while being guided and constrained by the contextual features in the environment (Pintrich, 1995, 2000; Zimmerman, 2001).

Self-regulated learners are metacognitively, motivationally, and behaviorally active participants in their own learning processes (Zimmerman, 1986). They regulate themselves metacognitively by setting goals, and planning, organizing, monitoring, and evaluating their learning processes. In terms of motivation, they take responsibility for their successes and failures, view themselves as self-efficacious, and attribute learning outcomes to factors that are generally under their control, such as effort and strategy use. They also regulate their behaviors by selecting, structuring, and creating environments that support learning.

Historical Trends in Theory and Research on SRL

The notion of SRL has evolved over the past three decades, in response to emerging paradigms in educational science and psychology (Paris & Paris, 2001). Early descriptions of SRL mainly included planning, strategic behavior, and metacognitive
awareness. In the 1970s, particular interest was given to general learning strategies and how to teach them (Weinstein & Mayer, 1986). Research in this period revealed that learning-disabled, younger, and inexperienced learners were less likely to use rehearsal, elaboration, and organization strategies. Because the prominent approaches to cognition associated learning with knowledge acquisition, early strategy training studies employed didactic methods. These studies were conducted as highly controlled laboratory experiments (Paris & Paris, 2001).

By the 1980s, researchers had realized that knowing strategies and the procedures to implement them were not sufficient for students to be strategic. Learners also needed to be aware of their strategic knowledge and had to know when to use and how to coordinate, monitor, and control their cognitive actions (Mayer, 1998; Schoenfeld, 1992). The idea of metacognition, introduced by Flavell (1979) to refer to a learner’s knowledge about, and control over his/her cognitive processes, became one of the major components of SRL. Researchers began to explore which kind of metacognitive knowledge (e.g., task, strategies) and skills (e.g., control, monitoring) were useful for effective learning. Specifically, comprehension monitoring gained much attention (Weinstein & Mayer, 1986). In training studies, students were provided explanations about how strategies function and why they are useful rather than simple directions to use them. In most studies, however, instruction did not go beyond providing explicit information about the declarative, procedural, and conditional knowledge necessary for effective strategic learning (Paris & Paris, 2001). Even though the research conducted in this period showed an association between students’ participation in strategy-training interventions and improvements in task performance, few studies reported the transfer of strategies across
different contexts (Butler, 1998a).

Through the mid-1980s and 1990s, conceptions of SRL evolved to include interactions between students’ knowledge (e.g., metacognitive and domain specific) and cognitive and metacognitive skills (e.g., strategy use, planning, and monitoring), as well as their motivation (e.g., self-efficacy beliefs and attributions) (Alexandar, 1995; Butler & Winne, 1995; Pintrich 1989; Schunk, 1994). Researchers have investigated several components of SRL, including cognitive and motivational strategies that learners use (e.g., Garcia & Pintrich, 1994; Zimmerman & Martinez-Pons, 1986, 1988), types of goals they adopt for learning tasks, (i.e., goal orientations; e.g., Pintrich, 2000), beliefs in their capabilities to accomplish learning tasks, (i.e., self-efficacy; e.g., Schunk, 1989), and attributions for success and failure (e.g., Schunk, 1983, 1984b, 1994). Some studies focused on understanding the complex relationships among these components while others examined their impact on academic achievement. These studies mainly relied on self-report questionnaires and structured interviews to assess students’ cognition, metacognition, motivation, and behaviors, generalized across settings and situations.

During the same period, emphasis on constructivist and sociocultural theories of learning led researchers to focus on social conditions, as well as on individual factors that support students’ SRL. Considering learners as active constructors of their own meaning through social interaction and the use of cultural tools, rather than passive recipients of knowledge, researchers have examined the social conditions that support students’ effective learning and have developed more sophisticated and effective intervention models (e.g., reciprocal teaching, Palincsar & Brown, 1984). They have identified the social conditions under which students learn effectively. Through experimental and
quasi-experimental methods they also developed instructional practices and assessed the impact of this instruction on variables associated with SRL (e.g., Ames, 1992a, b; Bluemenfeld, Puro, & Mergendoller, 1992; Butler, 1998a, b; Graham & Harris, 1989; Hofer, Yu, & Pintrich, 1996; Palincsar & Brown, 1984; Pape, Bell, & Yetkin, 2003; Verschaffel et al., 1999). Most of these studies took place in classroom environments, rather than in laboratory settings (Paris & Paris, 2001).

Statement of the Problem

This brief overview of historical trends in theory and research on SRL illustrates that, until recently, self-regulation has been mainly viewed as an individual process. SRL had been conceptualized and measured as an aptitude (Perry, 2002; Winne & Perry, 2000), that is, “relatively enduring attribute of an individual that can be aggregated over or abstracted from behavior across multiple events” (Perry, 2002, p.1). The implicit assumption underlying such an approach is that “the constructs [associated with SRL] reside within the individuals and are relatively stable” (Patrick & Middleton, 2002, p.27). Hence, the social aspects of SRL have been viewed mainly as peripheral, compared to individual or intrapsychological processes. This view led to a lack of attention regarding understanding the role of context in a student’s development of self-regulation. Context has either been ignored or reduced to a set of extraneous variables that influence individuals. The sharp dichotomy between the individual and the context has left the interactions between these two facets largely unexplored.

Context, broadly defined, involves the features of learning environments (e.g., classroom, school), cultural factors (e.g., ethnicity, nationality), and the multiple social contexts (e.g., family, other students), in which individuals operate (Urdan, 1999).
Recently, educational researchers and psychologists have pointed out the limitations of research that fails to integrate context and emphasized the need for research attending to the role of context in shaping students’ cognition and motivation (Anderman & Anderman, 2000; Boekaerts, 2002; Brophy, 1999; Goodenow, 1992; Pape et al., 2003; Pintrich, 1994, 2000, 2003; Salomon, 1995; Turner & Meyer, 1999). In part, this emphasis on context reflects the growing interest in situational perspectives regarding cognition and motivation (Paris & Turner, 1994; Rogoff, 1990; Tharp & Gallimore, 1988; Wertsch, 1985). These perspectives argue that what and how students learn, and how students are motivated to learn are situated in, influenced by, and changed through the nature of classroom contexts, as well as through the broader contexts that involve social, cultural and home environments.

Students construct cognitive interpretations of events that influence their learning, and these interpretations are unique in different situations (Paris & Turner, 1994). For example, the presence of competitive versus noncompetitive peers may change a student’s effort and persistence. Therefore, it is the interaction between the individual and the context that determines the direction and strength of his or her actions. Situational perspectives also emphasize the reciprocity of these interactions. Context, not only influences student cognition and motivation but is itself influenced by them. The focus of interest is, therefore, not on “individuals,” but on “individuals acting in social contexts” (Butler, 2002; Meyer & Turner, 2002; Perry, 2002). Even though research based on decontextualized constructs may reveal several facets of SRL (e.g., ability to analyze tasks, efforts to monitor progress toward a goal) based on generalizations across different situations, they can not provide detailed insight into students’ SRL in real situations.
The growing demand for more ecologically valid and practically relevant research is another concern that influences researchers to include context in their research agenda (Brophy, 1999; Salomon, 1995). Most SRL research has been conducted in experimental contexts, designed deliberately for the purposes of the particular study. Such contexts are considerably different from natural settings. In a typical classroom environment, instruction is constrained by time demands, which limits teachers’ choices of activities and students’ opportunities for choice and autonomy. Classrooms also are challenging places for promoting SRL because students’ performances are constantly assessed, and their successes and failures are public. These factors constrain students’ from developing the competency necessary to be self-regulated learners. Research that fails to examine students’ SRL in natural classroom settings cannot capture the complexity of learning in classroom settings. Therefore, the practical implications drawn from such research are limited (Brophy, 1999, Perry, VandeKamp, Mercer, & Nordby, 2002; Weiner, 1996).

Even though the literature on context is limited, it has provided important conceptual ideas about the ways in which classroom contexts might influence students’ cognition and motivation (e.g., Ames, 1992a, b; Blumenfeld, 1992; Brophy, 1989, 1999; Gaskill & Woolfolk Hoy, 2002; Paris & Turner, 1994; Pintrich & Schunk, 2002; Turner & Meyer, 1999; Woolfolk Hoy, 2004). Researchers suggest that students develop the knowledge, skill, and beliefs that enhance their self-regulation when they engage in tasks and activities that focus on the meaningful aspects of learning, which offer a reasonable amount of challenge, when they have opportunities for making choices about their learning, controlling challenges, and collaborating with other students. SRL is also more likely to develop when teachers provide instrumental or scaffolded support through
several teaching methods, such as modeling and coaching. Additionally, the evaluation and recognition structures that focus on students’ improvement and effort might enhance SRL.

To date, there are only a few studies that have focused on the specific ways in which classroom context influences students’ SRL (e.g., Blumenfeld et al., 1992; Meece, 1991; Meyer & Turner, 2002; Pape et al., 2003; Perry, 1998). Some of these studies have examined how different instructional approaches and evaluation practices are associated with the goals students adopt as they engage in academic work (i.e., goal orientations; e.g., Meece, 1991; Patrick et al., 2001), while others have explored classroom context, in terms of its effects on students’ strategic learning (e.g., Perry, 1998; Meyer & Turner, 2002; Turner et al., 2002). Yet, other studies have explored how classroom practices might help students translate their goal orientations into strategy use (e.g., Blumenfeld et al., 1992). With regard to mathematics education, research has documented that the nature of mathematical tasks and activities, classroom norms, and the nature of teacher support might influence student SRL (Meyer & Turner, 2002; Pape et al., 2003; Turner et al., 2002; Verschaffel et al., 1999). However, the results are far from conclusive. Particularly, little is known about the ways in which mathematics classrooms could support or constrain students’ self-efficacy and strategic learning.

Theoretical Framework

Among the theories of SRL, social cognitive and sociocultural perspectives provide useful insights into students’ development of adaptive self-efficacy and strategy use, and the contexts that support these forms of self-regulation. Social cognitive theory explains human functioning through reciprocal interactions among personal processes,
environmental factors, and behaviors (Bandura, 1997). The interaction of personal,
behavioral, and environmental factors influences three cyclical phases of self-regulation:
forethought, performance control, and self-reflection (Zimmerman, 2000). During the
forethought phase, self-regulated learners set appropriate goals and plan their learning
activities in order to achieve their goals. When faced with an academic task, they begin to
analyze the task and interpret the task requirements in terms of their existing knowledge
and beliefs (Pintrich, 2000; Schunk, 2000; Zimmerman, 1989, 2000). Performance
control involves selecting, adapting, or inventing appropriate strategies to accomplish
learning goals. During the implementation of strategies, self-regulated learners monitor
and control their behaviors, cognition, motivation, and emotions. According to their
progress toward goals, they adjust their strategies, as necessary. Finally, during the self-
reflection phase, self-regulated learners make judgments of their progress by comparing
self-monitored information with a standard or a goal. These self-reflections influence
their future goals and efforts, and, hence, complete the self-regulatory cycle.

Social cognitive perspectives also offer various self-regulatory processes (e.g.,
self-monitoring, self-reaction) and accompanying beliefs (e.g., self-efficacy) that come
into play during different phases, and these impact students’ regulation of cognition,
motivation, affect, and behavior. Among these, self-efficacy, which refers to perceptions
about one’s capabilities to organize and implement actions in order to achieve designated
performances (Bandura, 1997), is assumed to be a key factor affecting one’s self-
regulation.

People’s beliefs in their efficacy influence the choices they make, their
aspirations, how much effort they mobilize in a given endeavor, how long they
persevere in the face of difficulties and setbacks, whether their thought patterns
are self-hindering or self-aiding, the amount of stress they experience in coping
with taxing environmental demands, and their vulnerability to depression.
(Bandura, 1991, p.257)

In social cognitive theory, the individual and the environment are related, but
distinct from one another. Consistent with this assumption, the emphasis is given to how
students regulate their cognition, motivation, and behavior, and how environmental
factors might help them to develop necessary skills (Meyer & Turner, 2002; Pintrich,
2000). Because the theory assumes that learning mainly occurs from the consequences of
one’s own actions (i.e., mastery learning), and/or by observing models (i.e., vicarious
learning), most classroom research involved examining how teachers influence student
SRL, through modeling, social guidance, and feedback (Schunk & Zimmerman, 1996,
1997). Recently, social cognitive researchers have expanded their analyses of the social
aspects of SRL in classroom settings by including other classroom features, such as
teacher and peer support, authority, and evaluation structure (e.g., Perry, 1998; Perry &
VandeKamp, 2000; Perry et al., 2002).

Sociocultural perspectives take a broader position in explaining context and its
role in students’ development of self-regulatory competence. The theory offers a different
conceptualization of context and reciprocity, in two related ways. First, sociocultural
perspectives assume that individuals, and the social environment that they are a part of,
constitute mutual elements of a single, interacting system (Cole, 1985). In other words,
context is not conceptualized in terms of its effects; rather, it is considered as an integral
part of the self-regulatory development. Consistent with this approach, sociocultural
researchers focus on the relationships between individuals and the features of social, cultural, historical, and institutional contexts, in which individuals function (Wertsch, del Rio, & Alvarez, 1995).

Second, sociocultural perspectives assume that students develop self-regulation, as they participate in multiple social and instructional environments. Self-regulation originates and develops within these contexts through the reciprocal interactions among the students and the teacher, as well as through the opportunities available (e.g., tasks, classmates, and family). While the ultimate goal is “self”-regulation, sociocultural researchers use terms, such as “adaptive learning” or “co-regulation,” in order to stress the role of ongoing interactions between individuals and contexts in the development of SRL (McCaslin & Good, 1996; McCaslin & Hickey, 2001; Rohrkemper, 1989). As an example, the model of co-regulation emphasizes the shared responsibility among teachers and students, in establishing and maintaining the relationships that promote self-regulation. Student responsibility lies in the coordination of multiple social worlds, goals, and expectations; whereas, teachers are responsible for providing supportive scaffolding and affording the opportunities that mediate student regulation (McCaslin & Good, 1996). Hence, SRL is built through negotiation or a shared understanding of goals, tasks, and activities, and it develops through scaffolded support that helps students build competence through increased understandings (Meyer & Turner, 2002).

In an attempt to understand students’ development of self-efficacy and strategic learning in mathematics, and the ways that classroom context supports it, both social cognitive and sociocultural perspectives are of great importance. While social cognitive perspectives provide an understanding of the structure and functioning of self-regulatory
processes, sociocultural perspectives offer support for understanding the ways in which SRL is supported or constrained, through ongoing interactions between students and the classroom context.

Purpose of the Study

The current study aimed to investigate the classroom practices that hold potential for impacting student self-efficacy and strategic learning in one sixth-grade mathematics classroom and to examine the ways in which individual students’ participation in these classroom practices potentially relates to their self-efficacy and strategic learning development. In order to achieve the main goal, the study entails four sub-goals. First, in order to understand students’ classroom practices, there is a need to understand the general structure of the classroom context in which these practices are situated. For this purpose, the nature of the tasks and the activities (e.g., types of tasks and participation structure), and the nature of the instructional and motivational practices (e.g., teacher support, recognition and evaluation structures) were examined in terms of whether or not they held potential for supporting student self-efficacy and strategic learning.

The second sub-goal was to explore individual student’s participation in these classroom practices. For this purpose, three students with different levels of mathematics achievement and self-regulation were selected purposively from this sixth-grade mathematics class. While particular emphasis was given to these students’ interactions with the teacher (e.g., teacher support and recognition), their engagement with the tasks and activities (e.g., participation structure), as well as their interactions with other students during group activities (e.g., help seeking from other students), were also examined. The third sub-goal was to examine changes in these students’ self-efficacy and
strategic learning over the course of the study. Finally, the fourth sub-goal was to examine these students’ development of SRL, in relation to their classroom practices.

Research Questions

Below is the main research question addressed in this case study:

In what ways do the classroom practices in this sixth-grade mathematics classroom support individual student’s self-efficacy and strategic learning?

Several sub-questions within the main research question were explored:

(1) What is the nature of the classroom practices (i.e., tasks and activities; instructional and motivational structures) that hold potential for impacting student self-efficacy and strategic learning in this classroom?

(2) What are the focal students’ self-efficacy beliefs in relation to mathematics over the course of the study?

(3) What self-regulatory strategies do focal students choose to employ as they engage in mathematical tasks over the course of the study?

(4) What is the nature of focal students’ participation in relation to the classroom practices? Specifically, how do focal students’ interactions with the teacher and classroom experiences (e.g., tasks, other students) provide the opportunity for self-efficacy and strategy development within this sixth-grade mathematics classroom?

(5) In what ways do the focal students’ classroom practices interact with their self-efficacy and strategic behavior?
Significance of the Study

The current study was stimulated by (a) the need for research that examines the role of classroom context in students’ development of SRL competency, and, (b) the growing demand for more ecologically valid and practically relevant research that provides useful knowledge for educators. Hence, the current study makes two contributions to the field of SRL. In this study, classroom context was considered to be integral to the development of students’ self-regulation, and particular emphasis was given to understanding the dynamic interactions between individual student’s characteristics (i.e., self-efficacy, prior content knowledge, and strategic competence) and classroom experiences. In particular, the reciprocal relationship between student characteristics, interactions with their teacher, and the opportunities provided in the class was explored. Theoretically, this dynamic conceptualization has potential for extending our understanding of aspects of classroom context that support self-efficacy and strategic learning development.

The results of the study also have strong implications for restructuring mathematics instruction in order to promote student self-regulation. Because the study was conducted in a classroom setting, the findings will inform mathematics teachers by providing evidence of how and why particular classroom practices support students’ self-efficacy and strategic learning, while others do not. A better understanding of the ways in which classroom practices support or constrain student SRL also enhances teacher educators in their attempt to develop mathematics programs that support student self-regulation.
Limitations, Delimitations, and Assumptions

The study has a number of limitations. First, because the researcher was interested in observing classroom events and the focal students in their natural settings, the results of the study are limited to the events that are available to be recorded in this classroom setting. Second, students’ self-efficacy and strategy use were assessed through their verbal statements, behaviors, and written responses to self-report instruments. Even though these data collection methods provide some understanding of student cognition and motivation, they may not reflect all complex internal processes. Finally, this study is an exploratory, descriptive case study. While the ultimate goal was to understand how students’ classroom practices are related to their self-efficacy and strategic behavior, the current study did not set out to offer a causal explanation of this relationship.

The study is delimited studying two ways. First, the definition of SRL is limited to students’ self-efficacy beliefs and strategy use. SRL is a broader concept; however, that includes other cognitive, motivational, and affective processes (e.g., goal orientations, attributions, interest, attitude, and anxiety). The inclusion of these processes, while important, would have made the research study too diffuse and the research process difficult to manage. Second, the study necessarily examined a limited number of dimensions of classroom context. There are several other classroom context dimensions that could not be addressed in this study, such as classroom management, peer culture, and emotional support. The study was delimited to the SRL constructs and classroom context dimensions that are most pertinent for student self-efficacy and strategic learning, based on extant literature. Finally, a major assumption regarding this study is that the students are cooperative throughout the study and answer all questions honestly and to
the best of their ability.

**Definition of Terms**

**Self-regulated learning** refers to academically effective forms of learning, through which learners set goals, and monitor, control, and regulate their cognition, motivation, and behavior, and reflect on their learning process, while being guided and constrained by the contextual features in the environment (Pintrich, 1995, 2000; Zimmerman, 2001). In this study, SRL is defined in terms of students’ self-efficacy and strategic learning.

**Self-efficacy** refers to “beliefs in one’s capabilities to organize and execute the courses of action required to produce given attainments” (Bandura, 1997, p.3). In this study, self-efficacy is defined as students’ judgments about their ability to successfully accomplish a task, as well as to a student’s confidence in his/her skills to perform that task (Pintrich, Smith, Garcia, & McKeachie, 1993).

**SRL strategies** refer to “actions directed at acquiring information or skill that involve agency, purpose (goals), and instrumentality self-perceptions by a learner” (Zimmerman & Martinez-Pons, 1986, p.615). In this study, the focus was given to the following strategies that are most pertinent to student SRL and achievement: cognitive strategies (rehearsal, elaboration, and organization), metacognitive strategies (planning, monitoring, and regulating), effort regulation, and help seeking.

**Problem-specific strategies** refer to the students’ procedures, which were carried out in strategic ways for them to complete the solutions they had planned. Specifically, these procedures enabled them to perform the strategies they chose to solve the specific problem.
Classroom context involves “beliefs, goals, values, perceptions, behaviors, classroom management, social relations, physical space, and social-emotional and evaluative climates that contribute to the participants’ understanding of the classroom” (Turner & Meyer, 2000, p.70). In this study, classroom context is defined in terms of students’ interactions with the teacher and the opportunities provided in the classroom (e.g., tasks and other students) that may influence as well as is influenced by students’ cognition, motivation, and behaviors. Particular interest was given to the nature of tasks and activities and students’ engagement with them (e.g., types of tasks and participation structure), as well as to the nature of instructional and motivational practices (e.g., teacher support, recognition, and evaluation structures).
CHAPTER 2

THEORETICAL RATIONALE AND REVIEW OF LITERATURE

Introduction

As indicated in the first chapter, this study focuses on a descriptive examination of the ways classroom context supports or constrains middle grade students’ self-efficacy and strategy use in mathematics by incorporating concepts and principles drawn from sociocultural and social cognitive perspectives. The purpose of this chapter is to provide an overview of the theories that constitute the theoretical framework of this study and to review the literature that is most pertinent to the proposed study. The chapter includes four major sections. The first section involves an overview of SRL from a social cognitive perspective in order to provide an understanding of the structure and functioning of self-regulatory systems. The next section is devoted to a sociocultural view of SRL with an emphasis on the role of context in students’ development of SRL. The third section involves review of the research on two aspects of SRL that are of interest in the current study: self-efficacy and strategy use. Finally, the last section includes review of literature that investigates the role of classroom context in students’ development of self-efficacy and strategic learning.
SRL from a Social Cognitive Perspective

A social cognitive view of self-regulation is based on three basic assumptions related to (a) human agency in triadic reciprocal dependency between personal, behavioral, and environmental factors, (b) enactive and vicarious learning, and (c) cyclical phases, key processes, and accompanying beliefs in self-regulatory systems.

*Human Agency in Triadic Reciprocal Causation*

Social cognitive theory assumes that human functioning is determined by many interacting factors, and hence, individuals are only contributors to, rather than the sole determiners of, their actions. Human agency operates within an interdependent structure involving a reciprocal dependency between personal, behavioral, and environmental factors (Bandura, 1997). With regard to self-regulated learning, personal factors include covert cognitive functioning and beliefs such as self-efficacy, metacognitive processes, strategic knowledge, and perceptions of affects and values. Behavioral factors involve an individual’s actions, verbalizations, and choices. Environmental factors include the structure of learning context and social and enactive experiences formed by modeling, verbal persuasion, and various symbolic forms of information (Bandura, 1986; Zimmerman, 1989).

In triadic model, personal, behavioral, and environmental factors are viewed as separate but interdependent sources that influence each other bidirectionally (Bandura, 1986, 1997). For example, as a personal factor, self-efficacy beliefs influence achievement behaviors such as choice of task and persistence. In turn, the way students act changes their self-efficacy beliefs. For instance, monitoring their progress by taking notes makes students realize that they are capable of performing well and hence
positively impacts their self-efficacy. Similarly, a student’s self-efficacy to solve a particular mathematical problem is determined not only by personal perceptions of efficacy but also by environmental factors such as a teacher’s encouragement.

*Enactive and Vicarious Learning*

Social cognitive perspectives assume that learning occurs enactively through actual doing or vicariously by observing models as they perform (Schunk, 2000, 2001). Enactive learning involves learning from the consequences of one’s own actions. These consequences serve as sources of information and motivation. They inform individuals about the accuracy and appropriateness of their actions and influence their motivation to learn. Vicarious learning involves learning without actually performing but by observing others, reading, or watching TV. In social cognitive theory, observational learning through modeling is particularly important. By observing modeled behaviors and their consequences, students generate beliefs about the likely outcomes of actions, which influence their future behaviors.

From social cognitive perspectives, self-regulatory competence develops initially from social sources (e.g., modeling, social guidance and feedback) and afterward shifts to self-sources (e.g., self-reinforcement, self-monitoring) through a series of levels: observation, emulation, self-control, and self-regulation (Schunk & Zimmerman, 1996, 1997; Zimmerman, 2002a). At the observational level of self-regulatory competence, novice learners are able to distinguish the features of the skill by observing model(s) learning or performing. At the emulation level of self-regulatory competence, learners imitate the general form or style of the model, but they do not directly copy the model. For instance, they may imitate the type of questions models ask while learning without
using the same words. Social guidance, feedback, and reinforcement are important influences during these levels. At more advanced levels, the source of regulation shifts from social sources to self-initiated sources. Self-control level is characterized by learners’ independent performances within structured circumstances. They begin to regulate their performances by using the representational standards of the expert model’s performance (Bandura & Jeffery, 1973 as cited in Zimmerman, 2002) and self-reinforcement. Finally, at the self-regulated level, learners can adapt their learning strategies according to changing personal and contextual conditions (Bandura, 1986).

**Cyclical Phases, Key Processes, and Associated Beliefs**

Self-regulated learning is a cyclical process because personal, behavioral, and environmental factors are constantly changing and students need to use feedback from prior experiences to adjust their current efforts (Zimmerman, 1998, 2000). The interaction of personal, behavioral, and environmental factors influences three cyclical phases of self-regulation: forethought, performance control, and self-reflection (Zimmerman, 2000). Various self-regulatory processes and associated beliefs come into play during different phases of self-regulation. Throughout the cyclical phases, these processes and accompanying beliefs interact with each other and influence the ways learners analyze the tasks, set appropriate goals and devise a plan, select, adapt, and implement appropriate strategies, monitor their progress, and reflect on the outcomes, which influence subsequent goals and efforts.

In order to explain this structure and functioning of self-regulatory systems, researchers have developed several models (e.g., Bandura, 1986, 1991; Pintrich, 2000; Schunk, 2000; Zimmerman, 1998, 2000). Table 2.1, which is adapted from the models of
SRL (Pintrich, 2000; Zimmerman, 2000), displays the key processes and associated beliefs that come into play during each phase of self-regulated learning and the areas for regulation.

**Forethought.** During forethought phase, self-regulated learners set appropriate goals and plan their behaviors in order to achieve their goals. These goals serve as a criterion for learners against which to assess, monitor, and guide their cognition. When faced with an academic task, self-regulated learners begin to analyze the task and interpret the task requirements in terms of their existing knowledge and beliefs (Pintrich, 2000; Schunk, 2000; Zimmerman, 1989, 2000). They also make a strategic plan based on their prior content knowledge and metacognitive knowledge (i.e., knowledge about tasks and strategies).

There are a number of key motivational beliefs and affects underlying the cognitive self-regulatory processes. Students’ purposes for engaging with the task (goal-orientation), beliefs in their competence to successfully perform the task (self-efficacy), as well as beliefs about the importance, utility and relevance of the task (task value beliefs), and their interest in the content area (task interest) are involved in motivational and affective aspects of forethought phase. During this phase, regulation of behavior involves planning for time management and effort through such activities as making schedules for studying and allocating time and effort for different activities.
<table>
<thead>
<tr>
<th>Areas for Regulation</th>
<th>Phases</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Forethought</td>
</tr>
<tr>
<td></td>
<td>Performance Control</td>
</tr>
<tr>
<td></td>
<td>Self-Reflection</td>
</tr>
<tr>
<td>Cognition</td>
<td>Task Analysis</td>
</tr>
<tr>
<td></td>
<td>- prior content knowledge and</td>
</tr>
<tr>
<td></td>
<td>metacognitive knowledge activation</td>
</tr>
<tr>
<td></td>
<td>- goal setting</td>
</tr>
<tr>
<td></td>
<td>- strategic planning</td>
</tr>
<tr>
<td></td>
<td>Self-control</td>
</tr>
<tr>
<td></td>
<td>- selection and adaptation</td>
</tr>
<tr>
<td></td>
<td>of cognitive strategies</td>
</tr>
<tr>
<td></td>
<td>Self-monitoring</td>
</tr>
<tr>
<td></td>
<td>- metacognitive awareness and</td>
</tr>
<tr>
<td></td>
<td>monitoring of cognition</td>
</tr>
<tr>
<td>Motivation/Affect</td>
<td>Goal orientation</td>
</tr>
<tr>
<td></td>
<td>Self-efficacy</td>
</tr>
<tr>
<td></td>
<td>Perceptions of task difficulty</td>
</tr>
<tr>
<td></td>
<td>Interest/task value activation</td>
</tr>
<tr>
<td></td>
<td>Self-control</td>
</tr>
<tr>
<td></td>
<td>- selection and adaptation</td>
</tr>
<tr>
<td></td>
<td>of strategies for</td>
</tr>
<tr>
<td></td>
<td>managing motivation</td>
</tr>
<tr>
<td></td>
<td>and affect</td>
</tr>
<tr>
<td></td>
<td>Self-monitoring</td>
</tr>
<tr>
<td></td>
<td>- awareness and</td>
</tr>
<tr>
<td></td>
<td>monitoring of</td>
</tr>
<tr>
<td></td>
<td>motivation and affect</td>
</tr>
<tr>
<td>Behavior</td>
<td>Time and effort planning</td>
</tr>
<tr>
<td></td>
<td>Self-monitoring of behavior</td>
</tr>
<tr>
<td></td>
<td>Controlling effort</td>
</tr>
<tr>
<td></td>
<td>- increase/decrease effort</td>
</tr>
<tr>
<td></td>
<td>- persist/give up</td>
</tr>
<tr>
<td></td>
<td>- help-seeking</td>
</tr>
<tr>
<td></td>
<td>Choice behavior</td>
</tr>
</tbody>
</table>

Table 2.1: Phases and Areas for Regulation
Performance control. The performance control phase involves selecting, adapting, or inventing appropriate strategies to accomplish learning goals. During the implementation of strategies, self-regulated learners regulate their cognition, motivation, and behaviors through two major self-regulatory processes: self-control and self-monitoring (Pintrich, 2000; Zimmerman, 2000). Cognitive control involves the selection and use of various strategies including rehearsal, elaboration, and organizational strategies. Similarly, there are several strategies to control motivation and affect such as positive self-talk to control self-efficacy, making the task more relevant to increase task value, or attributing poor outcome to low effort.

In most models of self-regulation, control and regulation activities are assumed to be strongly related to self-observation or monitoring. Self-monitoring refers to deliberate attention to aspects of one’s performance (Bandura, 1991). However, this process is not a simple mechanical appraisal of one’s performance. Preexisting cognitive structures and self-beliefs impact which aspects of one’s performance are given the most attention. They also impact the way one perceives and restores information about performance. Depending on these cognitive structures and beliefs the quality of self-monitoring (i.e., informativeness, regularity, proximity, and accuracy) changes.

There are two important functions of self-monitoring: self-diagnostic and self-motivating (Bandura, 1991; Schunk, 2001). Systematic observations on their thoughts, emotions, and behaviors, and the conditions under which they occur inform students about the factors affecting their psychological functioning. This information contributes self-directed change in accordance with the task and contextual demands. Self-monitoring also informs students about their progress toward the goal and motivates them
for changing their behaviors as necessary. For example, based on monitoring of their behavior, the difficulty of the task, and their goals, students may increase or decrease their effort, persist or give up, or seek help from others.

*Self-reflection.* This phase involves students’ judgments and reactions of their performance on the task. Self-judgment involves one’s evaluations of performance and attributions of causal consequence to the results (Zimmerman, 2000). Self-evaluation refers to comparisons of monitored performances against some standard, such as one’s previous performance, another person’s performance, or a fixed standard of performance. Students’ judgments about their progress partly depend on attributions to their successes and failures. Self-regulated learners tend to attribute poor performance to lack of effort or inadequate strategy use, which lead them to believe that they will perform better if they work harder or if they use more efficient strategies (Zimmerman, 1998).

Self-evaluations and causal attributions are closely related to self-reactions. One form of self-reaction involves feelings of satisfaction or dissatisfaction and associated affect regarding one’s performance (Zimmerman, 2000, 2002b). When students believe that they make progress and they are satisfied with the goal accomplishment, they feel efficacious and are motivated to complete the task (Schunk, 2001). Another form of self-reactions is adaptive versus defensive reactions. Adaptive reactions refer to adjustments directing students to better forms of self-regulation by changing the goals or choosing more effective strategies (Zimmerman, 2000, 2002b). In contrast, defensive reactions serve to protect learners’ self-image from dissatisfaction by withdrawing opportunities to learn or perform. These reactions are contrasted with SRL and limit personal growth. At this phase, students may also reflect on their behaviors, which may influence their
choices. These self-reflections influence forethought phase regarding the future goals and efforts, thus completing the self-regulatory cycle.

Summary

A social cognitive view of SRL is based on three major assumptions. First, self-regulated learning is achieved through reciprocal interactions among behavioral, environmental, and personal factors. The triadic view of self-regulation emphasizes the importance of self-regulatory mechanisms governing cognitive and motivational functioning as well as the continuing dependency of self-regulatory processes on a variety of environmental and behavioral factors. Second, self-regulated learning is achieved through the consequences of one’s own actions (i.e., enactive learning) and/or by observing models (i.e., vicarious learning).

Throughout the development of self-regulatory competence, social sources (e.g., modeling, social guidance and feedback) of regulation gradually shift to self-sources (e.g., self-reinforcement, self-monitoring). Third, social cognitive theory assumes that the interaction of personal, behavioral, and environmental factors influence three cyclical phases of self-regulation: forethought, performance control, and self-reflection (Zimmerman, 2000). During forethought phase, self-regulated learners set appropriate goals and plan their behaviors in order to achieve their goals based on their existing knowledge and beliefs. The performance control phase involves various monitoring and control processes to regulate cognition, motivation, and behavior. Finally, self-reflection phase involves evaluations of performance against a standard, making attributions to success or failure as well as reacting to judgments about the performance.
All students go through these phases and use self-regulatory processes to some degree as they engage in academic work; however, self-regulated learners are the ones who develop knowledge, beliefs, and skills that support their self-regulation. Therefore, understanding how SRL develops is as important as understanding its structure and functioning. In the development of SRL, the social cognitive assumption of triadic reciprocity among personal, behavioral, and environmental factors implies that the individual and the environment are related but distinct constructs. Therefore, the emphasis is on understanding how students regulate their cognition, motivation, and behavior and how environmental factors might help them develop necessary knowledge, beliefs, and skills (Meyer & Turner, 2002; Pintrich, 2000). Sociocultural perspectives take a broader position in explaining the relationship between the individual and the environment as well as the role of context in students’ development of SRL. The next section is devoted to a discussion of this topic.

SRL from a Sociocultural Perspective

Sociocultural theory, which has its roots in Vygotsky’s work, aims to understand human mental functioning in terms of contextually situated processes (Wertsch, 1990). Central to this effort is the explanation of relationships between human mental functioning and the cultural, historical and institutional situations in which this functioning occurs (Wertsch et al, 1995). In the following sections, a sociocultural view of SRL is explained by applying the main concepts and principles drawn from the theory: (a) shared and mediated agency, (b) SRL as a socialization process.
**Shared and Mediated Agency**

Sociocultural perspectives assert that individuals and the social environment that they are a part of constitute mutual elements of a single, interacting system (Cole, 1985). Consistent with this approach, the theory suggests that agency, which is generally conceived as a property of the individual, extends beyond the individual. One of the major assumptions for this assertion is that agency is often shared by dyads and small groups. Instead of an isolated individual, it is often a group or dyad that carries out the mental functions. In such situations, “the socially distributed cognition is greater than or at least qualitatively different from the sum of the individuals’ cognitive processes that constitute it” (Wertsch, Tulviste, & Hagstrom, 1993, p.339). Hence, agency is considered a distributed property rather than an individual property.

