MIDDLE SCHOOL STUDENTS' REPORTED SELF-REGULATION STRATEGIES IN COMPLETING ONLINE MATHEMATICS HOMEWORK

by

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DEDICATION

Mom, it is because of you and the skills you have taught me that allow me to persist when faced with a challenge. I love you, and I am grateful for every sacrifice you have made for me.

I dedicate this work to my three loving boys, John, David, and Joseph. I encourage you to dream and make bigger-than-life plans. I will always be there to support you!

I acknowledge my husband, Paul, for supporting me. I appreciate that you encourage me to reach to the possibilities on our journey together.

To Jennifer, my cousin and best friend, I miss you dearly. You continue to inspire me to be a better human. I love you, and this work is in honor of you and for Nicki and C.J. (xoxo - Aunty Pepper).

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ABSTRACT

The purpose of this qualitative descriptive case study is to benefit our understanding of the potential of online homework as it relates to developing and supporting students' self-regulated learning (SRL). This descriptive case study explores the use of self-regulated learning (SRL) strategies reported by students in the context of completing online mathematics homework (OHW). Eighth-grade students (10 total) from a traditional middle school were interviewed using a validated data collection instrument, the Self-Regulated Learning Interview Schedule or SRLIS (Zimmerman & Martinez-Pons, 1986, 1988). Students' open-ended responses were interpreted using a framework of self-regulation theory and coded using 14 self-regulation strategies to identify the strategies used and to understand differences or similarities among students among different achievement groups (low or high).

Students reported using a variety of SRL strategies while completing OHW. All but two students reported *goal-setting and planning* and *seeking social assistance* (from teachers, adults, and peers). Additionally, this study identified two new categories of seeking non-social assistance—online resources in general and those from the Khan Academy in particular.

Among achievement groups, students in the high-achievement group reported greater use of the cognitive SRL strategy *organizing and transforming*, whereas students in the low-achievement group had more recurrent reports of *no strategy*. Students in the low-achievement group reported use of the motivational SRL strategies, *environmental*

structuring and *self-consequences*, whereas students in the high-achievement group reported no use of motivational SRL strategies, but instead reported parent-initiated involvement.

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LIST OF ABBREVIATIONS

NAEP	National Assessment of Educational Progress
NCES	National Center for Educational Statistics
NCTM	National Council of Teaching Mathematics
OHW	Online Homework
SRL	Self-Regulated Learning
SRLIS	Self-Regulated Learning Interview Schedule
MSLQ	Motivated Strategies for Learning Questionnaire
CAASPP	California Assessment of Student Performance and Progress
LMS	Learning Management System
M/C	Multiple Choice
EOC	End of Course

CHAPTER ONE: INTRODUCTION

Teachers routinely prescribe academic practice beyond the school day for the purpose of providing students opportunities to practice lessons and reinforce learning (Cooper et al., 2006; Epstein, 1988). A survey by the National Assessment of Educational Progress (NAEP) reports that approximately 80% of students ages 9 to 17, are expected to complete homework (Loveless, 2014). A study of high school freshmen found students report that math homework requires the greatest investment of time and is frequently assigned 4 to 5 days per week (Wilson & Rhodes, 2010). Most students consider homework meaningful and understand its purpose to help improve skills not yet mastered (Huisman, 2016; Wilson & Rhodes, 2010). According to the NAEP, the amount of homework has remained relatively stable over the last 30 years with students averaging one hour of homework on a given day.

The practice of completing homework in elementary and middle school has long been positively associated with student achievement (Cooper, 1989; Cooper et al., 2006; Epstein & Van Voorhis, 2001; Rutter et al., 1979). Findings in two meta-analyses have established a positive correlation between student homework and academic achievement over 30 years of peer reviewed studies (Cooper et al., 2006; Fan et al., 2017). An empirical study with data from the National Center for Educational Statistics (NCES) and approximately 25,000 eighth-grade students selected from over 1,000 schools concluded that mathematics homework was found to have “a consistently and statistically meaningful effect on test scores” (Eren & Henderson, 2011, p.11).

Teachers communicate that in addition to learning and academic achievement, another purpose of homework is to meet non-instructional objectives (Epstein, 1988; Epstein & Van Voorhis, 2001). Students can develop self-regulation by practicing skills and concepts learned beyond the instructional hours of a school day with little or no instructional support (Kitsantas et al., 2011). Analogous to the responsibility of adult work, Corno and Xu (2004) view homework as a job of childhood.

Although homework practice has long been stable, increasing use of technology has changed the way in which students complete work. In 2001, the National Council of Teaching Mathematics (NCTM) began to challenge research to discover, develop and implement web-based assessments (Nguyen et al., 2006). In the same year, Bennett's (2001) study pioneered the introduction of studies in mathematics using online assessments in lieu of traditional paper-and-pencil. Several years later, research undertaken "to discover the development and implementation methods and the extraneous effects of web-based assessment on students' learning and achievement" was published (Nguyen et al., 2006). The Nguyen et al. study found advantages offered by online mathematics homework within the framework of self-regulation. These strategies relate to students' self-regulation when afforded opportunities to retake assignments, receive immediate scores, simplify problem-solving, support learning with scaffolded practice, and provide a general motivation to practice (learn) more.

Advances in technology has resulted in opportunities for students to do their homework online, providing students with immediate feedback. Today, it is common to refer to these assessments as OHW (Lunsford & Pendergrass, 2016). A meta-analysis conducted by Magalhães et al. in 2020 determined that a majority of studies related to

online homework (OHW) occurred after 2009. In the early inception of OHW, Mendicino et al. stated that "the opportunities for students to do their homework online increase as the digital divide narrows and more states become committed to one-to-one computing" (2009, p. 332). Mendicino et al. (2009) investigated the potential of online homework and concluded that "students learned significantly more" when comparing traditional paper-and-pencil homework to computer or web-based assessments (p. 331).

Since Mendicino et al. (2009) small-scale study of OHW, more recent research studies have examined OHW and its effect on student achievement (Arasasingham et al., 2011; Babaali & Gonzalez, 2015; Eichler & Peeples; 2013; Fyfe, 2016; Halcrow & Dunnigan, 2012; Lazarova, 2015; Mendicino et al., 2009; Parker & Louden, 2013; Richards-Babb et al., 2011; Smithrud & Pinhas, 2015; Zerr, 2007). In contrast to findings of Mendicino et al. (2009), the majority of contemporary peer-reviewed research comparing OHW to traditional homework (paper & pencil), result in findings of "no significant difference."

Statement of Problem

Media comparison studies continue to find that students' academic achievement does not change when they complete homework online as compared to traditional handwritten work (Bowen et al., 2012; Chau, 2012; Davis & McDonald, 2016; Lunsford & Pendergrass, 2016; Magalhães et al., 2020; Trussell, 2020). Yet, researchers continue to publish studies related to OHW and academic achievement which compare OHW to traditional paper-and-pencil homework. Meanwhile, a limited number of studies have sought to understand OHW beyond academic achievement. This research focuses on learning and metacognition, self-efficacy, motivational beliefs, and student satisfaction in

completing OHW (Casselman & Atwood, 2017; Chamala et al., 2006; Nguyen et al., 2006; Pundak et al., 2013; Smolira, 2008; Wilson & Rhodes, 2010; Xu et al., 2018). These studies are related to various degrees to self-regulated learning (SRL). As Zimmerman (2008) and others have shown, student use of SRL strategies is a predictor of increased student academic outcomes.

Developing self-regulated learning skills equips students with necessary abilities to be self-efficacious and persistent in the presence of difficult tasks in order to develop into independent life-long learners (Hong et al., 2008; Roth et al., 2016; Zimmerman, 2008). Ramdass and Zimmerman (2011) report that homework facilitates the development of these important SRL skills at the middle school and high school levels. Similar studies communicate a positive relationship between students' execution of homework and developing SRL skills (Cadime et al., 2017; Corno & Xu, 2004; Kitsantas et al., 2011; Warton, 2001; Xu & Wu, 2013). The task of completing homework encourages students to learn to plan and prepare through the process of setting goals, managing time and environment, reflecting on learning, seeking help, and utilizing resources—while avoiding distractions and delaying gratification (Cadime et al., 2017; Corno & Xu, 2004; Ramdass & Zimmerman, 2011; Xu & Wu, 2013). Vandevelde et al. (2013) state that "SRL becomes increasingly important in transition periods in which students switch from a more closely monitored environment, like primary education, to an environment, like secondary education" (p. 408). Moreover, correlations have been established between academic success and the possession of effective SRL skills (Xu et al., 2017; Ramdass & Zimmerman, 2011).

The current belief is that young children begin to develop SRL skills as early as pre-school (Vandevelde et al., 2013). Hong et al. (2008) suggest that student self-regulatory strategies are increasingly challenged throughout middle and high school. They determined that students become less engaged in homework as they progress through school from kindergarten to 12th grade. Homework practice competes with increasing after-school activities, technology distractions (e.g., social media), reduced family involvement, and less structured environments outside class. Several studies including Halcrow and Dunnigan (2012) and Richards-Babb et al. (2011) have researched student perceptions and important SRL skills such as planning, motivation, execution, self-efficacy, learning, seeking help, and perseverance. Richards-Babb (2011) notes that "There has been little in-depth analysis of student perceptions" (2011, p. 83). Moreover, after an initial study on OHW and self-regulation, Xu et al. (2018) also conclude that research on factors contributing to "regulating students' emotion to complete online homework has been notably missing" in the literature (Xu et al., 2018, p. 243). Much of the research that is available has been largely undertaken using self-report questionnaires or using the reported perceptions by teachers and parents rather than the students themselves (Cadime et al., 2017; Lindner, 1996; Pintrich et al., 1993; Roth et al., 2016). These instruments often fail to relate to actual behavior and are subject to criticism (Roth et al., 2016; Vandevelde et al., 2013).