The second way in which agency extends beyond the individual is grounded on Vygotsky’s claim that any human function is mediated by tools and signs, which are the products of sociocultural milieu. This conception implies that the appropriate designation of agent is not the individual in isolation but the combination of individual or a group of individuals together with mediational means (Wertsch, 1998; Wertsch et al., 1993). In this view, individual(s) continue(s) to take the major responsibility for carrying out an action, but their actions are shaped by the mediational means employed. The unit of analysis for agency is therefore, “individual(s)-operating-with-mediational-means” or “mediated agency” (Wertsch et al., 1993, p.342).

**SRL as a Socialization Process**

Sociocultural approaches assume that self-regulated learning is inherently a social process. It originates and develops as learners participate in multiple social, cultural, and
institutional environments. Within these contexts, learners internalize goals, values, knowledge, and strategies that promote their self-regulation in academic learning through social interactions and use of cultural or mediational means (e.g., speech, symbol systems, and representations). The theory particularly emphasizes interactions with more experienced ones (e.g., adult, teacher) where that person provides the “other regulation” necessary for the learner to perform the task (Wertsch, 1979).

Sociocultural researchers explain the transition from other regulation to self-regulation through four major stages (Vygotsky, 1981; Wertsch, 1979). The first stage can be characterized by the learners’ limited understanding of the task and the adult’s or more experienced other’s regulation. Through speech, symbols, and representations that are tied to the learner’s definition of the situation, the learner and more experienced other develop shared understandings. During the second stage, learners begin to participate in communication successfully and make connections between the adult’s utterance and the task situation through mediational means. At this stage, for instance, learners begin to practice symbols and representations (e.g., drawings, concept maps, mathematical language) to understand and complete the tasks with the adult’s guidance. Their understanding of the task situation, however, is limited and the responsibility for regulating behavior and carrying out plans still lies with the adult.

At the third stage of regulation, learners become aware of the role and function of the mediational means that enable them to carry out the tasks independently and take more responsibility. Their regulation, however, is still dependent on adult guidance. For instance, learners could generate questions or examples to assist their understanding and completion of the tasks with adult guidance. At the last stage, the use of cultural means
becomes part of the learner’s internal organization through social interactions. In this way, they begin to take over the communicative and regulative responsibilities from the more experienced others and develop self-regulatory competence.

While the ultimate goal is “self”-regulation, sociocultural researchers uses the terms such as “adaptive learning” or “co-regulation” in order to stress the role of ongoing interactions between individuals and the context in the development of SRL (e.g., McCaslin & Good, 1996; McCaslin & Hickey, 2001; Rohrkemper, 1989). For example, the model of co-regulation emphasizes the shared responsibility among teachers and students in establishing and maintaining relationships that promote self-regulation. In this model, students’ responsibility is to organize multiple social worlds, goals, and expectations, whereas teachers are responsible for providing scaffolded support and opportunities that mediate student regulation. In this sense, as a social process, self-regulated learning is built on negotiation or shared understandings of goals, tasks, and activities and develops through scaffolded support to help students build competence through increased understandings, opportunities for self-regulatory practices, and exercising autonomy (Meyer & Turner, 2002).

*Intersubjectivity, ZPD, and scaffolding.* In an attempt to understand the role of context in students’ development of SRL, it is very important to discuss three related concepts: intersubjectivity, ZPD, and scaffolding. In the context of a social activity, the transition from regulation by others to self-regulation highlights the degree of “intersubjectivity” or “consensual interpretation” that exists between the participants of the activity (Henderson & Cunningham, 1994). During the first stages of self-regulatory competence, learners have a limited understanding of the task and the context.
Intersubjectivity, or “shared understanding based on a common focus of attention and some shared presuppositions” (Rogoff, 1990, p.71), forms the ground for communication in the classroom environment and supports students’ understanding and participation to the activities. It is essential to establish intersubjectivity because even though the students and the teacher function in the same context, they may understand this context in such different ways that they are not normally doing the same tasks (Wertsch, 1984). Without achieving a shared understanding, students cannot participate in joint decision-making processes from which they expand their self-regulatory knowledge and skills.

Even though intersubjectivity is achieved by all participants’ effort and willingness, most of the time it is the teacher who takes the most responsibility to adjust students’ attention and level of understanding. Teachers’ advanced communication skills and knowledge allow them to recognize different understandings involved in a classroom activity. Through the use of speech that is tied to students’ understanding of the problem situations, the teacher assists negotiations on a new level of intersubjectivity, allowing students to redefine their understandings of the situation and enabling them to interact and work with the teacher effectively. The level of intersubjectivity constantly changes because new understandings emerge through these interactions. Throughout this process, students gain shared understandings of classroom goals, expectations, and problem situations that enable them to participate in classroom activities within their zone of proximal development.

The “zone of proximal development (ZPD)” refers to “the distance between actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in
collaboration with more capable peers” (Vygotsky, 1978, p.86). Students’ ZPD is determined by considering their level of functioning under assistance and their level of independent functioning. Because ZPD involves functions that are incomplete, but in the process of maturing (Wertsch & Rogoff, 1984), providing students opportunities to function within their ZPD leads them to perform at a reasonably challenging level and hence develop their self-regulation. There are several ways to arrange and structure classroom activities so that students work within their ZPD (Rogoff, 1990). For instance, teachers may break down the tasks into subtasks that students can manage. They can also structure students’ involvement in classroom activities through joint participation. As students gain more experience performing tasks, the responsibility for learning is transferred from the teacher or the group to the individual student.

From sociocultural perspectives, teacher support is best captured by the notion of “scaffolding.” As the metaphor implies, scaffolding refers to the “gradual withdrawal of adult control and support as a function of children’s increasing mastery of a given task” (Diaz, Neal, & Amaya-Williams, 1990, p.139). Scaffolding ranges from performing an entire task to providing occasional hints. Successful scaffolding involves focusing students’ attention on the task and keeping them motivated and actively engaged with the task. Successful scaffolders also simplify the task so that students can manage the components and direct students’ attention to important and relevant features of the task. Furthermore, they model task performance, control frustration, and encourage students’ independent functioning (Wood, Bruner, & Ross, 1976 as cited in Rogoff, 1990). Through calibrated support, students can participate in self-regulatory practices at the
level they are capable of. In this way, the responsibility for control over learning is systematically and supportively transferred to students.

Summary

Whereas social cognitive perspectives provide insight into the ways contextual factors influence students’ development of SRL, sociocultural perspectives take a broader position in explaining context and its role in this process. Context is considered an integral part of self-regulatory development because human agency extends beyond the individual – it is shared and mediated by cultural means. Sociocultural perspectives also assume that SRL is inherently a social process, because it is achieved as students participate in multiple social, cultural, and institutional environments through social interactions and use of mediational means. The three interrelated concepts (i.e., intersubjectivity, ZPD, scaffolding) imply that the development of SRL is built on the negotiation or shared understandings of goals, tasks, and activities that allow students to build competence through increased understanding. Students’ develop self-regulatory competence through scaffolded support that assists them to exercise autonomy and participate in self-regulatory practices at a level that is reasonably challenging for them.

Self-Regulated Learning Research

Research on SRL in academic settings is quite diverse. Some researchers investigate the cognitive (e.g., task analysis, cognitive strategy use, and self-evaluation), motivational (e.g., self-efficacy, goal orientation, motivational strategies), and behavioral (e.g., time and effort planning) components of SRL that were discussed at the beginning of this chapter. Research in this area focuses particularly on understanding the complex and dynamic relationships among these aspects of SRL. Other researchers investigate
factors affecting students’ development of self-regulatory competence. Research in this area focuses on designing instructional practices and examining their effectiveness on students’ regulation of their cognition, motivation, and behavior. The present study focuses upon the motivational (i.e., self-efficacy) as well as cognitive and behavioral (i.e., cognitive, metacognitive, effort regulation, help-seeking strategies) aspects of SRL that are most pertinent to students’ SRL and academic achievement. This section includes review of literature that explored the ways each of these aspects influences SRL and provides conceptual work examining the role of classroom context on students’ development of self-efficacy and strategy use.

**Self-Efficacy**

Perceived self-efficacy, which is a key factor affecting human functioning in social cognitive theory, refers to “beliefs in one’s capabilities to organize and execute the courses of action required to produce given attainments” (Bandura, 1997, p.3). In academic settings, self-efficacy refers to students’ beliefs in their capabilities to learn, to accomplish a task, or to succeed in an activity. Efficacy beliefs reflect future-oriented judgments rather than actual level of competence (Woolfolk Hoy, 2004). Students may overestimate or underestimate their actual abilities and these estimations may have consequences on the actions they choose to pursue and the efforts they exert on these pursuits. Self-efficacy beliefs are task- and situation-specific judgments about one’s competence and are used in reference to some type of goal (Bandura, 1986; Pintrich & Schunk, 2002). In other words, one’s self-efficacy may vary depending on several factors such as the nature of tasks, required skills, preparation, and environmental conditions. For instance, a student’s efficacy for solving a mathematics problem that requires application
of a concept may be lower compared to efficacy for solving a problem that requires basic skills.

Perceived self-efficacy is assumed to be influential during all phases of self-regulation (Pajares, 2002; Schunk & Ertmer, 2000). Students’ self-efficacy affects their choice of activities and goal setting during the forethought phase. Students with low self-efficacy may avoid difficult tasks; those who believe in their capabilities set challenging goals and maintain strong commitment to accomplishing them (Bandura, 1997; Schunk, 2000). Zimmerman, Bandura, and Martinez-Pons (1992) found that students’ perceived capabilities to use a variety of self-regulated learning strategies affected their perceived self-efficacy for academic achievement, and through that influence, affected their goal setting and their achievement. Results of this study also supported that students with higher perceived self-efficacy beliefs set higher goals for themselves.

During the performance control phase, students with high efficacy beliefs use more self-regulatory strategies, expend greater effort, and persist longer in the face of difficulties than students who doubt their capabilities (Pintrich & DeGroot, 1990; Pintrich, Roeser, & DeGroot; 1994; Wolters & Pintrich, 1998; Zimmerman & Martinez-Pons, 1990). In a cross-group developmental study, Zimmerman and Martinez-Pons (1990) found that 5th-, 8th-, and 11th-grade, regular and gifted school students’ perceptions of verbal and mathematical efficacy were significantly positively correlated with their reported use of self-regulatory strategies (e.g., self-evaluating, keeping records, and monitoring). Similarly, Pintrich and his colleagues have examined relationships among several self-regulated learning components with middle grade students across different subject areas including mathematics, science, English, and social studies.
Social cognitive theory suggests that self-efficacy beliefs are constructed from four sources of information: enactive mastery experiences, vicarious (observational) experiences, verbal persuasion, and psychological and affective states (Bandura, 1997; Pintrich & Schunk, 2002; Schunk, 1989). Students’ own performances are the most influential sources of efficacy. In general, successes raise efficacy and failures lower it. Students also appraise their capabilities in relation to the attainments of others. Observing similar peers achieving a goal makes students believe that they are capable of accomplishing the task as well. Students also derive efficacy information by others’ persuasions about their ability to perform a task. However, positive persuasory feedback is not likely to support self-efficacy if students’ subsequent performances are not successful. The last source of efficacy includes physiological factors such as heart rate and sweating. As an example, students may interpret bodily symptoms signaling anxiety as they lack necessary skills.

These four sources do not influence self-efficacy automatically because information acquired from each source is appraised cognitively (Bandura, 1986, 1997). Students weigh and combine the contributions of several factors such as perceptions of their ability, task difficulty, amount of effort expended, amount and type of external...
assistance received from others, perceived similarity to models, and persuader credibility (Bandura, 1997; Schunk, 1984a). Therefore, students’ self-efficacy is not merely a reflection of their cognitive skills. Students with the same level of cognitive skill development may differ in their intellectual performances depending on the strength of their perceived efficacy.

Taking into account these four sources, researchers suggest several classroom features that positively impact students’ efficacy beliefs (Gaskill & Woolfolk Hoy, 2002; Linnenbrink & Pintrich, 2003; Pajares, 2002; Pintrich & Schunk, 2002; Schunk, 1985, 1998; Woolfolk Hoy, 2004). Because mastery experiences are critical in developing a sense of efficacy, classroom practices should provide opportunities for students to experience success. One way to accomplish this is to provide students with meaningful tasks and activities that are challenging but can be mastered with effort. Tasks that are too easy do not entail the sense of accomplishment, while tasks far beyond students’ skill level frustrate them and result in low self-efficacy.

Teachers also need to set clear, specific, and proximal goals for students in the class (Linnenbrink & Pintrich, 2003; Pintrich & Schunk, 2002). These goals make tasks more manageable for students and help them to observe their progress, which conveys more reliable information about their abilities (Schunk, 1985, 1991). In an earlier study, Bandura and Schunk (1981) found that, during a subtraction skill-development program, providing students with a proximal goal of completing one set of training packets in each session increased students’ self-efficacy beliefs. However, providing students with distant goals such as completing the entire training packet by the end of the last session or asking them to do their best resulted in no benefit compared to the proximal goal condition.
Incorporating effective modeling practices into classroom instruction is another way to promote students’ development of positive perceptions of self-efficacy (Gaskill & Woolfolk Hoy, 2002; Pajares, 2002; Schunk, 1984a, 1985, 1998). When students observe teachers thinking and performing cognitive skills, this could convey to them that they possess the capability to succeed if they perform in a similar way and enhance their self-efficacy. In particular, coping models that initially challenge but gradually improve their performance enables students to observe typical deficiencies and recoveries from these deficiencies (Schunk, 1985, 1998). These experiences convey to students that making mistakes is inevitable but one can overcome difficulties with effort and positive thoughts, thus increasing their efficacy. Researchers also suggest that models that are of similar or slightly higher competence provide the best information for assessing capabilities, particularly when students have few cues to assess efficacy (Schunk, 1989, 1991; Schunk, Hanson, & Cox, 1987).

To develop self-efficacy, students also need evidence that they are mastering knowledge and skills (Schunk, 1985). Acquiring this information by themselves would be difficult, especially when working on complex tasks. Providing frequent, immediate, and accurate feedback helps students develop adaptive efficacy beliefs (Gaskill & Woolfolk Hoy, 2002; Linnenbrink & Pintrich, 2003; Pajares, 2002; Pintrich & Schunk, 2002; Schunk, 1985, 1989). Feedback that students are making progress informs them that they are mastering the knowledge and skills and enhances self-efficacy. On the other hand, teacher feedback pointing out areas that need improvement also enhances efficacy beliefs when teachers provide scaffolded support and opportunities to improve the skill.
The attribution of students’ successes and failures to factors such as ability, effort, or strategy use is also an important source of efficacy. Research has shown that ability feedback for prior success enhances self-efficacy better than effort feedback for early successes (Schunk, 1983, 1984b). However, effort feedback for early successes is more credible when students lack skills and need to work hard. In these cases, researchers suggest that switching to ability feedback as students develop skills better enhances self-efficacy (Schunk, 1989, 1991). In a classroom setting, providing sincere praise that focuses students to pay attention to his or her progress rather than relying on social comparison and maintaining a classroom environment that creates positive physiological states are also important in developing adaptive sense of efficacy in the classroom.

Strategy Use

Learning strategies, in a broader sense, refer to cognitive processes and behaviors that students employ to achieve academic tasks (Garcia & Pintrich, 1994; Weinstein & Mayer, 1986). Zimmerman and Martinez-Pons (1986) describe SRL strategies as “actions directed at acquiring information or skill that involve agency, purpose (goals), and instrumentality self-perceptions by a learner” (p.615). It is important to distinguish SRL processes such as self-control and self-monitoring and SRL strategies that are designed to promote these processes (Zimmerman, 1990). All learners are assumed to use self-regulatory processes to some degree; however, self-regulated learners are the ones who are aware of the strategies that influence their learning and willing to employ these strategies to achieve academic goals.

Even though there are a number of different SRL strategies (e.g., cognitive and motivational strategies), in this study, focus is given to some cognitive and metacognitive
strategies as well as effort regulation and help seeking strategies that are most pertinent to student SRL and achievement. Cognitive strategies include rehearsal, elaboration, and organization strategies that impact learners’ processing of information (Pape & Wang, 2003; Pintrich, 1989; Pintrich & DeGroot, 1990; Pintrich et al., 1993; Weinstein & Mayer, 1986; Zimmerman & Martinez-Pons, 1986, 1988, 1990). Basic rehearsal strategies involve reciting or naming the information to be learned. Copying, highlighting, or underlining the material in a passive and unreflective way can also be considered rehearsal strategies. These strategies are assumed to help students attend to, select, and acquire information, but they do not seem to be effective in helping students to construct relations among information or integrate the information with prior knowledge (Pintrich et al., 1993; Weinstein & Mayer, 1986).

Elaborative and organization strategies are more effective in accomplishing tasks that require comprehension of material at a deeper and more conceptual level (Garcia & Pintrich, 1994; Weinstein & Mayer, 1986). Elaborative strategies involve paraphrasing, summarizing, creating analogies, taking notes by reorganizing and connecting ideas, explaining the ideas to someone else, and asking and answering questions. These strategies help students integrate and connect new information with prior knowledge. Similarly, organization strategies help students to select appropriate information and build internal connections among them. Examples of organization strategies include clustering, selecting main ideas from text, and outlining.

Besides cognitive strategies, researchers have identified metacognitive strategies that may have influence on students’ learning and performance (Garcia & Pintrich, 1994; Pape & Wang, 2003; Pintrich, 1989; Pintrich & DeGroot, 1990; Pintrich et al., 1993;
Zimmerman & Martinez-Pons, 1986, 1988, 1990). Most models of metacognitive control assume three general types of metacognitive strategies: planning, monitoring, and regulating. Planning strategies such as analyzing the task and setting goals help students to activate their prior knowledge related to the task. In this way, students can organize and comprehend the material easier. Monitoring strategies assist students to keep their attention on the task, understand the material, and integrate it with prior knowledge. Examples of monitoring strategies include tracking of attention while working on a task and self-testing by asking questions to check for comprehension.

Regulating strategies are closely related to monitoring strategies because they refer to the adjustments of cognitive activities based on the information acquired through monitoring strategies. For example, students may realize that they have difficulty in understanding the task as they ask questions to monitor their comprehension, and hence, they go back and review the material. Regulating strategies improve students’ learning by assisting them to check and correct their learning activities. Students also use various strategies to control their effort and attention and to get support from others (Garcia & Pintrich, 1994; Pape & Wang, 2003; Pintrich, 1989; Pintrich & DeGroot, 1990; Pintrich et al., 1993; Zimmerman & Martínez-Pons, 1986, 1988, 1990). Effort regulation refers to students’ commitments for completing the task even when the task is difficult or uninteresting. Help seeking strategies, on the other hand, involve managing time and sources (e.g., people) for assistance.

Throughout the cyclical phases of SRL (i.e., forethought, performance-control, and self-reflection) strategic learners analyze the tasks, interpret task requirements, and organize their thoughts and actions to accomplish the tasks. As they work on the tasks,
they monitor their progress towards their goals and adjust their learning activities as necessary by using several strategies. There are a large number of studies supporting that strategy use is related to and predictive of academic performance (Pape & Wang, 2003; Pintrich, 1989; Pintrich & DeGroot, 1990; Zimmerman & Martinez-Pons, 1986, 1988, 1990). For instance, Pintrich and DeGroot (1990) found that students’ reported use of SRL strategies (e.g., comprehension monitoring, goal setting, planning, effort management, and persistence) was the best predictor of their actual performance among other variables such as self-efficacy, intrinsic value, and test anxiety in seventh grade science and English classes.

Similarly, in a study with high school students, Zimmerman and Martinez-Pons (1986) have examined the strategies that high- and low-achieving students use through structured interviews. They identified 14 strategy categories (e.g., self-evaluation, goal-setting and planning, seeking information, environmental structuring) related to six different learning contexts based on students’ responses. By using these categories, they examined the types of strategies students used (strategy use), the number of times each category of strategy was mentioned (strategy frequency), and the frequency that students reported using each strategy category (strategy consistency). Discriminant function analyses revealed that high- and low-achievement groups significantly differed in terms of all three variables, while strategy consistency was found as the most reliable predictor of group assignment. The high-achievement group reported significantly greater use of all strategy categories except self-evaluation. The two achievement groups were differentiated most by their reported use of seeking information, keeping records and monitoring, and organizing and transforming strategies. Seeking teacher, peer, and adult
assistance were found as the next three strongest strategy categories predicting group assignment.

In a more recent study with middle grade students, Pape and Wang (2003) explored sixth and seventh grade students’ self-reported strategy use and the relationship between strategy use, mathematical problem-solving behaviors, and their success in problem solving by using the strategy categories developed by Zimmerman and Martinez-Pons (1986). Students were asked to report the strategies they used to accomplish tasks in reading and mathematical-problem solving as well as the frequency of their use of each strategy and their confidence in using each strategy. Mathematical problem-solving behaviors and success in problem solving were assessed through a think-aloud stimulus. The results showed that high- and low-achieving students did not differ in terms of the number of strategies they used, their confidence in using these strategies, and the frequency of strategy use. High-achieving students, however, reported the use of more different strategies than low achievers. Even though problem-solving success was not related to the use of strategies, the frequency of strategy use, and confidence in using strategies, students’ problem-solving behavior was related to their strategy use. Students, who transformed the information in the problem and used problem context to understand and solve the problem, were more likely to report using several different strategies, particularly self-evaluation, organizing and transforming, and goal setting and monitoring strategies.

Social cognitive researchers contend that there is a reciprocal relationship between self-efficacy and strategy use (Bandura, 1986; Zimmerman, 2000). Efficient strategy use, as a predictor of achievement, leads to successful mastery experiences,
which enhance efficacy beliefs (Gaskill & Woolfolk Hoy, 2002). While there are quite a few studies supporting positive relations between strategy use and self-efficacy (e.g., Pintrich & DeGroot, 1990; Middleton & Midgley, 1997; Zimmerman & Martinez-Pons, 1990; Wolters & Pintrich, 1998), only a few studies have examined how strategy use (e.g., goal setting, self-evaluation) affects students’ efficacy beliefs (e.g., Bandura & Schunk, 1981; Schunk, 1996).

Teaching students to be strategic learners is a difficult task because it requires more than the acquisition of strategies. While most of the early strategy instruction programs emphasize the acquisition of strategies through didactic teaching methods, recent approaches that are based on constructivist and sociocultural theories of learning provide more sophisticated and effective intervention models (Paris & Paris, 2001). These models share some assumptions that should be taken into consideration when designing and implementing strategy instruction in classroom setting. Butler (1998c) suggests that strategic learners engage in “a recursive cycle of cognitive activities including analyzing tasks; selecting, adapting, or even inventing strategies; monitoring performance; and shifting approaches as required” (p.376). Therefore, effective strategic learning instruction should promote all of these cognitive activities. Helping students to analyze the task or assisting them in reflecting on their performance are as important as helping them implement the strategies. Strategy instructions that are embedded in the context of meaningful tasks are more likely to address this problem because they can approach the tasks holistically (e.g., Butler, 1998a, b; Graham & Harris, 1989; Palinscar & Brown, 1984; Pape et al., 2003).
Because students interpret tasks based on their existing knowledge and beliefs, they may adopt unproductive goals and employ inappropriate strategies if their existing knowledge is limited (Butler & Winne, 1995; Wertsch, 1979). For this reason, establishing a shared understanding of task demands and providing students with opportunities to learn how to analyze and interpret tasks independently should also be an important feature of a strategy instruction. Researchers also argue that strategy instruction should be individualized because students may have different struggles (Butler, 1998c, Pape et al., 2003; Pressley et al., 1992). Some students may have difficulty analyzing the tasks while others struggle with monitoring their performance effectively. Furthermore, instructions that view strategies as static, predefined sets of steps restrict the flexible adaptation of strategies to diverse tasks and situations (Butler, 1998c). The dynamic nature of strategy implementation is likely to be achieved when students engage in interactive dialogues about strategies across various contexts (e.g., Butler, 1998a, b; Palincsar & Brown, 1984; Pape et al., 2003).

Effective strategy instruction should also encourage the active engagement of student participation. Butler (1998c) argues that it should be the students, not the teacher, who analyze the task, reflect on the cognitive processes, determine the strategies that work best for different task situations, and abstract the generalized descriptions of the steps that constitute the strategy. It is this active involvement that allows students to value, use, and transfer self-regulatory knowledge and strategies across contexts. Yet, the importance of teachers’ roles as models should not be underestimated. There are several effective instructions that use modeling successfully (e.g., Palincsar & Brown, 1984; Pape et al., 2003; Schoenfeld, 1985, 1987, 1992). Students also need to value strategies in
order to use them. Perceived strategy value can be enhanced through teacher feedback showing how using strategies improves performance (Pressley et al., 1992).

Summary

In this section, two components of SRL, namely self-efficacy and strategy use, were briefly described and the ways they influence student SRL were discussed. Research has suggested that students who believe in their capabilities set challenging goals for themselves, use more self-regulatory strategies, expend greater effort, and persist longer in the face of difficulties than students who doubt their capabilities. The effective use of SRL strategies also promotes SRL processes and hence impacts student learning and academic performance. This section also included literature that provides conceptual ideas about how classroom context could enhance students’ development of self-efficacy and strategic learning. The next section is devoted to the review of literature that examined aspects of classroom context on students’ development of self-efficacy and strategy use.

Classroom Context and SRL Research

Even though literature has highlighted the importance of classroom context in shaping students’ cognition and motivation, to date, only a few studies have focused on the specific ways that classroom context facilitates or constrains students’ self-efficacy and strategy use. Perry (1998) explored how several features of classroom context affected young children’s perceptions of control and support, their beliefs, values, and expectations, as well as their strategy use in writing and portfolio activities through observations, interviews, and questionnaires. She observed five second-grade and third-grade classrooms in terms of the opportunities for choice and control over challenge,
authority structure, teacher and peer support, and evaluation practices. Based on classroom observations and teacher questionnaires, she identified high- and low-SRL classrooms. In high-SRL classrooms, teachers provided students opportunities to choose what to work on and to modify tasks to control challenge. They also provided instrumental support and created opportunities for self, peer, and teacher evaluation.

Observations and interviews with students revealed evidence that students in these classrooms were more likely to engage in self-regulatory behaviors such as planning, monitoring, problem solving, and evaluating during complex reading and writing tasks. These students also demonstrated attitudes and approaches that focused on learning and personal growth. In contrast, in low-SRL classrooms, students were engaged in closed, simple tasks that were not authentic. Teacher support focused on procedural aspects of tasks rather than constructing meaning and strategic learning. In these classrooms, students’ choices were limited and they had less opportunity for controlling challenge and self-evaluation. Students in these classrooms were more focused on teacher evaluations and they were more likely to use ineffective strategies. Particularly, low-achieving students were observed avoiding challenging tasks and communicating perceptions of low ability and low efficacy for learning.

The nature and degree of teacher support students need to be self-regulated learners were also examined by Meyer and Turner (2002). These researchers described teachers’ scaffolding in three ways: (a) helping students build competence through increased understandings of tasks and concepts, (b) assisting them in developing autonomy by providing opportunities for strategy use and transferring responsibility, and (c) creating a positive classroom climate by supporting students’ intrinsic motivation,
emotional well-being, and peer collaboration. The study explored instructional scaffolding through discourse analysis in nine sixth-grade mathematics classrooms. Only one teacher’s discourse pattern showed consistency in instructional scaffolding. This teacher facilitated students’ building competence and developing understandings and provided opportunities for autonomy while supporting shared responsibility as they developed self-regulatory processes. In this classroom, students’ overall ratings of strategy use were the highest compared to the students in other participating classes.

Both Perry’s and Meyer and Turner’s studies found that teacher support for student autonomy is critical in the development of self-regulation. In a recent study, Stefanou et al. (2004) identified three forms of autonomy support that may produce differences in student engagement and self-regulation. Organizational autonomy support refers to providing students opportunities to control over classroom management issues, such as choosing group members or evaluation procedures. Procedural autonomy support encourages student ownership of class procedures such as choosing the materials for a class project. Cognitive autonomy support, on the other hand, encourages student ownership of learning processes by providing them with several opportunities such as generating their own ideas, discussing multiple approaches, and evaluating their own and other’s ideas. Through naturalistic observations, the researchers examined teacher autonomy support in four fifth- and sixth-grade mathematics classrooms. As they expected, support for autonomy was carried out in different forms in these classrooms. Observations support the researchers’ contention that organizational and procedural autonomy may be necessary but not sufficient in promoting student engagement and
motivation. Cognitive autonomy support may provide greater involvement by empowering student independence in their learning processes.

*Instructional Models*

Researchers have also designed and implemented instruction to develop student self-regulation (e.g., Butler, 1998a, b; Palincsar & Brown, 1984; Pape et al., 2003; Perry & VandeKamp, 2000; Perry et al., 2002). In the following sections, the models of instructional practices that aimed to support student SRL in several subject matters and in mathematics are discussed respectively.

*Reciprocal teaching.* The practice of “reciprocal teaching” outlined by Palincsar and Brown (1984) was designed to enhance reading and comprehension monitoring of seventh grade students with poor comprehension skills. Students were introduced four strategies to enhance their comprehension skills: summarizing (self-review), questioning, clarifying, and predicting through meaningful activities. The basic idea in reciprocal teaching was that the teacher and students alternatively took responsibility in leading the discussion of a reading passage. Whoever is leading the discussion formulates a question based on the text, constructs a summary of the content, discusses difficulties and provides clarification when necessary, and makes a prediction about future content.

During reciprocal teaching, the instructor’s role was initially to model the effective use of strategies when it was her turn to lead the discussion. This procedure enabled the teacher to model her behavior in a relatively natural way so that students could observe the expert reader’s strategies. As students became more experienced, the teacher demanded them to perform slightly above the level they achieved previously. Students’ active participation allowed the teacher to monitor their progress and provide
the appropriate feedback and support. Reciprocal teaching was found effective in one-to-one, student dyads, and whole-classroom instructions in terms of increasing students’ reading comprehension through experimental studies.

Strategic content learning. Inspired by the scaffolded instruction supported by reciprocal teaching, Butler (1998a, b) developed strategic content learning (SCL) approach. Even though two models share common components, SCL differs from reciprocal teaching in several ways (Butler, 1998c). First, rather than teaching specific strategies, SCL focuses on supporting students’ self-regulated engagement with tasks and assists them in constructing knowledge and beliefs that enhance self-regulation. Second, in SCL, the instructor supports students’ decision-making as they make choices about regulating their learning. Scaffolding in reciprocal teaching, however, was more aligned with the idea of adult’s control of children’s participation and task engagement. Third, in SCL the emphasis is given to students’ developing individualized strategies based on their prior understandings. Although students were active agents in reciprocal teaching approach, the strategies they were expected to develop were defined in advance. In SCL, students are also given more responsibility for evaluating and selecting strategies on the basis of their understanding of task demands. Finally, even though both models give emphasis on interactive dialogues in stimulating students to construct knowledge and strategies, students are specifically encouraged to articulate their own strategies in SCL.

In this model, instructional practices are defined in terms of students’ reflective engagement in cycles of SRL (i.e., task analysis, strategy implementation, self-monitoring). SCL instruction begins with students’ analysis of the task, defining criteria for successful performance, and setting appropriate task-specific goals with the help of
the instructor. During this process, particular emphasis is given to construct a shared framework for understanding. Once students define task goals, they are supported to determine strategies to achieve their goals. During this process, students implement their existing strategies and evaluate their effectiveness through guidance. Instructors also support students to learn how to monitor their progress toward their goals, generate internal feedback about their success and modify their approaches to task when necessary. Students are also supported to construct personalized strategies in order to accomplish their goals.

Butler and her colleagues (Butler, 1998a, 2002; Butler et al., 2000, 2001) examined the effectiveness of SCL with postsecondary students with learning disabilities across three instructional settings: one-on-one, small-group, and whole-class settings. Qualitative and quantitative analyses of pretest and posttest assessments and the qualitative tracing of students’ progress in case studies provided evidence that students’ task performance, metacognitive knowledge about task, and key self-regulatory strategies improved. Students also developed positive perceptions of self-efficacy. Results also suggested that SCL enabled students to be actively involved in developing their personalized strategies and to transfer these strategies across different contexts and tasks.

**Instructional practices in mathematics.** This section is devoted to the discussion of instructional practices aimed to enhance students’ SRL in mathematics. Similar to reciprocal teaching approach, Schoenfeld’s (1985, 1987) method for teaching mathematical problem solving to college students involved modeling, coaching, and scaffolding in a variety of activities. He designed these activities to enhance students’ metacognitive awareness and use of mathematical problem-solving strategies. Modeling
is used to demonstrate students how an expert chooses and applies heuristic methods in problem solving. Students are also given opportunities to practice these methods under the teacher’s guidance. During this process, the teacher encourages students to use certain heuristic methods, orchestrates their decision-making, and provides scaffolding. As students gain more experiences these forms of support and external regulation gradually decreases and students take more responsibility and control over their problem-solving processes.

Schoenfeld (1985, 1987) designed four classroom techniques based on these key features of instruction. First, he used showed students video-tapes of other students working on problems and then asked them to discuss the model’s problem-solving behaviors. The purpose of this technique was to make students aware of their own thinking processes. He also modeled problem-solving behaviors including recoveries from false starts. Schoenfeld used whole class discussions to help students reflect on their problem-solving activities. During these discussions, he orchestrated students’ suggestions and guided them to reflect on and control their thinking processes. Even though all students were expected to generate ideas and keep track of others’ suggestions, each student took responsibility to complete one aspect of the task. As they gained more experience, they took more control over the problem solving activities. Schoenfeld used small group activities to create a context in which students formulated and defended their own points of view, listened to others’ ideas, evaluated these ideas, and finally took part in group decisions. These self-regulatory skills can be difficult to develop when students work alone. During small group sessions, he asked three questions: “What (exactly) are you doing? Why are you doing it? How does it help you?” (Schoenfeld, 1987, p.206)
These questions encouraged students to reflect on their actions to articulate their reasoning.

In a series of studies, Schoenfeld (1985, 1987) assessed the effectiveness of these instructional practices. He videotaped students working in pairs before and after the instructional practices. Students’ problem-solving behaviors were analyzed in terms of six problem-solving stages (read, analyze, explore, plan, implement, and verify), time spent on each stage, and the sequence of the stages. Students showed improvements in their problem-solving behaviors after the instruction. While 60% of the solution processes lacked any sign of self-regulation before the instruction, only 20% of solution processes were of that type after the instruction. Students were able to generate, employ, and transfer a variety of problem-solving approaches. They also improved self-regulatory skills such as planning and organization.

Verschaffel et al. (1999) designed an intervention based on the similar instructional techniques in order to improve fifth grade students’ self-regulatory strategy use for solving mathematical application problems and help them develop positive beliefs and attitudes with regard to mathematics and mathematical problem-solving. The main features of this instructional model are (1) using complex, realistic and challenging problems, (2) using extensive and systematic instructional techniques (e.g., modeling, scaffolding, coaching, articulation, reflection, and exploration), and (3) establishing social and sociomathematical norms supporting self-regulation. Classroom discussions were particularly focused on constructing norms about what constitutes as a good mathematical problem, a good response, or a good solution procedure. Students were
encouraged to articulate and reflect on their personal beliefs, problem-solving strategies, and feelings with respect to mathematical application problems.

The effectiveness of this learning environment was assessed with an experimental design. The experimental group received 20 lessons over about three months. Three parallel instruments were administered before, immediately after, and three months after the intervention. Standardized achievement testing was used to assess students’ general mathematical knowledge and skills. Word problems assessed students’ strategy use to solve nonroutine problems, and a questionnaire assessed students’ beliefs about and attitudes toward mathematical problem solving. In order to get better insight into the qualitative changes in students’ problem solving processes, pairs of students from each experimental group were also asked to solve problems in a structured interview and their problem solving processes were analyzed.

The experimental group outperformed the control group on the nonroutine word problem test and on the standardized achievement test. Findings also supported a positive effect of the instruction on retention tests administered three months after the instruction. No significant improvement was found, however, regarding students’ beliefs about and attitudes toward mathematical problem solving. Interviews with students showed substantial improvement in the intensity and quality of students’ use of some but not all self-regulatory strategies that were addressed during the instruction. Even though the instruction influenced students’ self-regulation and performance positively, its effect was not as strong as what the researchers expected. Shortcomings in the implementation of the instructional practices (e.g., time constrains, inefficient group work) expressed by the teachers may partly explain these unexpected findings. Such difficulties can be lessened
with the teachers’ active participation in the design of the learning environment. The next study is a good illustration of a teacher and researcher collaboration.

Pape et al. (2003) examined the design and implementation of a mathematics instruction aimed to develop students’ SRL. In this teaching experiment, the teacher and the researcher worked collaboratively through cyclical patterns of planning, implementing, analyzing the outcomes, and restructuring the instruction. Central to this effort was embedding explicit strategy instruction in sociohistorical models of mathematics learning. The instruction was based on several factors including: “(1) the nature of mathematical tasks; (2) the inquiry microculture built on significant classroom discourse and co-construction of knowledge; (3) the classroom norms for co-participation; (4) the cyclical nature of SRL behaviors and attributions; and (5) building positive self-schemas toward strategic behavior” (p.184).

Two seventh grade mathematics classes participated in the study. Several data sources were used to analyze the design and implementation of the instruction including field notes and videotapes of classroom practices, the artifacts of instructional planning sessions, and students’ written reflections on their strategy use and attributions. Several features of the instruction were found to be critical in the development of students’ mathematical thinking and self-regulation. These features are using multiple representations and rich mathematical tasks; creating classroom discourse that supports students’ thinking through modeling experiences and scaffolding; structuring classroom discussions that explicitly and deliberately focused on strategy use; providing students with tools to observe and monitor their learning and to make adaptive attributions for success and failures; and providing differentiated support and explicitness for varying
needs of individual students. The results also provided support for the development of students’ communicating mathematical understanding, justifying their reasoning, and articulating their strategies.

Summary

Research on classroom context has shown that students develop adaptive forms of self-efficacy and strategy use when they have opportunities for making choices about their learning, have control over challenges, participate in tasks and activities, and interact and collaborate with other students. Teachers that recognize effort and personal improvement; provide instrumental or scaffolded support through several teaching methods such as modeling and coaching; encourage student autonomy; and provide opportunities for self- and other-evaluation also enhance students’ efficacy beliefs and strategy use. While it is important to identify classroom features that can influence student SRL, the reciprocal interactions between students and classroom context may be more informative in understanding students’ development of SRL. By taking into account the literature reviewed in this chapter, the current study aims to describe individual students’ classroom practices in terms of interactions with the teacher and classroom experiences (e.g., tasks and other students) and examine how they are related to the development of self-efficacy and strategic learning.
CHAPTER 3

METHODOLOGY

Restatement of the Purpose and Research Questions

The current study explores the ways in which classroom contexts support students’ SRL in mathematics by incorporating concepts and principles drawn from sociocultural and social cognitive perspectives. The major argument is that students develop necessary knowledge, skills, and beliefs through their participation in classroom practices. Hence, the main purpose of this case study was to describe the nature of the classroom practices within one sixth-grade mathematics classroom and to examine how these classroom practices are related to students’ self-efficacy and strategic learning. The central research question that guided the study was:

In what ways do the classroom practices in this sixth-grade mathematics classroom support individual student’s self-efficacy and strategic learning?

To answer the main research question, the following sub-questions were addressed:

(1) What is the nature of the classroom practices (i.e., tasks and activities; instructional and motivational structures) that hold potential for impacting student self-efficacy and strategic learning in this classroom?
(2) What are the focal students’ self-efficacy beliefs in relation to mathematics over the course of the study?

(3) What self-regulatory strategies do focal students choose to employ as they engage in mathematical tasks over the course of the study?

(4) What is the nature of focal students’ participation in relation to the classroom practices? Specifically, how do focal students’ interactions with the teacher and classroom experiences (e.g., tasks, other students) provide the opportunity for self-efficacy and strategy development within this sixth-grade mathematics classroom?

(5) In what ways do the focal students’ classroom practices interact with their self-efficacy and strategic behavior?

Research Perspective

The nature of the research questions inherently requires qualitative inquiry methods. In a broader sense, qualitative researchers “study things in their natural settings, attempting to make sense of, or to interpret, phenomena in terms of the meanings people bring to them” (Denzin & Lincoln, 2000, p.3). For this purpose, the researchers should take the position of the participants and try to see what meanings they ascribe to their actions, why they act the way they do, and what purposes they think are served by their actions. Such a perspective inherently denies an objective reality independent from the observer. Because multiple realities are assumed, the researcher attempts to produce descriptive analyses that focus on deep and interpretive understandings of the phenomenon under investigation. Consistent with this perspective, the current study aims
to provide thick and rich descriptive analyses of students’ classroom practices and of the ways these practices support or constrain their self-efficacy and strategic learning.

Considering the purpose and research questions, case study design was employed. Yin (1994) posits that “case studies are preferred strategies when ‘how’ or ‘why’ questions are being posed, when the investigator has little control over events, and when the focus is on a contemporary phenomenon within some real-life context” (p.1). Case studies draw attention to the question of what specifically can be learned from a single case (Stake, 2000) and aim to construct an in-depth description and interpretation of a particular situation (Merriam, 1998). Researchers, however, can also jointly study a number of cases in order to explore a phenomenon, population, or general condition (Stake, 2000). Hence, case study research may involve single as well as multiple-case studies depending on the nature of research questions they address.

Stake (2000) outlines three types of case studies in terms of their purposes: intrinsic, instrumental, and collective. An intrinsic case study “is undertaken because, first and last, the researcher wants better understanding of this particular case. Here, it is not undertaken primarily because the case represents other cases or because it illustrates a particular trait or problem.” In an instrumental case study, “a particular case is examined mainly to provide insight into an issue or to redraw a generalization. The case is of secondary interest, it plays a supportive role, and it facilitates our understanding of something else” (p.437). A collective case study is an instrumental case study extended to several cases. The individual cases are chosen because they are thought to be instrumentally useful in understanding or theorizing about a larger collection of cases.
The current study is an example of instrumental case study design because one sixth-grade mathematics classroom was examined to better understand the ways classroom practices support or constrain students’ development of SRL. The study also employs collective case study design because within this classroom context the focus was also given to understand three students’ classroom practices and development of self-regulatory competence. These students were selected purposively by using maximum variation sampling strategy (Patton, 2002) to incorporate a range of SRL competency and classroom practices. The main premise was that understanding the dynamic interactions between these three students’ classroom practices and their self-regulation may lead to greater understandings of the ways classroom contexts support or constrain students’ development of SRL.

Two levels of analysis were used in this “embedded case study” (Yin, 1994, p.41). Classroom-level analyses were conducted to investigate the nature of tasks and activities as well as the nature of the teacher’s instructional and motivational practices. Focal students constituted the subunits of analysis. Analyses at this level focused on understanding the ways classroom practices were structured for individual students. Even though focal students’ participation in classroom practices and their self-regulation were the focus of this study, using multiple units of analysis led to exploration of the phenomenon being studied for individual students within a particular classroom context.

Participants and Context of the Study

The study was conducted in one sixth-grade mathematics classroom in a medium-sized Midwestern city in the United States. The school population consisted of predominantly White students (59%), with 27% African American, 10% Asian or Pacific
Island, and 4% Hispanic students. Approximately 32% of students in the school were eligible for free lunch and 9% of them were eligible for reduced lunch. Mrs. Thompson, the teacher of the classroom in which the study was conducted, had been teaching sixth-grade mathematics for 15 years. She had some knowledge and experience about self-regulated learning through a two-year professional development program (Pape, 2000; Pape & Costner, 2002) for middle school mathematics teachers. The program focused on mathematics instruction based on NCTM standards (2000) and self-regulated learning from a social cognitive perspective.

Mrs. Thompson taught three groups in two-period blocks everyday. Among these groups, this specific classroom was selected because of the feasibility of data collection procedures. Even though Mrs. Thompson had her students in two-period blocks everyday, one group of students came to her room during the third and fifth periods. These students went to another class during the fourth period and return to Mrs. Thompson’s class for the fifth period. This group was not selected for the study because it would not have been feasible to collect data during the non-consecutive periods. The other group of students, on the other hand, met with the teacher during the sixth and seventh periods, which resulted in time conflicts with the researcher’s agenda.

After the approval from the Behavioral and Social Sciences Institutional Review Board of the Ohio State University, students and their parents were informed about the study, and consent forms were delivered (see Appendix A). Out of 25 students enrolled in the classroom that was selected for the case study, 19 of them agreed to participate in this study. Only seven of the participating students were female. Participants’ age ranged
from 11 to 13 (M = 11.87, SD = .57). They reported their ethnicity as White (n=11), Asian American (n=2), African American (n=2), Hispanic (n=1), and other (n= 3).

Selection of focal students. Among the 19 participating students, three of them who represented the widest range of mathematics achievement and SRL competence were selected for in-depth analyses. In order to identify high-, average-, and low-achieving students, teacher ranking of the students based on their prior and current mathematics grades was examined. Students with different levels of SRL competency (i.e., self-efficacy and strategy use) were identified by examining their responses to a questionnaire, which was administered at the beginning of the study. Based on these two criteria, Alice, Kyle and Mike were selected as focal students.

Mrs. Thompson ranked Alice as the first, Kyle as the 10\textsuperscript{th}, and Mike as the 18\textsuperscript{th} student in terms of mathematics achievement. Based on teacher ranking, Alice, Kyle, and Mike were in the group of high-achieving, average, and low-achieving students, respectively. As the second criterion, mean scores and standard deviations for self-efficacy and strategy use were calculated for each student in the class. Descriptive statistics were employed to examine individual student’s scores in relation to the class average. The mean scores and standard deviations for the survey instrument administered in January and April are presented for focal students and the whole class in Appendix B.

The scores corresponding to the 25\textsuperscript{th}, 50\textsuperscript{th}, and 75\textsuperscript{th} percentiles for each scale were also examined in order to get a better understanding of students’ scores relative to each other. By definition, 25\textsuperscript{th} percentile, or first quartile, is the score that separates the lowest 25\% of the distribution from the rest. The second quartile, or 50\textsuperscript{th} percentile, is the score that has 50\% of the distribution below it. The third quartile, on the other hand, is the
score that divides top 25% of the distribution from the bottom three-fourths. The quartile scores for each scale administered in January and April are presented in Appendix B. Mike’s scores were above the third quartile on all scales. That is, he reported higher levels of strategy use and self-efficacy than most students in the class. Alice’s self-efficacy, effort regulation, and help-seeking strategy use scores were above the third quartile. Her metacognitive strategy use score was above the second quartile whereas cognitive strategy use score was below the first quartile. That is, she reported metacognitive strategies similar to most students, whereas most of the students in the class reported higher levels of cognitive strategy use than Alice. On the other hand, Kyle’s self-efficacy score was below the first quartile. His metacognitive and effort regulation strategies scores were above the second quartile, help-seeking strategies score was below the second quartile, and cognitive strategies score was above the first quartile. Comparison of focal students’ self-efficacy and strategic efforts are also presented in Appendix H and Appendix I.

In summary, the examination of survey data revealed that Mike, the low-achieving student, reported higher levels of self-efficacy and strategy use than most of the students in the class. Alice, the high-achieving student, believes in her capabilities in mathematics while she reported relatively lower levels of cognitive and metacognitive strategy use compared to most students in the class. On the other hand, Kyle, the average achieving student, was similar to most of his classmates in terms of his reported strategy use; whereas his self-efficacy was lower than most students in the class. Throughout the discussion, the terms, such as low levels of self-efficacy or high levels of strategy use are
used to indicate the relative position of the student within the distribution of self-efficacy and strategy use scores.

Gaining Entry and the Researcher’s Role

The study was conducted from December to May during the 2004-2005 academic year. The researcher visited the classroom three days a week during the first two months in order to establish rapport with students before data collection began. She introduced herself as a researcher interested in the ways students learn and study mathematics. During this period of time, the researcher positioned herself at one corner of the classroom and took field notes during the whole-class instruction. She also participated in class activities with students as much as possible. She circled around the tables during the group activities and assisted the students upon their request. These activities allowed her to interact with the students at a comfortably familiar level and to get to know the students. When the actual data collection started in January, students seemed to be more accustomed to the researcher’s presence in their classroom. For the next three months the researcher visited the classroom every day in order to collect data. She usually positioned herself to observe and interact with the focal students during group activities. Even though her focus was mainly on these students, she continued interacting with all participating students. Furthermore, in addition to the focal students, the researcher interviewed five other students in the class. Hence, neither the teacher nor the students knew who the focal students were which might have decreased the impact of being the focus of the study.
Data Sources and Collection Procedure

A number of different kinds of data were collected by using several data
collection techniques in order to understand the nature of the classroom practices, the
focal students’ self-efficacy and strategic learning over the course of the study, and the
nature of their participation in classroom practices. Table 3.1 presents the time schedule
for data collection and Table 3.2 presents the summary of data sources and collection
procedures.

<table>
<thead>
<tr>
<th>Date</th>
<th>Data Collection Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>December 2004</td>
<td>Pilot study</td>
</tr>
<tr>
<td>January 2005</td>
<td>Administration of the survey instrument</td>
</tr>
<tr>
<td>January 2005-February 2005</td>
<td>Conducted interviews with the focal students</td>
</tr>
<tr>
<td>January 2005- March 2005</td>
<td>Conducted videotaped observations</td>
</tr>
<tr>
<td></td>
<td>Journal writing</td>
</tr>
<tr>
<td>April 2005</td>
<td>Administration of the survey instrument</td>
</tr>
<tr>
<td>April 2005-May 2005</td>
<td>Conducted interviews with the focal students</td>
</tr>
</tbody>
</table>

Table 3.1: Time schedule for the data collection procedures
<table>
<thead>
<tr>
<th>Why</th>
<th>Observations</th>
<th>Interviews</th>
<th>Journal writing</th>
</tr>
</thead>
<tbody>
<tr>
<td>• To assess focal students’ self-regulation in relation to each</td>
<td>• To understand the nature of classroom practices</td>
<td>• To assess focal students’ self-efficacy and strategic behaviors in relation to particular</td>
<td>• To gain insight into the focal students’ self-efficacy and their perspective in relation to</td>
</tr>
<tr>
<td>other and other students in the class</td>
<td>• To understand the focal students’ participation in these classroom</td>
<td>mathematical tasks</td>
<td>classroom tasks and activities</td>
</tr>
<tr>
<td>• To select focal students</td>
<td>practices and their self-regulatory behaviors</td>
<td>• To understand focal students’ strategic behaviors as they learn and study mathematics</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>and the ways their strategic behaviors are related to their classroom practices</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• To assess focal students’ self-efficacy and strategic behavior (e.g., analyzing the task,</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>controlling, and monitor) within the context of the specific mathematical tasks</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Reflections on classroom activities</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Self-efficacy</td>
<td></td>
</tr>
<tr>
<td>Who</td>
<td>All participating students</td>
<td>Focal students</td>
<td>Focal students</td>
</tr>
<tr>
<td></td>
<td>• The teacher and all participating students, especially focal students</td>
<td></td>
<td></td>
</tr>
<tr>
<td>What</td>
<td>Classroom practices:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Self-efficacy</td>
<td>• tasks and activities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Strategy use (cognitive, metacognitive, effort regulation, and</td>
<td>• teacher instructional support</td>
<td></td>
<td></td>
</tr>
<tr>
<td>help-seeking)</td>
<td>• teacher motivational support</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3.2: Data sources and collection procedures
Table 3.2 continued

<table>
<thead>
<tr>
<th>Questionnaire</th>
<th>Observations</th>
<th>Interviews</th>
<th>Journal writing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>What</strong></td>
<td>Focal students’:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• interactions with the teacher</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• engagement with the tasks and activities</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• interactions with classmates</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• self-regulatory behaviors</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>When/How long</strong></td>
<td>At the beginning and at the end of the study</td>
<td>22 lessons from January to March</td>
<td>At the end of four lessons</td>
</tr>
<tr>
<td></td>
<td>Approximately 20 minutes</td>
<td>One class period (approximately 80 minutes)</td>
<td>Approximately 10 minutes</td>
</tr>
<tr>
<td><strong>How</strong></td>
<td>Survey instrument (items were adapted from literature: Pintrich &amp; DeGroot, 1990; Pintrich et al., 1993; Wolters, 1999, 2004)</td>
<td>Field notes (Categories for observations were adapted from literature: Patrick et al., 1997; Perry, 1998; Meyer &amp; Turner, 2002)</td>
<td>Journal prompts</td>
</tr>
<tr>
<td></td>
<td>• Video and audio recordings</td>
<td>• Problem-solving sessions with think-aloud protocol</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Semi-structured interview</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Video and audio recordings</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Mathematics Self-Efficacy and Strategy Questionnaire

A survey instrument was administered to all participating students in January and April of the school year. The Mathematics Self-Efficacy and Strategy Questionnaire included scales measuring self-efficacy and strategy use in relation to mathematics (see Appendix C). Students’ response to the survey administered at the beginning of the study was used as one of the criteria to select students for the case studies. Another purpose for using the instrument was to gain insight into the focal students’ self-efficacy and strategic learning in relation to each other and other participating students in the class. Students’ self-efficacy in mathematics was assessed by items adapted from the self-efficacy subscale of the Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich et al., 1993). These items were designed to assess judgments about one’s ability to successfully accomplish a task as well as one’s confidence in his/her skills to perform that task. Items were altered so that they better reflect the beliefs of middle grade students regarding mathematics class. In addition, the response scale was altered from a 7-point to a 5-point scale to facilitate middle grade students’ responses. One of the items from this scale was “I’m certain I can do even the most complex class work.”

Strategy use, which constituted cognitive (rehearsal, elaboration, and organization), metacognitive (planning, monitoring, and regulating), effort regulation, and help seeking strategies, was assessed with items derived from several scales (Pintrich & DeGroot, 1990; Pintrich et al., 1993; Wolters, 1999, 2004). The items were selected and/or adapted to better reflect the strategy use of middle grade students in mathematics, and the 7-point scale was modified to a 5-point scale for the middle school population of this study. For example, two of the items from this scale were “When doing work for
math, I try to relate what I’m learning to what I already know” and “When I come across difficulty doing a math problem, I go back and try to figure out where I went wrong.” Students were asked to indicate the extent to which they believed each item to be true of them on a 5-point Likert scale from 1 (not at all true) to 5 (very true).

The reliability of the scales was examined in a pilot study with students from two other classes (N = 35) of the same teacher. The reliability of the self-efficacy scale assessed by coefficient alpha was .86 (M = 4.05, SD = .72). The cognitive strategies scale (M = 3.58, SD = .75) and metacognitive strategies scale (M = 3.52, SD = .76) had also high reliability (α = .87). The reliability estimates for the effort regulation scale (M = 4.40, SD = .54) and help-seeking strategies scale (M = 3.47, SD = .62), however, were quite low (α = .54 and .30 respectively). Scores from these scales were used for descriptive statistics but their accuracy was held tentative.

**Videotaped Classroom Observations**

Videotaped classroom observations were the major data source in this study. The purpose of these observations was twofold: (1) to understand the nature of the classroom practices and (2) to understand the focal students’ participation within these classroom practices and explore their self-regulatory behaviors. Twenty-two observations were conducted over a period of three months from January to March. While individual observations focused on only one focal student, other focal students and class-level instructional practices were also observed as necessary. Each focal student was observed during three to four lessons as they engaged in class activities such as individual and small group work. Each observation lasted for one class period, approximately 80 minutes. During the observations, video- and audio-recording devices were used to
record the instruction. A video camera was set at one corner of the classroom before the students arrived and was kept running during the entire lesson. In order to capture the focal students’ responses to the classroom practices and their self-regulatory behaviors, audio recording devices were also placed in different locations of the classroom.

During each observation, the researcher positioned herself so as to observe the teacher and the focal students without interrupting the classroom activities. When the students worked individually or as a group, she positioned herself near the focal student and communicated with him or her to gain better insight into what he/she was doing and thinking. Because the researcher had been communicating with all students in the classroom during the group activities from the beginning of the study, her interaction with the focal students became a regular part of the classroom practices. In addition to video- and audio-recordings, the researcher took field notes. These field notes were especially useful when students worked individually or within a group because it was hard to capture their participation through video- and audio-recordings during these activities. Field notes included the name of the student being observed, observation date, running record of the description of activities, time related to each activity, and other information related to the observations (e.g., problems with recording devices, interruptions in the class).

A list of categories derived from literature (i.e., Patrick et al., 1997; Perry, 1998; Meyer & Turner, 2002) as well as those that emerged from the observations guided the researcher to determine what aspects of classroom practices to focus on. In general, three aspects of instructional practices were the focus of the observations: the nature of tasks and activities, the nature of teacher instructional support, and the nature of recognition
and evaluation structure in the classroom. Observations of the focal students mainly focused on their interactions with the teacher. In addition, their participation in whole-class discussions, engagement with the tasks, and interactions with other students during group activities were observed. Any indication of strategic behaviors was also recorded (e.g., help-seeking, effort regulation). The categories for observations of classroom context and the focal students are presented in Appendix D.

After observations were completed, data derived from video- and audio-recordings were combined with the field notes to create a data corpus of classroom observations. For this purpose, the researcher watched the videotapes and listened to the audiotapes of 22 classroom observations and completed the descriptions of classroom activities with verbatim transcriptions of the teacher’s and the students’ statements. After completing the descriptions and transcriptions, the researcher reviewed the data corpus to make sure that she provided good descriptions and included actions, interactions, and statements important for the study.

Focal Student Interviews

Interviews with the focal students were conducted in order to assess their self-efficacy and strategic behaviors in relation to particular mathematical tasks. These interviews also provided the opportunity to explore relationships between students’ strategic learning and their classroom practices. Two interviews were conducted with individual students at the beginning and at the end of the study. The first interview consisted of a problem-solving session in which students were asked to rate their confidence to successfully complete six mathematical problems by using a scale ranging
from 1 (not confident at all) to 5 (very confident). Then they were directed to solve the problems, which require open-ended responses through a think-aloud protocol.

The problems were similar to those observed during the classroom observations. They were typical word problems related to the mathematical content (e.g., fractions, proportions) that students had already been instructed. Parallel tasks were selected at the beginning and end of the study. These tasks were similar in terms of the mathematical content, the level of difficulty, and the task requirement. Appendix E presents the problems and think-aloud protocols.

During the problem-solving sessions, students were asked to report their thoughts and cognitive processes as they perform the tasks. After they completed each task, the researcher asked questions (see Appendix E) as necessary in order to obtain further information about the strategies students used to analyze the task as well as to control and monitor their problem solutions. The same procedure was followed for the interviews conducted at the end of the study. In addition, upon the completion of the problem-solving session, a semi-structured interview was conducted to explore further the students’ strategic behaviors and the ways their strategic behaviors were related to their classroom practices (see Appendix E). Each interview session took approximately 50 minutes and was video and audio recorded.

Journal Writing

In order to gain the students’ perspective on the classroom practices and assess their self-efficacy in relation to the classroom tasks and activities, they were asked to write journals at the end of four lessons. They were prompted to reflect on their participation in the class activities during (see Appendix F). In particular, they were
asked to describe the purpose of the activities, their perceptions of the teacher’s expectations, perceived difficulty of the activities, assessment of their performance, and self-efficacy regarding the tasks and activities. Each journal entry took approximately 10 minutes to write.

Data Analysis

Data analysis can be described as a process that “involves organizing what you have seen, heard, and read so that you can make sense of what you have learned” (Glesne & Peshkin, 1992, p.127). It is a “complex process that involves moving back and forth between concrete bits of data and abstract concepts, between inductive and deductive reasoning, between description and interpretation” (Meriam, 1998, p.178). In qualitative inquiry, data analysis is an ongoing, continuous engagement beginning with data collection (Glesne & Peshkin, 1992; Merriam, 1998). This allows the researcher to continuously reflect on the data and shape the study as it proceeds.

In this case study, data collected through various sources were analyzed to describe and explore (a) the nature of the classroom practices in terms of the opportunities they provided relative to the development of self-efficacy and strategic learning, (b) the focal students’ self-efficacy and strategic learning over the course of the study and their participation in classroom practices, and (c) the interplay between the focal students’ classroom practices and their self-regulation (i.e., self-efficacy and strategic learning) assessed throughout the study. Separate analyses were conducted to achieve these purposes.
Analyzing Classroom Observations

Data drawn from field notes and transcriptions of audio and video recordings of 22 lessons were analyzed to build a descriptive model of the classroom context in terms of the opportunities it holds for the development of self-efficacy and strategic learning. At this stage of analyzing the data, the unit of analysis was classroom practices that involved the teacher’s instruction as well as the students’ engagement with the classroom activities. Patton (2002) describes the first step of qualitative data analysis as developing a coding scheme and identifying categories or themes related to the phenomena being studied. Coding is an essential step that “forces the researcher to make judgments about the meanings of contiguous blocks of text” (Ryan & Bernard, 2000, p.780).

In this study, coding began with reading the data corpus of classroom observations (i.e., field notes integrated with audio and video recordings) several times, searching for the incidents and examples of instructional practices that might impact student self-efficacy and strategic learning based on the theory and the current research. Even though a priori coding categories drawn from the literature guided these initial analyses, developing the final coding scheme involved both inductive and deductive analysis. Patton (2002) points out that these existing categories or themes should not dominate the analysis; rather they should provide a direction to the researcher in organizing and illuminating the participants’ experiences. Taking these suggestions into account, a priori categories were used to confirm emerging themes rather than to identify them. For instance, even though teacher recognition was one of the a priori categories, the particular ways that this teacher recognized her students were identified through inductive analyses drawn from classroom observations.
An essential step in developing the final categories is to identify the similarities or characteristics of the data within a category. For this purpose, researchers need to look for “recurring regularities” (Patton, 2002, p.465) that reveal the patterns sorted into the categories. The next step is examining the categories for internal and external homogeneity. The former criterion refers to “the extent to which the data belong in a certain category hold together or ‘dovetail’ in a meaningful way” (p.465). The latter criterion, on the other hand, suggests that the differences distinguishing categories should be clear. Researchers should also review the category system for accuracy, meaningfulness, and completeness. These techniques guided the researcher in developing coding categories for analyzing the data drawn from observations. Appendix G presents the description of each category used to analyze classroom context.

In order to organize the presentation and discussion of the analyses relative to self-efficacy and strategic learning, two analytical tools were used. In particular, classroom practices were analyzed in terms of three out of four sources of self-efficacy, enactive mastery experiences, vicarious (observational) experiences, and verbal persuasion (Bandura, 1997). The fourth source of self-efficacy, physiological and affective states, was not included in the analyses as it was not the focus of the study. The analyses of data focused on understanding the ways students’ enactive and vicarious experiences were structured as well as verbal persuasion provided by the teacher regarding students’ capabilities. Subsequently, classroom practices were also analyzed in terms of the opportunities and challenges related to the transition from other- to self-regulation as suggested by sociocultural perspectives.
A similar procedure was followed in order to analyze the focal students’ participation in classroom practices. At this stage of analyzing the data, the unit of analysis was the individual student acting within the classroom context. Appendix H presents the categories developed for the analysis of focal students’ classroom practices. In order to describe and examine each focal student’s participation in classroom practices in relation to his or her self-efficacy and strategic learning, the same analytical tools were used. That is, analyses were focused on understanding each focal student’s enactive and vicarious experiences as well as teacher’s verbal persuasion regarding his or her capabilities. Each focal student’s participation in classroom practices was also examined in terms of the opportunities and challenges for strategic learning. That is, focal students’ classroom practices were examined in terms of the ways they provided him/her opportunities to develop understanding, to build competence for and through strategic learning, and to develop sense of ownership over strategy use.

*Analyzing Focal Students’ Self-Efficacy and Strategic Learning*

Focal students’ self-efficacy and strategic learning were assessed through a variety of sources. Students’ responses to the questionnaire administered at the beginning and end of the study were used to examine their self-efficacy and strategic learning in relation to each other as well as in relation to other participating students in the class. For this purpose, descriptive statistics were employed. Mean scores for self-efficacy and strategy use scales were calculated for all participating students. Furthermore, the scores corresponding to the 25th, 50th, and 75th percentiles for each scale were calculated. These data were used to compare focal students’ self-efficacy in relation to each other as well as in relation to other participating students in the class. Focal students’ responses to the
questionnaire were also examined to identify changes on their self-efficacy and strategic learning over the course of the study. For this purpose, changes on each item that were greater than one value on the Likert scale measure were noted.

Focal students’ self-efficacy and strategic behaviors within the context of the specific mathematical tasks were examined through problem-solving sessions at the beginning and at the end of the study. Self-efficacy ratings in relation to each mathematical task were noted and examined across the problem-solving sessions conducted in January and in April/May. Students’ strategic behaviors in terms of analyzing the tasks, selecting, implementing, and evaluating problem-specific strategies, as well as monitoring and evaluating problem solutions were also examined within the context of these mathematical problems. Finally, students’ self-efficacy ratings assessed through journal writing were noted and examined descriptively in order to triangulate data collected through the questionnaires and problem-solving sessions.

Cross-case Analysis

While data analyzed within each case (i.e., focal student) provided insight into their classroom practices, self-efficacy beliefs, and strategic behaviors, analyzing data across the cases allowed the researcher to generate explanations regarding the interplay between these factors. It should be noted, however, that constructing individual cases is the first step of cross-case analyses.

Where there are several cases to be compared and contrasted, an inductive approach begins by constructing individual cases…Once that is done, cross-case analysis can begin in search of patterns and themes that cut across individual experiences. The initial focus is on full understanding of individual cases before
those unique cases are combined or aggregated thematically. This helps ensure that emergent categories and discovered patterns are *grounded* in specific cases and their contexts. (Patton, 2002, p.57)

Cross-case analyses are used to build general explanations that work for each of the cases, even though they show some differences (Yin, 1994). The focus is given to understanding the processes and outcomes occur across the cases within specific contexts (Miles & Huberman, 1994). In this study, analysis across the cases involved comparison of focal students’ development of self-efficacy and strategic behavior as well as their classroom practices in order to identify the patterns that explain the interplay between these factors.

*Presentation of Data Sources*

Throughout the data analysis, the following conventions were used. “Mrs. T” stands for “Mrs. Thompson,” “Ss” stands for the “students,” “A” stands for “Alice,” “K” stands for “Kyle,” “M” stands for “Mike,” and “I” stands for the researcher. Data sources are designated by abbreviations that identify the data source and date the data were collected. The following scheme will be used throughout the results section:

CO: data corpus of classroom observations that constituted field notes augmented with the videotape and audiotape transcriptions (e.g., CO/ Feb 17, 2005- classroom observation, February 17, 2005),

I-1: first interview that constituted problem-solving session (e.g., I1-A/ Jan 25, 2005- first interview with Alice on January 25, 2005; I1-K (P#4)/ Feb 4, 2005- first interview with Kyle, problem #4, February 4, 2005),
Establishing Trustworthiness

Trustworthiness is related to how an “inquirer persuade[s] his or her audience (including self) that the findings of an inquiry are worth paying attention to, worth taking account of” (Lincoln & Guba, 1985, p. 290). There are several criteria for establishing trustworthiness in qualitative inquiry: credibility, transferability, dependability, and confirmability (Lincoln & Guba, 1985). Findings are credible when they capture the experiences and meanings of the participants in a context as well as the dynamics of the context. Transferability is concerned with the extent to which the findings can be applied to other settings. The dependability of a qualitative research is related to whether the results are consistent with the data collected. Researcher’s interpretations also should be confirmable through data paths that allow the readers to trace both the data and the assertions based on the data to their origin.

In this study, credibility of the findings means that the descriptions and interpretations of the classroom context and of the focal students’ classroom practices and their SRL are consistent with what has been experienced by the participants. To enhance credibility, four methods were used: prolonged engagement and persistent observations, triangulation of data sources, member checking, and peer debriefing. The researcher spent over a period of six months in the field throughout the study. She was present in the
classroom every day over a period of three months and conducted repeated observations. The prolonged engagement and persistent observations allowed the researcher to get to know the teacher and the students and better understand the classroom context. In this way, participants also had a chance to become accustomed to the researcher’s presence in the class.

The second technique to enhance credibility of findings was to triangulate the data by using multiple data sources (i.e., field notes of observations, video and audio recordings, interviews, questionnaire, and student journals). The third technique to enhance credibility was member checking. During the think-aloud protocol, the researcher checked with the focal students to clarify her interpretations of their behaviors, interactions, and statements. Finally, the last method to enhance credibility of findings was peer debriefing that occurred within two research teams that have expertise in self-regulated learning. They reviewed the instruments to collect the data and their comments were used to revise questionnaire items and interview questions. In addition, through their feedbacks on data analyses, the researcher refined the analytical methods and category descriptions. The research teams also reviewed the transcriptions of video recordings.

Transferability is achieved through thick descriptions that could allow the readers to see if the results can be transferred to other settings. In this study, characteristics of the participants and adequate descriptions of the events, experiences, and classroom practices were provided. In this way, readers are able to determine to what extent they could apply the findings of the study to their situation. In this study, dependability and confirmability were achieved in three ways. The researcher coded the data at least two times in order to
examine the intra-rater reliability. Furthermore, a graduate student, who has been conducting a related study, also coded three field notes to examine the inter-rater reliability. The third way to achieve dependability and confirmability was through an inquiry audit. In this study, this was maintained through careful documentation of the data and the description of data analysis process.
The analysis of the data is presented in three broad sections to address the research questions posed. In the first section, the nature of the classroom practices in one sixth-grade mathematics classroom is described and examined in terms of the opportunities they provided relative to the development of self-efficacy and strategic learning. The second section is devoted to the analysis of individual cases. The main purpose of this section is to construct individual cases by examining how opportunities for the development of self-efficacy and strategic learning are structured for individual students. This section presents an analysis of three focal students’ self-efficacy and strategic learning as assessed over the course of the study along with their participation in classroom practices. Finally, the last section is devoted to the cross-case analysis. This section seeks to elucidate focal students’ development of self-efficacy and strategic learning in terms of the reciprocal interactions formed between individual students and opportunities provided in the classroom.

The Nature of Classroom Practices

The first objective of the study is to describe the nature of the classroom practices and examine the ways these classroom practices may impact students’ self-efficacy and
strategic learning. For this purpose, data drawn from observation field notes and transcriptions of video and audio recordings of 22 classes over a period of three months are analyzed. The analyses of classroom practices are presented in three subsections: the nature of tasks and activities, teacher instructional support, and teacher motivational support. Within each subsection, classroom practices are described and analyzed with respect to their potential to impact self-efficacy and strategic learning.

To organize the discussion relative to self-efficacy, three out of four sources of efficacy – enactive mastery experiences, vicarious (observational) experiences, and verbal persuasion – are used as an analytical tool. That is, analyses are focused on understanding the ways students’ enactive and vicarious experiences are structured as well as forms of verbal persuasion provided by the teacher regarding students’ capabilities. Even though physiological and affective states are also an important source of self-efficacy, including this source requires examining further aspects of classroom context such as emotional and affective support, which would have made the study difficult to manage given the limited time and resources. With regard to strategic learning, classroom practices are analyzed in terms of the opportunities and challenges for the transition from other- to self-regulation. These classroom practices are also analyzed to understand the ways they could support or constrain students’ regulation during three phases of SRL: forethought, performance control, and self-reflection.