Research continues to produce studies of OHW. Typically, these studies report on its academic potential or equivalency to traditional homework, or they report on OHW's effect on student engagement. In general, what has been discovered is that the immediate and individualized feedback that can be provided by OHW motivates students by

encouraging practice (Lunsford & Pendergrass, 2016). Furthermore, teachers can rely on convenience and automatic grading to reduce their workload (Magelhães et al., 2020). Meanwhile, an interrelationship exists between students' independent OHW tasks and SRL, and the availability of research as it applies simultaneously both to OHW and SRL is minimal. The examination of student self-regulation through completion of OHW is rare and presents a clear gap in research. Given the potential benefits of SRL, this study aims to shed further light on the degree to which SRL is used and applied in the context of OHW.

Purpose

The study described here is a result of my experience of creating and integrating OHW in an 8th grade math curriculum beginning in Fall 2015. Previously, I was an 8th grade math teacher at the site of this study and created the online mathematics homework system in stages over three years preceding this study. This researcher-developed OHW was programmed for student practice of math procedures and concepts and complemented lessons taught in a traditional classroom. My initial, informal perceptions of the results of this integration included a possible increase in engagement among those students struggling academically. I received positive feedback from students and parents regarding the introduction of OHW, and this seemed to suggest that this homework was, at least technically speaking, easy to complete. However, some feedback from students, parents and teachers also suggested that improvements could be made. This research study is thus a culmination of this initial development and refinement work, and has the potential to help teachers and researchers understand both OHW and its relation to SRL. Given the potential proliferation of OHW in mathematics and other school subjects, this

study offers a greater understanding what aspects of OHW may be contributing to effective self-regulation.

The purpose of this qualitative study is to benefit our understanding of the potential of OHW as it relates to developing and supporting students' self-regulated learning (SRL). The methodology of this research is a descriptive case study that explores students' use of SRL strategies using self-regulation theory and frameworks (Pintrich, 1999; Zimmerman, 2000) in the context of an online math homework program developed by the researcher. How students implement SRL strategies for learning and OHW is discussed from the perspective of the student by using transcripts from semi-structured interviews using students' open-ended responses from a validated interview instrument. The research questions in this study include:

[RQ1] What self-regulation strategies do students report using while completing OHW in mathematics?

[RQ2] What are differences or similarities of reported self-regulation strategies among students in different achievement groups (low or high) while completing mathematics OHW?

Scope

The study employs a holistic, descriptive, single case-study designed to identify SRL strategies and the consistency of students' use of those strategies in mathematics OHW. The study was conducted at a large public middle school located in Southern California that serves an economically and culturally diverse population. The school mathematics curriculum is aligned with the California Common Core State Mathematics Standards and has approximately 300 8th grade students enrolled in one of nine sections

of Grade 8 Math. I worked with a convenience sample of 10 students from this 8th grade cohort who volunteered to participate and provided written parental consent and student assent.

Both of the school's Grade 8/Pre-Algebra Math teachers assigned the same programmed OHW to all students. This study was initiated in the fourth year of implementation. It was the second year for complete integration of OHW across all Math 8 classes. Students accessed OHW assignments through Canvas, a learning management system (LMS). Students were assigned an average of 40 math questions per week among four online assignments. There were 36 total assignments each trimester and a total 108 assignments for the school year with relatively equal point values for scoring each grading period. After completing an assignment, students received immediate and individualized feedback through computer scoring and questions were marked correct or incorrect. Homework, classwork and participation accounted for 30% of their final trimester grade. Question response types include multiple choice, true/false, matching, inline choice (drop-down), multiple response, numerical response and essay response.

Qualitative data was collected by asking participants to respond to six structured scenarios which required open-ended responses using a validated interview instrument referred to as the Self-Regulated Learning Interview Schedule (SRLIS) (Zimmerman & Martinez-Pons, 1986, 1988). The scenarios contributed to collecting data on student SRL strategies with respect to completing typical tasks of schoolwork in general and were modified to relate to the context of this study and OHW. Please refer to Appendix A.1 for the original and adapted Version of SRLIS Questions. Students' responses were systematically analyzed and cyclically coded a priori with 14 SRL strategies

(Zimmerman & Martinez-Pons, 1986, 1988) and categorized using Pintrich's conceptual framework of self-regulation including metacognitive, cognitive, resource management, or motivation type strategies (Pintrich, 1999). Each student was provided a link and requested to complete an online questionnaire using a Google form after their interview. I developed the questionnaire with eight open-ended response-type questions with similar scenarios and contexts to the SRLIS. For example, students are prompted to respond to the questions, "When did you think about starting your homework? How were you able to get started?" In comparison, the first scenario of the SRLIS asks, "Your teacher has assigned OHW assignments due later this week. Do you have a method to help you learn and remember what is discussed in class to help you complete your online math homework?" Student responses provided an additional data source to validate interview data and collect additional data on occasion on a student-by-student basis. Please refer to Appendix A.2 for the questions in the post-interview online student questionnaire. Member checking was also used as an additional quality control measure.

Summary

Completing mathematics homework—whether traditional or online-has been shown to increase student academic achievement. In fact, studies continue to compare the two methods using media comparison studies producing results of no significant difference. Meanwhile, students' ability to exhibit SRL strategies is associated with an increase in students' academic achievement. We know that the task of completing homework encourages students to monitor and control learning, but few studies shed light on the relationship between student self-regulation learning (SRL) strategies and associated OHW. The current study addresses this gap by studying student reported use

of SRL strategies, and also by considering the relationship of strategies identified with the overall level of student performance.

CHAPTER TWO: REVIEW OF THE LITERATURE

Finding new pedagogical strategies and practices is a constant priority, with technologies often providing opportunities for such pedagogical innovation. Consequently, nearly 20 years ago, Bennett (2001) predicted that the internet will reinvent online assessments in the same way it has revolutionized commerce and social interaction. Since then, the use of online homework in the K-12 setting has seen tremendous growth. Internet access for students continues to increase and is now available in more than 93% of homes in member countries of the Organization for Economic Co-operation and Development (OECD). Moreover, the OECD reports that the integration of computer technology at schools provides an opportunity for students to complete online homework (OHW) at school (OECD, 2016).

This chapter begins by reviewing prior research on online homework in general, arguing that media comparison studies that still dominate in this area. Comparing the instructional efficiency of online homework to traditional paper and pencil homework currently adds little value. Findings are then presented from the research that cover the essential components of OHW: individualized feedback, provision of scores, multiple attempts, and scaffolding with hints which may contribute to students' use of self-regulation while completing OHW.

This chapter also presents an overview of self-regulation theory itself and students' general use of self-regulation strategies for learning. Lastly, the chapter concludes with a literature review covering available studies on homework (online and

traditional) and self-regulation. This review strongly suggests that there is a clear gap in the research when it comes to SRL and homework in general, offering a clear justification for this present study.

Peer-Reviewed Studies of Online Homework

Research has shown that students accept the idea of completing homework on a computer just as well as they accept traditional methods with paper-and-pencil (Barnsley, 2014; Scherer & Siddiq, 2015; Schubert, 2012). In the present study, OHW is defined as the electronic delivery of a set of questions and student responses that is able to generate immediate and individualized feedback based on student input. This type of homework is increasingly more common and can either be stand-alone or, as in the case of this study, and programmed in a learning management system (LMS) (Jungic et al., 2012; Trussell, 2020).

The earliest peer-reviewed articles related to the use of OHW were published between 1989 and 2001. In 2001, Bonham et al. asked *Online Homework: Does it Make a Difference?*, when students were offered online physics homework in a large-scale college course. Unsurprisingly, these same authors arrived at a finding of "no significant difference." By 2009, Hodge et al. summarized that only a few studies of OHW have "moved beyond the examination of *equivalency*" of the two methods of assigning and completing homework (2009, p. 618). Nonetheless, studies continue to ask: Are students learning more or less with OHW than traditional homework using paper-and-pencil? Moreover, results from media comparison studies continue to result in findings of no significant difference. In other words, research continues to put forward equivalency studies only to conclude that OHW is just as effective as traditional methods (Bowen et

al., 2012; Chau, 2012; Davis & McDonald, 2016; Lunsford & Pendergrass, 2016; Magalhães et al. 2020).

A shift in our focus on research and OHW thus becomes important. It is no longer fruitful to debate whether OHW is as good as paper and pencil. Rather, researchers need to focus on how students engage with OHW in ways that are perhaps different from traditional homework. The fact that the instant feedback and multiple attempts that OHW can readily facilitate can be understood in relation to self-regulation presents one avenue for research of this kind. This chapter thus summarizes research on what we know about various models of self-regulation and self-regulated learning (SRL) strategies, SRL studies associated with traditional homework, and focuses in particular on the limited number of studies that examine SRL in conjunction with OHW. This review also includes specific findings with respect to OHW and its unique design attributes.

Essential Components of Online Homework

In general, studies on learning mathematics with OHW present findings that students of all mathematical ability levels enjoy doing their homework online and report an increase in motivation to do homework on the computer (Nguyen et al., 2006; Schubert, 2012). While early adopters touted the benefits of OHW that allowed students more practice time and that saved teacher time in large-enrollment courses, immediate and automatic feedback capabilities in OHW are specifically useful for students. While a hallmark of effective math instruction is the incorporation of frequent and immediate feedback, in regards to OHW, this is considered to be an essential design element (Lunsford & Pendergrass, 2016).

A meta-analysis on which homework format (traditional or online) benefitted student performance found that students describe OHW in these studies as helpful in either 1) providing immediate feedback and 2) being allowed multiple attempts for mastery (Magalhães et al., 2020). Studies speculate that automatic feedback and OHW promote active learning (Parker & Loudon, 2013; Schubert, 2012; Trussell, 2020). Moreover, studies of OHW and automatic feedback report an increase in students' interest and motivation to learn (Hodge et al., 2009; Lunsford & Pendergrass, 2016; Nguyen et al., 2006; Schubert, 2012).