*The Nature of Tasks and Activities*

In this section, the characteristics of the tasks and activities and the manner in which they were structured are examined. First daily class activities are briefly described. Then the nature of the tasks (i.e., purpose and expected product) provided during these...
activities and the ways the students engaged in these tasks (i.e., participation structure) are discussed in terms of their potential influence on self-efficacy and strategic learning. In the last section, opportunities to control challenge through homework assignments are described. This description provides the context for exploring how these opportunities could impact student self-efficacy and strategic learning.

Daily class activities. In this classroom, students typically engaged in daily class activities such as problem of the day (POD), pair and small-group activities, class discussions, and trading and discussing homework assignments. Classroom instruction generally followed a regular sequence of activities. Almost every day, the lesson began with a task or an activity called problem of the day (POD). For a majority of the PODs, 17 out of 20 observed in 22 lessons, the purpose was to review previously taught concepts and skills. Students were usually given 10 minutes to work individually, and then they shared their findings, ideas, and strategies through the class discussion guided by Mrs. Thompson.

Typically, following the POD, Mrs. Thompson introduced a new topic or reviewed previously taught concepts and skills, mainly through pair or group work and class discussions. Mrs. Thompson often introduced a new topic by first providing a task that students engaged with in small groups or pairs. During these group activities, she required students to work together and discuss their ideas, discoveries, and strategies. Another way she introduced a new topic was through whole-class discussions, during which students shared their ideas related to the topic. Students were often asked to trade and discuss homework activities in order to review previously learned concepts. Checking homework usually consisted of students’ trading and grading each other’s
paper while the teacher was giving correct answers. Students were then given the opportunity to ask questions about the problems they made mistakes on or struggled with and shared the strategies they used to solve the problems. Whole-class discussions, as can be seen, constituted a significant portion of Mrs. Thompson’s instruction.

The nature of tasks. The nature of the tasks carried out during the class activities is analyzed in terms of the purpose (i.e., introduction vs. review), the type of expected product (i.e., single correct answer, multiple correct answers, multiple representations), and students’ participation structure (i.e., individual work vs. group/pair work). The analyses of the data showed that while 87% (27 out of 31) of the tasks observed in 22 lessons required a single correct answer, students were provided the opportunity to solve 68% (21 out of 31) of them using multiple representations (e.g., words, symbols, drawings). A striking pattern observed was that all the activities used to introduce a topic allowed multiple representations (see Table 4.1).
<table>
<thead>
<tr>
<th>Expected Product</th>
<th>Allows one single correct answer</th>
<th>Allows multiple correct answers</th>
<th>Allows multiple representations&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Total Freq.</th>
<th>Total Per.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>13</td>
<td>93%</td>
<td>1</td>
<td>7%</td>
<td>14</td>
</tr>
<tr>
<td>Review</td>
<td>14</td>
<td>82%</td>
<td>3</td>
<td>18%</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td>27</td>
<td>87%</td>
<td>4</td>
<td>13%</td>
<td>21</td>
</tr>
</tbody>
</table>

Note. Freq = Frequency; Per = Percentage; Percentage for purpose.

<sup>a</sup>This category includes tasks that allowed single correct answer as well as multiple correct answers.

Table 4.1: Expected task product by task purpose

For example, Mrs. Thompson introduced the calculation of the surface area of rectangular prisms by presenting an activity in which she handed out Kleenex boxes to each table group and asked the groups to discuss how to figure out exactly how many square units of graphing paper they needed to cover all the faces of the box. She provided students various options to explain their reasoning, such as the following quotation (CO/ Feb 22, 2005), Mrs. T: “Either with words, or numbers, or formula, in your journals, [you] write down after you discuss it. How would you figure out how much wrapping paper would go over the rectangular prism that you have?” Mrs. Thompson explicitly made it clear that multiple representations were expected and supported students’ use of
multiple representations by stating possible representations students may use to explain their thinking.

With regard to participation structure, students usually worked in small groups or with partners when they were introduced to a new concept (79%: 11 out of 14). On the other hand, they usually worked individually when the purpose of the task and activity was to review previously learned topics (88%: 15 out of 17) (see Table 4.2).

<table>
<thead>
<tr>
<th>Participation structure</th>
<th>Individual work</th>
<th>Group and/or pair work</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Freq.</td>
<td>Per.</td>
<td>Freq.</td>
</tr>
<tr>
<td>Purpose</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Introduction</td>
<td>3</td>
<td>21%</td>
<td>11</td>
</tr>
<tr>
<td>Review</td>
<td>15</td>
<td>88%</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
<td>58%</td>
<td>13</td>
</tr>
</tbody>
</table>

*Note. Freq = Frequency; Per = Percentage; Percentage for purpose.*

Table 4.2: Student participation structure with respect to purpose of the tasks

Overall, the nature of tasks and the way they were structured may be characterized by their flexibility during early stages of learning. Giving students some flexibility to express themselves through multiple ways could be one way to form a common ground for communication that supports shared understandings and student participation in classroom practices (Wertsch, 1979). In this way, it may increase the potential that students can engage with the tasks, and hence increase the potential that
they develop necessary knowledge and skills to be strategic learners, which also potentially supports self-efficacy.

The flexibility on the nature of the tasks may also impact students’ enactive experiences and thereby their self-efficacy. Increasing the potential that students engage with the tasks through multiple representations may increase the potential for success and decrease the potential impact of failure. Failure, especially if it occurs early in the learning experience, undermines one’s self-efficacy (Bandura, 1986, 1997). Hence, it is especially important to use multiple representations during early stages of learning where students are developing their sense of efficacy in relation to the specific mathematical topic or concept. Shared responsibility through group or pair work during early phases of learning could also lessen the impact of early failures because success as well as failure is shared. Thus, flexibility in the nature of tasks and students’ participation structure observed in this sixth grade mathematics classroom may positively impact students’ self-efficacy as well as strategic learning.

*Control over challenge.* While the tasks and activities as well as the requirements were the same for all students during class activities, Mrs. Thompson provided students with challenging homework assignments and allowed high-achieving students to choose between the regularly assigned homework and more challenging homework assignments. Other students were also allowed to complete challenging homework assignments in addition to their regular homework for extra credit. The following quotation illustrates Mrs. Thompson’s explanation regarding a challenge assignment (CO/ Feb 4, 2005).

Mrs. T: Now, those of you who I talked to about doing challenge work, the challenge problem is on here [showing the worksheet] - 5 through 11. You may do just those or you may take a few from up here and those too. Those of you,
who I didn’t talk to about doing challenge work, you are, you need to do these [referring to the regular homework assignment], but you may also choose to do the challenge problems. OK? And everybody is doing #4, which is a little bit of combining problem solving, um, it’s a little bit of a challenge anyway, and so we’ll see if you can figure that out. If you’re good to get # 4, then you’re good to go ahead to do the challenge. So, anybody is welcome to do those because challenge happens to be on the same paper today also. And, some of you, this is introductory for you, you haven’t had this before, so let’s ... (inaudible) practice the skill first, then everybody would be able to move into doing some more complicated ones, um, after you practice the, um, basic ones that we kind a went over.

Even though this differential treatment might be considered as an indication of the teacher’s higher expectations for some students, Mrs. Thompson conveyed her rationale in terms of individual differences among students and expressed her high expectations for all of them. That is, some of them had already mastered the skills while others needed further practice to master them. After they studied the basic skills, all students would be able to do more complex work.

Providing opportunities to control challenge has potential to influence student strategic learning as well as self-efficacy. Challenges must be in balance with individuals’ skills in order for them to engage in activities (Csikszentmihalyi, 1975). When the activity is too difficult for students, it may bring frustration, worry, and anxiety that could negatively impact learning. On the other hand, when there is no challenge, students get bored and do not engage in activities to improve their skills. Hence, tasks that are moderately difficult lead to most efficient learning (Paris & Turner, 1994). In this classroom, students who already mastered the basic skills were provided an opportunity to further challenge themselves and to improve their skills as strategic learners through homework assignments. Furthermore, for these students, completing challenging tasks
may foster a sense of accomplishment beyond their mastery of basic skills and enhance self-efficacy (Bandura, 1986, 1997).

In summary, the nature and structure of the tasks and activities in this classroom has potential to positively impact student self-efficacy and strategic learning because they provide students opportunities to engage with the tasks in multiple ways, to control challenge according to their knowledge and skills, and to experience success. It should be noted, however, that merely affording opportunities cannot support strategic behavior and self-efficacy. Teacher support guiding students’ engagement plays an important role. The following sections are devoted to analyses of teacher instructional and motivational support.

Teacher Instructional Support

Teacher instructional support observed in this classroom served two purposes: promoting shared understandings and building competence for and through strategic learning. Classroom practices that sought to promote shared understandings of goals, concepts, strategies, and problem situations constituted a significant portion of Mrs. Thompson’s instruction. She promoted shared understandings mainly by communicating the goals, negotiating meaning, assisting peer modeling, and supporting students’ strategic knowledge. These classroom practices provided students entrée to participation in joint learning activities through which they could build competence for and through strategic learning with teacher assistance. In the following sections, each type of teacher support is described and examined in terms of its potential impact on student strategic learning and self-efficacy. Table 4.3 briefly describes each type of teacher instructional support and the number of instances observed in 22 lessons.
<table>
<thead>
<tr>
<th>Teacher instructional support</th>
<th># of instances in 22 lessons</th>
<th># of instances per lesson</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Communicating classroom goals by:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• writing agenda of the day written on the board each day</td>
<td>22</td>
<td>1</td>
</tr>
<tr>
<td>• stating messages related to specific tasks and class activities</td>
<td>7</td>
<td>0.32</td>
</tr>
<tr>
<td><strong>Negotiating meanings by:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• clarifying and elaborating terms, notations, words, concepts, procedures, and problem situations; highlighting key features and contrasts about concepts and procedures; and contextualizing concepts within real-life situations</td>
<td>68</td>
<td>3.01</td>
</tr>
<tr>
<td><strong>Assisting peer modeling by:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• setting expectations for student demonstration and articulation of their mathematical processes, and facilitating and refining students’ modeling by recasting and rephrasing their explanations</td>
<td>43</td>
<td>1.95</td>
</tr>
<tr>
<td><strong>Supporting the development of strategic knowledge in relation to:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• forethought phase of SRL (e.g., analyzing the tasks)</td>
<td>9</td>
<td>0.41</td>
</tr>
<tr>
<td>• performance control phase of SRL (e.g., selecting and implementing problem-specific strategies; monitoring and controlling the execution of these strategies.)</td>
<td>29</td>
<td>1.32</td>
</tr>
<tr>
<td>• self-reflection phase of SRL (e.g., communicating a criteria for evaluation)</td>
<td>16</td>
<td>0.73</td>
</tr>
<tr>
<td><strong>Fostering joint learning activities by assisting students to analyze the tasks and to select, implement, and evaluate problem-specific strategies</strong></td>
<td>50</td>
<td>2.27</td>
</tr>
</tbody>
</table>

Table 4.3: Teacher instructional support
Communicating classroom goals. Mrs. Thompson regularly shared and clarified the instructional goals she set for each class through the agenda of the day and through her messages. The agenda of the day was written on the board each day and informed the students about the daily class activities (e.g., POD, Trade & Discuss HW). Mrs. Thompson also communicated goals through her messages regarding specific tasks and activities. In seven out of 22 observed classes, she explicitly conveyed the goals through her messages related to class activities. The following example from a class on the volume of a rectangular prism is an illustration of the teacher’s messages regarding goals and expectations for students’ learning (CO/ Feb 25, 2005). As this example illustrates, Mrs. Thompson provided a rationale along with the goal, which potentially made the instruction more meaningful for the students.

Mrs. T: A lot of you already knew that there is a formula [for volume of a rectangular prism] - and a lot of you knew what it was; a quicker way to figure out the volume of a rectangular prism. If you didn’t know, you were discovering as you did that- most of you figured that out yesterday. So, in your journal entry today, make sure you write the formula for volume of a rectangular prism and then even if you already knew that, the next task would be to explain in words. Why the formula works? … And it should be based on what you did with the activity. What did you do? What did you figure out? And then the last one- What did you notice? What did you discuss? What did you discover? What came to your mind?

Communicating goals has the potential to impact student strategic learning and self-efficacy in two ways. First, conveying specific goals may increase the potential that the teacher and the students work towards the same goals. This is crucial because even though the teacher and the students may engage in the same tasks and activities, students’ interpretation of task requirements might be different from that of the teacher. Hence, they may adopt less profitable goals, which undermine strategic learning (Butler, 1998c; Wertsch, 1979). Communicating clear and specific goals also makes the tasks more
manageable for students and helps them to observe their performances and progress. In this way, such classroom practices convey more reliable information regarding students’ capabilities as they make appraisals of self-efficacy (Schunk, 1985, 1991).

Negotiating meaning. Mrs. Thompson also promoted shared understandings by negotiating meaning. She adjusted her instruction for students’ needs by clarifying and elaborating upon terms, notations, words, concepts, procedures, and problem situations; by emphasizing key features or contrasts; and by contextualizing concepts within real-life situations. In 22 lessons, this type of support was observed in 68 instances. She frequently asked questions to make sure that students knew the terms and notations being discussed and provided clarifications whenever needed, as in the following example.

Here, Mrs. Thompson clarified the square of a number as they were discussing the area of a square (CO/ Feb 1, 2005).

Mrs. T: If you take the same number times the same number- What’s another name to write that down? What’s another name to write side times side?
S: Side squared.

One of the most common ways that Mrs. Thompson supported shared understandings was to clarify and elaborate upon concepts, procedures, and problem situations. In some instances, this type of support included making connections between two different representations of the same concept as in the following example (CO/ Jan 20, 2005), Mrs. T: “What’s another name for 5 out of 30 in simplest form?” Ss: “one sixth.” Frequently, her support included emphasizing the common features and contrasts among and between concepts and helping students to make connections between new concepts and prior knowledge. She did this by encouraging students to share their ideas
related to a new topic and then adjusting her instruction based upon students’ initial understandings.

In the following example, Mrs. Thompson introduced the exploration of the area of a rectangle by having students make connections with the calculation of the perimeter of a rectangle, which they had already worked on (CO/ Feb 01, 2005). She then highlighted the unit of measurement as the contrasting feature between the two concepts. First, she asked students to outline any sized rectangle on a sheet of a graph paper and find its dimensions and perimeter. After students discussed the figures, Mrs. Thompson reminded them about the formulas for the perimeter of a rectangle: \( P = 2 \times l + 2 \times w \) or \( P = 2 \times (l+w) \). Then she helped students make connections between perimeter and area by emphasizing the unit of measurement used to find the perimeter and area of a rectangle.

Mrs. T: What is the most simplistic way to get the perimeter besides adding up the sides or using the formula? What can you do that’s really simplistic? It may not be the quickest way, really basic way.

Daniel replied that they could count the squares all the way around. Another student indicated that he found different answers when he counted the squares inside the border and when he used the formula. Mrs. Thompson suggested counting the squares outside the border and then asked the following question while referring to the student’s statement.

Mrs. T: If perimeter is the distance around the outside, what is area? What is the area of the rectangle that you drew? Or what is the definition of area? How do you find it? What do you know about area?

Students responded: “inside the figure,” “inside the perimeter of the figure,” “the surface of the figure inside.”

Mrs. T: He counted inside the squares. That’s a key word squares of the definition of area…this is crucial, right here, the number of square units.

Then she if any of the students knew what square units meant.

Daniel: The number of units.

The discussion followed by Mrs. Thompson’s clarification of unit of measurement and the illustration of the difference between linear and square units through examples.
As this episode illustrates, Mrs. Thompson’s introduction to the activity by asking students to find the perimeter besides adding up the sides or using the formula created a context for discussion in which students shared their ideas. When one of the students counted the unit squares to find the perimeter, Mrs. Thompson adjusted the instruction by clarifying the unit of measurement for perimeter and area.

Mrs. Thompson also promoted students’ understanding by contextualizing mathematics concepts within real-life situations. For example, when Tricia had difficulty understanding why they had to count 0’s in a data set in order to find the average, Mrs. Thompson adjusted the problem situation to one that was familiar for her (CO/ Jan 31, 2005). She explained that zero represented one out of eight homework scores of a student. She then asked Tricia if it would be fair for other students not to count the zero and divide the total number of homework scores by seven when computing the average score for this student. Through the discussion, Tricia and other students came to realize that zero was also a piece of data and that they should count it in order to find the average.

The central feature of these classroom practices was that meaning was negotiated rather than simply provided by the teacher. To do so, Mrs. Thompson frequently requested that students share their ideas and provided them feedback and assistance when they needed. She supported students’ new understandings by allowing them to talk through their own ideas. The following episode illustrates a typical example. In this lesson, students were discussing a POD, which required finding one-fourth of a number (CO/ Feb 3, 2005).
Mrs. T: So, 1/4\(^{th}\) of the total circle is taken up by the first quarter sale. So, Jamal said we need 1/4\(^{th}\) of 800. Now, he also said take 800 divided by four. Is 800 divided by 4 the same as 1/4\(^{th}\) of 800?
Ss: Yes
Mrs. T [showing 1/4\(^{th}\) of 800 = 200 on the board]: What operation would you do here for “of”?
Ss: Divide
Ss: Times
Mrs. T [showing how to multiply 1/4 \times 800/1= 800/4 on the board]: When you multiply with fractions, multiply numerators, 800 times 1, and 4 times 1, and look what you end up with?
Ss: Same
Mrs. T: Same thing. So, when you have a numerator of 1, and a denominator 4, multiplying by 1/4\(^{th}\) is the same as dividing by that denominator. OK? Cause [sic], you have 1/4\(^{th}\) of- that means you’re cutting 800 into 4 equal sections.

Teacher support for negotiating meaning is particularly important at early stages of learning because students have limited understandings of terms, concepts, and problem situations (Vygotsky, 1981; Wertsch, 1979). Without developing such understandings they would not be able to actively engage in tasks and activities. Teacher support, focusing on negotiations of meanings, could form a common ground for communication supporting students’ participation in joint learning activities through which they could build competence in strategic learning. In this way, this type of teacher support has potential to impact student strategic learning, as well as their self-efficacy through its potential impact on their performance.

Assisting peer modeling. Mrs. Thompson also promoted shared understandings through peer modeling. She established a classroom environment that fostered effective peer modeling opportunities by setting expectations for student demonstration and verbalization of their mathematical processes and by facilitating and refining student explanations that are developmental within classroom discourse. Mrs. Thompson often required students to articulate their thoughts. She encouraged students’ involvement by
conveying that their explanations did not need to be perfect or complete. In addition, she helped them articulate their ideas by providing clarifications and elaborations. She reviewed the steps carried out by the students and paraphrased their thinking to make it explicit for other students. While peer modeling itself might not be sufficient to facilitate student understanding, it was Mrs. Thompson’s recasting and rephrasing of students’ statements that made peer modeling an effective way to establish shared understandings. In this sense, these activities have potential to impact student strategic learning.

The following passage illustrates a typical episode highlighting Mrs. Thompson’s role in peer modeling practices (CO/ Feb 25, 2005). In this example, Michael was sharing his solution for a homework assignment. The problem was about finding the function rule for the input and output numbers given.

Mrs. T: He started with the output number and worked backwards. He took the output number, divided by the input number, so he worked with the number that was given there and when he did that- what did you get, Michael?
Michael: 500
Mrs. T: You got 500. And you took the output number 32 and divided by .064, what did you get?
Michael: 500
Mrs. T: And was that consistent throughout?
Michael: Yeah.
Mrs. T: So, if you take output and divide by the input to get 500, what does that tell you about going from the “in” number to get the “out” number? What does that tell you if you use that strategy?
Another student explained.
Mrs. T [paraphrased the student’s explanation]: So, he worked backwards and did the opposite operation and found out that you were multiplying by 500. Cause [sic] if you go backwards, work backwards, 25 the output number, divided by the input number to get 500, then we know 500 times the input will give you the output. So, a good strategy was working backwards on that- taking the numbers that you knew, and particularly on that one because some of you had a trouble doing [it] in your head.
Observing how other students perform could also give students information about their own capabilities (Schunk, 1985, 1991, 1998). In particular, attainments of other students similar to them could convey that students can succeed as well. Conversely, failures of models may lower observers’ sense of efficacy. Observing a classmate overcome his/her difficulty through strategic behaviors may serve to increase other students’ repertoire of strategies leading to greater success. Furthermore, these vicarious experiences have the potential to support self-efficacy as they convey to students that they could overcome similar difficulties as well. In this classroom, while students mainly observed mastery behaviors (33 out of 43), they were also able to observe each other’s coping behaviors.

In the following example, students were sharing their solutions for a POD (CO/ Feb 2, 2005). The problem required students to write an equation and find the length of one side of a square pen, when the perimeter was given 64 feet. Nathan shared his equation, \( P = 64/4 \), which was not correct. Mrs. Thompson wrote down the equation he suggested on the board and asked him to explain what each part represented. Through the discourse facilitated by Mrs. Thompson, Nathan was able to find the correct answer, while other students observed how he overcame his difficulty.

Nathan: Perimeter is 64 feet, and that’s the 64, and the square has like [sic] four sides, so that’s four, so 64 divided by four. And all the sides are equal in square. After Nathan’s explanation, Mrs. T showed the formula on the board and told him that he said perimeter equals 64 but then he also used the symbol for perimeter “\( P \)” in the formula. In other words, they have “perimeter” twice in the formula.

Nathan: Perimeter is 64.

Mrs. T: Ok, so what should it equal? When you divided perimeter, which is 64, divided by four, what do you find?

Nathan: 16

Mrs. T: 16. What does that represent?

Nathan: Like how long the side is.
Mrs. T [showing “P” on the formula]: So, instead of P, what should we put? Nathan and other Ss replied altogether: S. T wrote “S” instead of “P” in the formula: S=64/4.

While the nature of information conveyed by modeling could lead to social comparison among students, Mrs. Thompson emphasized the instructive function of modeling and avoided its evaluative functioning. She focused on students’ ideas, strategies, and reasoning instead of comparing their abilities and performances. In the following episode, Tricia was having difficulty finding a fraction between 0.4 and 0.5 among multiple-choice answers (CO/ Feb 8, 2005). Mrs. Thompson used Todd’s modeling to help her understand the problem. While doing this, she emphasized the strategy Todd had used and avoided making comparison among students.

Mrs. T: So, do you agree Todd that this would be 45 hundredths. It’s half way between?
Ss: Yeah.
Mrs. T: Half way between 40 hundredths and 50 hundredths is 45 hundredths. Tricia, do you see how we got that? He put a zero on here to make 4 tenths equivalent [to] 40 hundredths, or 50 hundredths. He said 45 hundredths is halfway between 40 and 50 hundredths, is 45 hundredths. OK. 0.45- and then as a fraction 45 hundredths, and then Todd said that that choice was not given as one of the choices. So, he said that he simplified, divided by the numerator and denominator by five, you got 9/20. Do you agree with that?
Ss: Yes.

This peer modeling experience assisted not only Tricia but Todd. While Mrs. Thompson’s paraphrasing of Todd’s thinking serves as a model for Tricia, it also provides Todd verbal persuasion and information regarding his mastery experience. In this way, these peer modeling practices could also support the model’s developing self-efficacy.

In summary, the peer modeling practices described above have potential to impact students’ strategic learning because they promote shared understandings and strategic
behaviors. In addition, observing students similar to oneself could convey information regarding students’ own capabilities as they appraise self-efficacy.

Supporting the development of strategic knowledge. Mrs. Thompson also promoted shared understandings of strategic knowledge. Through her messages and explanations, as well as whole-class discussions, she supported students’ developing strategic knowledge that could help them at the forethought, performance-control, and self-reflection phases of self-regulation. For this purpose, she offered strategies and explained how and when to use them, encouraged the students to talk about their own strategies, and helped them value strategic learning by making connections between strategy use and performances.

With regard to the forethought phase of SRL, she offered several strategies to analyze the tasks such as rereading, underlining, and using context clues and prior knowledge to understand the task requirements. In 22 lessons observed, this type of teacher support was observed in nine instances. Mrs. Thompson often emphasized that while the students might not understand the problem or might not know how to solve it when they first read the problem, using strategies could help them. The following episode is taken from an activity in which students were expected to describe three real-life situations where they need to find the perimeter and area of a figure (CO/ Feb 04, 2005). During the discussion, Mrs. Thompson emphasized how examining the problem situation might help them to understand what the problem asks.

Mrs. T: That [analyzing the problem situation] is a really important skill and I’m really glad now that we did that cause [sic] some of you struggled with them a little bit initially. A lot of times when you read a word problem, that we’re gonna [sic] work on next week- now we’ve done some of these problems. In real life, let’s say, OK, this is a perimeter problem; so find the perimeter of this. Or this is
an area problem, find the area. That doesn’t happen. You have to look at the situation and you have to decide what type of situation it is and you have to decide what formula you’re gonna [sic] use. For example, if you look at something and it’s a rectangle, and you wanna [sic] find the area of it, it may not have flashing neon lights that say “find the area of me, I’m a rectangle.” You look [at] the situation, say, um- they’re asking you to find how much paper needed to cover that bulletin board. Now, no where in there, I say find the area, but you know, when you’re covering the bulletin board, and the bulletin board is a rectangle, you need to use area of a rectangle formula. If I say, how much, I wanna [sic] know, how much starboard do I need go around the bulletin board, I would need, OK, that’s a perimeter of a rectangle situation, so I need to use perimeter of a rectangle formula. So, that’s one reason we’re working on that. We’re taking to problem solving level next week- we’re actually now taking these formulas we use and applying them to the situation. OK?

Mrs. Thompson also supported students’ developing strategic knowledge related to the performance control phase of SRL. In 22 lessons observed, this form of teacher support was recorded in 29 instances. For instance, she offered students samples of problem-specific strategies and explained them how to use these strategies. As an example, when they were discussing a problem that required finding the surface area of a rectangular prism, Mrs. Thompson asked how many of the students would draw a picture. When none of the students raised their hands (CO/ Feb 23, 2005):

Mrs. T: None of you would draw? OK, you don’t have to. But I think a lot of you may just not sure [about how to solve the problem]. I think a good strategy for many of you would be, when you see there’s a rectangular jewelry box, a lot of you may wanna [sic] go ahead and draw, because it may help you.

She then encouraged students to use the strategy by showing how they could use the drawing to find the surface area of the figure. When she asked “Now, that I offer that strategy, how many of you think [you] would do this?” (CO/ Feb 23, 2005), more students raised their hands. Mrs. Thompson also expected students to share their own problem-specific strategies as well as compare and evaluate each other’s strategies during group work and whole-class discussions. These classroom practices helped students
realize that there could be more than one way to solve a problem and some ways may be more effective than the others.

Students also need to develop strategic knowledge in order to monitor and control execution of their problem-specific strategies. The following quotation is taken from a class discussion, in which students were sharing their findings for the mean of a data set. During the discussion, one of the students realized that she had made a mistake. Mrs. Thompson reminded her and the other students about common mistakes in statistics and offered strategies that could help them monitor their solution procedures (CO/ Jan 31, 2005).

Mrs. T: That’s one of the things that you need to be careful about. Sometimes, when you’re doing statistics, it’s really easy just to make an error because you count wrong. When you’re- and- a lot of times, you’re totaling the columns of numbers on your calculator, you might hit more than one number. You should always count and do that twice, because a lot of students think that if they use a calculator, it’s automatically right, and you need to be very careful because we could make [a] mistake like counting the piece of data wrong. Count twice or check your total twice.

Mrs. Thompson also supported students’ developing strategies for studying mathematics. She encouraged them to practice skills and study over their notes. For instance, when they were reviewing topics during class discussions, she asked students to look over their notes if they did not know the answer, as in the following example (CO/ Jan 25, 2005):

Mrs. T: You can look in your journals like we do when we go over skills, um, either your hands in the air, cause [sic] you know the answer, or you’re looking back in your journal, because you- in your notes- because this is the time to review your information. You don’t have to know about in your memory, but you should be looking at, and that’s the way how we learn.
In addition to supporting students’ developing strategic knowledge, it is also important to show them that using strategies really makes a difference in their performances. If students do not believe that using strategies helps their performances, they probably will not use them (Pressley et al., 1992). Mrs. Thompson usually conveyed this relationship implicitly by providing feedback related to success that highlighted strategic learning. However, in a few instances, she conveyed explicit messages. For example, when the students were reviewing the characteristics of three-dimensional figures, Tricia could not answer a question. Mrs. Thompson suggested her reviewing class notes, which resulted in her answering the teacher’s question correctly. Mrs. Thompson explicitly attributed the student’s success to the strategy of looking in her notes by saying “There you go. See how it works. See, you can look at your notes and you will notice the characteristics. Keep looking at your notes, cause [sic] that will help you.” (CO/ Feb 17, 2005).

During the self-reflection phase of SRL, students evaluate their performances with regard to criteria and regulate their behaviors accordingly (Zimmerman, 2000). Therefore, it is important to know the criteria they need to use to evaluate their performances. In 22 lessons, Mrs. Thompson communicated the criteria for her evaluation in 16 instances. Frequently, she conveyed the criteria through class discussions as in the following example related to graphs (CO/ Jan 20, 2005):

Mrs. T: So one of the things that you will be expected to do as a sixth grader is to look at the table or data and decide what your low and high number would be and what will be the good amount to count by [referring to interval]. OK?

Mrs. Thompson also conveyed criteria for evaluation regarding students’ explanations and presentations of their work. The following quotations illustrate her
typical messages. The first quotation is taken from a lesson in which students were discussing area. When one of the students described area as “stuff in the middle of perimeter” Mrs. Thompson reminded him and other students to use mathematical terms. The second quotation, on the other hand, demonstrates another criterion for her evaluation related to presenting their work.

Mrs. T: …the number of square units in a closed figure. You have to say- you can’t say “stuff in the middle.” Because we know what you mean by or stuff inside but you have to say the number of square units (CO/ Feb 2, 2005).

Mrs. T: Make sure for your problem of the day that you show neatly and clearly your steps. This problem was on the last practice proficiency and it’s a 4-point problem on a grading rubric and I would say the majority of my students missed it. So, it’s really important that you show your steps, show each step, do each thing that it asks you to do on your own. So, when we discuss it, you’re ready to share that and everyone, each and every one of you has an understanding of how to solve the problem like this (CO/ March 1, 2005).

Mrs. Thompson’s messages, explanations, and encouragements about strategy use can impact students’ strategic learning in a variety of ways. First, talking about strategies can make students aware of these strategies, thus increasing the possibility to use them. Also, providing conditional knowledge regarding strategy use could increase the possibility of effective use of these strategies. With regard to the phases of SRL, students were given opportunities to develop strategic knowledge to analyze the tasks as well as to select, compare, and evaluate problem-specific strategies. The criteria for evaluation conveyed by the teacher could also encourage students to reflect on their performances and regulate themselves accordingly. Because students appraise self-efficacy by evaluating their capabilities, knowing the criteria for the teacher’s evaluation could help them to make more accurate evaluations regarding their performances and progress, which could impact their self-efficacy.
Fostering joint learning activities. Teacher support focused on promoting shared understandings of goals, concepts, problem situations, and strategies could increase the opportunities for students to actively engage in tasks and activities. Students still need assistance, however, to build competence for and through strategic learning. In this classroom, Mrs. Thompson fostered students’ competence through joint learning activities. Typically, these classroom practices were in the form of collaborative problem solving activities in which the teacher guided student participation and engagement while individual students were responsible for carrying out a simple aspect of the task. During these activities, students analyzed the tasks, selected, adapted, and implemented strategies, as well as compared and contrasted different strategies to determine what worked best, all with Mrs. Thompson’s scaffolded support. While one student analyzed the task, another selected and implemented a problem-specific strategy, and yet another student suggested an alternative strategy. These joint-learning activities enabled students to go through the phases of regulation with the teacher and peer assistance and provided them opportunities to build competence for and through strategic learning. In 22 lessons, 50 instances were observed as evidence of this type of teacher support.

With regard to the forethought phase of SRL, Mrs. Thompson usually assisted students to analyze the tasks by asking questions with the purpose of understanding the problem situations (e.g., What is given? What is the unknown in this situation? What kind of shape is that?). She also asked questions focusing on students’ thinking processes as they analyzed the tasks (e.g., If I would ask what the problem is asking you, where would you look for that in the problem? What are you basing your decision upon? What
are some things that need to be true? How did you know that they are referring to the perimeter? What in there tells you that it is the perimeter, not the area?).

Through joint learning activities, Mrs. Thompson also assisted students to select and implement problem-specific strategies during the performance-control phase of self-regulation. Mrs. Thompson frequently asked students to share the problem-specific strategies they used to solve the problem, explain how they came up with the strategy, and justify why the strategy worked. Even though she encouraged students to explain their ideas clearly, she did not expect that their ideas should be perfect, complete, or even correct. Through her messages, she expressed the importance of sharing ideas, findings, and strategies in building competence. The following quotation illustrates a typical message that she conveyed for this purpose (CO/ Jan 27, 2005).

Mrs. T: A lot of [you]- that you are- um, confident to share your answer because we know that not all of these are right. But that’s OK because when we discuss this, um- hopefully, you can, somebody can prove and we can justify, and we can get it correct. But those of you who were willing to share that- even if you didn’t get it correct … that’s ok because that way you engage in … and this will help you with the skills.

While students were explaining their ideas and strategies, Mrs. Thompson often helped them to clarify and elaborate by asking questions. This kind of support could help students focus on generating ideas and strategies because the cognitive load related to expressing these ideas is decreased with the teacher assistance. Furthermore, the teacher’s elaborations could also make students’ ideas and strategies explicit to each other and hence increase other students’ participation in the discussion. As an example, in the following episode, the class was discussing a POD, which was about finding all the dimensions (length and width) of rectangles that have an area of 36 square units (CO/ Feb
This episode illustrates Mrs. Thompson’s support for Ted’s discussion of his response and strategy as well as how he came up with the strategy. In this way, other students were also able to participate in the discussion and then they completed the task altogether.

Mrs. T: How did you know what rectangles to draw, Ted?
Ted replied that he divided 36 by 2, 3, and 4.
Mrs. T: By 2 or 3 or 4. Is that your strategy? OK, so if you divide 36 by 2, what did you get?
Larry: 18
Mrs. T: 18. If you divide 36 by 3, what did you get?
Ted: 12
Mrs. T: So, what’s true about 18 and 2, or 12 and 3? They’re what?
Larry: They’re multiples of 36.
Mrs. T: 36 is a multiple of them. What are those numbers to 36? They’re not multiples. What do you do with those numbers to get 36, Melissa?
Melissa: Multiplying.
Mrs. T: You multiply them. So, numbers are gonna [sic] multiply together are called what?
S: Factors.
Mrs. T: Factors. So, you’re on the right track, Larry- factors. So, when you multiply 2 times 18, you get 36. When you multiply 3 times 12- How do you get area of a rectangle, Tricia?
Tricia: Length times width.
Mrs. T: Length times width. So, if area equals length times width for a rectangle, then, you have to have two numbers that you said what factors of 36, such as 2 times 18. So, dimensions- when you multiply- are actually factors of 36… So, let’s list all the possible length and width we have.