One of the earliest studies of the effects of immediate feedback focused on its relation to middle school student attitudes towards mathematics (Nguyen et al., 2006). Two student groups (n=74) were given four sets of either OHW or traditional homework. Each group performed comparable practice on fractions and decimals. The study protocol was designed for students to participate for 30 minutes each day, three times a week, for three weeks. Students received immediate feedback and automatic grading. Additionally, students could choose to resubmit their OHW and were automatically provided with comparable mathematics problems. The highest grade of an individual student's various attempts was recorded. To conclude the study, students were given a questionnaire with Likert-response statements and asked to respond from 5-Strongly Agree to 1-Strongly Disagree. Nguyen et al. (2006) documented that instant scoring and feedback increased students' interest in doing math and gave them a perception that they became better in problem solving. Students report that OHW feedback made the learning enjoyable, stimulating and exciting (Nguyen et al., 2006).

Research by Parker and Loudon (2013) and Trussell (2020) evaluated OHW with students in large introductory college organic chemistry courses. Both researchers concluded that immediate, response-specific feedback is a key advantage of OHW and they speculated that it promotes active learning. Students were asked at the end of semester in a feedback form if assignments were valuable for learning, to which they replied that the instant feedback of the OHW in particular was helpful. Furthermore, Trussell (2020) stated that students were known to request access to the OHW when it was not offered to them.

Parker and Loudon (2013) suggested that while OHW may be effective for improving student learning, students' who reported benefiting from their initial experience with OHW may require external incentives (e.g., extra credit) when offered the opportunity to use the OHW again in subsequent semesters. Moreover, it should be noted that in contrast to the majority of the peer reviewed studies included in this research, one study found that OHW and feedback did *not* improve learning for students at grade-level (Fyfe, 2016). Fyfe conducted a qualitative study on 6th and 7th grade middle school students (n=103) in which students worked on OHW in Algebra and received either no feedback, correct answer feedback, try-again feedback or explanation after each problem. Only students with low prior domain task knowledge produced better post-test scores.

Despite some variation, studies generally report that prompt and individualized feedback from OHW is associated with greater student motivation (Lunsford & Pendergrass, 2016; Schubert, 2012). These two features provide an opportunity for learning and result in gains in students' *belief* in their own capabilities. They improve

students' self-efficacy which, as shown above, is an important component of motivation in SRL (Brewer, 2009). In a large-scale study (n=1333), Hodge et al. (2009) investigated students' motivation and perceptions of learning in relation to the use of OHW in a college Algebra course. A majority of students (just over 70%) affirmed that they were more motivated to complete OHW than traditional paper-based work and Hodge et al. (2009) attributed greater student motivation to the immediate feedback. Similarly, as a further example, a survey of college students (n=409) in a 2012 study by Jungic et al., found that students in a calculus course strongly agreed that OHW positively changed their attitude to homework

Studies speculate that students' motivation and self-efficacy improve through the use of features of OHW, further suggesting that SRL skills are brought into play when students are given more control over their work and to base their behavior on their own efficacy assessment (Jungic et al., 2012; Kulik & Kulik, 1991; Mendicino et al., 2009). Moreover, self-regulation is only achieved through active learning, by allowing one to construct meaning from their learning (Boekaerts & Corno; 2005).

The Role of Self-Regulation in Learning (SRL)

Theoretical self-regulation frameworks are particularly relevant to the field of education psychology and have made important contributions to understanding student learning (Panadero, 2017). Typically, we associate learning and academic achievement as related to one's metacognitive ability (one's ability to think about one's own thinking). Students engage in metacognition when they set goals, monitor their progress and reflect on their learning. Yet, self-regulation as a whole goes beyond metacognition, strictly speaking (Panadero, 2017). Zimmerman (2000) describes self-regulation as a process in

which learners proactively and progressively transform "thoughts, feelings and behaviors to obtain goals" (p. 14). We refer to these processes as self-regulated learning (SRL).

Zimmerman published one of the first SRL models which he developed, in part, through use of the Self-Regulated Learning Interview Schedule (SRLIS) in a 1986 study (Panadero, 2017). Panadero (2017) refers to Zimmerman's (2000) three-phase model of self-regulation and learning as the "Zimmerman Model." In the first phase, forethought, students analyze the task, set goals, and plan. In the second phase, performance, students engage in and execute the task. In the third, self-reflection, students self-evaluate and self-reflect (i.e., engage in metacognition in support of further SRL). This model reflects the fact that learning is influenced through the interrelationship of metacognitive processes, and motivational and executive functions to allow for progressive self-regulatory development (Panadero, 2017).

In the mid 1980's, we began to understand self-regulation and the role of cognitive, motivational, and emotional aspects of learning. Cognition differs from metacognition in that it is a process or operation where a product (output) is produced from taking in and processing information (e.g., retrieving information, rehearsing, monitoring). Whereas metacognition is cognition applied to this processing itself (Winne, 2018). As Panadero (2017) points out, various theoretical models of SRL have been developed (e.g., by Boekaerts, 1991; Efklides, 2011; Winne & Hadwin, 1998; Hadwin, Järvelä and Miller; 2011; Pintrich, 1999; and Zimmerman, 1989, 2000) each one sharing similar processes with significant overlap between them (Panadero, 2017). According to these researchers, self-regulated students are those who are metacognitively, motivationally, and behaviorally active in their own learning processes and in achieving

their goals (Schunk & Greene, 2018). Self-regulated learning theory encompasses knowing how to regulate time, resources, and to use other strategies to achieve learning goals (Sun et al., 2018). In other words, SRL is thought to be an "umbrella under which a considerable number of variables influence learning" are included (Panadero, 2017, p.1). Furthermore, effective use of a range of self-regulatory and learning strategies is believed to be the hallmark of sophisticated self-regulated learning (Winne & Hadwin, 2008).

Research of students' use of self-regulation and its relation to students' academic achievement is essential to educational research with studies to determine the underlying components of SRL. A majority of these studies assess SRL by analyzing quantitative data obtained using self-report questionnaires (Roth et al., 2016). These surveys are economical, and due to their general nature (i.e., not domain-specific), they fail "to explain the full range of cognitive and affective processes that make up SRL" (Boekaerts & Corno, 2005). Furthermore, Roth et al. (2016) suggest that self-report questions may not be relatable to students and their own learning experience, or they may cue students who may not otherwise mention a strategy. Roth et al. (2016) estimate that less than 15% of published SRL studies published rely on instruments other than self-report surveys (e.g., interviews, think-alouds, diaries observations).

Peer-Reviewed Studies of SRL and Online Mathematics Homework

Completing homework is a process which requires the student to sustain attention and avoid distractions, to set goals and make plans by examining both the big picture and the details, while keeping organized and managing time constraints. Self-regulation helps the student to "remain calm when faced with obstacles, [to] shift from one assignment to another, [to] move forward without getting stuck on one part, and [to] remember to turn

in the homework" (Stockhall, 2017, p. 4). Using confirmatory factor analysis, Cadime et al. (2017) suggests that "homework not only contributes to academic performance, at a general or specific level (i.e., math and science), but has also been associated with the students' self-regulation abilities" (p. 1). Ramdass and Zimmerman (2011), suggest that SRL strategies are associated with students completion of homework as early as elementary grade, and that they remain important in higher levels of educational endeavor, including high school and college.

Thus far, this review has examined studies on homework completion in relation to various stages of SRL among students with differentiated abilities and grade levels. At best, there are only a few scattered studies of OHW with research design methods that impart findings connected to research on SRL. Moreover, only a limited number of peer-reviewed research reports were available that combined both the domain of mathematics and the context of OHW. Those of greatest relevance to the present study are reviewed systematically below.

The following studies include findings obtained from mixed methods research and offer additional insight on SRL as it pertains to the current study. In these studies, participant reports were gathered through a range of methods, including questionnaires, focus groups, and interviews. Open-ended questions allowed students to elaborate on their use of self-regulation in ways that are not typically obtained through self-report surveys. In this part of the literature review, I categorize the findings of relevant research as they are related to this current study. Findings of each study is organized through Pintrich's (1999) self-regulation theoretical framework. Pintrich's (1999) framework of self-regulated learning is based on four broad categories of SRL: metacognition,

cognition, resource management, and motivation related to specific learning strategies. Furthermore, these overarching categories of specific SRL skills will be utilized later in this study and discussed again in Chapter 3: Methodology. Each of these overarching SRL categories can be further described:

- Metacognition, the planning, monitoring, and regulating control in efforts to reach learning goal;
- Cognition, the rehearsal, elaboration, and organizational strategies for recall or comprehension of materials;
- Resource Management, student-initiated management and control of a learning environment and use of help-seeking strategies;
- Motivation, students' self-efficacy, task value beliefs and intrinsic or extrinsic goal orientations.

One study of similar significance, mentioned previously in this review is reported by Nguyen et al. (2006; n=74). Like the present study, this research included interviews from twelve students on SRL strategies used in students' completion of OHW in mathematics. Unlike the present study, these students were randomly selected from different gender and ethnic groups. Interviews were approximately 10 minutes in length and students were informally asked to share their thoughts on and attitudes towards mathematics, using computers in learning, and perceptions of computer-based math instruction (OHW). As such, this study provides a valuable precedent for the present study. Beyond the initial results regarding student *learning attitudes* concerning OHW, the findings of the Nguyen et al. study can be organized using Pintrich's 1999 framework

to provide a listing of advantages offered by OHW for each major type of SRL strategy: metacognitive, cognitive, resource management and motivation.

Metacognitive

- The ability to retake assignments.
- The immediate provision of scores.
- General support of learning as computers were already integrated into their daily tasks (i.e., goal-setting and planning).

Cognitive

- Simplification of problem solving (students speculated that their scores would be higher if given more time to practice on their computer devices).
- Increased legibility (math looked easier and cleaner), and simplification of entry and revision activity.
- Experience of greater control among math-phobic students (and therefore less anxiety).

Resource Management

- Provision of hints for problem-solving (i.e., scaffolding).
- Seek information to support learning tasks (e.g., use computers to convert units, online calculators, find answers to homework questions).

Motivation

- Provision of opportunities to learn many new things and that they would be motivated to practice (learn) more.
- Perception of being smarter (i.e., self-efficacy) on a computer.