Mrs. Thompson also expected students to share different findings and solution strategies and encouraged them to compare and contrast each others’ ideas. In the following episode, students were discussing a POD, which was about finding an algebraic representation of a given problem situation by using the distributive property (CO/ Jan 25, 2005). Even though they agreed on one of the multiple choice answers, Mrs. Thompson fostered a context so that students could discuss various solution strategies and how they are related to each other.
Mrs. T: Who will explain that to us? Why do you think it’s B? [5 × ($9-.01) =]
How does that fit the situation? How does that use the distributive property?
Jamal explained. While he was explaining, Mrs. T asked questions like “what
does nine dollars minus one cent?” “Where does the five come from?” Ss
answered her questions together.
Mrs. T [writing down the equation on the board]: So, how does that equation
work? What would you do to solve that?
Roger suggested doing the subtraction first and then multiplying by 5.
After Mrs. T performed the first operation she asked if there was another way to
solve the new equation by using the distributive property: 5 × ($8.99) =?
One of the Ss suggested: (5×$8) + (5×0.99) =?
After they discussed his suggestion, Mrs. Thompson asked if there was another
way to find the answer. Another student suggested: 5 × (8 +0.99) =?
Another student suggested: (5×9) - (5×0.01) =?
During the discussion Mrs. Thompson asked Ss to compare both suggestions.
Mrs. T: “How is this equation [(5×9) - (5×0.01) =?] related to this equation [5 ×
($9-0.01) =?] that we chose as the answer here? How are these two equations
related?”
She asked students how their classmate found the second equation by using the
first equation.
Luke: Like um, and, um- probably like you said, go to, he has to do that, 5 times 9
then 5 times, um- 1 cent.
Mrs. T: Yeah, he used the distributive property… He did, he distributed this. He
did five times a nine, minus five times the one cent.
Then the students discussed how the equations are related to each other.
This episode illustrates how Mrs. Thompson guided the discussion by asking questions
that stimulated students to find different solution strategies. Even though they agreed on
the answer, 5 × ($9-0.01), she created a new problem situation by asking students how
they could solve 5 × ($8.99) by using the distributive property. After students suggested
several ways, including (5×$8) + (5×0.99), 5 × (8 +0.99), (5×9) - (5×0.01), she assisted
them in seeing how these findings were related to each other, which could help them
transfer their solution strategies across different problem situations.
In addition to sharing their own ideas, Mrs. Thompson also expected students to
listen to and discuss each other’s ideas. When a student shared an idea or a strategy, she
usually avoided giving feedback immediately. She first clarified and elaborated upon the
student’s idea before fostering discussion by encouraging other students to state their agreement or disagreement along with their reasons. For example, one of the activities required students to fold a paper by its shorter side (called as hamburger style) and longer side (called as hotdog style) and then to compare the perimeter of each figure without using a standard unit of measurement (CO/ Jan 28, 2005). Students first worked individually at their table groups and then shared their findings and ideas through whole-class discussion.

Michael was one of the students who shared his strategy. He put one figure on top of the other in order to compare the width and length of the figures. While he was talking about his strategy, Mrs. Thompson elaborated his explanation by asking questions such as “OK, what are you matching? What part of the rectangle are we talking about? Show us where the perimeter is? OK, then what about this side and this side?” Michael’s initial idea was that the perimeter of the figure was greater when it was folded like a hot dog style. He showed that his strategy worked when he was comparing the length of the figures. However, while he was comparing the width of the figures, he realized that the width of the figure was greater when it was folded as hamburger style. Hence, he changed his mind and decided that the perimeters of both figures should be the same.

Mrs. Thompson guided the discussion by asking another student, Nathan, to share his idea because he was also thinking that the figure folded hot dog style has the greater perimeter. By referring to Michael’s idea,

Mrs. T: So, you agree that hot dog has longer- these longer sides, so it has more perimeter than shorter sides. But now- what about when you get to the width of the both of them. How can you prove that? This is when Michael changed his mind. He believed that hot dog has longer sides, over looking at lengthwise this
way, but then what about the width of these compared to the width of that. Can you prove that they’re not the same? This one has more perimeter?”

Nathan suggested using estimation but he struggled to prove his point. Mrs. Thompson turned to the class and asked, “Does anybody notice anything about the widths of these? If I put one [figure on] top of the other [figure] - width of the hot dog compared to the width of the hamburger.” She also reminded students about the definition of perimeter “What is perimeter- just these two sides?” For the rest of the activity, students shared their ideas (e.g., folding the papers twice or three times, using a pencil to measure the length of the sides) and made comments on each other’s strategies. Even though not all the strategies and solutions were correct or efficient, students were given opportunities to evaluate their strategies and saw why they worked or didn’t work.

Most of the episodes described earlier demonstrate that teacher feedback and assistance constituted a significant part in supporting students’ understanding as well as competence. Teacher feedback could inform students about their findings, ideas, and problem-specific strategies, which could possibly impact their strategic learning. In the following quotation Mrs. Thompson provides feedback to students who regarding their problem-specific strategies (CO/ Feb 25, 2005). Here, they were asked to find the problem situation that matched with the given algebraic equation. These students had found the correct equation by solving each of the given choices, even though they did not need to solve the equations.

Mrs. T: Basically what you’re doing, put your number in and see if it equals 400. Now, in this particular problem, and that’s great- that you guys want to solve it, you didn’t even have to solve it through, did you? You just need to pick which one matched the correct answer.
Feedback related to success could also work as persuasory efficacy information and hence has potential to impact student self-efficacy.

Even though Mrs. Thompson conveyed the criteria for evaluation, students rarely evaluated their own performances during joint learning activities. In fact, classroom practices related to evaluation was implicit. For instance, students were required to keep a record for their homework assignments (e.g., page number, due date) and write down their grades for homework assignments and quizzes. While this tool could have been used to monitor progress and evaluate performance, it was mainly used to help students organize and remember their homework assignments.

In short, the joint learning activities described in this section have the potential to support students’ transition from other- to self-regulation as related to strategic learning. Through these activities, students were given opportunities to exercise strategic learning by analyzing the tasks, and selecting, implementing, and comparing problem-specific strategies, as well as monitoring and evaluating their solution procedures with teacher assistance. The collaborative nature of joint-learning activities also lessens the impact of failure at early stages of learning, which is critical in developing self-efficacy. In this sense, these activities could also enhance students’ self-efficacy.

Teacher Motivational Support

Teacher motivational support was usually in the form of recognition of students’ ideas and strategic efforts, indicating praise, and providing attributional feedback. Table 4.4 briefly describes the type of teacher motivational support and the number of instances observed in 22 lessons.
Teacher motivational support

<table>
<thead>
<tr>
<th>Recognizing students by:</th>
<th># of instances in 22 lessons</th>
<th># of instances per lesson</th>
</tr>
</thead>
<tbody>
<tr>
<td>• acknowledging their ideas and strategic effort</td>
<td>64</td>
<td>2.90</td>
</tr>
<tr>
<td>• indicating praise</td>
<td>41</td>
<td>1.86</td>
</tr>
<tr>
<td>Providing attributional feedback</td>
<td>6</td>
<td>0.27</td>
</tr>
</tbody>
</table>

Table 4.4: Teacher motivational support

Recognition of students’ ideas constituted a significant portion in Mrs. Thompson’s instruction. In 22 lessons, this type of motivational support was observed in 64 instances. As can be seen in many of the episodes presented earlier, she frequently referred to, acknowledged, and talked through students’ responses, ideas, and strategies. This could provide students with realistic and sincere information about their capabilities and progress and positively impact students’ self-efficacy. Furthermore, recognition of students’ strategic efforts may increase the possibility of employing these strategic behaviors in the future. The following quotation is taken from a class discussion about circle graphs. After Alice and Todd shared their ideas, Mrs. Thompson recognized their contribution by referring to their statements (CO/ Jan 20, 2005).

Mrs. T: So, circle graphs are used, then let’s write this down and put together what Alice and Todd said, to “represent parts of the whole” [referring to Alice’s explanation and writing down on the board]…OK, so Todd made a statement that a circle represents the one whole thing that you’re talking about [drawing a circle].

The following quotation, on the other hand, illustrates an instance when Mrs. Thompson recognized students’ strategies. Here, she was reviewing the discussion for the POD by
referring to the problem-specific strategies offered by Dennis, Todd, and Jamal (CO/ Feb 24, 2005).

Mrs. T: So, there are two ways to get the total area of this total figure. We can do the area of the whole thing, which Dennis said initially- 14 times 12, 10 plus 4, to get the total length, times 12, which is this way, and- or- Todd’s way, he said 12 times 10- which Jamal said we get the area of just this part and then the smaller rectangle, 12 times 4 and then he said add those two areas together, to get the total area of the whole thing.

Mrs. Thompson also praised students’ performances, particularly when they used effective strategies, presented unique and different ideas, and provided good and clear explanations. In 22 lessons, she indicated praise in 41 instances. Frequently, she restated the behavior that she praised rather than simply stating that they were doing a good job. By verbally recasting the behavior, she made the specific behavior explicit to the students, which could increase the credibility of the verbal persuasion and increase the impact of the efficacy information. The following quotations illustrate Mrs. Thompson’s praise directed to the whole-class when they provided good explanations and demonstrated strategic effort.

Mrs. T: You know, I’m hearing really good things in your writing…One, I’m hearing people restating the question, nobody saying “it” [referring to table] or “she” [referring to Mrs. Comfort- the character in the problem situation]. You’re saying, “The reason Mrs. Comfort was upset about” You’re restating it. I’m hearing complete sentences and a really good way-…to answer a math question- is you use your math vocabulary and math examples. I hear people talking about perimeter. So those are excellent samples, um- of question- um- or- answers to questions, because of not only understanding mathematically- using math vocabulary and responding, um- using math vocabulary, responding in complete sentences (CO/ Feb 7, 2005).

Mrs. T: Most of you, um- really did a good job and I think that, um- one of the things I’m most impressed about is your problem solving. A lot of you don’t… (inaudible) didn’t necessarily know exactly what to do but you were talking about ideas, you were talking about what you could do and some of you’re saying, well, “I know this but I’m confused about this.” That’s excellent! (CO/ Feb 23, 2005).
Teacher praise was not only directed to the whole class but also directed to individual students. In the following example, one of the students noticed a relationship between parts of a figure on which they had been working, and Mrs. Thompson praised him for his discovery (CO/ Jan 27, 2005).

Mrs. T: Did you hear what he’s saying? He just said that a minute ago 8/40 and 7/40 is 15/40. So he’s saying these two pieces [showing the two pieces representing 8/40 and 7/40 of the figure] together should be the same size… [showing the piece representing 15/40 of the figure]. That’s excellent! Very good!

While Mrs. Thompson expressed her faith in students’ capabilities by praising and recognizing their ideas, she avoided criticizing and revealing student shortcomings. She often framed her messages regarding common mistakes and misunderstandings by referring to a third person like “some sixth graders think that…” or by using the term “sixth-grade boo-boo.” The following example illustrates a typical instance in which Mrs. Thompson conveyed her positive beliefs regarding students (CO/ Jan 20, 2005).

Mrs. T: Now, what you have to do- if you’re going to make your bars, vertical bars, now you need to put a number scale on here…Now, there is a…I’ve done this long enough that I’ve seen the sixth grade boo-boo. So we kinda start with sixth grade boo-boos. You guys are not gonna believe what some six graders do. I know none of you would do this. Do you know what they do? They take those numbers from the table- those are the numbers and they put [them] on the y-axes. Can you do that?
Ss: No.
Mrs. T: You can’t do that. You can’t use those exact numbers.

Another form of teacher motivational support was through the teacher’s attributions to student success and failure. Even though Mrs. Thompson rarely provided attributional feedback, her attributions mostly focused on strategy use. Only six instances were observed as evidence of her attributional feedback; four of them were related to strategy use. In the following example, after a discussion of a POD, she asked students to
raise their hands if they had initially found an incorrect answer but then reread and changed their answer. She then attributed students’ success to using monitoring strategies by stating “OK, good. I’m very impressed by that because that shows that you’re using the strategy, going back, rereading, double checking” (CO/ Feb 17, 2005). On the other hand, when students made a mistake, she attributed their failure to using inefficient strategies or lack of experience. By attributing students’ failures to factors that they could control, she expressed her trust in students’ capabilities, which could positively impact their self-efficacy. Furthermore attributing students’ performances to strategy use could also help them to see the connections between their performance and strategy use, and hence encourage strategic learning.

In summary, teacher motivational support described in this section has the potential to impact student self-efficacy as it conveys to students the teacher’s beliefs about their capabilities. Teacher recognition and praise related to students’ strategic behaviors and attributional feedback that is focused on strategy use could also increase the likelihood of using strategies and may positively impact students’ strategic learning.

Analysis of Focal Students’ SRL and Classroom Practices

The second objective of this study is to explore individual students’ self-efficacy and strategic learning along with their participation in classroom practices. For this purpose, three students with different levels of mathematics achievement and SRL competency were selected. This section includes in-depth analysis of these cases. For each case, background information (e.g., age, SES, general characteristics) is presented first. Next, evidence of the focal student’s self-efficacy is presented. For this purpose, focal students’ self-efficacy as assessed through the questionnaire is given. These data
were used to understand each focal student’s self-efficacy in relation to other students in the class. Next, focal students’ self-efficacy within the context of specific mathematical tasks assessed through the problem-solving sessions is presented. Finally, data collected through student journals are presented to triangulate data drawn from the questionnaires and problem-solving sessions.

The next section presents evidence of each focal student’s strategic behavior. First, results obtained from the questionnaires are presented. These data were used to examine each focal student’s reported strategy use in relation to other students in the class. Next, focal students’ strategic behaviors within the context of specific mathematical tasks are presented. These data were analyzed to understand focal students’ strategic behaviors in terms of analyzing the tasks, selecting, implementing, and evaluating problem-specific strategies, as well as monitoring and evaluating problem solutions.

Finally, within each case, the last section is devoted to the description and examination of the focal student’s classroom practices that may support or constrain his/her self-efficacy and strategic learning. In order to organize the findings parallel to the first section, three sources of self-efficacy are used as an analytical tool. That is, analyses are focused on understanding each case’s enactive and vicarious experiences as well as verbal persuasion provided by the teacher regarding his/her capabilities. Students’ participation in classroom practices is also analyzed in terms of the opportunities and challenges for strategic learning. For this purpose, analyses are focused on understanding the ways each focal student’s classroom practices provided him/her opportunities to
develop understanding, to build competence for and through strategic learning, and to
develop a sense of ownership over strategies.

*Focal Student #1: Alice*

Alice is a 12-year old Caucasian female student who did not receive free or
reduced school lunch during the 2004-2005 school year. Mrs. Thompson ranked her as
the highest achieving student in the class in terms of her prior and current grades in
mathematics. Mathematics is Alice’s second-favorite class, after reading and language
arts. She sat next to Maggie, who was also identified as a high-achieving student by the
teacher. They seemed to get along well in the class. When Mrs. Thompson allowed
students to choose a partner for group activities, they usually worked together. During
interviews with her, Alice mentioned that she was in a class similar to a gifted class in
elementary school, where she worked on a lot of sixth-grade mathematics (I2-A/ April
20, 2005). Hence, she expressed that she did not change the way she studied mathematics
when she began middle school. For her, middle school mathematics is “just a little more
complicated. It involves more thinking than just looking at it and solving it” (I2-A/ April
20, 2005).

*Evidence of self-efficacy.* Data obtained through multiple sources over the course
of the study suggest that Alice was very confident in her mathematics abilities. Her self-
efficacy scale score was above the third quarter in January and April, which indicates that
she was very confident in her capabilities compared to most students in the class (see
Appendix B). Alice also reported high self-efficacy regarding specific mathematical tasks
during the first problem-solving session (M = 5, SD = .00). Her self-efficacy remained
high for the parallel tasks on the second problem-solving session (M = 5, SD = .00). She
successfully completed all the problems except P#4 on the second problem-solving session (see Appendix E for the problems).

Data obtained through student journals also support the conjecture that Alice was confident in her capabilities to accomplish classroom tasks. She answered the question “How well can you successfully complete the tasks similar to the one’s that we’ve done today?” as “very well” for all four lessons (see Appendix F for journal prompts). On the first day students wrote a journal, the class worked on an activity to find the area of a parallelogram. Alice stated in her journal that she found the activity easy because she already knew the topic (J1-A/ Feb 2, 2005). She also stated that she “had trouble staying focused” (J1-A/ Feb 2, 2005) and admitted that she did an average job that day. Even though she reported doing an average job, she was confident in her abilities to successfully accomplish the task, which could be related to her past mastery experiences.

The next time students wrote a journal, they reviewed the circumference of circles and then Mrs. Thompson introduced an activity for finding the area of a circle. Alice stated in her journal that she found the activities somewhat difficult because she missed class the previous day and she was a little bit behind (J2-A/ Feb 10, 2005). She rated herself as doing an excellent job, however, because “[she] understood the lesson and [she] did what [she] was told to do” (J2-A/ Feb 10, 2005).

On the third day that they wrote a journal, the students played a game. They took turns matching drawings of geometric figures with their descriptions, which were of cards faced down. Alice found this activity somewhat difficult and stated, “I don’t have that great of a memory, but I know the definitions” (J3-A/ Feb 22, 2005). In this lesson, she thought that she did an excellent job because she knew the definitions of geometric
figures. Students wrote the last journal on the day they studied finding patterns of area when they doubled the sides of a square. Alice found this activity easy and stated that she did an excellent job because she followed the directions and knew what to do (J4-A/ March 1, 2005). Supporting these findings, during her interview, Alice expressed that she is good at most of the tasks they do in the class and described herself as an advanced student in mathematics (I1-A/ April 20, 2005). In brief, data obtained from multiple sources provide evidence that Alice was very confident in her mathematics capabilities that could be related to her past and current mastery experiences.

**Evidence of strategic behavior.** Analyses of survey data provide evidence of Alice’s reported strategy use compared to other students in the class (see Appendix B). Her cognitive strategy use scale score was below the first quartile; that is, she reported lower levels of cognitive strategy use compared to most other students in the class in January and April. Her score was above the second quartile in terms of metacognitive strategy use scale and above the third quartile in terms of effort-regulation and help-seeking strategy use scales in January. The same pattern was observed for the help-seeking strategy use scale in April. With regard to the metacognitive strategy use scale, Alice’s score moved above the third quartile. In other words, she reported higher levels of metacognitive strategy use compared to most other students in the class. Her score for the effort regulation scale, on the other hand, moved above the second quartile in April.

The data obtained through problem-solving sessions were analyzed to understand Alice’s strategic behaviors in terms of analyzing the tasks and selecting and implementing problem-specific strategies as well as monitoring and evaluating the solution procedures. Alice demonstrated strategic behaviors to analyze all the problems
during the problem-solving sessions at the beginning and end of the study (see Appendix E for the problems). She often broke the problems down into small parts and reread and focused on understanding the problem situation. For example, she stated that she had to go back and read P#2 again in order to better understand during the first problem-solving session (I1-A (P#2) / Jan 25, 2005).

Alice: At first like I didn’t really understand because I had to kind of - sometimes I have to kind of- read the question again even if it’s like a simple question but when it’s like- I wasn’t sure whether it said Meijer sells 50 potatoes or 50 pounds of potatoes or whether it said 50 potatoes in four days and all that kind of stuff.

She made a similar comment for P#3 during the same session. In this problem, she commented that going back to the problem and reading again helped her to figure out what the problem asked (I1-A (P#3) / Jan 25, 2005).

Alice: Uh - probably because like it’s kind of a difficult problem because if you’re saying - first it says Ren has 13 more. Then it says Ren has 27. You kind of expect it to say Chet has 27. So like you figure out what Ren has- but it’s kind of confusing at first. But you’ve just got to reread it.

Analyzing the tasks helped Alice to select efficient problem-specific strategies. For example, she commented on P#4 that if the given numbers were multiples of each other, she could have solved the problem by multiplying. Based on her analysis of the task, she decided to solve the problem by setting up a proportion rather than using multiplication. The following quotation illustrates how Alice’s analyzing the task helped her to select the problem-specific strategy (I1-A (P#4) / Jan 25, 2005). It should also be noted that she might not be able to select this strategy without having an understanding of proportion.

Alice: I don’t know. It was kind of - at first -it was like six motorcycles in nine hours and then 16 - six and 16. You can’t just multiply to get - six by something to get 16. So you have to work out the problem instead of- like if it was six
motorcycles and nine hours and- how long did it take to make 12 motorcycles? And that would be easy because you would just have to multiply it … it makes it a little more complicated when- like it says six motorcycles and 16 motorcycles. It’s more complicated than just going from six to 18 because those numbers are all composed of six and it would be easier. But when it goes from six to 16 you have to work out the problem rather than just multiply it.

Alice also demonstrated use of strategic behaviors to control and regulate her problem solutions during both problem-solving sessions. When she realized that the strategy she selected did not work well, she tried another strategy. For example, she started solving P#1 by drawing a circle graph during the first problem-solving session. She, however, realized that this strategy would be difficult to employ because she had to divide the graph into $1/4$ and $1/5$. Instead of trying to figure out how to execute this strategy, she decided to change fractions into decimals and successfully completed the task. This example also illustrates that Alice’s competency in mathematics provided her with a range of problem-specific strategies from which she could select the more efficient.

Similarly, in the following quotation, Alice compared two solution procedures, evaluated their effectiveness, and chose the more efficient for herself (I1-A (P#5)/ Jan 25, 2005).

Alice: Uh - At first I thought it was going to take longer because I figured like $2.00 for the first 20 minutes and then 7 cents per minute and then after you take away the 20 minutes you still have 25. And some people would probably do like mark off every cent that would come up. Like 25 is 7 cents and then they would add another 7 cents and then they would add another 7 cents but when you multiply it makes it a lot easier.

Alice also demonstrated strategic effort to overcome her difficulties when she was executing problem-specific strategies. For example, during the second problem-solving session, regarding P#1, she stated that she was not sure about the value of $1/8$ of 100 at
first but then she remembered that 125 was 1/8 of 1000. By using this knowledge, she was able to complete the problem (I2-A (P#1)/ April 20, 2005).

Alice also monitored her problem solutions and evaluated her answers. One of the strategies she used most frequently during the second session was checking her answer to see whether it made sense to her. She also indicated that she would check the steps she followed to solve the problem when she was not sure about her solution. For instance, during the first problem-solving session, after she solved the P#1, she stated that she pictured the problem situation in her head to figure out what $\frac{1}{4}$ and $\frac{3}{5}$ of a whole would be to make sure that she correctly solved the problem. During the second problem-solving session, Alice used strategies to monitor her solution for P#4, 5, and 6, which required relatively higher levels of thinking compared to other problems. With regard to P#6, she stated that she used estimation to check whether her answer made sense (I2-A (P#6)/ April 20, 2005).

Alice: … like I knew that if I took like- for example if I had took 180 times 3 it would be somewhere close to 200 times 3 which would be about 600. So I knew it was about somewhere close. And then I knew here if I took like 550 times 3 it would give me like 1500, or 1600- I don’t know. But I kind of knew like it would be somewhere around there.

Alice’s strategic behaviors as described above assisted her in successfully completing all the tasks but one during both problem-solving sessions. Through her strategic efforts, for example, she was able to recover from a false start and successfully completed the P#5. In the following quotation, she indicated that she had difficulty understanding the problem but kept going back to the problem, rereading, and starting over (I2-A (P#5)/ April 20, 2005).
Alice: Probably for me it [the hardest part of the problem] would be figuring out – like I kept saying “0.4 of a mile times 10 equals four.” “0.4 times 10 equals four.” But I never really comprehended that that would be like important to the problem until I realized that like the taxi charges $2.35 for the first 0.4 and then 0.75 for the rest. So when I finally realized that 0.75 times 9 plus the first 0.4 would be (inaudible) number…It kind of helped me to start it again and just like keep looking at it and rereading it until I like finally got it.

In summary, analyses of data obtained from the questionnaire and problem-solving sessions provided some evidence regarding Alice’s strategic behavior. Even though she reported lower levels of cognitive and metacognitive strategy use compared to other students in the class, Alice demonstrated and articulated several strategies as she worked on the mathematical tasks during the problem-solving sessions.

*Participation in classroom practices.* Alice’s classroom practices were observed in 21 observed lessons and provided her a variety of opportunities to engage in tasks and activities, most of which resulted in success. Within the two lessons during which Alice was specifically observed engaging with the POD, she successfully completed both problems before most of her classmates. When the whole-class discussion began, Alice was almost always ready and willing to share her findings and solution strategies. Her participation, however, was not limited to the discussions about the PODs. In 21 lessons, 64 instances were recorded as evidence of her participation in classroom practices, mainly through whole-class discussions. She answered the teacher’s questions correctly or accomplished the task she was assigned to complete in ninety-four percent of these instances (60 out of 64).

These successful experiences may have assisted Alice in maintaining the high self-efficacy observed throughout the study. In addition, Alice was one of the students Mrs. Thompson allowed to choose challenging homework assignments instead of the
regularly assigned homework. Alice often took this opportunity. During her interview, she stated, “I had already done a lot of sixth grade math last year. So I kind of like having the challenge because it’s a little harder than stuff that I already know…I think they are helpful because it’s going to get me more prepared for seventh-grade math next year” (12-A/ April 20, 2005). As evidenced in her statements, challenging homework assignments provided Alice with opportunities to engage in tasks that could convey additional information regarding her capabilities. In this way, mastering these tasks seemed to provide a greater sense of accomplishment than mastering regular homework assignments.

Alice’s participation in whole-class discussions created opportunities for her to develop knowledge and skills and build competence. As an example, Mrs. Thompson introduced finding the volume of a prism by asking students if they knew what mass was. Alice shared her idea by stating, “how much matter is in an object” (CO/ Feb 24, 2005). During the discussion, another student described mass in terms of square units fit inside the figure, which was followed by Alice raising her hand and elaborating her description, “how many cubic units can fit inside of the 3D figure.” Alice’s contribution to the discussion was not only approved by the teacher but also created a context in which Mrs. Thompson directed students’ attention to the difference between units of measurement relative to area and volume: Mrs. T “So, we said then, volume is the number of cubic units that fit into a 3D figure. Compare or contrast that to the area.” In 21 lessons, 27 instances were observed as evidence of Alice’s participation in this type of activities by sharing her knowledge, ideas, and personal experiences.
Alice also found opportunities to exercise strategic behavior through her participation in joint learning activities in which the students analyzed tasks and selected, implemented, and compared problem-specific strategies together. In 21 lessons observed, 44 instances were recorded as evidence of her participation in this type of activities. Alice shared her findings and explained her solution strategies through these activities. As an example, the following quotation is taken from a class discussion where students were discussing a homework assignment, which required finding the area of two identical triangles that form a parallelogram (CO/ Feb 8, 2005).

Alice: I said, um- C because, um- if you do the base times height to get the triangle on the right, if you did, um- well then 12 times 8 inches to get 96- like you wouldn’t have to divide by two, because the triangle on the left would be the other part.

One of the main features of joint-learning activities was that Mrs. Thompson encouraged students to share and compare different ideas, approaches, and problem-specific strategies. Alice took this opportunity and shared her own ideas and strategies as well as made comments on other students’ ideas. For instance, the following episode was taken from the activity in which students were asked to fold a paper by its shorter side (hamburger style) and its longer side (hot-dog style) and compare the perimeters of two figures without using a standard unit of measurement. Here, Alice stated her agreement with Kyle’s strategy (CO/ Jan 28, 2005).

Alice: Well, like, um- Kyle said before, if you fold them half again, um- like if you do that- it’s just gonna [sic] be half of what you originally have. So, if the halves are equal then like, um- the whole thing should be equal. Mrs. T: OK. So, when you fold that in half, you’re saying that it’s just half of the same thing, of the original. Alice: Yeah.
Whole-class discussions like the one described below also fostered a context in which Alice used elaborative strategies like making connections between new and prior understandings. In the following example, Mrs. Thompson introduced the area of circles by reminding students about the definition of area and asking how they could apply this definition to find the area of a circle (CO/ Feb 10, 2005).

Alice: Number of square units inside the circle.
Mrs. T: Number of square units in the circle.
Alice [interrupting the teacher]: Yeah, but it doesn’t make sense.
Mrs. T: Yeah, that’s what area is, isn’t it? But it sounds kind of funny, doesn’t it?
Alice: Cause it doesn’t fit.

When Alice tried to apply her knowledge about area (i.e., number of square units inside a closed figure) to find the area of a circle, she realized that the notion of square units did not fit within this new situation. Mrs. Thompson supported Alice’s strategic effort by showing her agreement and guided the discussion by asking students why it would be difficult to count the number of square units in the circle.

Alice’s participation in class activities also fostered a context in which she received feedback. To illustrate, during the lesson described below, students were discussing the POD, which was about finding the fractional representations corresponding with geometric figures that make a whole square. After the teacher listed students’ findings for each figure, she asked them to share their strategies. Alice was one of the students who shared her solution strategy (CO/ Jan 27, 2005).

Alice: Well, I do- like if that’s already divided into equal fourths.
Mrs. T [interrupting her]: OK. Stop there, what do you mean by equal fourths?
Alice: Like parts of the square.
Mrs. T [walking towards the board and drawing a square, dividing it into four equal parts]: So, she’s saying, um- if you have the large square, one of the larger equal parts you see, does everybody see those four equal parts?
Ss: Yeah.
Mrs. T: OK. That’s what you’re talking about, OK. Go ahead Alice.
Alice [continuing her explanation]: …Like I divided into 16ths, um, and I knew that if as long as all the pieces are equal that it would be 16ths even though some of [them] might be triangles, some of them might be squares…
Mrs. T [showing the figure on the board]: So, if this is a fourth and you cut this in half and A, B, what are each of those?
Alice: Eights.
…
At the end of the discussion, Mrs. Thompson summarized students’ strategies:
Now, Alice’s strategy was- look at the 4th and then divide the pieces in each fourth into equal pieces was her strategy to get that.
Mrs. T: Was Alice’s strategy a good strategy? Looking at the fourths and cutting each fourth into equal parts?
Ss: Yes.

In this example, Mrs. Thompson paraphrased and elaborated upon Alice’s explanation by asking questions so that other students could also understand her solution procedures and make comments about her ideas. At the end of the discussion, Mrs. Thompson and other students agreed with her strategy. In this way, Alice received information regarding the effectiveness of her strategy and her success, which could enhance her strategic learning as well as her self-efficacy.

Alice’s participation in these activities also created a context in which she received assistance when she needed. In the following passage, students were discussing whether they should count zeros in a data set when they were finding the average (CO/Jan 31, 2005). By sharing her idea, Alice had an opportunity to receive the assistance she needed.

Mrs. T: She [Alice] says that two of the data turn to zero; she divided by six instead of eight. She divided by six. You wanna [sic] respond to that Nathan?”
Nathan disagreed and said that zero is still a number.
Mrs. T: And, what does that [zero] represent in that situation, Nicole?
Nicole: Homework grade.
Mrs. T: It’s a homework grade, so, if you get a zero on a homework grade, should I just not count it?
Ss: Yeah.
Mrs. T: So, you need to count on this piece of data. Yeah?

During the joint learning activities, Mrs. Thompson often stimulated students’ strategic behaviors by asking questions to analyze the tasks as well as select, compare, and evaluate problem-specific strategies. While students decided what strategies to employ and how to employ these strategies, Mrs. Thompson provided support when needed. There were instances, however, in which students demonstrated strategic effort without teacher assistance. These instances may indicate students’ internalization of these strategic behaviors because without abstracting and generalizing a strategy they would not be able to apply it to a new situation. In 21 lessons observed, Alice demonstrated this type of strategic behaviors in 15 instances. These strategic efforts included selecting and implementing problem-specific strategies as well as employing more general strategies for monitoring understanding and elaborating.

The following episode could be an example of these types of strategic behaviors Alice demonstrated (CO/ Feb 24, 2005). Here, students were discussing a POD that was a multiple-choice question. After they agreed on the answer, \(12 \times (10 + 4)\), one of the students suggested another solution, \((12 \times 10) + (12 \times 4)\). Even though his idea was not incorrect, Alice noticed that it was not one of the given choices and showed her disagreement by stating, “But that one's not one of the answers there.” During the follow-up discussion, Mrs. Thompson recognized Alice’s strategic effort, which could promote her sense of ownership over the strategy.

Mrs. T: I liked what Alice said. Everybody look up this way. If you did this way and found the area of the two smaller ones, and you went down below to the multiple choice to pick that but it wasn’t there. So, if it is written, if you found it this way- this is your knowledge of distributive property [writing \((12 \times 10) + (12 \times 4)\) on the board]. We can rewrite this as 12 is the number repeated, we can
rewrite that- 12 and then add the 10 plus 4 [writing $12 \times (10+4)$ on the board] because distributive property says if you multiply both by 12 we can add the other two numbers first, then multiply them both by 12 [showing & writing this up on the board].

During the whole-class discussions, Alice was also situated within a position of modeling mastery behavior. In 21 lessons, 11 instances were recorded as evidence of her modeling a successful performance. As can be seen in the sample episodes presented above, Mrs. Thompson often rephrased her statements to facilitate peer modeling. These experiences could provide Alice opportunities to observe her successful performances and hence have potential to strengthen her self-efficacy. Mrs. Thompson’s recognition of her ideas could also inform Alice about her accomplishments. In 21 lessons observed, Mrs. Thompson recognized Alice by referring to and talking through her ideas and strategies in 29 instances. This type of recognition provides persuasory efficacy information because it conveys the teacher’s realistic and sincere beliefs regarding Alice’s capabilities.

The next episode is an example of this type of efficacy information conveyed through the teacher’s messages. It is taken from a lesson in which Mrs. Thompson introduced circle graphs by asking students “What is a good time to use the circle graph?” After Alice and Todd shared their ideas, Mrs. Thompson described circle graphs by rephrasing and referring to their ideas (CO/ Jan 20, 2005). In this way, Alice not only received feedback regarding her success but was also recognized by the teacher.

Mrs. T: OK. So, she [Alice] gave the comparison of- like comparing the type- like what we did with bar graph but we’re comparing who likes monkeys, who likes lion, we’re comparing the amount, the other, parts out of one whole thing…So, circle graphs are used, then let’s write this down and put together what Alice and Todd said, “to represent parts of the whole” [referring to Alice’s explanation and writing on the board].
Alice also received persuasive efficacy information through Mrs. Thompson’s praise. In 21 lessons observed, Mrs. Thompson praised her in eight instances because she used effective strategies and presented alternative ideas and solution strategies. The following quotations taken from the episodes presented earlier are typical examples of teacher praise directed to Alice.

Alice: Multiply to get a power of ten.
Mrs. T: Excellent, because what are the decimal places based on?
Ss: Tenths.
Mrs. T: Tenths, powers of tens (CO/ Feb 1, 2005).

Mrs. T: I liked what Alice said. Everybody look up this way (CO/ Feb 24, 2005).

In summary, Alice frequently experienced success through her engagement with tasks and activities in the classroom. She also found opportunities to challenge herself through homework assignments. Mastering these challenging tasks could provide a greater sense of accomplishment than the regular tasks and help her to maintain high self-efficacy. Mrs. Thompson’s recognition could also convey information regarding her capabilities as she appraises self-efficacy. Furthermore, peer modeling practices created context in which Alice modeled successful performances. These practices and Mrs. Thompson’s recasting and rephrasing her mastery behaviors also provided Alice opportunities to observe her successful performances. In this way, these experiences could also strengthen her self-efficacy.

Alice’s participation in classroom practices also created opportunities for her to develop knowledge and skills to be strategic learner. By sharing her ideas and understandings she not only received feedback but also assistance when she needed. Through joint learning activities, she analyzed the tasks, selected, implemented, and
compared problem-specific strategies with or without teacher assistance. During these activities, Mrs. Thompson’s recognition of her strategic efforts could promote her ownership over these strategies.

*Focal Student #2: Kyle*

Kyle is an 11-year old Caucasian male student who did not receive free or reduced school lunch during the 2004-2005 academic year. Mrs. Thompson ranked him as an average-achieving student in the class based on his prior and current grades in mathematics. During his interview, Kyle mentioned that his favorite class was science. With regard to mathematics, he stated, “I don’t like the math the best is because sometimes you can get really hard with all the numbers and it’s like hard for me. I don’t understand.” He also pointed out that he used to like mathematics more in elementary school because it “seemed a lot easier. Now I’m in middle school, it is starting to get a little bit harder…It is just like a lot of procedures you have to go through” (I2-K/ May 3, 2005). Kyle indicated that he had to change the way he studied mathematics when he began middle school. In particular, he had to pay more attention to directions when working on mathematical tasks. Kyle sat next to Nathan, from whom he frequently received help. He, however, often worked with the students at other tables when Mrs. Thompson allowed them to choose a partner.

*Evidence of self-efficacy.* Data obtained from multiple sources over the course of the study suggest that Kyle was not confident in his mathematics abilities compared to most students in the class. His self-efficacy score was below the first quartile in January (see Appendix B). Over time, Kyle’s self-efficacy score decreased slightly but remained
within this range. In particular, his score decreased for the items that are related to accomplishing complex and difficult tasks.

Kyle reported slightly higher self-efficacy (M = 4.33, SD = .52) regarding specific mathematical tasks during the first problem-solving session. His self-efficacy ratings remained the same for four parallel problems during the second problem-solving session and decreased by two levels for P#4 and P#5, which required relatively higher levels of thinking compared to other problems (M = 3.67, SD = 1.03). These findings support survey results indicating a decrease in Kyle’s self-efficacy to accomplish complex and difficult tasks. Whereas Kyle successfully completed only two problems (P#2, 5) during the first problem-solving session, he was more successful during the second problem-solving session (see Appendix E for the problems). He successfully completed three problems and partially completed two problems. The only problem he was not able to complete successfully was the one for which he reported the lowest self-efficacy.

Data obtained through his journals support these findings. Kyle reported moderate self-efficacy (M = 3.00, SD = .82) to accomplish the classroom tasks on the days they wrote journals. He answered the question “How well can you successfully complete the tasks similar to the one’s that we’ve done today?” as “good enough” on the day they studied area of a parallelogram (J1-K/ Feb 2, 2005) and on the day they worked on finding patterns when doubling the sides of a square (March 1, 2005). Parallel with his efficacy ratings, he thought that he did an average job on these days. Kyle admitted that he did a poor job on the day they studied circumference and area of a circle (J2-K/ Feb 10, 2005) and rated his self-efficacy “poorly.” He found the activities they worked on these three days difficult and confusing. Kyle reported somewhat higher self-efficacy on
the day they played a game about matching geometric figures with their descriptions. He found this activity easy because they “just played a matching game” (J3-K/ Feb 22, 2005).

Briefly, analyses of data collected through the questionnaire and problem-solving sessions suggest that Kyle was less confident in his mathematics capabilities than most of his classmates. In particular, he reported low efficacy regarding the tasks and activities he perceived as complex and difficult. Analyses of his journals also support these findings.

Evidence of strategic behavior. Analyses of survey data provide evidence of Kyle’s reported strategy use compared to other students in the class (see Appendix B). His cognitive strategy use scale score was above the third quartile in January; that is, he reported higher levels of cognitive strategy use compared to most other students in the class. His score was above the second quartile in terms of metacognitive and effort regulation strategy use scales, and below the second quartile in terms of help-seeking strategy use scale. In other words, he was similar to most of his classmates with regard to his reported use of other self-regulatory strategies. The same pattern was observed in relation to his scores on all scales except help-seeking strategies scale in April. Kyle’s score on this scale moved above the third quartile; that is, he reported higher levels of help-seeking strategy use compared to his classmates.

The data obtained through problem-solving sessions also provided some evidence of Kyle’s strategic behaviors. Like Alice, Kyle demonstrated strategic effort to analyze all the problems during both problem-solving sessions. Typically, he broke down the problem into parts, reread, and paraphrased the problem situation. During the interview, he stated, “Sometimes I make mistakes and I don’t read it right. I just like read it real fast
and I don’t understand it. And so now I try to go back in if I don’t understand it” (I1-K/ Feb 4, 2005). Kyle demonstrated similar strategic behaviors to analyze the problems during the second problem-solving session. He, however, demonstrated greater focus on understanding the problem situation and tasks requirements. This type of strategic effort was explicitly observed for P#4 and P#5 in February and for P#1, 3, 4, 5, 6 in May. During the interview in May, he stated that his looking back at the P#1 and rereading helped him to figure out what the problem was asking (I2-K (P#1)/ May 3, 2005):

I: Did you have any difficulty in understanding the problem?
Kyle: Uh - at first I did- cause of the percentage and how Amanda paid the rest so.
I: And what helped you?
Kyle: I just like looked- I read it another time and then I figured out what it wanted you to do.

Kyle’s effort to understand the problem situation helped him to select efficient problem-specific strategies. For example, during the second problem-solving session, after he read P#3, he rephrased the problem situation in his own words: “Okay. So I had ten minutes before. But then I put in a quarter and I got 25 minutes. So I do 25 minus 10 equals 15. And then - so a quarter would probably be worth 15 minutes.” (I2-K (P#3) /May 3, 2005) Later he stated, “I noticed that if he had like ten minutes and he had 25, you’d probably have to minus [sic].” These statements indicate how his understanding of the problem situation assisted him to choose an effective strategy. In fact, Kyle was not able to solve the parallel version of the same task (P#3) correctly in February because he had focused on the numbers and key words (e.g., “more” means “plus”) instead of trying to understand the problem situation.

Even though Kyle was able to select an appropriate problem-specific strategy when he correctly analyzed the tasks, he struggled with executing the strategy because of
his lack of skills in mathematics. As an example, Kyle started solving P#4 by rephrasing the problem situation (I1-K (P#4)/ Feb 4, 2005): “Okay. If they make six in nine hours and then they need to make 16 motorcycles so how many times does six go into 16?” His articulation of the problem situation helped him to set the ratio correctly. In order to find the ratio, Kyle first multiplied six by two and found 12, and then he multiplied six by three and found 18. Since he was not able to find 16, he changed his strategy and set another ratio. This time he wanted to find out “how many motorcycles they can make per hour or two hours.” Even though the ratio he set was correct, he was not able to find it by using addition. Later, he stated his difficulty as, “I was trying to do uh- six - nine divided by six. But then I’m not really a good divider so - I tried to do the plus [sic] and that didn’t work out. So then I just didn’t know what else to do.”

The above example illustrates Kyle’s strategic efforts in terms of controlling and regulating his problem solving behaviors to overcome his difficulties. Because he was aware of his struggle with division, he tried to find the ratio without using division. He was not, however, successful in his attempts. Kyle demonstrated similar difficulties and strategic behaviors during the second problem-solving session. With regard to the parallel task (P#4), he set the ratios correctly and considered the multiplicative relationship between the ratios to solve the problem, as illustrated in the following quotation (I2-K (P#4)/ May 3, 2005):

Kyle: So she runs 18 minutes then 18 + 18 equals 36- but that’s too much. So that would be ten km. You’d have to minus a little bit. So probably 9 + 18 equals uh-27 but that’s still too much. So I’d have to minus [sic] probably more than half-maybe more like- 8, um, let’s try 7+18 equals 25. That’s less than half. Probably 2 + 5 equals 7. So she would probably run 7km in 25 minutes.
He, however, used estimation to find the ratio. Even though his method helped him to solve the problem, he found an approximate answer. Likewise, with regard to P#5, Kyle used multiple additions to find “how many 0.04 miles go into four miles” (I2-K (P#5)/ May 3, 2005). After a few attempts, however, he gave up solving the problem.

Besides using estimation and multiple additions, Kyle used several other ways to make the execution of problem-specific strategies easy for him, some of which resulted in success. For example, with regard to the P#5 during the first problem-solving session, Kyle explained how he simplified multiplication of 0.25 by seven as, “I just counted because I knew that- I remembered that 25 goes into 100 four times so I did- that would equal 8 to go 200 so and then I had seven so I just minus [sic] $0.25” (I1-K (P#5)/ Feb 4, 2005). Similarly, in order to multiply five by 1.01 to solve P#6, Kyle used the distributive property; he multiplied five by one and 0.01 separately and then added the results (I1-K (P#6)/ Feb 4, 2005).

Kyle used relatively fewer strategies to monitor his solution procedures and evaluate his answer. During the first problem-solving session, he stated that he looked back at the numbers, names, and key words to make sure that he got the correct information while he was solving the problems (P# 3, 4, 5, 6). He did not, however, demonstrate any strategic behavior to check his answer and solution procedures. During the same problem-solving session, he was not able to correctly solve P#1 because he made a procedural error. He demonstrated more strategic effort to monitor his problem solving procedures in May. In fact, he was able to notice his mistake on P#1 while he was checking his solution. Similarly, after he solved P#3, he stated that the hardest part about solving the problem was to make sure that he was not making a mistake because the
problem seemed easy: “I just like read it over to make sure they weren’t like tricking me somewhere” (I2-K (P#3) /May 3, 2005). Kyle also stated that he redid the addition to make sure his answer was correct when solving P#2.

Kyle successfully completed two problems (P#2, 5) in February. Even though he selected an appropriate strategy for P#1, he made a computational error. He focused on the key words instead of trying to understand the problem situation, which caused him to choose incorrect problem-specific strategies for P#3 and P#6. As discussed earlier, Kyle was not able to execute his problem-specific strategies for P#4 in January and P#5 in May because of his lack of skills. Kyle’s strategic behaviors related to analyzing the tasks and monitoring the solution procedures assisted him to complete more problems in May. He successfully completed three problems (P#1, 2, 6) and partially completed two problems (P#3, 4).

In summary, Kyle demonstrated several strategic behaviors in order to analyze the tasks such as rereading, breaking down the task, and paraphrasing during both problem-solving sessions. Even though these strategies often helped him to select an appropriate problem-specific strategy, his lack of skills related to some mathematics concepts constrained his execution of these strategies appropriately. Kyle demonstrated greater strategic effort in terms of analyzing the tasks as well as monitoring his solution procedures during the second problem-solving session.

Participation in classroom practices. Kyle’s classroom practices during 20 observed lessons provided him opportunities to engage with tasks and activities through whole-class discussions as well as small group activities. Compared to the students at Alice’s and Mike’s table group, students at Kyle’s table group interacted more with each
other. Hence, unlike Alice and Mike, Kyle frequently shared his ideas in addition to receiving and providing assistance during group activities. Kyle’s classroom practices resulted in successful and unsuccessful enactive experiences. In 20 lessons, 26 instances were observed as evidence of his participation in class activities through whole-class discussions and small group activities of which 62% (16 out of 26) were successful.

Within the four lessons during which Kyle was specifically observed engaging with the POD, he successfully completed three PODs, two of which was through the teacher and peer assistance. In the following example, students were expected to describe three real-life situations that they needed to find area and perimeter of a figure (CO/ Feb 4, 2005). After reading the POD, Kyle shared his idea with his table group:

Kyle: Like building a house.
Nathan: But it has to be complete sentences.
Luke [repeating Kyle's suggestion]: Building a house, windows!
Nathan: But how? (inaudible)
Luke [interrupting Nathan]: Put the lines [making a frame by using his arms in the air]
Nathan: Oh, like how big it is or something?

This episode shows that Kyle created a context to discuss his ideas by interacting with other students at his table group. Nathan’s questions asking for elaboration and Luke’s suggestions might have assisted Kyle to revise his response because when Mrs. Thompson came close to their table his description was more specific than the first one: “I got building a house- like setting a room- like putting a desk somewhere.” Mrs. Thompson helped him to further elaborate his example by asking why he would need to know the perimeter. Kyle’s response “like put the walls on” illustrates that he developed his example further through these interactions.
Kyle was able to complete most of the PODs with some effort before they began the whole-class discussions; however, he rarely volunteered to share his findings within these discussions. Likewise, he participated in the construction of joint understandings less frequently than Alice and Mike. In 20 lessons, only eight instances were observed as evidence of his participation in this type of activities. For example, the following episode is taken from a class discussion in which the students were comparing the properties of squares and rectangles (CO/ Jan 31, 2005). Kyle’s participation created a context in which he was able to elaborate his explanation, which could help him develop better understandings.

Mrs. T: Is a rectangle a square?
Ss: No.
Mrs. T called on Kyle to explain.
Kyle: Because, um, the sides- the length and the width, it is like- the same.
Mrs. T: Ok, so what has to be true for it to be a square?
Kyle: All sides have to be the same… if you put two squares together, it would make a rectangle. But if you take a rectangle, it’s long and … (inaudible)

In 20 observed lessons, Kyle participated in joint learning activities through whole-class as well as small group discussions in 27. His participation supported a context in which he exercised strategic behaviors and received feedback and assistance he needed. For example, during the activity in which they were comparing the perimeters of papers folded as hamburger style and hot-dog style, Kyle argued that both figures have the same perimeter because when they folded them by their shorter sides one more time they would get the same figure. As illustrated in the following episode, by sharing his idea Kyle received feedback from Mrs. Thompson regarding his strategy (CO/ Jan 28, 2005).
Mrs. T: So, since you can fold it to be the same, you think the…
Kyle [interrupting]: These equal.
Mrs. T: Ok, now, are we still looking at the same perimeters here?
Mrs. T: Did we change the perimeter?
Ss: Yes.
Mrs. T: So, we wanna keep it as looking at the perimeter of this and perimeter of this, right?

Kyle usually needed teacher pressure and encouragement in order to share his ideas through whole-class discussions. Considering his low self-efficacy relative to other students in the class, his unwillingness might be expected. Because he participated in fewer class discussions, he received relatively less feedback and assistance from the teacher through these discussions compared to Mike and Alice. Mrs. Thompson often provided him feedback and assistance during the small group activities. She usually came over to his table and provided help not only to Kyle but also to other students at the table. The following example illustrates one of these instances. Here students were expected to find a rule for the perimeter of any regular polygon when the number of the sides and the length of the sides for several regular polygons were given. Kyle’s answer was “adding up the four sides or multiply by four” which could only be applied to the polygons with four-sides. As illustrated below, through the teacher’s guidance, Kyle and other students at his table group completed the task together (CO/ Feb 8, 2005).

Mrs. T: Now, if you want to find the perimeter of a pentagon, that all the sides are four, you could have 4 plus, 4 plus, 4 plus, 4 plus, 4. OK?
Mrs. T: What would be the quicker way to do it?
Larry: Multiply by um…
Nathan: Multiply the number of sides times the number of [sic] length, you get the perimeter.
Mrs. T: So, that would work for any one, right?
Mrs. T [turned to Kyle]: So, you did a specific one, multiply by four. But what if it has five sides- if they’re saying six sides- if they’re saying seven, well, Nathan, tell him again, but slow, so he understands what you’re saying.
Nathan: Um…multiply the number of sides by the length.
Kyle: Oh.

Such guidance is particularly important in the early stages of developing new skills because a student’s self-efficacy has not been firmly established yet. In this sense, these guided enactive experiences have potential to support Kyle’s self-efficacy. Teacher assistance could also support Kyle in developing the necessary knowledge and skills to build competence and hence impact his strategic learning.

Kyle also received feedback and assistance from the students at his table group. In the following episode, students were reviewing the area of triangles (CO/ Feb 4, 2005).

Kyle was able to complete the first two problems with Nathan’s assistance.

Kyle [asking Nathan]: So, you just multiply these?
Nathan: Yeah, and divided by two. Write down the formula, too.
Kyle: Times it, what?
Nathan: Here, here, hold on.
Luke [showing the formula on the board]: Here, the combination is up there.
Kyle: You times and then divided by two?

After Kyle completed the first problem, he showed his work to Nathan and asked for his approval: “Like this? You do this and then you…” Nathan looked at his paper and interrupted him “Umm, actually, no, no.” Then he showed his own paper and explained how he solved the problem. With Nathan’s assistance, Kyle started over. A few minutes later, Hassan asked for help and Kyle was the one who provided assistance. His explanation indicates mastery of the skill: “Base times height divided by two, it’s like the same procedure. Four times six equals 24 and 24 divided by two equals 12.”
Even though Kyle was able to complete the first problem, he still needed assistance for the next problem. He asked Nathan if he could use the same procedure and, only after Nathan’s approval, he began working on the problem. For the following problem, which required more than simply applying the formula, Kyle asked for Nathan’s assistance again. Nathan, however, was discussing other problems with Luke and Larry and did not respond to Kyle’s request. When Nathan’s assistance was withdrawn, Kyle gave up trying to solve the problem.

Kyle’s frequent inability to successfully complete the tasks without others’ assistance may be associated with his relatively lower self-efficacy. He usually relied on other students’ feedback and assistance, especially when he was challenged. This reluctance probably occurred because he was not confident in his capabilities. On the other hand, these guided enactive mastery experiences could provide limited information regarding his competence. In this sense, his reported lower self-efficacy in relation to difficult and complex tasks might be related to his lack of enactive experiences.

The episode presented above also illustrates Kyle’s vicarious experiences within the small-group activities. Specifically, Nathan’s modeling of mastery behavior helped Kyle to complete the task. Hence, when Hassan asked for help, Kyle was the model who demonstrated the mastery behavior. In 20 lessons, only three instances were recorded as evidence of Kyle’s modeling successful performances, two of which took place during group activities. The following episode is an example of Kyle’s modeling a successful performance during a whole-class discussion (CO/ Feb 17, 2005). He shared his solution for the POD, which involved finding the amount of molding needed to go around a rectangular doorframe with dimensions 80in. by 30in.
Kyle: Like- I first- I though it was like- I had to add them all up to get 220, and then…
Mrs. T [interrupts]: So, you added all, what?
Kyle: Like 80 and 80 and 30 and 30.
Mrs. T: So, you added side plus side plus side plus side. You use that formula?
Kyle: Yeah.
While Kyle was explaining, Mrs. T wrote the formula and the answer: 220.
Kyle [continues]: And then I went back to the directions, and I saw that I’m not suppose to count the bottom cause they’re going to put like a frame on it, and you weren’t supposed to put the bottom, so I did 30 minus [sic] 220 and I got 190.
Mrs. T: Kyle- that was very impressive- your strategy. And it was also impressive the way you expressed. Didn’t he express very clearly?
Ss: Yes.
Mrs. T: I love the way you said; first this is what I did but then I went back to the problem, and I reread the directions and then this is what I did and proved your answer. This was an excellent strategy and that was an excellent explanation, very clear.

This episode also illustrates his internalization of these strategic behaviors. In 20 lessons, three instances were observed as evidence of this type of strategic behavior. Mrs. Thompson recognized and praised Kyle’s strategic effort, which could promote his sense of ownership over this strategic behavior and serve as persuasory efficacy information. Compared to Alice, Kyle received relatively less teacher recognition. In 20 lessons, five instances were observed as evidence of the teacher’s recognition of Kyle’s ideas and strategic effort, and two instances were observed as evidence of teacher praise.

In summary, Kyle’s efforts to participate in classroom practices resulted in successful as well as unsuccessful enactive experiences. He usually engaged with tasks and activities through whole-class discussions as well as small group work. During group activities, he often experienced mastery with classmate assistance. Since he accomplished the tasks with assistance, these guided mastery experiences may provide Kyle limited information regarding his own capabilities. Compared to Alice, Kyle received less
persuasory efficacy information through teacher recognition. Similarly, he had fewer opportunities to observe his own mastery behavior through modeling practices.

Kyle found opportunities to develop understandings of mathematical concepts and exercise strategic behaviors through his participation in whole-class and small group discussions. During these activities he received feedback and assistance from the teacher as well as from the students in his table group. He also found opportunities to observe other students’ performances in his table group. Mrs. Thompson encouraged Kyle’s participation in whole-class discussions and recognized his ideas and strategic effort, and also provided support at his table group. Compared to Alice, Kyle demonstrated fewer behaviors that could be evidence of his internalization of strategic learning.

**Focal Student #3: Mike**

Mike is an 11-year old Caucasian male student who received free school lunch during 2004-2005 academic year. Mrs. Thompson ranked him as a less proficient student in the class based on his prior and current grades in mathematics. During his interview (I2-M/ May 12, 2005), Mike stated that he liked all of his classes but preferred reading and mathematics. He pointed out that he liked mathematics more that year than the year before because he understood it better, even though he admitted the material was harder for him. He indicated that he was studying and learning more than in previous years. Mike sat next to Ted, with whom he rarely interacted during the group activities. He usually worked with students from other table groups when Mrs. Thompson allowed them to choose partners.

Evidence of self-efficacy. Data obtained through multiple sources suggest that Mike was very confident in his mathematics capabilities early in the year but his self-
efficacy decreased over the course of the study. His self-efficacy scale score was above the third quartile in January (see Appendix B). In fact, he was one of the three students who reported the highest self-efficacy. Mike reported lower self-efficacy in relation to accomplishing complex and difficult tasks and his self-efficacy score moved above the second quartile in April.

Mike’s self-efficacy regarding specific mathematical tasks exhibits a similar pattern. He reported that he was very confident in solving most of the problems during the first problem-solving session (M = 4.33, SD = 1.03). His self-efficacy decreased slightly later in the school year (M = 3.00, SD = .00). It should be noted that even though Mike reported lower self-efficacy, he was able to successfully complete more tasks during the second problem-solving session.

Mike reported moderate self-efficacy (M = 3.75, SD = .50) to accomplish the classroom tasks on the days they wrote journals. His answer to the prompt, “How well can you successfully complete the tasks similar to the one’s that we’ve done today?”, was “well” for three out of four lessons (J1-M/ Feb 2, 2005; J2-M/ Feb 10, 2005; J3-K/ Feb 22, 2005). He stated that he found the activities easy on the day they studied circumference and area of a circle (J2-M/ Feb 10, 2005) and on the day they played a game about matching geometric figures with their descriptions (J3-K/ Feb 22, 2005). Mike noted that he found the activities about the area of a parallelogram somewhat difficult because the topic was new for him (J1-M/ Feb 2, 2005). He stated, however, that he did an excellent job because he “took notes and paid attention.” Mike also reported that the activity about finding patterns when doubling the sides of a square was somewhat difficult for him and stated that he did an average job. He responded to the question
asking how well he could successfully complete similar tasks as “good enough” on this
day (J4-M/ March 1, 2005).

Briefly, data collected through the survey and problem-solving sessions provide
evidence that Mike was very confident in his mathematics capabilities compared to most
of his classmates early in the year; however, his self-efficacy decreased over the course
of the study. It should be noted that even though Mike reported lower self-efficacy for
solving the problems in May, he successfully completed more problems than he did in
January.

Evidence of strategic behavior. Analyses of survey data provide evidence of
Mike’s reported strategy use compared to other students in the class (see Appendix B).
Mike’s scores on all strategy use scales were above the third quartile in January. The
same pattern was observed for all strategy use scales except the help-seeking strategy
scale in April. Mike’s score on this scale decreased and moved above the quartile.

The data obtained through problem-solving sessions also provide some evidence
of Mike’s strategic behaviors in relation to specific mathematical problems. Like Alice
and Kyle, Mike demonstrated strategic behaviors to analyze the problems during both
problem-solving sessions. He often analyzed the tasks by breaking them into parts and
rereading. He also wrote down the given information in order to analyze some problems
(P#1, 3, 6 in February and P#3 in May). With regard to the P#6 on the first problem-
solving session, he stated that writing down what he thought on the paper helped him to
understand the problem. Mike also pointed out that Mrs. Thompson encouraged him to
use this strategy: “[Mrs. Thompson] explained to me that that’s better and I didn’t [sic] it
was but it really was” (I1- M/ Feb 10, 2005).
Teacher ranking indicated that Mike was less proficient than other students in the class, which constrained his selection and execution of problem specific strategies. In fact, he carried out incorrect problem-specific strategies for P#1 and P#4 in February. For example, in order to solve P#4, he set up a proportion but disregarded the multiplicative relationship between the ratios and used subtraction to solve the proportion (I1-M (P#4)/ Feb 10, 2005).

Mike: I knew that six wasn’t going to go into 16 evenly and what I did was 6 times 3 and I got 18 and then I did 9 times 3 and I got 27. And I knew since there is 18 and I had two more things than I needed and then I subtracted that by two and I got 16. And then I subtracted 27 - 9 times 3 equals 27 from minus 2 and got 25.

Even though Mike was not able to solve the parallel tasks during the second problem-solving session, he demonstrated more strategic behaviors and better understandings related to the concepts. With regard to P#4, which required solving a proportion, Mike was aware that his difficulty was the necessity to “get something to go into 18 evenly.” Like Alice, he commented, “it would be [sic] easier if there was like a number that would go into 18 evenly without doing something in 3/4 and stuff like that” (I2-M (P#4)/ May 12, 2005). These statements indicate better understanding of the multiplicative relationship between ratios. Similarly, with regard to the P#1 which required changing percents and fractions into each other, Mike stated his difficulty as (I2-M (P#1)/ May 12, 2005):

Mike: I know who has the most or paid the most but I don’t know how to explain it.
I: Who paid the most?
Mike: Uh - I’m pretty sure Amanda did.
I: Why do you think so?
Mike: Cause 1/8th isn’t really that much and 35% isn’t really that much – so that equals like a little less than 50%, and that’s how.
Even though Mike stated that he knew $\frac{1}{8}$ of the total amount together with the 35% of it would be less than 50% he was not able to explain his reasoning. He noted, however, that he would have changed 35% into a fraction if he had a calculator and then compared the amounts by drawing figures representing the fractions. These examples indicate that Mike was more aware of his difficulties and able to articulate how to overcome these difficulties in May.

Compared to Alice and Kyle, however, Mike demonstrated fewer strategic behaviors in order to make his solution procedures easier to execute. Similar to Kyle, he used multiple additions instead of division and multiplication. For instance, during the second problem-solving session, Mike used addition in order to see how many times 0.4 of a mile goes in to four miles (P#6). He added 0.4 ten times to get four. Even though this strategy might seem less efficient and more time consuming, it allowed Mike to successfully complete a problem that he may not otherwise have been able to complete.

Mike also stated that he looked back at the problem and re-read it to make sure that he was on the right track for P#1, 4, 5 on the first problem-solving session, and P#2, 3 on the second problem-solving session. He, however, did not realize his mistake on P#2 even though he stated using a monitoring strategy. Mike also indicated that writing down his work was another way to check his solution (P#2, 6) in February. He commented (I1-M/ Feb 10, 2005), “It’s just like when you spell a word. I don’t like saying it out. I’m better at writing it down.” As illustrated in the following example, with regard to P#3, he also noted that he checked whether his answer made sense to him (I1-M (P#3)/ Feb 10, 2005).
Mike: I kind of messed up right here at first because it didn’t look right. Because I added these—this one right here—instead of subtracting.
I: I noticed that - why did you change your result?
Mike: Because like it says - Ren has 13 more and not less.
I: Uhhuh. You thought that it couldn’t be right?
Mike: Yeah.

Mike checked his findings and solution procedures only for P#5 and P#6 during the second problem-solving session. Regarding P#5, after he added 0.75 nine times, he stated that he needed to check his addition because he was not sure about the result.

Mike successfully completed only two problems (P#2, 6) and partially completed one problem (P#3) in January. He employed incorrect problem-specific strategies to solve P#1 and P#4 and analyzed the problem situation incorrectly for P#5. Mike was able to successfully complete more tasks (P#2, 3, 5, 6) in May through his strategic effort in terms of analyzing the tasks. Even though he still was not able to solve the parallel versions of P#1 and P#4 correctly, he was more aware of his difficulties that prevented him to employ incorrect problem-specific strategies.

To summarize, like Alice and Kyle, Mike demonstrated strategic behaviors in order to analyze the tasks by breaking them into parts, rereading, and writing down the given information. During the first problem-solving session, he particularly struggled with the selection and execution of problem-specific strategies. However, he demonstrated more strategic behaviors and better understandings of mathematical concepts regarding these problems during the second problem-solving session.

*Participation in classroom practices.* Mike’s participation within 17 observed lessons provided him opportunities to engage in tasks and activities mainly through whole-class discussions. In 17 lessons, 32 instances were observed as evidence of his
participation in classroom practices of which 75% (24 out of 32) were successful. Within
the three lessons during which he was specifically observed engaging with the POD, he
was able to partially complete one POD. He struggled to complete the PODs, especially
when they required higher-level skills like problem-solving strategies. Even though Mike
was often among the last to finish the POD, he put effort into participating in whole-class
discussions by sharing his ideas.

In the following example, students were expected to find the decimal equivalents
of fractions representing the area covered by each continent and then rank the continents
by size (CO/ Feb 1, 2005). After they found the decimal equivalents through whole-class
discussion, one of the students put the decimals in order. While she correctly ordered the
numbers, Mike disagreed with her and suggested that 0.05 must be greater than 0.2. As
illustrated in the following episode, his participation in discussion created a context in
which he received teacher feedback and assistance.

Mrs. T [showing the 0.05]: What’s on one’s place?
Ss: Zero.
Mrs. T [showing 0.05]: Now, how many tenths are right here?
Mike: Zero.
Mrs. T [showing 0.2]: How many tenths are here?
Mike Two.
Mrs. T: So, tenths place, this is a bigger place then hundredths cause tenths would
be strips in our model, hundredths would be the individual places. Remember we
can also put zeros here [writing 0.20] and that would be the same thing. OK,
because two tenths is the same as twenty- the little individual hundredths. So, now
you have five hundredths and twenty hundredths. So, twenty hundredths and
thirty hundredths is more than five hundredths. OK? Good?

Mike also participated in whole-class discussions and contributed to the
construction of shared understandings. In 17 lessons, 16 instances were recorded as
evidence of his participation in this type of activities, usually by providing definitions of
basic concept (e.g., area, perimeter, and circle). Through these activities, he experienced mastery and received feedback that indicated his success. In this way, these classroom practices have potential to support his strategic learning as well as his self-efficacy.

Mike also found opportunities to build competence by participating in joint learning activities. In 17 lessons observed, 28 instances were recorded as evidence of his participation in this type of activities, mainly through whole-class discussions. During these activities, he shared his solutions and explained and justified his findings, ideas, and problem-specific strategies. As mentioned earlier, Mrs. Thompson frequently supported students in explaining their ideas by asking questions and rephrasing their statements. This type of support was especially important for Mike’s participation because he often needed assistance to express his ideas. For example, in the following episode, students were discussing a homework assignment (CO/ Feb 1, 2005). After Mike shared his findings, Mrs. Thompson asked him to explain his solution. With the teacher’s assistance and classmates’ participation in the discussion, they elaborated upon Mike’s explanation.

Mrs. T: The total outside that we’re talking 60cm for a perimeter of a square. Perimeter equals 60cm. We’re talking about all the way around. The total is 60cm. Now, the question asks what the length of one side is.
Mike: 15 cm.
Mrs. T: OK, how did you get that?
Mike: It’s just a quarter of 60.
Mrs. T: OK, quarter- why is that quarter of?
Larry: Because you can multiply of 15 by four to get 60.
Mrs. T: Where does the four come from?
Larry: Four sides of the square.
Mrs. T: Four sides of the square. Are they all the same?
Ss: Yes.
Mrs. T: So, he’s saying, take 60 divided by four because 60 is the total perimeter, so he’s saying take 60 divided by four to get just one of the sides. And since all the sides, they are all the same, you can divide by four.
Through his participation in these activities, Mike found opportunities to analyze tasks, select and implement strategies, and receive teacher feedback. For instance, during the discussion of a problem which required finding and then comparing the area of two rectangular figures, Mike volunteered to share his solution on the board (CO/ Feb 8, 2005). After finding the areas of two figures \((15 \times 60 = 900\) and \(15\times20=300\)), he divided both areas by two \((900/2=450\) and \(300/2=150\)) and then found the answer by dividing 450 by 150. Subsequently, another student suggested dividing 900 by 300 without simplifying by two. Mrs. Thompson facilitated the discussion by asking Mike and other students to compare both strategies.

Joint learning activities also provided Mike opportunities to exercise and internalize strategic behaviors. In 17 lessons, five instances were recorded as evidence of this type of behavior. For example, during a whole-class discussion, Mike stated his disagreement when the answer did not make sense to him. Mrs. Thompson recognized this effort, stating, “That’s good that you’re thinking about whether your answer makes sense. It just didn’t make sense to you when you’re thinking about in terms of inches” (CO/ Feb 8, 2005). This type of teacher support could enhance his sense of ownership over the strategy use. Similarly, during the activity in which students were comparing the perimeters of papers folded as hamburger style and hot-dog style, Mike’s strategy was using his pen as a nonstandard unit of measurement. His strategic effort was recognized by the teacher (CO/ Jan 28, 2005):

Mrs. T: Did you hear what he said? He used pen as a measuring stick. That’s a good nonstandard unit of measure… Now, Mike had a great strategy of using his pen as a nonstandard unit of measure.
Mrs. Thompson’s recognition provided persuasory efficacy information that could inform Mike about his achievement. In 17 lessons, eight instances were recorded as evidence of teacher recognition of Mike’s ideas and three instances were also recorded as evidence of teacher praise. The example above also illustrates one of the three instances where Mike modeled a successful performance.

Briefly, similar to Kyle, Mike’s efforts to participate in classroom practices resulted in successful as well as unsuccessful enactive experiences. Unlike Kyle, Mike participated in more whole-class discussions. His engagement created contexts in which he received feedback regarding his performances. Compared to Alice, Mike’s classroom practices provided less persuasory efficacy information. Mike’s participation in whole-class discussions also created opportunities for him to develop knowledge and skills through which he could build competence for and through strategic learning. By sharing his ideas, Mike frequently received feedback and assistance when needed. He exercised strategic behaviors and received teacher feedback and support through his participation in joint learning activities. During these activities, Mrs. Thompson’s recognition of his strategic effort could also promote his ownership of these strategies.

Cross-Case Analysis

Data were analyzed across the cases to identify patterns and themes that may explain the interplay between students’ development of SRL (i.e., self-efficacy and strategic learning) and their participation in classroom practices. For this purpose, focal students’ development of self-efficacy and strategic learning were compared. Then their classroom practices were examined in relation to their development of self-efficacy and strategic learning.
Self-Efficacy

Students’ self-efficacy ratings as drawn from several sources of data illustrate some differences with regard to these students’ existing and evolving self-efficacy over the course of the study (see Appendix I). Alice and Mike reported higher self-efficacy at the beginning of the study, whereas Kyle’s self-efficacy was low compared to most students in the class. All three focal students reported high self-efficacy in relation to specific mathematical tasks; however, only Alice was able to complete all the tasks successfully. Kyle and Mike were less successful with regard to solving the problems on which they reported high self-efficacy.

Over the course of the study, Alice maintained high self-efficacy, whereas Kyle’s and Mike’s self-efficacy decreased in relation to the class average. Specifically, they reported lower self-efficacy in relation to accomplishing complex and difficult tasks. Interestingly, even though Kyle and Mike reported lower self-efficacy with regard to solving parallel mathematical tasks during the second problem-solving session, they successfully completed more problems than they did during the first problem-solving session. The decrease in these students’ self-efficacy ratings may indicate some calibration of their judgments. These students were simply more realistic about their performances in relation to accomplishing the tasks on the second problem-solving session.

Strategic Behavior

Focal students’ self-reported and observed strategic behaviors as assessed through the surveys and problem-solving sessions illustrate some similarities as well as differences (see Appendix J). In particular, all three students reported average to high use
of metacognitive, effort-regulation, and help-seeking strategies compared to other students in the class in January and May. The only difference was that Alice reported less use of cognitive strategies compared to Kyle and Mike as well as most students in the class.

Focal students’ strategic behaviors as observed during the problem-solving sessions revealed more differences. In particular, all three students demonstrated strategic efforts to analyze the tasks. Breaking down the tasks into parts and rereading were the most common strategies observed. In addition to these strategies, Kyle paraphrased the problems and Mike wrote down the given information to help him analyze the tasks.