- Experience of increased enjoyment and stimulation in learning math on the computer.
- Increased enjoyment of mathematics as a subject.

Schubert's (2017; n=95) research into the effects of three weeks' use of OHW on student achievement and attitude in an Algebra course using MathXL (a web-based computer program) is also closely related to the study reported on here. Evidence of student academic achievement was found with an increase of scores between pre- and post-tests ($p < .05$). Moreover, students' homework completion using the program during this 3-week study increased from 45% to 95%. Students completed a self-report questionnaire using "yes/no" and Likert-scale questions related to self-efficacy, motivation, technology and OHW. In addition to self-report surveys, semi-structured interviews were conducted with three students taken from low-, average- and high-achievement groups (9 total). Despite its limited time frame, the findings from this research are of direct relevance to the current study, and they can also be organized using Pintrich's 1999 categories:

<u>Metacognitive</u>

- Learning improved by receiving immediate and individual feedback and scoring.
- Ability to work at one's own pace.

<u>Cognitive</u>

- Organization of assignments is easier as compared to printed worksheets.
- Convenience of OHW and to work online from anywhere.
- Reworking incorrect problems (practicing) and resubmit them to be rescored (for scoring).

Resource Management

- Assistance with features which help show steps of a math problem, and specifically not having to seek assistance from the teacher.
- Resources available online such as calculators and graphing.

Motivation

- Able to avoid distractions and stay focused (specific to perceptions of low-achieving math students).
- Working on the computer was active which helped avoid distractions.

Finally, Gutierrez (2017) conducted a study of student perceptions of OHW in math for high school students (9th-12th grade) in three private schools (n=64). Using a self-report survey, students widely reported the perception that OHW benefited their learning, with 91% of the students confirming the claim that OHW directly aided learning. Students perceive automatic feedback, grading, multiple attempts and access as benefits in using OHW. In addition to Likert-type responses, two additional open-ended questions were included in the survey which asked students to describe "What helps you learn and what prevents you from learning with OHW?" Moreover, 14 interviews were conducted with participants in semi-structured focus groups consisting of 3-5 students at two of the three schools. The summary of student reports from the study include the following:

Metacognitive

- Receiving automatic feedback aids learning.

Cognitive

- The computer is easy to access.

- Online homework keeps track of work which prevents me from losing it.

Resource Management

- Individualized help with examples and videos help me understand the [math] problem.
- Online resources are always available to help (e.g., calculator)
- Additional information is available to seek out when necessary.

Motivation

- Opportunities for multiple attempts encourage self-efficacy

As to what aspects of OHW *prevent* learning, Gutierrez (2017) reported the following: no teacher to help, nowhere to write down work, distractions (games/videos), multiple-choice, lessons are generic, lack of internet/technology issues, and that OHW is different from tests. Moreover, students reported that they found it was easy to cheat and utilize guessing in multiple attempts.

Summary

Online homework is increasing as schools incorporate technology into their daily routines, yet contemporary research continues to focus largely on comparing online homework (OHW) and traditional homework in terms of student achievement. With the exception of the three studies analyzed above, research on students' use of self-regulation and learning OHW are limited and present a clear and present gap in the current research.

SRL skills are important, particularly as growing demands are placed on middle school students due to increasing teacher expectations, student independence, and self-sufficiency outside the classroom (Cleary & Zimmerman, 2004; Zimmerman, 2002). Importantly, students who possess self-regulation skills are characterized as being able to

"direct their behavior or strategies to achieve self-set goals" (Cleary & Zimmerman, 2004, p. 538). We know that students' ability to control and monitor their learning can vary greatly and those who can self-regulate have higher levels of achievement (DiFrancesca et al., 2016).

In general, findings show that OHW enhances students' perceptions of their own learning efficacy, along with supporting their motivation, organization, and planning. There is a need to understand middle school students' self-regulation strategies and OHW including metacognitive processes (self-evaluation, setting goals, keeping records, and self-instruct) and work towards behavior goals (organizing, seeking help, creating self-consequences) as well as entailing motivation at various stages during the acquisition process (Zimmerman & Martinez-Pons, 1986, 1988). One could describe the possibility of increased self-regulation in OHW as forming a virtuous circle: While SRL provides immediate improvement in learning the subject-matter at hand, acquiring its strategies and techniques while engaging in such learning contributes to academic success overall.

CHAPTER THREE: METHODOLOGY

The purpose of this qualitative study is to better understand the potential of online homework (OHW) by examining middle school students' reported use of self-regulated learning (SRL) strategies in an online math homework program. This study utilizes a descriptive case study design. Stake (1995) suggests that a case study is appropriate when investigating a situation in its uniqueness, particularity, and complexity. This study is a single case bounded by an 8th-grade math program, and the deployment of OHW in mathematics in a traditional middle school. This study uses SRL theory frameworks as outlined in canonical research by Pintrich (1999) and Zimmerman (2000). The purpose of this research is to understand this specific case and provide interpretations to inform and enrich reflective practice (Stake, 1995). This is undertaken with the acknowledgement that its findings—particularly those concerning the correlation of self-regulation strategies with high- and low-performing student groups—are not statistically generalizable. These instead illuminate the case under investigation, and suggest possibilities for future research.

In education, there is increasing interest in self-regulated learning (SRL) strategies and their relation to academic achievement in independent learning contexts such as in homework completion. SRL sees students as active participants in their learning, as utilizing metacognitive and cognitive processes and as acting on the basis of identifiable behavior goals. (Zimmerman & Martinez-Pons, 1986, 1988).

Research questions in this study are:

[RQ1] What self-regulation strategies do students report using while completing mathematics with OHW?

[RQ2] What are differences or similarities of reported self-regulation strategies among students in different achievement groups (low or high) while completing mathematics with OHW?

This chapter provides the following concerning the methodology of this study:

- a description of the context of the case and timelines
- criteria used for participant selection
- sources of data (student interview and online questionnaire)
- interview instrument selection
- data collection procedures
- member-checking processes
- processes for analyzing and coding transcript data
- processes for the interpretation of data

Research Design

The research of van Manen (1990) suggests that complex human relationships and actions cannot fully be explored through quantitative studies that simply offer an explanation of objects and of the "natural" way things behave. Instead, we need to ask students questions that they can relate to and reflect upon for their learning strategies and report those aspects of their experiences for us to better understand (Roth et al., 2016). Yet, data analyzed in SRL research is typically generated from self-report survey instruments. In total, over 87% of the 225 studies published between 1988-2013 relied on

student responses to at least one SRL survey (Roth et al., 2016). These surveys produce quantitative data and are often utilized in large-scale studies for ease of administration, and yet, the extent to which they relate to actual self-regulation behavior varies as students use of SRL strategies is domain specific and self-report instruments tend to rely on learning on general (Boekaerts & Corno, 2005; Roth et al., 2016; Vandevelde et al., 2013). In studying my own students' use of SRL strategies in their work with OHW, I utilized a descriptive case study. In my study, and in keeping with this method, I worked to maintain an emic or "insider's" perspective and produce rich, detailed data through open-ended interview questions—corroborated through a questionnaire instrument and member checks. A descriptive case study has a special relationship to theory: It highlights phenomena and concepts (i.e., SRL strategies, OHW functionalities) in order to "expand to inform, confirm, refute, and further shape a priori theories" (McGinn, p. 288; in this case, theories concerning SRL strategies). The use of a descriptive case study allows the reader, as McGinn adds, "to see the case through the theory-driven lens of the researchers." The present study takes an early but widely-utilized set of SRL strategies. It combines these with general student data and student reports of their action and behavior with a particular learning context: Engagement with online mathematics homework. "In so doing," McGinn predicts, "robust concepts emerge, conflate, and expand." In the case of this study, such concepts may include revisions to common descriptions of SRL strategies or possibly entirely new strategies. They may also include less robust associations between student achievement and the use of particular SRL strategies.

For this study, I collected qualitative data from semi-structured interviews conducted with 10 participants individually as a primary data source. A review of student

open-ended post-interview online questionnaires were used to corroborate coded data and serve to triangulate findings, as described below. Data from student interviews was validated through a member-checking process and a researcher-created I-poem. The I-poem was used as an opportunity to promote the student's voice, increase accuracy of data, and provide an age-appropriate method of member-checking while avoiding asking students to validate transcript data, line-by-line (Simpson & Quigley, 2016). Using data of participants' achievement scores on summative state and district mathematics annual assessments, I grouped students into low- and high-achievement groups. Data was analyzed using protocol coding while including descriptive data in the form of key phrases. The findings generated from this study answer the research questions and were made possible by organizing data, looking for patterns among SRL codes and among broader self-regulation categories.

As a teacher, my philosophical assumptions align with a constructivist paradigm. I seek to conduct this case study with an interest in understanding perceptions of the participants (middle school students). Creswell and Miller (2000) describe a constructivist paradigm as one that uses highly contextualized data and values procedures such as trustworthiness (credibility, transferability, dependability, confirmability) and authenticity. I have included sections on researcher bias and limitations of this study, as well as procedures to enhance its validity.

Description of the Case

The participating school site is one middle school in Southern California which serves over 750 economically and culturally diverse students in a high performing school district. In the 2017-18 academic school year, over 90% of students "nearly met", "met"

or “exceeded” state common core math benchmark standards as assessed in the CAASPP (California Assessment of Student Practice and Performance) annual assessment.

Approximately 300 of the 8th grade students were enrolled among 8 sections of at-grade level mathematics courses taught by two mathematics teachers with coursework aligned to the California Common Core State Standards (CCSS). All students participated in the mathematics OHW program for the 2018-19 school year, and ten of these students participated in this study. Yin (2018) refers to the case study as an investigation into a clearly defined bounded system, and in this study the case is bounded by the online homework program.

Students access online homework assignments through Canvas, a district-supported learning management system (LMS) and are assigned an average of 40 questions per week among 4 online assignments. There are 36 total assignments each trimester and a total 108 assignments for the school year. The weekly assignments were released every Monday at 8:00 am and due on Sunday at 9:59 pm. These assignments are assigned with repeated frequency and consistency. As a previous 8th grade math teacher for this course for six years, the OHW specific to this study is teacher-created to align with the day-to-day pacing of teaching instruction.