All three focal students demonstrated strategic efforts in terms of selecting and implementing problem-specific strategies and monitoring their solution procedures to some extent. Whereas Alice articulated a range of problem-specific strategies from which she selected those that she found most efficient and demonstrated strategic behaviors to execute her solution procedures, Kyle and Mike demonstrated some difficulties in selecting and implementing problem-specific strategies. Specifically, Mike’s weak content knowledge constrained his selection of appropriate problem-specific strategies to solve the problem. In fact, he employed incorrect problem-specific strategies in order to solve two problems during the first problem-solving session. Even though Kyle usually was successful selecting an appropriate problem-specific strategy, his lack of skills in mathematics constrained the execution of these strategies. He was aware of his difficulties, however, and demonstrated strategic effort to control and regulate his solution procedures.
During the second problem-solving session, Alice’s strategic behaviors did not show any major differences, whereas Kyle’s and Mike’s did. Even though Kyle was still struggling with the concepts with which he had difficulty during the first problem-solving session, he demonstrated more strategic efforts in terms of analyzing tasks and monitoring. In particular, he focused on understanding the problem situation for more problems in May. Furthermore, he demonstrated more strategic effort to monitor the execution of problem-specific strategies. Mike also demonstrated more effective strategic behaviors during the second problem-solving session. He was more aware of his difficulties and able to articulate how to overcome these difficulties. He also demonstrated better understandings of mathematical concepts that might have impacted his strategic efforts as observed in May.

Classroom Practices and SRL

Analyses of focal students’ classroom practices revealed some differences in terms of their engagement with the tasks and activities as well as their interaction with the teacher and other students. As already discussed within each case, these classroom practices have the potential to impact students’ self-efficacy and strategic learning. In order to better understand the ways they support or constrain students’ self-regulation, in this section, these classroom practices are examined across the cases by taking into account focal students’ self-efficacy and strategic learning assessed over the course of the study. The themes that emerged from these analyses are presented in Appendix K. Even though they are related to each other, each theme is discussed separately for the sake of clarity. Note that while the total number of classroom observations is 22, Alice was present in 21 lessons, Kyle was present in 20 lessons, and Mike was present in 17
lessons. In order to facilitate the comparison, the proportion corresponding to the number of instances per day is included in parenthesis.

*Participation structure.* One of the major differences observed among the three cases was the way they participated in classroom practices. While focal students usually worked individually during the POD and in small groups during the introduction to a new topic, their engagement differed during these activities. For example, whereas Alice and Mike interacted less with students at their table groups, Kyle found more opportunities to share his ideas within his group. He received and provided help during these interactions.

Alice and Mike participated in more whole-class discussions than Kyle. It should be noted that even though Mrs. Thompson called on each student at least once during almost every lesson, students who volunteered had a greater chance to be called upon. Kyle usually needed teacher encouragement to share his ideas within whole-class discussions. Taken into account his low self-efficacy relative to Alice and Mike, Kyle’s unwillingness to participate in whole class-discussions might be expected because students may avoid engaging in tasks in which they do not feel confident (Pajares, 1997). Supporting this finding, Mike, the lower-achieving student who was confident in his capabilities, participated in more class discussions than Kyle. While Mike’s high self-efficacy relative to Kyle may be one reason for this behavior, the role of classroom context supporting his participation should not be disregarded.

*Experiencing mastery.* Another major difference observed among the three cases was the number of times the focal students experienced mastery through their participation in classroom practices. As can be seen in Appendix K, Alice’s efforts to participate generally resulted in success. Mike also experienced mastery more than Kyle.
Examining the way each focal student experienced mastery also revealed some differences. Alice usually experienced success without any assistance, whereas Mike and Kyle needed teacher guidance to accomplish tasks and activities. Kyle also received assistance from students at his table group, especially when he struggled with tasks and activities. He experienced mastery through others’ guidance more than Mike and Alice did. While guided mastery experiences might help Kyle to develop skills that he has not mastered, these experiences could convey limited information regarding his capabilities because he accomplished the tasks with assistance. In this sense, the decrease observed in Kyle’s self-efficacy in relation to the tasks that he perceived as difficult could be related to his lack of enactive experiences rather than his lack of mastery experiences.

Engagement with strategic learning activities. Focal students’ participation in classroom practices that reflect their transition from other- to self-regulation was also different. For example, Alice’s competence in mathematics enabled her to frequently contribute to the construction of shared understandings without much assistance. Through her participation, Alice frequently received feedback from the teacher regarding her success. Even though Mike was not as proficient as Alice in mathematics, he also participated in these types of activities but to a lesser extend, and his participation created contexts in which he received teacher assistance. In this way, he found opportunities to develop knowledge and skills that may help build his competence. He demonstrated better understandings of the concepts in May, which could be related to his participation in these classroom practices. Unlike Alice and Mike, Kyle participated in fewer classroom practices related to the construction of shared understandings. In this sense, his
struggle with the same concepts during both problem-solving sessions might be related to his lack of participation in this type of classroom practices.

A similar pattern was observed with regard to the cases’ participation in joint learning activities through which they exercised strategic learning. The only difference was that Kyle participated in more classroom practices related to these types of activities. In fact, both Kyle and Mike demonstrated more strategic behaviors in May, which might be related to their participation. They also reported more accurate judgments about their capabilities for specific mathematical tasks later in the year, which could also be related to their engagement with strategic learning activities.

The nature of each focal student’s participation in these activities also showed differences. While all three students found opportunities to exercise strategic behaviors by sharing their findings, ideas, and strategies, Kyle and Mike needed more assistance to employ the strategies. In other words, Mrs. Thompson often guided their strategic efforts. On the other hand, Alice needed relatively little guidance to exercise strategic behaviors. Mrs. Thompson supported her strategic efforts by providing feedback related to her success. All three students found varying levels of opportunity to compare and evaluate other students’ ideas and strategies, but Alice was able to take more opportunities since she was more competent in mathematics than Kyle and Mike.

Parallel with these findings, Alice demonstrated more strategic behavior that could reflect her internalization of the strategies than Kyle and Mike did. It should be noted that while the observation of strategic efforts might indicate an internalization of a strategy, the opposite might not be true. In other words, the lack of instances observed does not indicate that Kyle and Mike internalized fewer strategies than Alice. In fact,
both Kyle and Mike demonstrated behaviors that indicated their internalization of strategies to some extent during the problem-solving sessions; however, Alice found more opportunities to receive feedback regarding her strategies by sharing them.

Teacher recognition. Focal students’ participation in classroom practices also differed in terms of the information they were given regarding their capabilities and strategic behaviors. Mrs. Thompson frequently provided students with feedback regarding their success by showing her approval. Thus, students’ mastery experiences were almost always accompanied by teacher feedback related to their success. Alice, who often experienced mastery within whole-class discussions, received more teacher feedback regarding her success than Kyle and Mike, who experienced mastery in relatively fewer instances. This form of persuasion may result in Alice’s consistently high self-efficacy. While the form of teacher recognition did not differ among the three focal students, the amount of recognition they received differed. The number of instances observed as evidence of two forms of teacher recognition (i.e., acknowledging students’ ideas and indicating praise) directed to focal student is illustrated in Appendix K. As can be seen, Alice received more teacher recognition when compared to Kyle and Mike.

Modeling successful performance. Peer modeling activities accompanied by the teacher’s recasting and rephrasing could enhance the observers’ as well as the models’ self-efficacy and strategic learning. Modeling successful performance is basically a mastery experience for the model. In addition, they provide the model with an opportunity to observe his or her accomplishments and information about his or her competence. This is especially important for students with low self-efficacy, such as Kyle. Because self-efficacy beliefs reflect future-oriented judgments rather than actual
level of competence (Woolfolk Hoy, 2004), students may underestimate their actual abilities, which leads to low self-efficacy. Modeling a successful performance may enhance the model’s experience of success. Such activities may also increase the model’s awareness of his or her thinking processes and strategic behaviors. Even though Kyle and Mike would have benefited more from peer modeling practices, relatively few instances were observed in relation to their modeling a successful performance when compared to Alice.

Contrast over challenge. Alice, Kyle, and Mike also demonstrated differences in terms of the opportunities they took to challenge themselves. Alice found opportunities to challenge herself by doing challenging homework assignments. Mastering these tasks could provide a greater sense of accomplishment than mastering regular homework assignments, which may nurture her sense of efficacy. Furthermore, engaging with more difficult tasks could provide opportunities to strategic learning and to improve her knowledge and skills. Mike and Kyle pointed out that they did not have adequate experience to complete challenging assignments; therefore, they did not choose to do these assignments. Classroom observations also revealed that Kyle frequently avoided engaging in challenging tasks and relied on other students’ assistance, which could be expected considering his low self-efficacy relative to other students in the class.
CHAPTER 5

CONCLUSIONS

In the area of educational psychology, classroom context has been recognized as an important contributor to students’ self-regulated learning for the last two decades (Hickey, 1997; Paris & Paris, 2001; Paris & Turner, 1994; Pintrich, 2003; Turner & Meyer, 2000). Researchers have identified several aspects of classrooms (e.g., classroom goal structures, strategy instruction, student autonomy, teacher support, and evaluation practices) and examined their impact on student cognition and motivation (Ames, 1992b; Blumenfeld et al., 1992; Butler, 1998a, b; Palincsar & Brown, 1984; Pape et al., 2003; Perry, 1998; Pintrich et al., 1994; Verschaffel et al., 1999). While the role attributed to contextual factors varies according to the theoretical perspective in which each study is situated, these studies revealed promising findings in understanding the ways classroom context could support or constrain student self-regulation. However, classrooms are complex and dynamic settings, and we still know little about the ways they function to support student strategic learning and self-efficacy.

This study is motivated by situational perspectives emphasizing the reciprocal interactions between individual and contextual factors in understanding development of self-regulation. Therefore, the focus is not merely on “students” but “students
For this reason, the first goal was to examine the nature of one sixth-grade mathematics classroom practices in terms of the opportunities for the development of self-efficacy and strategic learning. Next, three focal students’ development of self-efficacy and strategic learning were explored over the course of the study along with their participation in these classroom practices. Then cross-case analyses were conducted to examine focal students’ development of self-efficacy and strategic learning in terms of the reciprocal interactions formed between individual students and opportunities provided in the classroom context. In the following sections, the results drawn from analyses of classroom context and focal students are discussed in terms of sociocultural and social cognitive perspectives in which this study is situated as well as related research. Finally, implications for theory and practice and recommendations for future research are presented.

**Supporting Students’ Strategic Learning**

Sociocultural approaches suggest that the transition from other- to self-regulation can be achieved through scaffolded support (Diaz et al., 1990; McCaslin & Hickey, 2001). Scaffolding enables the learner to develop the necessary understanding and mastery to carry out a task with the help of more capable others (Wood et al., 1976). Establishing intersubjectivity or shared understandings between learners and experienced others is an essential component of scaffolding because intersubjectivity provides the rationale for learners’ taking responsibility for their learning (Rogoff, 1990). Central to the notion of scaffolding is the calibration of support, which allows learners to function within their zone of proximal development. That is, the nature and amount of control and support are adjusted as a function of the learner’s developing mastery. This can be
achieved by providing support in a variety of ways such as modeling a performance, giving occasional hints, and asking questions. As a result of careful, differentiated scaffolding, learners are more able to perform tasks and activities that are challenging yet attainable with some effort and assistance. Further, they improve their existing knowledge and skills through their experiences with more knowledgeable others. These co-regulated activities enable learners to build competence, leading them to internalize and take the ownership of learning processes.

In a classroom setting, scaffolding students’ transition from other- to self-regulation brings about challenges. For scaffolding to be effective, intersubjectivity should be established not only between the teacher and individual students but also among the students. Furthermore, the teacher needs to develop learning activities so that students at different levels of competence are able to function within their own ZPD. In this particular sixth-grade mathematics classroom, the teacher supported the transition from other- to self-regulation in a variety of ways. Figure 5.1 presents a conceptual model for the forms of teacher support observed in this classroom and their potential to impact to student strategic learning and self-efficacy.
Figure 5.1: Forms of teacher support and their potential to impact self-efficacy and strategic learning
As the model illustrates, several forms of teacher support hold potential for impacting three factors relative to transition from other- to self-regulation (i.e., developing understandings, building competence for and through strategic learning, and internalization of strategies.) It should be noted that the model presents hypothetical relationships based on the way teacher support was structured in this classroom as well as related theory and research. For example, even though providing opportunities for challenge may impact students’ vicarious experiences, these opportunities were not public and hence did not constitute a salient source of vicarious experiences in this particular classroom.

While the teacher supported all three factors related to the transition from other- to self-regulation, the amount and the nature of support directed towards each factor varied somewhat (see Table 4.3 and Table 4.4). For instance, teacher support directed to the construction of shared understandings constituted a significant portion of her instruction. She supported students’ understandings through several ways, including communicating classroom goals, affording multiple ways for students’ expressing their ideas, and cultivating contexts for the negotiation of meaning. While promoting shared understandings may not directly impact strategic learning, it fosters a climate and context in which students participated in joint learning activities.

Students collaboratively solved problems and completed tasks and activities with teacher guidance through joint learning activities. During these activities, teacher support mainly involved prompting students to analyze the tasks, and to select, implement, and evaluate problem-specific strategies as well as providing feedback and assistance when needed. Teacher support focused on two factors related to transition from other- to self-
regulation (i.e., developing understandings and building competence) has the potential to influence students’ internalization of strategic actions and thoughts. For the level of regulation evidenced in this sixth-grade classroom, the teacher support mainly focused on recognizing students’ strategic efforts to strengthen their ownership over these strategies and to increase their confidence and competence using these strategies.

Teacher facilitation of discourse was the key feature noticed in many of these classroom practices. During whole-class discussions, the teacher encouraged students to share their ideas and adjusted her instruction according to students’ existing understandings. By talking through and referring to students’ ideas, she assisted them to build understandings based on their existing knowledge and skills. Joint learning activities in which students completed tasks together were another aspect of classroom context where teacher facilitation of discourse played a critical role. During these collaborative problem-solving activities, the teacher guided students’ engagement and participation by asking questions that stimulated their strategic learning. Each student carried out one aspect of the task such as analyzing the problem situation or selecting, implementing, and evaluating problem-specific strategies. Hence, the responsibility for completing the task was distributed among students. During these discussions, the teacher assisted students by clarifying and elaborating upon their ideas without providing feedback immediately. Rather, she asked other students whether they agreed or disagreed with their peers’ ideas. In this way, other students were given opportunities to participate in discussions by making comments on peers’ ideas and suggesting alternative ideas. Without teacher facilitation of discourse, student engagement and participation would not be as effectively structured as they were in this classroom.
These findings support previous research that investigated teacher scaffolding in classroom contexts. In a series of studies, Meyer, Turner, and their colleagues (Meyer & Turner, 2002; Turner et al., 2002, 2003) examined the relationships between classroom discourse and students’ reported avoidance strategies in sixth-grade mathematics classrooms. These researchers found that students whose teachers focused on negotiating meaning and gradually transferred responsibility reported lower avoidance strategies (e.g., self-handicapping, avoidance of help-seeking). Teacher facilitation of classroom discourse was also found to be a significant instructional practice supporting student self-regulated learning through a teaching experiment in a seventh-grade mathematics classroom (Pape et al., 2003). Discourse that required student explanation and justification of their mathematical thinking while providing scaffolded support by modeling and questioning facilitated engagement in class activities.

Another striking feature observed in this classroom context was shared control and responsibility among the teacher and the students. This was achieved in several ways. The teacher expected and encouraged students to share their ideas and understandings related to the concepts being discussed. In other words, students were given control over as well as responsibility for the construction of meaning. Similarly, during joint learning activities, students took active roles in exercising strategic behaviors to complete tasks. Without providing appropriate support, it would be unrealistic to expect students to assume control and responsibility. In this classroom, students’ participation and engagement were facilitated through tasks and activities that allowed multiple ways of thinking and sharing ideas as well as teacher-scaffolded support.
These findings support and extend our understandings of the sociocultural perspectives of SRL regarding the roles the teacher and students take during the transition from other- to self-regulation. In particular, within sociocultural approaches learners are provided more scaffolding during early stages of regulation due to their limited understanding and abilities. The more knowledgeable others provide opportunities for greater amounts of individual control as the learner begins to take on the skills being taught (Vygotsky, 1981; Wertsch, 1979). In this sixth-grade mathematics classroom, the teacher created contexts in which students were able to take control and responsibility in the construction of shared understandings. They were given opportunities to guide the discussion by sharing their ideas. In other words, they were given responsibility to regulate their learning even at the early stages of co-regulation.

Butler (1998) describes this form of co-regulation as “socially mediated construction” (p. 380). This approach “emphasizes the mediating influence of students’ cognitive processing on the quality of their knowledge structures and allows for construction of unique structures by students exposed to the same information” (p. 381). In this study, variations observed in focal students’ constructions of knowledge and understandings as well as their strategic thinking support this active role played by students during class activities. The type of support for student autonomy observed in this classroom is also aligned with what has been termed “cognitive autonomy support” (Stefanou et al., 2004, p. 101). This form of support encourages student ownership over their learning processes by providing them with opportunities to generate, explain, and justify their ideas; to discuss multiple solutions and approaches; and to evaluate their own and other’s ideas.
Teacher support directed towards three factors related to transition from other- to self-regulation was observed simultaneously. This would be expected considering the fact that scaffolding should address students with various needs. For instance, even though the teacher support mainly focused on prompting and guiding students’ strategic efforts during the joint learning activities, there were instances in which the teacher needed to make clarifications for students, who had not yet developed mastery related to the concepts under discussion. Furthermore, during the same activity, some students demonstrated strategic behaviors that reflected an internalization of these strategies. The teacher supported these students by recognizing their strategic efforts.

Parallel with these findings, cross-case analyses revealed differences in focal students’ classroom participation. Accordingly, the amount and nature of support each focal student received from the teacher varied. For example, Alice, the most proficient focal student, often contributed to the development of shared understandings and exercised strategic learning without much teacher assistance. The teacher’s support for Alice’s strategic learning in this classroom typically involved providing feedback related to her success and recognizing her strategic effort to strengthen her sense of ownership over these strategic behaviors. On the other hand, both Kyle and Mike needed more teacher assistance in order to develop understanding and exercise strategic learning.

As illustrated in Figure 5.1, most aspects of teacher support discussed above have also potential to impact students’ self-efficacy through three sources (i.e., enactive mastery experiences, vicarious experiences, and verbal persuasion). The next section is devoted to the discussion of findings related to classroom practices supporting students’ self-efficacy.
Supporting Students’ Self-Efficacy

Classroom contexts contribute to students’ perceptions of their academic capabilities by conveying information about how capable they are (i.e., mastery experiences), how well other students similar to them are performing (i.e., vicarious experiences), and whether others believe in their capabilities to achieve (i.e., forms of verbal persuasion) (Gaskill & Woolfolk Hoy, 2002; Schunk, 1985). Students use these forms of information as they appraise self-efficacy in relation to specific tasks and activities. Successful performances are assumed to be the most influential source of efficacy information as they provide the most authentic evidence regarding one’s accomplishments (Bandura, 1986, 1997; Pajares, 1996; Pintrich & Schunk, 2002). In contrast, failure undermines students’ sense of efficacy, especially if it occurs early in the learning experience. Observing others’ attainments, or vicarious mastery experiences, also enhances students’ belief that they are capable of accomplishing a task (Schunk, 1989, 1991). Forms of persuasion through teacher feedback and recognition regarding successful performances constitute another source of efficacy information that could impact students’ judgments about their capabilities (Pajares, 1996; Pintrich & Schunk, 2002).

In this sixth-grade mathematics classroom, the teacher supported students’ engagement in tasks and activities in a variety of ways so that they experienced success. For instance, students engaged in tasks through multiple representations within collaborative learning activities during the early stages of developing a new skill. This flexibility allowed for potentially increased levels of success and decreased the potential impact of early failures. Through teacher scaffolding embedded within joint learning
activities, students were also given opportunities to develop strategic behaviors and build competence, which could impact their enactive experiences and hence their self-efficacy.

In this classroom, vicarious experiences were typically in the form of peer modeling. Teacher modeling was observed rarely. Instead, students were expected to demonstrate and articulate their thinking and problem solutions. Through teacher recasting and rephrasing of students’ actions and statements, these classroom practices served as peer modeling. Compared to teacher modeling, peer modeling may provide more valid vicarious efficacy information because of perceived model similarity (Schunk, 1989). Supporting this argument, Schunk and Hanson (1985) found that observation of peers solving subtraction with regrouping problems increased students’ self-efficacy more than observations of the teacher. These researchers found no difference between observing coping and mastery models. While observing mastery behaviors may increase students’ self-efficacy, some students may benefit from observing coping models that initially demonstrate difficulties but overcome through their perseverance (Schunk, 1989). In this classroom, the collaborative nature of classroom practices provided opportunities for students to observe how a coping peer overcame his or her difficulty with teacher or classmate assistance.

Peer modeling as structured in this class potentially provides several sources of efficacy information. First, it provides mastery information to the model, who is being asked to contribute to the learning of others by sharing his or her solution strategies or ideas. Second, it provides vicarious information for the observer, who may feel more efficacious as a result of watching a peer model mastery behavior. Third, the teacher’s rephrasing and recasting of the model’s behavior could work as a form of verbal
persuasion regarding his or her capabilities. In this way, the model gains two potential sources of information through the mastery experience and through the teacher’s recognition, which has potential to strengthen the impact of the efficacy information.

The teacher’s role in cultivating modeling practices is critical because peer-modeling activities could also reveal social comparative information regarding students’ abilities. Such comparative evaluation may be hazardous for students who demonstrate slower progress than other students. In order to strengthen self-efficacy through modeling while avoiding the cost of adverse social comparison, Bandura (1997) suggests emphasizing the instructive function of modeling while minimizing its comparative evaluative function. In this classroom, the teacher focused on the instructional functioning of peer modeling by emphasizing the students’ ideas and strategies while avoiding making comparisons between students.

Verbal persuasion observed in this classroom was typically in the form of teacher feedback related to success, recognition of students’ ideas and strategic efforts, and attributions to students’ success and failure. As already described in the previous paragraph, aspects of teacher support related to three sources of efficacy were observed simultaneously in most occasions. That is, a student’s mastery experience was usually accompanied by the teacher’s feedback and/or recognition related to successful performance. This might strengthen the impact of information derived from individual sources.

While analyses of classroom context provide insights into the opportunities for students’ development of self-efficacy, analyses of data across the three focal students support our understandings of the ways students’ existing and evolving self-efficacy may
be related to their classroom practices. As an example, Alice and Mike, who reported higher levels of self-efficacy, participated in more whole-class discussions than Kyle, who reported relatively lower levels of self-efficacy. Furthermore, unlike Alice and Mike, Kyle often relied on other students’ assistance when he struggled with tasks and activities. These findings are consistent with current literature suggesting that self-efficacy beliefs influence the choices students make, the effort they expend on the activities, and the amount of perseverance they show when they encounter a difficulty (e.g., Pajares, 2002; Pintrich & Schunk, 2002; Schunk, 1985).

While students’ self-efficacy may influence their choices and courses of action related to learning activities, these learning experiences may in turn impact their efficacy depending upon the amount and type of efficacy information they reveal and how students appraise this information. For instance, Alice’s classroom practices conveyed strong and consistent information regarding her accomplishments that might have helped her maintain high self-efficacy. She often experienced success through her participation in classroom practices and the teacher frequently recognized her accomplishments. She also found opportunities to challenge herself within homework assignment choices. Because she had already mastered basic skills, mastering these more challenging tasks may have provided a greater sense of accomplishment than simply mastering regular tasks.

Kyle’s classroom practices, on the other hand, conveyed less strong information regarding his accomplishments when compared to Alice. He experienced success in fewer instances. Because he participated in fewer whole-class discussions, he received relatively less feedback and teacher recognition related to his accomplishments. The
teacher provided scaffolded support to him during group activities and encouraged his participation in whole-class discussions so that he experienced success. However, Kyle’s self-efficacy remained low over the course of the study, particularly for the tasks he perceived as difficult. This may be related to his over-reliance on peer assistance when he struggled with tasks and activities. Because he experienced mastery through others’ guidance, these experiences may have provided only limited information regarding his capabilities.

Mike, the least proficient student relative to other focal students, was confident about his capabilities early in the year. He was not able to accomplish, however, most of the problems for which he reported high self-efficacy during the first problem-solving session. Like Kyle, his classroom practices conveyed relatively less strong efficacy information regarding his accomplishments. He participated in more whole-class discussions, however, and received more feedback and assistance when compared to Kyle. Even though Mike reported lower self-efficacy related to solving problems in May, he was more aware of his difficulties. He demonstrated better understandings and more strategic effort. In this sense, the decrease observed in his self-efficacy may indicate a calibration of his judgments about his capabilities. That is his assessments of competence may have been calibrated due to his increased competence in mathematics, resulting in more accurate and realistic estimates of his capabilities.

These findings are consistent with literature arguing that students may overestimate or underestimate their actual abilities and low achieving students may be less accurate in judgments of their capabilities compared to high achievers (Chen, 2003; Hackett & Betz, 1989; Pajares, 1996c; Pajares & Graham, 1999; Pajares & Miller, 1994).
Even though optimistic judgments of capability may motivate students to learn even though their performance is poor, unrealistically high self-efficacy may lead to maladaptive learning behaviors because students may not need to change their learning behaviors (Bandura, 1986; Pajares, 1997). Hence, the most functional self-efficacy judgments are those that slightly exceed what one can actually accomplish (Bandura, 1986).

It is a challenging task for teachers to assist students developing adaptive self-efficacy. In this classroom, several aspects of teacher support served this purpose. For example, the teacher assisted students to observe their performance and progress by communicating clear and specific classroom goals. She also recognized students’ successful performances and provided feedback regarding areas they needed to improve. This form of teacher support could help students to be more aware of their strengths and weaknesses, which may assist them in making more accurate judgments about their capabilities.

**Implications for Theory and Practice**

The present study’s findings have important implications for both theory and practice. With regard to the theoretical implications, the findings of this study provide support for the conceptualization of classroom context and its role on students’ SRL that are suggested by situational perspectives. In this study, classroom context was defined as a dynamic, interactive, and reciprocal context in which individual student factors functioned to create different opportunities for developing self-efficacy and strategic learning. Accordingly, focus was given to the reciprocal interactions between individual
student factors (i.e., self-efficacy, prior content knowledge, and prior strategic knowledge) and classroom practices.

Findings of the study showed that each of the focal students engaged with and interacted within the classroom context differently. For example, even though each focal student experienced mastery through classroom practices, the frequency and nature of these experiences varied. As a consequence of this differential engagement, the amount and nature of support they received was different. These differences brought about diverse opportunities and challenges for each student, which may have affected his or her development of self-efficacy and strategic learning in distinctive ways. The study provides support, therefore, for the conceptualization of the classroom as dynamic, interactive, and reciprocal in nature.

The results of the study also have practical implications for teachers. In this study several aspects of instructional practices were described and examined (e.g., the nature of tasks, modeling practices, teacher recognition) in terms of the way they may support or constrain students’ SRL. Hence, findings could guide the teachers in their attempts to develop and improve their own instructions to enhance students’ self-efficacy and strategic learning. The roles of the teacher and students situated within these classroom practices provide further implications for practice. In particular, findings of this study suggest that students need to be accountable for their learning, while it is also important to create context in which responsibility to complete class activities is shared as students build competence. Within this context, teachers need to guide students’ participation in and engagement so that responsibility for regulation is gradually transferred to the student.
Students’ development of self-efficacy and strategic learning is a dynamic process that involves individual as well as contextual factors. In order to support this development, teachers need to modify their instructional practices according to the particular needs and experiences of the whole class as well as for the individual students. In this study, individualized support was found to be an essential component of classroom context that enhance student self-efficacy and strategic learning. In order to provide effective scaffolding, teachers need to know about students’ knowledge, skills, and beliefs (e.g., self-efficacy).

Classroom discourse could be a significant tool to create and maintain contexts that support self-efficacy and strategic learning. Carefully structured discourse, as observed within peer modeling activities in this classroom, could enhance the effectiveness of instructional practices. Establishing classroom norms and expectations are essential to create effective discourse patterns. Teachers need to state their expectations for student participation in class discussion, while providing necessary support.

Recommendations for Future Research

In an attempt to understand the ways classroom context support student self-efficacy and strategic learning, this study examined the instructional practices in one sixth-grade mathematics classroom and focused its observations on three students’ participation in these classroom practices. The selection of students was based upon criteria such as teacher ranking and SRL competence. As such, both the instructional context in which the study took place and the participants are unique. Furthermore, the results of the study are limited to the events that were available to be recorded in this
specific classroom. Different instructional contexts and student characteristics must be examined for better understandings of the role of classroom practices play in students’ development of SRL.

In this study, students’ classroom practices were analyzed based upon observational methods. Current research also emphasizes the role of students’ perceptions about classroom context. For instance, Dorman (2001) found positive relationships between students’ sense of efficacy and their perceptions of several aspects of the classroom context, such as having opportunities to participate in discussions and to work collaboratively with other students. In future studies, observational methods could be supported with students’ self-reported perceptions of classroom context.

This study is an exploratory case study examining potential connections between classroom practices and student SRL. Even though cross-case analyses provide support for the ways students’ classroom practices may be related to their development of self-efficacy and strategic learning, they do not offer any correlational explanations regarding this relationship. Hence, the changes observed in students’ self-efficacy and strategy use could not be attributed to classroom practices in any direct way. Future research could examine this relationship through several methodologies such as “design experiments” (Cobb et al., 2003; Shavelson et al., 2003).
APPENDIX A

ORAL SCRIPT AND INFORMED CONSENT FORM, AND HUMAN SUBJECTS APPROVAL FORM
Hello my name is Elif Yetkin and I am a doctoral student at the Ohio State University. As part of my program I am required to complete a research study in my field of interest. The purpose of my study is to understand how classroom activities support students’ learning strategies and their motivation to learn mathematics. I am here to ask for your help with my project.

I would like to ask for your permission to do several things. During this project, you will be asked to complete a questionnaire, which will take about 20 minutes, two times. I will also ask you to write journals six or seven times, in class for about 10 minutes. I will also observe classroom activities and your participation to these activities, and take some notes throughout the study. I'd like to videotape the classroom activities each time that we are together so that I can remember what we do in the class. When you work on class activities I'd also like to audiotape your discussions so that I can remember what you said. Also, I would like to ask some of you to meet with me two times during this project to talk about the learning strategies you use as you work on mathematical tasks. Each interview will take approximately 50 minutes. I also would like to audiotape and videotape interviews so that I could remember what you did and said.

The audiotaping and videotaping are for my project only, and they will not be viewed by anyone else other than myself and the other researchers. Your name will not be used in any of my work. So for example if your name is David, I might call you John in my study. This is so no one can identify you from my research. Also, I will not use the name of your school in any written or oral report. Your participation in this study is voluntary. You can withdraw anytime from the study without any penalty or loss of your benefits as a student. Also, your participating or not participating in the study will not affect your grade in school in any way.

I am working under the direction of Professor Stephen Pape at The Ohio State University. If you have any questions, you may ask Professor Pape or myself. I can supply his contact information. Are there any questions about the study or about your involvement in the study?
Letter of Introduction for Participation in Social and Behavioral Research

Protocol Title: How does classroom context support or constrain student self-regulated learning: An exploration in a middle grade mathematics classroom

Protocol Number: 2004E0334

Principal Investigator: Stephen Pape, Ph.D.
Co-investigator: Elif Yetkin

Dear Parent/Guardian,

My name is Elif Yetkin, and I am a doctoral student at The Ohio State University working with Dr. Stephen Pape. I would like to invite your child to take part in my dissertation study.

The purpose of the study is to examine students’ classroom practices and how these practices are related to their use of learning strategies and their motivation in mathematics. Your child’s participation is very important and will help mathematics educators to improve classroom environments that support students’ motivation and strategy use. There is no known or foreseeable risk that might be expected from your child’s participation in this study.

The whole process of this study is as follows:

1. I will observe the classroom activities and students’ participation in these activities two or three days a week for a period of six months. During these observations, I may take notes about your child’s classroom practices as he/she engage in different class activities (e.g., small group, class discussions). I also may communicate with your child without interrupting his/her participation of class activities in order to better understand what he/she is doing and thinking. With your consent, audio- and video-recording devices will be used during these observations. If you do not consent, the video and audio recording devices will be positioned so your child’s behaviors and verbal statements will not be recorded.

2. Your child will be asked to complete a questionnaire that assesses his/her use of learning strategies and motivation to learn mathematics. The questionnaire will be administered in the classroom two times, at the beginning and at the end of the study. It will take approximately 20 minutes to complete.

3. Your child will also be asked to write journals about his/her participation of classroom activities in particular days. Throughout the study, your child will write six or seven journals. Each time journal writing will take about 10 minutes.

4. I will also ask some students to meet with me to talk about the learning strategies they use as they work on mathematical tasks. Your child may also be selected to participate in these interviews two times for about 50 minutes over six months. During these interviews, your child will work on mathematical tasks and I will ask him/her to speak out loud what he/she is thinking. I will also ask some questions in order to better understand his/her strategy use. Information collected from these interviews will help us...
understand the strategies students use as they learn mathematics. The interviews will be conducted in a room at the school at times convenient to your child’s schedule so your child will not miss out on regular classroom instruction. With your consent the interviews will be video-taped and audio-taped. The purpose of video- and audio-taping is to help the researcher to have an accurate record of what your child would do and say during the interviews.

Your child’s participation is entirely voluntary. Your child’s grade will not be affected by his/her decision to participate or not to participate in this study. The results of this study will not be used to evaluate your child’s behavior or performance. Your child’s grade will be determined by your child’s mathematics teacher. The researchers will not be involved in giving a grade your child. Your child may withdraw any time without consequences of any kind. Should your child decide to withdraw, his/her data will be destroyed without penalty or loss of benefits as a student.

All the video and audiotapes, field notes, questionnaire responses, and students’ journals will be stored at a secured location only accessible to the researchers and will be destroyed upon the completion of the study. All the information collected from this study will remain confidential and will be used only for the purpose of the research. We plan to share the results of the study through publication in academic journals and presentation at academic conferences. No reference will be made in written and oral reports that could be linked to your child or to the school. The names of persons and places will be changed; pseudonyms will be used for all names of persons and places.

If you have questions about your child’s rights as a participant of this study, please contact The Office of Research Risks Protection at (614) 688-4792.

We explained the purpose of this study and described what your child’s participation in the study might require. If you are willing to grant permission, and if your child is willing to participate, please sign the consent form attached to this letter and ask your child to return it to his/her mathematics teacher as soon as possible. It is necessary that both you and your child sign the form in the spaces indicated. Keep this letter for your records.

You may have questions or concerns during the time of your child’s participation in this study, or after its completion. If you have any questions regarding this study, please feel free to contact the researchers Dr. Stephen Pape or Elif Yetkin at the addresses and phone numbers provided below.

Sincerely,

Elif Yetkin
1220 Chambers Road
6431C Columbus OH 43212
Phone: (614) 486-9146
e-mail: yetkin.1@osu.edu

Dr. Stephen Pape
333 Arts Hall
1945 N. High Street
Columbus, OH 43210
Phone: (614) 292-8344
e-mail: pape.12@osu.edu
Consent for Participation in Social and Behavioral Research

Protocol Title: How does classroom context support or constrain student self-regulated learning: An exploration in a middle grade mathematics classroom

Protocol Number: 2004R0334

Principal Investigator: Dr. Stephen Pape
Co-Investigator: Elif Yetkin

I consent to my child’s participation in research being conducted by Stephen Pape and Elif Yetkin of The Ohio State University.

I have read and understand the information in the attached letter regarding the purpose of the study, the procedures that will be followed, and the amount of time it will take.

I know that I can (and/or my child can) choose not to participate without any penalty. If I agree to participate, I can (and/or my child can) withdraw from the study at any time, and there will be no penalty.

I consent to the use of field notes, audio and videotapes, and my child’s written responses to the questionnaires and classroom journals. I understand how the tapes and the written responses of my child will be used for this study.