When the student submits an assignment, they receive immediate scores, and incorrect items are identified. In some instances, rationales are provided to help students understand their errors. Students are permitted to complete a single homework assignment up to four times during the timeframe in which it is available. Students will receive the highest score (point total) from any one of their attempts on open assignments. Question response types include multiple choice, binary (true/false),

matching, inline choice (drop-down), multiple response, numerical response and essay or open-ended response. One limitation of this study is that characteristics of OHW may differ from those developed by publishers, universities or purposely programmed as in the case of this study (Magalhães et al., 2020). Moreover, OHW can be assigned for various types of credit (points/no points/extra credit), in multiple ways (due every day or occasionally) and in multiple formats (textbook, web-based, LMS).

Participant Selection

Prior to recruiting participants for this study, the Human Subjects Institutional Review Board was obtained from Boise State University (104-SB18-046) and school district approval was obtained from the school district. Permission was granted by the school-site principal and both of the grade 8 math teachers. Parent consent and student assent forms were provided to all students in each of the 8 math sections in the November of 2018. Parents and students were provided written information about the study and that students would be asked about their perceptions of online homework in math. Students were advised that participation in the study was optional and not required. Students interested in participating were asked to return both signed parent consent and student assent forms to their respective math teachers within approximately two weeks of distribution. As the researcher, I was not a teacher at the school-site at the time of this study.

This study used a convenience sample with a total of 14 students (9 boys/5 girls) who returned signed parent consent and student assent forms. Out of these 14, four students did not respond to my requests for an interview. The resulting data in this study is composed from interviews with 10 students (7 boys/3 girls). Participants in this study

included both general education students and students recognized as requiring Special Education services in a general education setting. One student was categorized as English Language Learner (ELL). Identifiers P1, P2, P3, et cetera are used to label each participant in a manner ensuring privacy and confidentiality.

Data Source: Interview Instrument

An earlier exploratory pilot study was completed by the author of this dissertation in 2017-18 and the preliminary research led to refinement of data collection, notably the selection of an interview instrument(s). In the pilot study, interviews using self-authored questions among 16 students provided inconsistent reports of SRL strategies across low- and high-achievement groups. It was determined that use of a validated interview instrument not only offered consistency of student reported SRL strategies, but added greater credibility to these findings due to the dependability and degree to which they are repeatable and consistent with related studies.

In quantitative studies, survey research instruments based on SRL theory are commonly used to measure self-regulation abilities among K-12 and post-secondary students. In general, a shortage exists of developed instruments that comprehensively measure all elements of SRL among primary students (Vandevelde et al., 2013). Additionally, SRL behaviors for post-secondary populations can look very differently from those specifically from a middle school (Cazan, 2014). In total, four validated survey instruments are commonly used to gather data on associated SRL strategies students use when learning with homework (not necessarily OHW) (see Table 1).

Table 1 **Instruments which Measure Students' SRL in Homework Completion and Summary of Findings**

	Author	Survey Instrument	Measures	Findings
Elementary & Middle School Students	Cadime, Cruz, Silva, & Ribeiro (2017)	Homework Behavior Questionnaire (Kptc)	**Traditional Homework** Planning (6 items), execution (7 items), and evaluation (8 items) *as reported by tutors & parents	Acceptable fit to the data for each 4 groups (boys, girls, elementary, middle school). Girls likely use more SRL strategies in homework completion.
Middle School Students	Xu, Du, & Fan (2017) Adopted from Xu (2003)	Homework Management Scale (HMS) Focus on mathematics	**Traditional Homework** Five factors relating to structuring the environment, managing time, distractions, emotions, and motivation (22 items)	Homework management is positively associated affect, expectancy belief, interest, value, learning, feedback, and parents. Utility value is students' belief in homework for learning. Negatively related to time spent watching television.
Post-Secondary Students	Hodge, Richardson, & York (2009) Adopted from Pintrich (1999)	Motivated Strategies for Learning Questionnaire (MSLQ)	**Online Homework** Utilized two of the original three subscales of the MSLQ (11 items) including peer learning (PL) and help seeking (HS)	Feedback may promote motivation to complete OHW and more likely to acknowledge the need for help and seek assistance from others. They believed their own efforts would have positive results. Students preferred opportunities to do both OHW and traditional, those with effective SRL were more likely to view OHW as beneficial to them.
	Xu, Fan, & Du (2018)	Online Homework Emotion Regulation Scale (OHERS)	**Online Homework** Volitional control in academic settings (4 items)	Emotion management and cognitive reappraisal positively associated with OHW purposes, behaviors, learning strategies, e-learning satisfaction.

Cadime et al. (2017) investigated the Homework Behavior Questionnaire (Kptc) instrument which examines the SRL processes for homework completion as reported by parents. It measures the processes, beliefs and behaviors characteristics during three stages including; 1) homework planning (6 items), 2) execution (7 items), and 3) evaluation (8 items). As an example, one question related to the planning stage reads: "Before he/she starts homework, he/she has doubts about which tasks should be done." It should be noted that this survey was translated from Portuguese to English.

In 2008, Xu tested the validity of the Homework Management Scale for middle school students (HMS). This instrument measures five factors contributing to self-regulation including structuring the environment, goal-setting and planning, handling distractions, motivation and controlling emotion. Later, this instrument was adapted to fit the domain-specific model of mathematics homework (Xu et al., 2017). They examine an additional seven factors including; prior academic achievement and self-efficacy, teacher feedback, perceived reasons for completing homework, homework interest, affect, value belief (utility), and expectancy belief (i.e., confidence to complete math assignments properly).

Hodge et al. (2009) utilized Pintrich (1999) validated self-report instrument called the Motivated Strategies for Learning Questionnaire (MSLQ) to examine OHW in a college algebra course. Their examination of student experience with OHW was in an attempt to move beyond determining its equivalency to traditional homework. The MSLQ is a validated instrument found to correlate with students' final college course grades across 14 subject domains (Pintrich et al., 1993). The MSLQ supports analysis of motivation (expectancy, value, affect) and learning (cognitive, metacognitive, resource management). Motivation subscales are associated with

student perceptions of self-efficacy, control beliefs, intrinsic and extrinsic motivation, and task value. Meanwhile, learning strategies subscales measure processing information, resource management, planning, monitoring and adjusting control over learning, time management, environment, and help-seeking.

Xu et al. (2018) created the Online Homework Emotion Regulation Scale (OHERS) in response to a gap in existing literature on emotion regulation in OHW completion. The instrument measures students' ability to regulate emotion (volition control) and to reframe or recontextualize unpleasant situations (cognitive reappraisal). Extending the previous work by Xu (2015), this instrument examines student perceptions of homework's purpose (peer-oriented and learning-oriented reasons), associated homework behaviors (effort and completion), associated learning strategies (SRL), and e-learning satisfaction.

The extent to which SRL surveys relate to actual behavior has been shown to vary (Boekaerts & Corno, 2005; Roth et al., 2016; Vandevelde et al., 2013). While SRL survey instruments are commonly used, they have been subject to debate, particularly concerning the alignment of self-report measures with other data such as achievement levels, observations, and interviews (DiFrancesca et al., 2016). Vandevelde et al. (2011) suggest that survey instruments, frequently used in SRL studies, may be problematic for adolescent students. Adolescent students tend to underestimate or overestimate their actual SRL behavior raising concerns regarding research validity. Vandevelde et al. (2013) also note issues with students self-reporting strategies on questionnaires that they believe are socially desirable which raise concerns regarding research validity.

While research studies continue to examine SRL behaviors through use of self-report instruments such as the Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich et al., 1993), a limited number (estimated 4%) of SRL research studies rely on interviews. This suggests an apparent failure to "access SRL in a manner close to real behavior and actual research practices" (Roth et al., 2016, p. 236). These few peer-reviewed studies rely on observations, think-aloud protocols, diaries, interviews, or "other" (Boekaerts & Corno, 2005; Roth et al., 2016).

Self-Regulated Learning Interview Schedule: A Structured Interview Instrument

Given that this descriptive case study seeks a deeper understanding of student self-regulatory behavior using a descriptive case study design, it would have been inappropriate to use a self-report survey for data collection—as most SRL research does. This would have largely eliminated the descriptive dimension of the study, setting it up either to affirm or contradict certain aspects of SRL theory, rather than to take on a generative relation to it. In 1986, Zimmerman and Martinez-Pons published an interview instrument called the Self-Regulated Learning Interview Schedule (SRLIS) to investigate students' use of SRL in a *naturalistic* (e.g., non-classroom) environment. This structured interview instrument was chosen to collect data. The SRLIS was validated in 1988 and identifies 14 SRL strategies and measures the reported methods of student self-regulated learning strategies by presenting students six hypothetical learning scenarios related to class, working at home, preparing for and taking tests, and motivation (Zimmerman & Martinez-Pons, 1986, 1988). Questions were designed to allow researchers to probe students that were reticent or non-verbal and to avoid leading students to artificially identify known SRL strategies (see Appendix - Table A.1).

Since this research study investigates the SRL strategies and OHW, the original scenarios associated with each question was adapted to apply to the context of OHW. As an example, originally the first scenario is for students to assume they are discussing a topic in class, such as the history of the civil rights movement, and asks for them to respond to how they remember this information. Students may be likely to report strategies such as taking notes, asking a friend, or referring to the textbook. Alternatively, this study changed the scenario to ask students how they remember what is discussed in class to complete OHW. An attempt was made to keep interview items as close to the wording and intent of each of the original six SRLIS scenarios. The modified scenarios provide a context for online mathematics homework (classroom situations, planning, completing assignments, preparing for tests, and motivation). Refer to Appendix A.1 for a comparison of the original interview instrument as compared to the modified version for this research study. The modified six scenarios were adapted from "Construct Validation of a Strategy Model of Student Regulated Learning" in the *Journal of Educational Psychology* (Zimmerman & Martinez-Pons, 1988) and were written as follows:

1. Your teacher has assigned OHW assignments due later this week. Do you have a method to help you learn and remember what is discussed in class to help you complete your online math homework?
2. Your teacher has assigned the task of completing 4 online math assignments to be completed as homework. In total, 36 assignments contribute to a major part (30%) of your overall grade. Do you have a particular method to help you plan your homework?

3. Your four online math homework assignments are due at the end of the week. When do you plan to submit them? Do you have any particular method you use for completing them?
4. One reason that teachers give math homework is to help students practice skills for tests. Do you have a particular method for using the online homework to prepare for your math tests?
5. Many times students have problems completing homework assignments because there are other more interesting things they would rather do. Do you have any particular method for motivating yourself to complete your homework under these circumstances?
6. Most students have to complete and submit their OHW from home. Do you have any particular methods for understanding and finishing assignments at home?

Data Source: Post-Interview Online Questionnaire

Creswell and Miller (2000) explain triangulation as the convergence of data from different sources such as interviews, direct observations, and documents to form themes and categories. One way to use data source triangulation is to "look to see if the phenomenon or case remains the same at other times" meaning that behavior related to SRL strategies were compared across two different occurrences for the same individual (and also between participants) as a check to whether the interpretation of data and its interpretation is consistent (Stake, 1995). This study triangulated data gathered through (1) semi-structured participant interviews using a modified version of a validated interview instrument referred to as the "Self-Regulated Learning Interview Schedule" (SRLIS) and (2) an online post-interview questionnaire on OHW with similar characteristics and intent to the interview questions (see Appendix - Table A.2).

I categorized participants into one of two achievement-level groups (low or high) using summative assessment data. These assessments included students' mathematics end-of-course benchmark scores (8th grade), along with prior year (7th grade) state summative CAASPP (California Assessment of Student Practice and Performance) results. All the participants in the high-achievement group scored *Standard Exceeded* on the CAASPP 7th-grade state mathematics benchmark exam, and all but one participant received a score of *Nearly Met* or *Met* mathematical standards set by the school district in an 8th-grade end-of-course exam. Each of the students in the designated high-achievement group scored greater than 50% on the current year 8th grade End of Course (EOC) common district mathematics exam data. All the other participants were placed in the low-achievement group. Two students were new to the school, and prior-year data was not available. Their current year 8th grade End of Course (EOC) common district mathematics exam data served as the only data to place them into one of the two achievement groups (see Table 2).

Table 2 Student Groups and Associated Summative Assessment Achievement Scores

	7th Grade CAASPP	8th Grade EOC Exam	
Group 2 High-Achievement	Standard Exceeded	Standard Met	Scores > 50%
	Standard Exceeded	Standard Nearly Met	
	Standard Exceeded	Standard Nearly Met	
	Not Available	Standard Nearly Met	
	Standard Exceeded	Standard Not Met	
Group 1 Low-Achievement	Standard Exceeded	Standard Not Met[a]	Scores < 50%
	Standard Met	Standard Not Met	
	Standard Nearly Met	Standard Not Met	
	Standard Nearly Met	Standard Not Met	
	Not Available	Standard Not Met	

[a] This student was placed in Group 1 (low-achievement) due to their overall 8th Grade EOC score which was 35 points below (out of 100 points) the student in Group 2 (high-achievement).

Refer to Table 3 for a summary of collected data by participant and achievement group.

Table 3 Summary of Participants and Completion of Online Questionnaire (Y/N) by Achievement Group (Low/High)

	Group 1 Low-Achievement					**Group 2 High-Achievement**				
Participant	P1	P3	P6	P7	P10	P2	P4	P5	P8	P9
Completed Online Questionnaire (Y/N)	Y	N	N	Y	N	Y	N	N	Y	Y

Data Collection Procedures

Primary Data: Structured Interviews

Interviews were scheduled directly with students through researcher-student communication including email, text, phone, and letter correspondence provided in student homerooms. Interviews were conducted between the dates of 12/12/2018 to 3/04/2019 (Trimester 2). Students and parents provided assent and consent, respectively, and agreed to digitally recorded interviews. Additional verbal assent was obtained from the student immediately before proceeding with interviews. Students were reminded that they may choose to stop the interview at any time and for any reason.

The researcher/student interviews were designed to be semi-structured, and the length of each interview was between 15 and 20 minutes total. The interviews were conducted similarly among all the participants. Participants who agreed to interviews were interviewed individually and scheduled either before or after school depending on their schedule. Interviews were held in a private office located within the school media center or in a conference room within the main school office. The room was occupied solely by the teacher and student during interviews to maintain confidentiality. Participant selection was held confidential from other teachers and students who are not part of this study. Questions, written in English and printed for the student, were placed in front of them for the duration of the interview.

Before initiating each student interview, I verified that parents had given signed consent for their child to participate in the study. Prior to reading the interview questions, I reminded students that our discussion would be confidential, that no other person other than the two of us, would have access to or know of any part of our conversation without it being anonymized and

aggregated. Students were prompted as a reminder that I would be digitally recording our interview so that I could listen to it again at a later time. Once more, I asked students to verbally provide assent to be part of the study. Next, students were provided the statement that "at any time, and for any reason, they could choose to leave the interview" without any harm or resentment.

To begin, students were told that I would be asking six questions related to online homework in math and I wanted them to share their opinion. For the purpose of the interview, students were asked to indicate the methods they used to accomplish the task of the given scenario, as well as report the consistency of their use of that strategy. I advised students that at the end of the interview I would be asking one question in addition to the six scheduled questions. I let them know that this last question will be asking them to come up with one additional question they would ask if *they* were interviewing a student. Finally, before asking the first question, I let students know that they could interrupt me for any reason during the interview to ask a question. The interview questions, which total six in number, as well as the student responses to them were both digitally recorded.

The interview procedures imitated the original study, that when a student mentioned one or more strategies, the researcher asked the student to rate the consistency with which strategy was used with a visually presented four-point scale from *seldom* to *most of the time* on a scale from 1 to 4 (see Table 4).

Table 4 Visual Chart for Student Self-Appraisal of SRL Strategy Use

Most of the Time	Frequently	Occasionally	Seldom
4	3	2	1

Note. Taken from "Development of a structured interview for assessing student use of self-regulated learning strategies," by Zimmerman and Martinez-Pons, 1986, *American Educational Research Journal*, *23*(4), p. 618.

After each question was read aloud, I provided wait time for them to respond and listened to their answers. I recorded any personal notes or observations to return to for data reduction. In some cases, I found it necessary to ask follow-up questions to understand the intent of or to confirm their response to the interview question or to probe further when a student failed to mention a single SRL strategy. This includes situations in which students would misinterpret a question that was asked to them. I was mindful to avoid suggesting any specific self-regulation strategies to the students. In the original study, Zimmerman and Martinez-Pons (1986) noted that the typical student responded with at least one defined strategy in each scenario. In this study, student responses ranged from reporting no use of SRL strategies to including as many as eight in their response to the six questions.

Before concluding each interview, each student was asked to formulate one additional question about online homework that they would ask another student in the student interviews that will follow. Asking students to form questions for their peers contributes to minimizing the researcher/student power imbalance (Creswell, 2013; Eder & Fingerson, 2001). This also provides one more opportunity to examine thoughts particular to the individual student and was used to further probe their reasons and prompted further discussion before ending the interview.

Notes were taken by the researcher proceeding each interview to provide context and to document interpersonal behavior observed during interviews.

Post-Interview Online Questionnaire

I developed an online questionnaire for students to reflect on their experience with OHW independently. The questionnaire has eight open-ended response-type questions with similar scenarios and contexts to the interview questions. This additional data source permitted me to verify the consistency of student responses in the interview data. Refer to Appendix A.2 for the questions in the post-interview online student questionnaire.

At the end of each student interview, all participants were provided a paper to access a Google Form and the questionnaire through either a link or QR code. I prompted students that this additional information would be helpful and I requested for them to complete the form at their convenience. Half of the students interviewed (5 total), responded to the follow-up online questionnaire between 3 weeks and 3 months after initial interviews (see Table 3). For students to proceed with the survey, the first section prompted students to provide their assent prior to proceeding and then select "Yes, please take me to the questions." These students represented both male and females from each of the two achievement groups. No students attempting to respond to the poll selected the choice of "No, I do not wish to answer these questions at this time."

The use of a secondary source of data provided confirmation for the findings developed from the primary data source. It generally did not provide additional information or further detail of the SRL strategies reported. For example, a student in the high-achievement group completed the questionnaire and wrote a response to question 3 which asks, "Did you complete this

homework alone or with other people? Can you tell me why?" The student wrote, "I try to do the easy one at tutorial and the harder one at home." This report confirmed a similar response to an interview scenario approximately 3 months earlier where this same student had reported "if it's like really hard [OHW] and I need [to] think, I'll save it for home because I have unlimited resources. But here I usually do the one that is easier." Similarly, one student in the low-achievement group wrote in response to the questionnaire, "[if] I need help then I ask friends." Likewise, this same student reported in the interview weeks earlier that "I would usually text a friend and wait until they reply and if they don't know, I'll keep on asking other people who know how to do it."

Most of the questionnaire data was confirmatory, although in a few instances, additional data was obtained from two of the five students that completed the questionnaire responses. One student wrote that completing homework at home by themself helped them know "what I am good and bad at." This statement indicates that the student utilized the SRL strategy of *goal-setting and planning* by planning, sequencing, and timing of completing OHW for learning. In the interview, the student spoke about completing OHW in terms of obtaining a good grade. This suggests that the student's goal-setting is informed both by intrinsic motivation ("for learning") and by extrinsic rewards ("a good grade"). In the second instance, the questionnaire asked students "Did you complete this homework alone or with other people? Can you tell me why?" In this instance, data from the questionnaire helped to add data to an interview that ended prematurely. The student was not able to respond to the last question (Scenario 6) before the school bell rang for students to attend their first class. With the interview now over, the student did not have an opportunity to respond to the last question, "Do you have particular methods for

understanding and finishing assignments at home?" This scenario typically yielded reports of self-regulation strategies such as students seeking assistance from peers or adults. The student wrote that sometimes they would ask their dad for help and this source of data was considered along with the transcript data (i.e., data added and analyzed as seeking social assistance from an adult).