I have had a chance to ask questions and to obtain answers to my questions. If I have further questions, I can contact the investigators at pape.12@osu.edu, (614) 792-8344; or yetkin.1@osu.edu, (614) 486-9146. If I have questions about my rights as a research participant, I can also call the Office of Research Risks Protection at (614) 688-4792.

Finally, I acknowledge that I have read and fully understand this form. I sign it freely and voluntarily. A copy has been given to me.

Print the Name of the Participant

Signed: ___________________________ Date: ____________
(Parent or Guardian’s Signature)

Signed: ___________________________ Date: ____________
(Student’s Signature)

Signed: ___________________________ Date: 11/30/2004
(Researcher’s Signature)
BEHAVIORAL/SOCIAL SCIENCES
INSTITUTIONAL REVIEW BOARD
RESEARCH INVOLVING HUMAN SUBJECTS
THE OHIO STATE UNIVERSITY

ACTION OF THE REVIEW BOARD

Research Protocol:

2003B634 HOW DOES CLASSROOM CONTEXT SUPPORT OR CONSTRAIN STUDENT SELF-REGULATED LEARNING: AN EXPLORATION IN A MIDDLE GRADE MATHEMATICS CLASSROOM, Stephen Pape, Elaine Yenkin, School of Teaching and Learning

Presented for review by the Behavioral/Social Sciences Institutional Review Board to ensure the proper protection of rights and welfare of the individuals involved with consideration of the methods used to obtain informed consent and the justification of risks in terms of potential benefits to be gained.

The Board APPROVED the protocol.

NOTE: The study has been approved for the participation of minors according to 45 CFR 46.404. Participation in the study (interviews, journal writing, questionnaire, and observation) does not place the subjects at greater than minimal risk and adequate provisions are in place for soliciting the permission of each child's parents, as well as assert from the children as required by 45 CFR 46, section 498.

Approval for proposed research includes all materials submitted by the investigator unless otherwise noted.

It is the responsibility of the principal investigator to retain a copy of each signed consent form for at least three (3) years beyond the termination of the subject's participation in the proposed activity. Should the principal investigator leave the University, signed consent forms are to be transferred to the Behavioral and Social Sciences Institutional Review Board for the required retention period. This application has been approved for a period of not more than one year. You are reminded that you must promptly report any problems to the Review Board, and that no procedural changes may be made without prior review and approval. You are also reminded that the identity of the research participants must be kept confidential.

Date: October 27, 2004  Signed:  
Chairperson

bs-023b Biomedical approval letter (08.84)
BEHAVIORAL AND SOCIAL SCIENCES
INSTITUTIONAL REVIEW BOARD
RESEARCH INVOLVING HUMAN SUBJECTS
THE OHIO STATE UNIVERSITY

ACTION OF THE REVIEW BOARD

Research Protocol:

2004B0334 HOW DOES CLASSROOM CONTEXT SUPPORT OR CONSTRAIN STUDENT
SELF-REGULATED LEARNING: AN EXPLORATION IN A MIDDLE GRADE
MATHEMATICS CLASSROOM, Stephen Pape, Elif Yelkin, Teaching and Learning
presented for review by the Behavioral and Social Sciences Institutional Review Board to ensure
the proper protection of rights and welfare of the individuals involved with consideration of the
methods used to obtain informed consent and the justification of risks in terms of potential benefits
to be gained.

The continuing review was APPROVED.

NOTE: The study has been re-approved for the participation of children according to 45 CFR 46.404.
Participation in the study (having previously collected data analyzed) does not place the subjects at
greater than minimal risk and adequate provisions are in place for soliciting the assent of the children and
the permission of their parents or guardians as required by 45 CFR 46, section 408. The IRB determined
that the permission of one parent is sufficient.

Approval for proposed research includes all materials submitted by the investigator unless otherwise noted.

It is the responsibility of the principal investigator to retain a copy of each signed consent form
for at least three (3) years beyond the termination of the subject's participation in the proposed
activity. Should the principal investigator leave the University, signed consent forms are to be
transferred to the Behavioral and Social Sciences Institutional Review Board for the required
retention period. This application has been approved for a period of not more than one year.
You are reminded that you must promptly report any problems to the Review Board, and that
no procedural changes may be made without prior review and approval. You are also
reminded that the identity of the research participants must be kept confidential.

Date: November 4, 2005 Signed: ____________________________

Chairperson

Behavioral approval letter (08.04)
Mean scores and standard deviations for focal students and the class

<table>
<thead>
<tr>
<th>Measures</th>
<th>Alice</th>
<th>Kyle</th>
<th>Mike</th>
<th>Class n=19</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Jan</td>
<td>April</td>
<td>Jan</td>
<td>April</td>
</tr>
<tr>
<td>Self-efficacy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>4.86</td>
<td>5.00</td>
<td>3.00</td>
<td>2.86</td>
</tr>
<tr>
<td>SD</td>
<td>.38</td>
<td>.00</td>
<td>.58</td>
<td>1.21</td>
</tr>
<tr>
<td>Cognitive str.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>2.45</td>
<td>2.73</td>
<td>3.82</td>
<td>3.82</td>
</tr>
<tr>
<td>SD</td>
<td>1.13</td>
<td>1.27</td>
<td>.75</td>
<td>.75</td>
</tr>
<tr>
<td>Metacognitive str.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>3.31</td>
<td>4.23</td>
<td>3.54</td>
<td>3.77</td>
</tr>
<tr>
<td>SD</td>
<td>1.03</td>
<td>.73</td>
<td>.66</td>
<td>.60</td>
</tr>
<tr>
<td>Help-seeking str.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>4.75</td>
<td>5.00</td>
<td>3.75</td>
<td>4.75</td>
</tr>
<tr>
<td>SD</td>
<td>.50</td>
<td>.00</td>
<td>.96</td>
<td>.50</td>
</tr>
<tr>
<td>Effort reg. str.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>4.80</td>
<td>4.40</td>
<td>3.80</td>
<td>4.40</td>
</tr>
<tr>
<td>SD</td>
<td>.45</td>
<td>.55</td>
<td>.45</td>
<td>.55</td>
</tr>
</tbody>
</table>

Scores corresponding to the first, second, and third quartiles

<table>
<thead>
<tr>
<th>Measures</th>
<th>January 1st quartile</th>
<th>January 2nd quartile</th>
<th>January 3rd quartile</th>
<th>April 1st quartile</th>
<th>April 2nd quartile</th>
<th>April 3rd quartile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-efficacy</td>
<td>3.28</td>
<td>4.00</td>
<td>4.71</td>
<td>3.14</td>
<td>4.00</td>
<td>4.86</td>
</tr>
<tr>
<td>Cognitive str.</td>
<td>2.90</td>
<td>3.36</td>
<td>3.82</td>
<td>2.90</td>
<td>3.18</td>
<td>3.64</td>
</tr>
<tr>
<td>Metacognitive str.</td>
<td>3.00</td>
<td>3.31</td>
<td>3.70</td>
<td>3.08</td>
<td>3.62</td>
<td>4.00</td>
</tr>
<tr>
<td>Help-seeking str.</td>
<td>3.50</td>
<td>4.00</td>
<td>4.50</td>
<td>3.75</td>
<td>4.25</td>
<td>4.50</td>
</tr>
<tr>
<td>Effort reg. str.</td>
<td>3.60</td>
<td>3.80</td>
<td>4.80</td>
<td>3.60</td>
<td>4.40</td>
<td>4.80</td>
</tr>
</tbody>
</table>
APPENDIX C

MATHEMATICS SELF-EFFICACY AND STRATEGY QUESTIONNAIRE
MATHEMATICS SELF-EFFICACY AND STRATEGY QUESTIONNAIRE

This questionnaire is designed to help us gain a better understanding of your learning strategies, study skills, and motivation for mathematics class. There are no right or wrong answers to this questionnaire. We want to know what you think, feel, and do when learning mathematics. Please respond as completely and honestly as you can and remember that no one in your school will see your answers.

Thank you for your participation!

Elif Yetkin & Stephen Pape
The Ohio State University
### PART 1

**DIRECTIONS:** The following statements are about your learning strategies and study skills for math class. Please circle the number that best describes how you study in math class in the scale to the right of each statement.

<table>
<thead>
<tr>
<th></th>
<th>NOT AT ALL TRUE</th>
<th>SOMEWHAT TRUE</th>
<th>VERY TRUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. When I study for math, I read my notes, my homework, and the textbook over and over.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2. When doing work for math, I try to relate what I'm learning to what I already know.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3. When I study for math, I go through my class notes and the textbook and try to find the most important ideas.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4. In math, I always put a lot of effort into doing my work.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>5. Before starting a math assignment, I try to figure out the best way to do it.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>6. When I'm working on math, I stop once in a while and go over what I have been doing.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>7. I try to change the way I study for math to fit the type of material I am trying to learn.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>8. I work hard to do well in math class even if I don't like what we're doing.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>9. Even when I have a lot of trouble learning math, I don't ask for help.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>10. When I study for math, I copy my notes over to help me remember the material.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>11. I try to make all the different ideas fit together and make sense when I study for math.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>12. When I study for math, I go over my class notes and the textbook and make an outline of important concepts or equations.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>13. Before I begin to study for math, I think about the things I will need to do to learn.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>14. In math, I keep track of how much I understand the work, not just if I am getting the right answers.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>15. If what I am working on for math is difficult to understand, I change the way I learn the material.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>16. When work is hard, I either give up or only study the easy parts.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NOT AT ALL TRUE</td>
<td>SOMEWHAT TRUE</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>----------------</td>
<td>---------------</td>
</tr>
<tr>
<td>17.</td>
<td>I ask my teacher to clarify math concepts I don't understand well.</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>18.</td>
<td>To learn the material for my math class, I practice saying the important material until I know it.</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>19.</td>
<td>I make up my own math problems to help me understand the important concepts.</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>20.</td>
<td>In math, I start my assignments without really planning how I will get it done.</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>21.</td>
<td>For math assignments, I double check my work to make sure I am doing it right.</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>22.</td>
<td>When I come across difficulty doing a math problem, I go back and try to figure out where I went wrong.</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>23.</td>
<td>Even when studying math is dull and uninteresting, I keep working until I finish.</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>24.</td>
<td>When I don't understand mathematics, I ask one of my classmates for help.</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>25.</td>
<td>When I study for math, I memorize key equations or facts.</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>26.</td>
<td>When I study for math, I put important ideas into my own words.</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>27.</td>
<td>Before I begin to solve a math problem, I think through it and decide what I need to get done.</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>28.</td>
<td>When I study for math, I ask myself questions to make sure I understand the material I have been studying.</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>29.</td>
<td>I try to adapt how I do my math assignments to fit with what the teacher wants or expects.</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>30.</td>
<td>I don't try very hard to finish my math assignments.</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>31.</td>
<td>I know who to ask for help in math if necessary.</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>32.</td>
<td>When I do math homework, I try to remember what the teacher said in class so I can answer the questions correctly.</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>33.</td>
<td>During class time I often find that I think of other things and don't really listen to what is being said.</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>
PART 2

DIRECTIONS: Here are some statements about yourself as a student in math class. Please circle the number that best describes what you think is the true scale to the right of each statement.

<table>
<thead>
<tr>
<th></th>
<th>NOT AT ALL TRUE</th>
<th>SOMEWHAT TRUE</th>
<th>VERY TRUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>I'm certain I can master the skills being taught in math class.</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2.</td>
<td>I'm sure I can figure out the most difficult math concepts taught in this class.</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>3.</td>
<td>I'm sure I can do an excellent job on the problems and tests assigned for homework for this class.</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>4.</td>
<td>I'm certain I can do even the most complex class work.</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>5.</td>
<td>I'm sure I can understand the basic math concepts taught in this class.</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>6.</td>
<td>I'm certain I can solve difficult word problems in math class.</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>7.</td>
<td>I'm certain I can explain how I solved a mathematical problem in this class.</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

Just a few more questions about yourself:

What is your gender?  □ Male  □ Female

How old are you?  __________

What is your race/ethnicity? If you are multiracial, check all that apply and circle your primary identity if you have one.

□ African American/Black
□ Asian American
□ Caucasian/White
□ Latina/o / Hispanic
□ Native American/American Indian
□ Other  __________

THANKS FOR YOUR HELP!
APPENDIX D

CATEGORIES FOR CLASSROOM OBSERVATIONS
Categories for the observation of classroom context

The nature of tasks and activities

(a) mathematical concepts being taught
(b) expected product (i.e., requiring one single answer or allowing multiple answers and representations) and whether the expected product was the same for all students or not
(c) purpose of the tasks and activities (i.e., review vs. introduction)
(d) students’ participation structure (i.e., individual, pair, and group work)
(e) teacher’s messages about the tasks and activities (e.g., purpose of the tasks and expectations)

The nature and degree of teacher instructional support

(a) modeling practices (i.e., teacher and peer modeling)
(b) support for the negotiation of meanings (e.g., clarification and elaboration of the tasks, concepts, and procedures)
(c) support for students’ strategic learning (e.g., discussions about strategies, feedback, and assistance regarding strategy use)

The evaluation and recognition structure

(a) the appearance, purpose, and type of recognition (e.g., whether praise and criticism was public or private, what praise or criticism was attributed to, what praise or criticism was contingent upon)
(b) the structure of formal and informal evaluation (e.g., the criteria for evaluation, opportunities for self-evaluation and for evaluation of other students’ work, attributional statements for success or failure, statements about the consequences of success or failure, and how students’ previous successes or difficulties were referenced)
### Categories for the observation of focal students

#### Interactions with the teacher

(a) teacher’s messages directed to the focal student regarding his/her ability  
(b) the nature of support the focal student received from the teacher (e.g., feedback and assistance regarding mathematical concepts or strategy use), whether the teacher or the student initiated the support, and the way he/she responded to the support  
(c) the teacher’s recognition and evaluation of the focal student’s work (e.g., praise, criticism, attributions to the student’s success and failure)

#### Interactions with other students

(a) the nature and degree of support the focal student received from other students (e.g., feedback and assistance regarding mathematical concepts or strategy use), whether the focal student or his/her classmate initiated the support, and the way he/she responded to the support  
(b) the role that the focal student assumed in group work (e.g., sharing ideas, making comments, providing help or receiving help)

#### Engagement and SRL behaviors

(a) focal student’s participation in whole-class discussions (e.g., answering questions, asking questions, and making comments)  
(b) focal student’s engagement with the tasks and activities during individual work (e.g., being challenged)  
(c) focal student’s strategic behaviors (e.g., help-seeking, effort regulation)
APPENDIX E

INTERVIEW PROTOCOLS
Directions
The purpose of this interview is to help me understand what students think about and do while working on math tasks. During the interview, I will ask you to do two things.

* First, I will show you some math problems and ask you to indicate how confident you are that you will give the correct answer to each problem.

* Then, I want you to work on each of these problems. Because I want to understand “what comes to your mind” as you work on the problem, I need you to say out loud everything that you think about or do including reading the problem, performing computations, and anything else that you think about. Try to “think-out-loud”—in other words, say whatever you are thinking as you read and solve the problem. You can use your journal and your textbook when you work on the problems, but please don’t use a calculator. If you cannot solve the problem, you may simply explain why you feel you cannot solve it and then go on to the next one. While you work on the problem I may ask you some questions to get a better understanding of your thinking.

If you don’t have any question, let’s start.
**Directions:** Please indicate how confident you are that you will give the correct answer to each question without using a calculator by circling the appropriate number. Please do not attempt to solve the problems. You will be asked to solve these problems after you complete this questionnaire.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Not Confident At All</th>
<th>Somewhat Confident</th>
<th>Very Confident</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>A group of students were asked their favorite flavor of ice cream between vanilla, strawberry, and chocolate. One-fourth of them chose vanilla and three-fifths of them preferred strawberry. The rest of the group chose chocolate. What percent of the group preferred chocolate flavor?</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>Meijer sells 50 pounds of potatoes a day. Kroger sells 1/5 as many potatoes as Meijer does in a day. How many pounds of potatoes does Kroger sell in 4 days?</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>Ren and Chet have just started collecting baseball cards. Ren has 13 more baseball cards than Chet. Ren has 27 cards. Write and solve an equation to find how many baseball cards Chet has.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>A factory produces 6 motorcycles in 9 hours. How many hours does it take to produce 16 motorcycles?</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>To make a phone call, you pay $2 for the first 20 minutes, then 7 cents per minute. How much will a 45-minute phone call cost?</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>At Kroger a pound of pears costs $1.16. That is 15 cents less per pound than at Meijer. How much does 5 pounds of pears cost at Meijer?</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
Directions: Please indicate how confident you are that you will give the correct answer to each question without using a calculator by circling the appropriate number. Please do not attempt to solve the problems. You will be asked to solve these problems after you complete this questionnaire.

<table>
<thead>
<tr>
<th></th>
<th>Not Confident At All</th>
<th>Somewhat Confident</th>
<th>Very Confident</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Kelly, Claudia, and Amanda wanted to purchase a sweater for a friend's birthday. Kelly paid one-eighth of the amount for the sweater, Claudia paid $35, and Amanda paid the rest. Who paid the greatest amount toward the sweater? Explain your answer.</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. At Speedway, gas sells for $1.69 per gallon. Gas at BP is 15 cents less per gallon than gas at Speedway. How much does 5 gallons of gas cost at BP?</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. You have 10 minutes left at a parking meter. After you put in a quarter, you have 25 minutes left. Write and solve an addition equation to find q, the number of minutes a quarter is worth.</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Wendy can run 5 km. in 18 minutes. If she keeps on running at the same speed, how far can she run in 25 minutes?</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. A taxi charges $2.35 for the first 0.4 mile and $0.75 for each additional 0.4 mile. Find the cost of a 4 mile taxi ride.</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Sam's Grocery sells 180 eggs a day. That is 1/3 as many eggs as Mike's Grocery sells a day. How many eggs does Mike's Grocery sells in 3 days?</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The following questions were asked after all math tasks were completed, as necessary:

1) Tell me what did you think when you first saw the problem? /what did you notice about the problem when you first saw /read it? If he/she tells that it is an easy/difficult problem ask ”Why do you think so? What makes the problem easy/difficult for you?”

2) Tell me what helped you to understand the problem. What did you do to help you understand the problem/in order to understand the problem? (?) How did this/these help you understand the problem?

3) Did you have any difficulty in understanding the problem? If yes, what did you do in order to overcome the difficulty? If he/she told that she didn’t get it ask “Which part you didn’t get it?” What could you do in order to get it?

4) Tell me what you did to solve the problem? As S explains what he/she did, ask “Why did you do that?/ How did you know that you need to…?”

5) What was the hardest part about solving this problem? Did you have a difficulty in solving the problem? If yes, what did you do in order to overcome the difficulty?

6) When you solve the problem, did you do anything to make sure that you’re on the right track in solving the problem? If yes, “What were some of the things you did?” If no, “Why you didn’t do that? Is there a reason not to do that?” When do you check your solution and when you don’t? How do you decide that? Or I noticed that you … “Why did you do that?”

7) If he/she changes his/her answer, “I noticed that you changed your answer as you work on the problem. Why did you change your answer? How did you know that you need to change it?” (?) How did this/these help you solve the problem?

Semi-structured interview questions:

1) What is your favorite class? How much do you like math class compared to other classes? Did you like math when you were in elementary school? How does math you do in this class different from math you do in elementary school? Did you change the way you learn/study math? How?

2) What are your strength and weakness in math? Do you do specific things to improve your skills in these areas? How does this class/your math teacher help you to improve your skills in these areas?
3) What was your goal in math class during the last grading period/at the beginning of this year? Remind about the goals they set at the beginning of the second 9-weeks. Why did you set this/these goal(s)? Do you feel that you accomplish this/these goal(s)? What did you accomplish during the last grading periods? What type of things did you do to accomplish this/these goal(s)? How did your teacher help you to achieve these goals? What are your current goal(s) in math class? Where do you go from here? What type of things have you been doing in order to achieve your goal? How does your teacher help you to achieve these goal(s)? What will you continue to do? How do you know that your goal has been met?

4) Talk to me about the activities or things you do in math class. What do you think about the…
   a) POD
   - purpose
   - trouble
   - already know/learned/teacher encouraged?
   b) class discussions (new topic, review previously learned topics)
   - purpose
   - What types if things you do to learn/remember what was discussed in the classroom?/when challenging?
   - already know/learned/teacher encouraged?
   c) homework assignments
   - purpose
   - What types if things you do to complete homework assignments? / When struggling?
   - already know/learned/teacher encouraged?
   d) quizzes
   - purpose
   - What types if things you do to prepare for quizzes?
   - already know/learned/teacher encouraged?

4.1) Why do you think you do …? Are they helpful?
4.2) What types if things you do … to learn/remember what was discussed in the classroom?
… to solve problems in the class (e.g., POD, regular problems/activities)?
… to complete homework assignments/challenge practices?
… to prepare for quizzes?

4.3) What do you do when you have trouble? When you’re struggling? Find something challenging? Are there any other things you do?
4.4) Is that something you already knew? (brought to the classroom?) Is that something you learned this year? Is that something your teacher encourages you to do? How did your teacher help you learn how to deal with this problem?
APPENDIX F

JOURNAL PROMPTS
**Direction:** Please reflect on your participation in today's math class by completing the following statements.

1) Today, our purpose in math class was...

2) During the classroom activities, our teacher expected us to...

3) I found today's class activities (select just one of the statements):
   a) easy       b) some difficult       c) very difficult
   because...

4) In today's activities, I think I did (select just one of the statements):
   a) an excellent job   b) an average job   c) a poor job
   because...

5) How well can you successfully complete the tasks similar to the one's that we've done today?
   a) not at all   b) poorly   c) good enough   d) well   e) very well
APPENDIX G

CATEGORIES FOR ANALYSIS OF CLASSROOM CONTEXT
Categories for Analysis of Classroom Context

1. Teacher Support
   1.1. Communicating classroom goals: refers to teacher messages that explain and clarify the purpose of classroom activities and the requirements of the tasks.
   1.2. Peer-modeling practices: refers to the instances in which students are provided with opportunities to observe each other's thinking and performing cognitive skills (e.g., steps carried out to solve a problem, problem resolutions, and recovery from false starts). This category may include students' articulations and demonstrations as well as the teacher's clarification and elaboration of students' articulations.
      1.2.1. Masterly modeling: refers to the instances in which a student demonstrates a successful performance to complete a task/solve a problem or the teacher articulates a student’s mastery behavior.
      1.2.2. Coping modeling: refers to the instances in which a student demonstrates a difficulty to complete a task while he/she accomplishes it by his/her own effort and/or teacher and/or peer assistance (e.g., problem resolutions, recovery from false starts).
   1.3. Supporting students’ strategic knowledge: refers to teacher messages, directions, explanations, as well as whole-class discussions regarding strategic behaviors. This category may include the teacher’s and students’ descriptions of a specific strategy and explanations of how and when to use it. Strategies to analyze the tasks: rereading, underlining, and using context clues or prior knowledge to understand the problems as well as problem-specific strategies (e.g., making tables, drawing diagrams) could be examples of the types of strategies being discussed.
   1.4. Negotiating meaning: refers to the teacher’s clarifications and elaborations of terms, notations, words, concepts, procedures, and problem situations; highlighting key features and contrasts about concepts and procedures; and contextualizing concepts within real-life situations.
   1.5. Fostering strategic learning: refers to the instances in which the students are given opportunities to exercise strategic learning with the teacher’s assistance. This category may include the teacher’s questioning and guidance while students analyze the tasks, select & implement strategies, and monitor the execution of strategies.

2. Teacher Recognition: refers to the teacher’s praise, criticism, and acknowledgement of students.
   2.1. Praise: refers to the appearance and purpose of praise directed to an individual student as well as the whole-class.
   2.2. Criticism: refers to the appearance and purpose of criticism directed to the individual student as well as the whole-class.
   2.3. Acknowledging students’ ideas and strategic effort: refers to the instances in which the teacher refers to and talks through the students' ideas and strategic effort.

3. Evaluation structure: refers to the nature of student evaluation and assessment; either formal (e.g., quizzes, homework assignments) or informal (teacher monitoring students’ progress and understanding, and student self-evaluation). This category may involve the
instances in which the teacher conveys the criteria for evaluation, deals with individual differences, and makes attributions to student success and failure.

3.1. **Criteria for evaluation:** refers to the instances in which the teacher communicates a standard for evaluation.

3.2. **Referring to a third person:** refers to the instances in which the teacher communicates the criteria for evaluation by referring to a third person.

3.3. **Grading:** refers to the instances that the teacher conveys the criteria for evaluation through her grading policy.

3.4. **Handling with individual differences:** refers to the instances that the teacher communicates differences among students and provides explanations for differential treatment in homework assignment.

3.5. **Attributions to success & failure:** refers to the teacher’s attributional statements for student success and failure.
APPENDIX H

CATEGORIES FOR ANALYSIS OF FOCAL STUDENTS
Categories for Analysis of Focal Students

1. **Enactive Experiences**: refers to the student’s observed behaviors that indicate his/her engagement (e.g., answering the teacher’s questions, making comments, interacting with other students to complete a task) by participating in class discussions as well as group work and individual work.

   1.1. **Type of enactive experience**
      
      1.1.1. **Enactive experience**: refers to the instances in which the student completed a task and activity by himself/herself (e.g., answering the teacher’s questions without getting any help).
      
      1.1.2. **Guided enactive experience**: refers to the instances in which the student completed a task and activity with the teacher or classmate assistance.

   1.2. **Result of enactive experience**
      
      1.2.1. **Enactive mastery experience**: refers to the instances in which the student successfully accomplished the task (e.g., correctly answered a question).
      
      1.2.2. **Partially successful/incomplete enactive experience**: refers to the instances in which the student completed parts of the task/activity.
      
      1.2.3. **Unsuccessful enactive experience**: refers to the instances in which the student could not complete the task successfully (e.g., providing an incorrect answer).

   1.3. **Enactive experience related to strategic learning**
      
      1.3.1. **Developing understanding**: refers to the instances in which the student participated in classroom practices supporting his/her development of understandings of terms, concepts, procedure, problem situations (e.g., answering the teacher’s questions regarding concepts and procedures, asking questions in order to understand a concept).
      
      1.3.2. **Building competence**: refers to the instances in which the student participated in classroom activities supporting his/her strategic learning (e.g., analyzing tasks, selecting, implementing, monitoring, and evaluating strategies) with/without teacher and/or classmate assistance.
      
      1.3.3. **Exercising strategic learning**: refers to the instances in which the student demonstrated a strategic behavior without any initiation from the teacher regarding the use of this particular strategy (i.e., transfer a strategy to a new situation/exercise a generalized strategy). These strategic efforts include selecting and implementing problem-specific strategies as well as using more general strategies (e.g., monitoring understanding, asking questions to elaborate understandings).

2. **Feedback and assistance**

   2.1. **Teacher feedback & assistance**: refers to the instances in which the teacher informed the student regarding his/her performance that needs to be improved and provided assistance to him/her.
      
   2.2. **Peer-feedback & assistance**: refers to the instances in which a classmate informed the student regarding his/her performance that needs to be improved and provided assistance.
3. **Modeling practice:** refers to the instances in which the student took or was assigned to a masterly or coping model.

   3.1. **Masterly modeling:** refers to the instances in which the student demonstrated a successful performance.

4. **Teacher recognition**

   4.1. **Acknowledgement of ideas:** refers to the instances in which the teacher referred to and talked through the students’ ideas.

   4.1.1. **Acknowledgement of strategic efforts:** refers to the instances in which the teacher referred to and talked through the students’ strategic behaviors.

4.2. **Praise:** refers to the instances in which the teacher praised the student’s participation, performance, strategic efforts, etc.
APPENDIX I

COMPARISON OF FOCAL STUDENTS’ SELF-EFFICACY
## Comparison of focal students’ self-efficacy

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Alice</th>
<th>Kyle</th>
<th>Mike</th>
</tr>
</thead>
<tbody>
<tr>
<td>Survey (January)</td>
<td>Reported self-efficacy rating above the third quartile</td>
<td>Reported self-efficacy rating below the first quartile</td>
<td>Reported self-efficacy rating above the third quartile</td>
</tr>
<tr>
<td>Problem-solving session (January, February)</td>
<td>Reported high self-efficacy and accomplished all of the tasks</td>
<td>Reported high self-efficacy but accomplished only two out of six tasks</td>
<td>Reported high self-efficacy but accomplished only two out of six tasks</td>
</tr>
<tr>
<td>Survey (April)</td>
<td>Maintained high self-efficacy compared to other students in the class</td>
<td>Decreased self-efficacy in relation to achieving complex and difficult tasks</td>
<td>Decreased self-efficacy in relation to achieving complex and difficult tasks</td>
</tr>
<tr>
<td></td>
<td>Reported self-efficacy rating above the third quartile</td>
<td>Reported self-efficacy rating below the first quartile</td>
<td>Reported self-efficacy rating above the second quartile</td>
</tr>
<tr>
<td>Problem solving session (April, May)</td>
<td>Reported high self-efficacy and accomplished all the tasks but one</td>
<td>Reported lower self-efficacy and accomplished three out of six tasks</td>
<td>Reported lower self-efficacy but accomplished four out of six tasks</td>
</tr>
</tbody>
</table>
APPENDIX J

COMPARISON OF FOCAL STUDENTS’ STRATEGIC EFFORTS
## Comparison of three cases’ strategic efforts

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Alice</th>
<th>Kyle</th>
<th>Mike</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Survey (January)</strong></td>
<td>Reported use of cognitive strategies rating below the first quartile</td>
<td>Reported use of cognitive strategies rating above the third quartile</td>
<td>Reported use of cognitive, metacognitive, effort-regulation, and help-seeking strategies above the third quartile</td>
</tr>
<tr>
<td></td>
<td>Reported use of metacognitive strategies rating above the second quartile</td>
<td>Reported use of metacognitive and effort-regulation strategies rating above the second quartile</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reported use of effort-regulation and help-seeking strategies ratings above the third quartile</td>
<td>Reported use of help-seeking strategies rating below the second quartile</td>
<td></td>
</tr>
<tr>
<td><strong>Problem-solving session (January, February)</strong></td>
<td>Analyzed the tasks by breaking into parts and rereading</td>
<td>Analyzed the tasks by breaking into parts, rereading, and paraphrasing</td>
<td>Analyzed the tasks by breaking it into parts, rereading, and writing down the given information</td>
</tr>
<tr>
<td></td>
<td>Selected efficient problem-specific strategy from a range of strategies, compared and evaluated the effectiveness of solution procedures</td>
<td>Selected appropriate problem-specific strategy but had struggled with the execution of problem-specific strategies, demonstrated strategic effort to make the execution of problem-specific strategies easier for him</td>
<td>Had struggled with the selection and execution of problem specific strategies, demonstrated fewer strategy use to help him execute problem-specific strategies</td>
</tr>
<tr>
<td></td>
<td>Monitored solution procedures and</td>
<td>Demonstrated fewer strategy use to</td>
<td>Demonstrated fewer strategic behavior to</td>
</tr>
<tr>
<td>Instrument</td>
<td>Alice</td>
<td>Kyle</td>
<td>Mike</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>----------------------------------------------------</td>
<td>------------------------------------------------------</td>
<td>-------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>evaluated the answer</td>
<td>monitor the solution procedures and evaluate the answer</td>
<td>monitor the solution procedures and evaluate the answer</td>
</tr>
<tr>
<td>Survey (April)</td>
<td>Reported use of cognitive strategies rating below the first quartile (maintained)</td>
<td>Reported use of cognitive strategies rating above the third quartile (maintained)</td>
<td>Reported use of cognitive strategies rating above the third quartile (maintained)</td>
</tr>
<tr>
<td></td>
<td>Reported use of metacognitive strategies rating above the third quartile (increased)</td>
<td>Reported use of metacognitive strategies rating above the second quartile (maintained)</td>
<td>Reported use of metacognitive strategies rating above the third quartile (maintained)</td>
</tr>
<tr>
<td></td>
<td>Reported use of effort-regulation strategies rating above the second quartile (decreased)</td>
<td>Reported use of effort-regulation strategies rating above the second quartile (maintained)</td>
<td>Reported use of effort-regulation strategy rating above the third quartile (maintained)</td>
</tr>
<tr>
<td></td>
<td>Reported use of help-seeking strategies rating above the third quartile (maintained)</td>
<td>Reported use of help-seeking strategies rating above the third quartile (increased)</td>
<td>Reported use of help-seeking strategies rating above the second quartile (decreased)</td>
</tr>
<tr>
<td>Problem-solving session (April, May)</td>
<td>Demonstrated similar use of strategies observed in January</td>
<td>Focused on understanding the problem situation</td>
<td>Demonstrated better understanding of the concepts</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Demonstrated more strategic effort in terms of monitoring the execution of problem-specific strategies</td>
<td>Demonstrated more awareness of his struggles and was able to articulate how to overcome these difficulties</td>
</tr>
</tbody>
</table>
APPENDIX K

COMPARISON OF FOCAL STUDENTS’ CLASSROOM PRACTICES
## Comparison of three cases’ classroom practices

<table>
<thead>
<tr>
<th>Classroom Practices</th>
<th>Alice (21 lessons)</th>
<th>Kyle (20 lessons)</th>
<th>Mike (17 lessons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participation structure</td>
<td>Mainly through whole-class discussions</td>
<td>Through whole-class discussions as well as interactions with students at his table group</td>
<td>Mainly through whole-class discussions</td>
</tr>
<tr>
<td>Experiencing mastery</td>
<td>Mainly without assistance (60/21=2.86)</td>
<td>Usually with teacher and classmate assistance (16/20= 0.8)</td>
<td>Usually with teacher assistance (24/17=1.41)</td>
</tr>
<tr>
<td>Engagement with strategic learning activities</td>
<td>Participation in the construction of shared understandings (27/21 = 1.29)</td>
<td>Participation in the construction of shared understandings (8/20 = 0.4)</td>
<td>Participation in the construction of shared understandings (16/17 = 0.94)</td>
</tr>
<tr>
<td></td>
<td>Participation in joint learning activities (44/21 = 2.10)</td>
<td>Participation in joint learning activities (27/20 = 1.35)</td>
<td>Participation in joint learning activities (28/17 = 1.65 )</td>
</tr>
<tr>
<td></td>
<td>Demonstration of internalization of a strategy (15/21 = 0.71)</td>
<td>Demonstration of internalization of a strategy (3/20 = 0.15)</td>
<td>Demonstration of internalization of a strategy (5/17 = 0.29)</td>
</tr>
<tr>
<td>Teacher recognition</td>
<td>Teacher acknowledgement of her ideas (29/21 = 1.38)</td>
<td>Teacher acknowledgement of his ideas (5/20 = 0.25)</td>
<td>Teacher acknowledgement of his ideas (8/17 = 0.47)</td>
</tr>
<tr>
<td></td>
<td>Teacher praise (8/21 = 0.38)</td>
<td>Teacher praise (2/20 = 0.10)</td>
<td>Teacher praise (3/17 = 0.18)</td>
</tr>
<tr>
<td>Modeling successful performance</td>
<td>Modeled successful performance (11/21 = 0.52)</td>
<td>Modeled successful performance (3/20 = 0.15)</td>
<td>Modeled successful performance (3/17 = 0.18)</td>
</tr>
<tr>
<td>Classroom Practices</td>
<td>Alice (21 lessons)</td>
<td>Kyle (20 lessons)</td>
<td>Mike (17 lessons)</td>
</tr>
<tr>
<td>---------------------</td>
<td>--------------------</td>
<td>-------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Control over challenge</td>
<td>Took opportunities to challenge herself through challenging homework assignments</td>
<td>Did not choose to do challenging homework assignments</td>
<td>Did not choose to do challenging homework assignments</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Relied on others’ assistance especially when struggled</td>
<td></td>
</tr>
</tbody>
</table>


Self-regulated learning and academic achievement (pp. 227-252). New Jersey: Lawrence Erlbaum Ass.


224