Member Checking Procedure

Clark and Richards (2017) suggest allowing participants to be the ultimate experts in their lives by positioning them as collaborators and helping the researcher to understand the role of a particular phenomenon (i.e., in their lives at home). From the perspective of the participant, processes of collaboration and member checking are seen as valuable. From the perspective of the researcher, member checking permits a student to contribute to the data and confirm or disconfirm interpretations made by the researcher lending credibility (Lincoln & Guba, 1985). Creswell (2015) describes this aspect of the study as an opportunity for participants to ensure that the "description is complete and realistic, if the themes are accurate to include, and if the interpretations are fair and representative" (p. 259). Typically, aspects of member-checking procedure are limited to a single event during which participants are provided with a transcribed or summary of interpretations to read (Carlson, 2010). This can cause negative reactions from participants as they are often dismayed or have negative reactions when a transcribed interview is read (Simpson & Quigley, 2016; Stake,1995). Lareau (2011) describes that, *in a sense*, this process requires a participant "to look at themselves from others' perspectives" (p. 331). This process can potentially cause participants undue embarrassment and despite exposing participants to potential embarrassment, Lareau (2011) states that the member-checking process

often results in no changes to the study's main argument. Participants in this research study are adolescents which brings additional challenges with concerns regarding the power differential between researcher and subject. While the imbalance of power cannot be completely eliminated, I utilized an innovative member-checking technique developed specifically for adolescents in qualitative research to reduce this inequity.

In 2016, Simpson and Quigley developed a strategy which provides an age-appropriate member checking process to promote student voice through the use of a researcher-created "I-Poem". The process of creating an I-Poem begins with the researcher listening to or reading an individual student interview for use of self or the voice of the "I". Each individual reference to a defined SRL categories will be used to create a line in the poem and will include possible "new" voices. Each respective interview was summarized in 10-12 lines with focus on "I" statements and a reported SRL strategy. At a follow-up interview, students were presented with a poem created from the interplay of both voices. Refer to Appendix B and Adolescent Member Checking: I-Poem Process to review the process and construction of an I-Poem from both this study and the pilot study.

Three participants from the study (P1, P4, & P5), of the 10 total participants, agreed to meet and once again, and gave verbal assent before beginning. I provided one copy to the student during the member checking interview. They were made aware that I wanted to ensure that the information I gathered represented them. Students were offered an opportunity to highlight any parts that they disagree with or that they want to discuss. Students were also asked the open-ended question "Do you need to make any changes?" and "Is there anything missing?" In some cases, I probed students for more information.

The process began as I read aloud each statement. For example, one line read aloud to a student said, “I always take notes on my homework to go back to correct my mistakes”. The student clarified that taking notes in his work consisted of opening new browser tabs to compare correct/wrong answers. The difference between these two strategies is that the first strategy infers the student is using self-evaluation as a strategy for learning. However, comparing “tabs” is more likely a process of deduction and choosing the correct answer by elimination. This meant that the student relied on guessing to correct work and no SRL strategy was associated with this report. At the conclusion of reading the poem, the student was asked to pick out the sentence(s) that felt most important. The last step was for the student to name their I-Poem (e.g., to underscore the composition as their own self-expression).

The iterative coding process and data analysis permits the inclusion of new data from additional sources to construct the participant’s experience, which can be interpreted in the findings. Any changes to the I-Poem and observations during the member-checking procedure were analyzed as it related to the student transcript data. Each student validated their I-poem in the member-checking process resulting in no change of the data or departure of the findings.

The Audit Trail

Creswell and Miller state “the process of establishing a clear audit trail is most important” in validating research (2000, p. 129). Audit trails require documenting both methodology decisions as well notes on researcher thinking. In the process of enhancing the qualitative validity of a study such as this, Lincoln and Guba (1985) refer to six categories of information necessary for an audit trail include keeping a) raw data (transcripts, digital audio recordings, survey notes, field notes); (b) data reduction/analysis (transcript notes, emerging

concepts, summaries); (c) data synthesis notes (themes, findings, interpretations, connections to existing literature); (d) methodology notes (procedure notes; (e) personal notes (tasks, reflexivity and expectations); and (f) instrument development. Personal notes include written accounts of thoughts and reactions that I experienced during stages of the research process. For example, after listening to participant accounts through interviews or digital recordings, I journaled my thoughts including experiences and thoughts related to previous interviews, teaching experience, or the pilot study (See Appendix C). Elements of data reduction and analysis are discussed in detail in procedures for analysis and interpretations.

Procedures and Processes for Analysis and Interpretations

This study was conducted to explore students' use of self-regulation strategies in completing mathematics OHW. I used a qualitative approach to analyze data gathered from interviews conducted with 10 students. Each student was asked to respond to the same six scenarios in planning and completing OHW in their math class during the interview. The structured format of the scenarios encouraged students to respond to the same questions, and students' open-ended responses permitted me to ask follow-up questions to expand upon student answers or probe into them to acquire more details. Students responses were digitally recorded and individually transcribed using an online audio-to-text speech recognition software (temi.com). The transcribed data of each individual interview was placed into a tab on a spreadsheet and assigned an identification code of P1, P2, P3, etcetera. The data was proofread while listening to the audio using multiple opportunities to ensure accuracy. Speaker tabs were added to indicate when I was speaking or when the student was speaking.

The goal of qualitative data analysis is to attain common themes by organizing data in codes, phrases and categories (Creswell, 2015). The analysis process began with data reduction which has been described as "the process of selecting, focusing, simplifying, abstracting, and transforming the data that appear in written up field notes or transcriptions" (Miles & Huberman, 1994, p. 10). Despite a case's uniqueness, generalizations can be produced by analysis in every phase of the research process, by examining the text of interview transcripts, word-by-word and line-by-line, and interpreting the responses of the informants, who are the most knowledgeable of the case. (Kuckartz, 2014; Stake, 1995; Yin, 2018).

First, I applied coding for data reduction, a process intended to simplify the large volume of text while making sense of the data. The process was cyclical: I applied a priori codes to transcripts of interviews through deductive reasoning with subsequent cycles using inductive reasoning by summarizing and identifying similarities, patterns, and relationships within and between groups (Miles & Huberman, 1994; Saldana, 2013). The second activity, data display, organized and created a display of the data in compressed form. Thus displayed, the data were examined, compared, and further analyzed to see how these comparison types relate to each other in increasingly abstract ways (Boeije, 2002; Fram, 2013; Glaser, 1965, Miles & Huberman, 1994). Lastly, drawing conclusions works to provide explicit meaning to the data without oversimplifying. The qualitative analysis procedures and processes will be discussed as it relates to each of these three activities (see Figure 1).

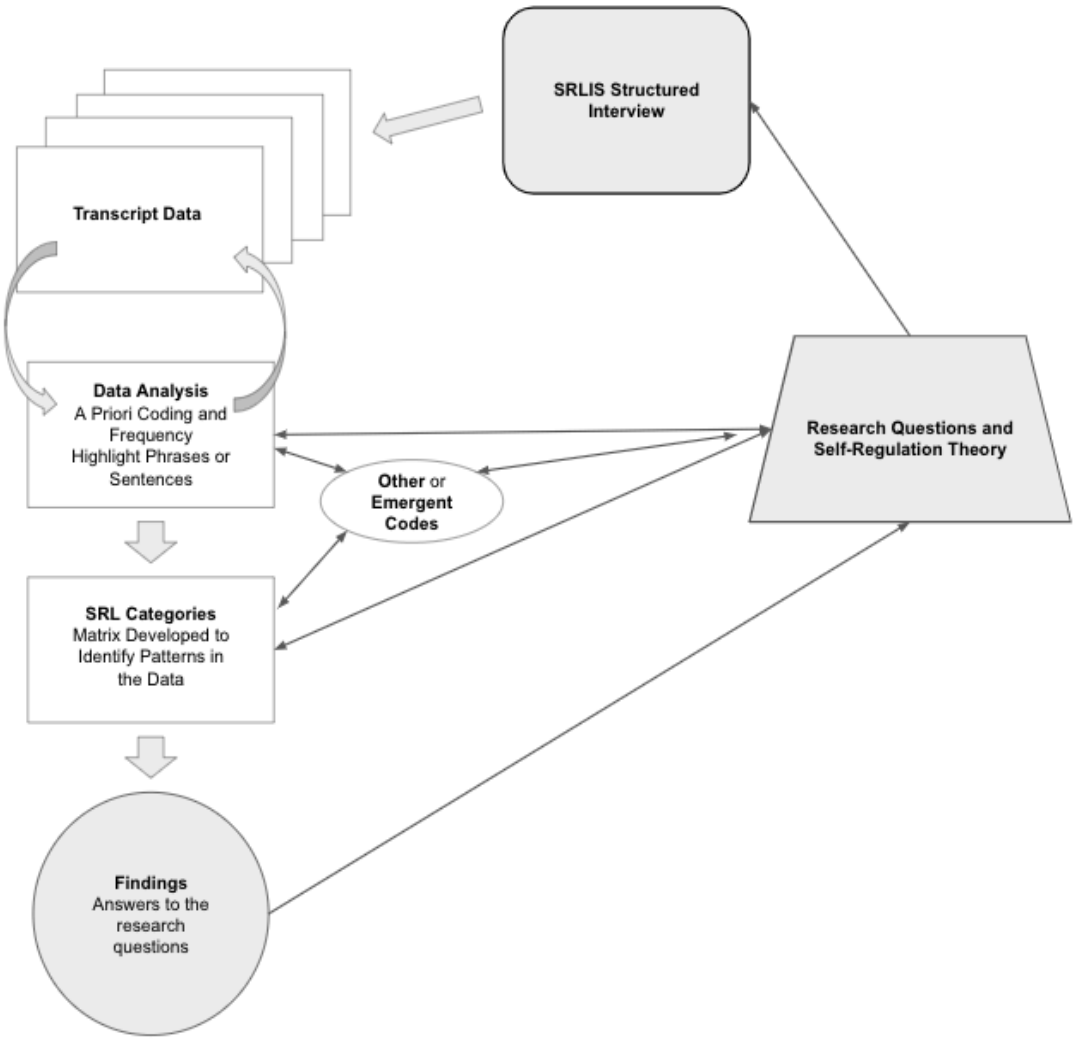

Figure 1 Processes of Data Analysis and Interpretation

Each transcript was coded in its entirety before proceeding to the next transcript. No attempts were made in the first or initial stage of coding to understand the findings in any general sense, yet the intent of the participant response was key to properly coding. Reflection and journaling notes were integral to choosing, rationalizing and applying a priori codes to the data throughout the process (Saldana, 2015).

Protocol Coding and Data Reduction

Coding is one type of data reduction that enables a researcher to arrange and group qualitative data so that patterns and interpreted meanings may emerge (Saldana, 2013). According to Saldana (2013), coding should "represent and capture a datum's primary content and essence" (p. 4). The process of coding in the first cycle is designed to be "simple and direct" (Saldana, 2013, p. 58). Protocol coding methods on passages of the data were applied in cycles of data reduction a priori, using 14 identified SRL strategies from Zimmerman and Martinez-Pons' validation of the SRLIS instrument (1986) (see Table 5). These codes served as a codebook for analysis and are derived from Zimmermans' (2000) self-regulation theoretical framework.

Table 5 Categories of SRL Strategies, Definitions, and Example Statements

Category of Strategies	Definitions
Self-evaluation (SelfEv)	Statements indicating student-initial evaluation of the quality or progress of their work, e.g., "I check over my work to make sure I did it right."
Organizing and transforming (OT)	Statements indicating student-initiated overt or covert rearrangement of instructional materials to improve learning, e.g., "I make sure to have my class notes and/or book ready to do my homework."
Goal-setting and planning (GOAL)	Statements indicating student setting of educational goals or subgoals and planning for sequencing, timing, and completing activities related to those goals, e.g., "I make sure to work on my OHW nightly so I can have it completed by the due date."
Seeking information (SEEK)	Statements indicating student-initiated efforts to secure further task information from nonsocial sources when undertaking an assignment, e.g., "I have a dictionary nearby" or "I use a graphic organizer to understand the problem before beginning."
Keeping records and monitoring (RECORDS)	Statements indicating student-initiated efforts to record events or results, e.g., "I keep a list of problems I got wrong."
Environmental structuring (ENV)	Statement indicated student-initiated efforts to select or arrange the physical setting to make learning easier, e.g., "I turned off my phone so I can concentrate."
Self-consequences (SC)	Statements indicating student arrangement or imagination of rewards or punishment for success or failure, e.g., "I tell myself good job if I make a good score." or "I won't let myself play video games until I'm done."
Rehearsing and memorizing (RM)	Statements indicating student-initiated efforts to memorize material by overt or covert practice. e.g., "I make sure I complete the OHW before (or more than once for) the test."
Seeking social assistance (SPA/STA/SAA)	Statements indicating student-initiated efforts to solicit help from peers (9), teachers (10), and adults (11), e.g., "I will ask my dad for help if I get stuck."
Reviewing Online Homework (REV_OHW)	Statements indicating student-initiated efforts to review missed problems to learn, e.g., "When I get a problem wrong, I redo it until I get it correct."
Reviewing Notes (REV_N)	Statements indicating student-initiated efforts to review notes to do OHW, e.g., "I make sure to look over my class notes before I do the OHW."
Reviewing records (REV_TXT)	Statements indicating student-initiated efforts to review textbook to do OHW, e.g., "I make sure to look over my textbook before I complete the OHW."
Other	Statement indicating learning behavior that is initiated by other persons such as teachers or parents, and all unclear verbal responses, e.g., "I just do what the teacher says."

Note. Taken from "Development of a structured interview for assessing student use of self-regulated learning strategies," by Zimmerman and Martinez-Pons, 1986, *American Educational Research Journal*, *23*(4), p. 618.

In general, transcripts were coded in order of date of interview (earliest to latest). All qualitative data was systematically analyzed and was examined multiple times. Coding was initiated by reviewing each transcribed interview and analyzing the text on a line-by-line basis. I read each sentence and compared its content to the statements and examples of the a priori definitions. If I interpreted a match, I typed the code to a column adjacent to the text. If the sentence did not match to one of the 14 a priori codes, I chose between keeping the sentence uncoded or code it as "Other". In cases where I used the code "Other," I returned to the data later relating to the sentence back to the context of the transcript. For the coding process, I constantly returned to the definitions of codes (see Table 5) while also keeping a journal where I wrote my own understanding of each code as I encountered having to choose between two. For example, several of my entries refer to applying the SRL strategy SEEK as a code. The code SEEK refers to seeking information from non-social sources to obtain further task information. For example, a student might report that they use the name of the OHW assignment to help them know that they will be solving equations. This information provides them information to which they may choose to gather resources like notes or their book. I continually referred to the journal to ensure consistent application of the codes throughout the data analysis process.

Focus was maintained throughout the process by reviewing the research question and by comparing the example statements associated with each SRL category from the original SRLIS construction and validation study with the aspects of OHW (Zimmerman & Martinez-Pons, 1986, 1988). The list of a priori statements and examples were reviewed often throughout the coding process (see Figure 2). Inductive reasoning was used to further understand the student perspective on use of SRL strategies.

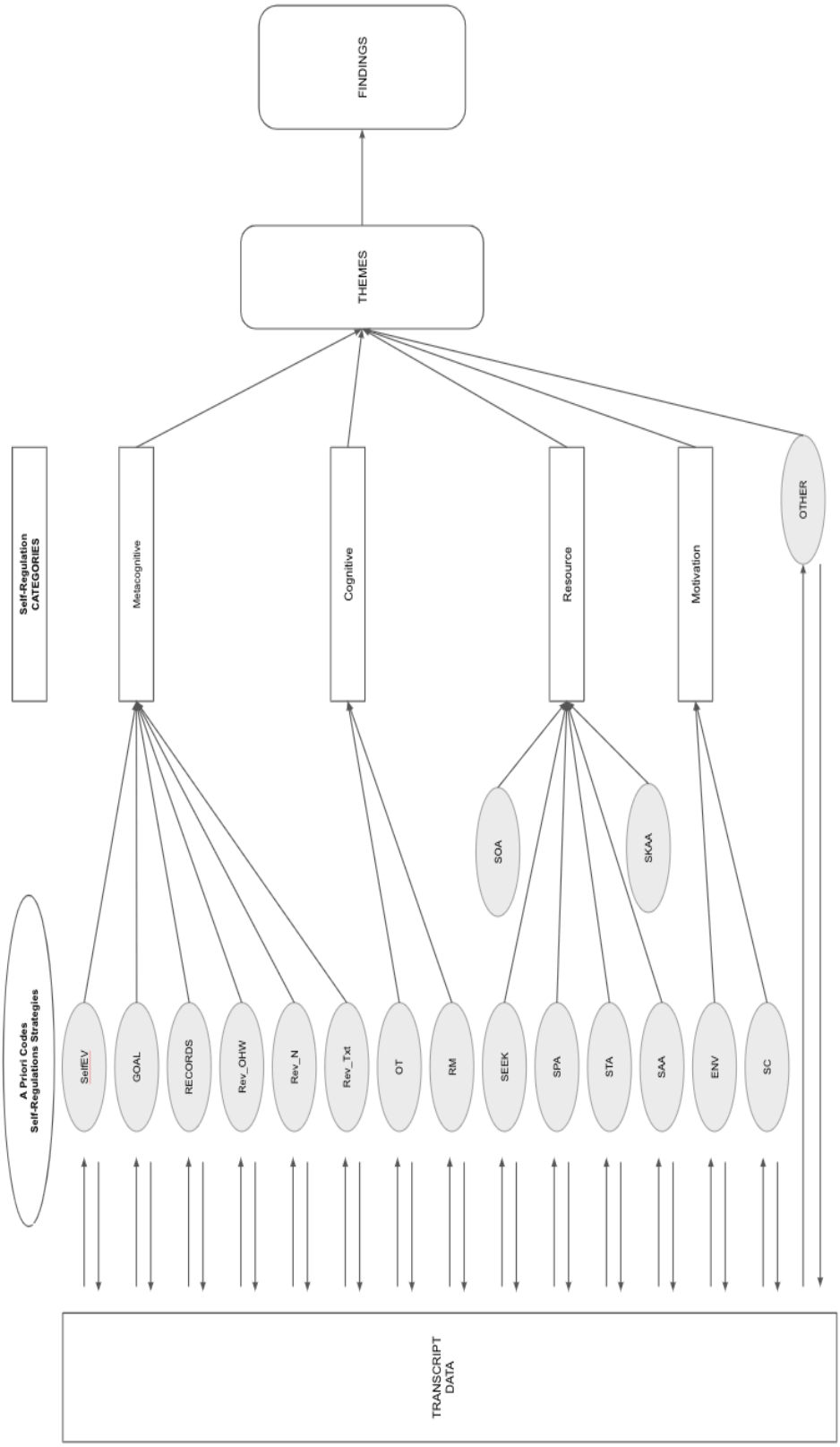

Figure 2 Processes of Protocol Coding and Data Reduction

Every mention of a strategy was coded including student responses to both initial questions and follow up questions. In addition, the student reported frequency of use from 1 (*seldom)*, 2 (*occasionally*), 3 (*frequently*), and 4 (*most of the time*) was recorded. There were occasions when students were not explicitly asked to rate their strategy. However, in each of these cases, I was able to interpret the student response. For example, when listening to the recorded interviews and reading the transcripts, sometimes a student mentioned a strategy and was not provided an opportunity to rate its use on a scale from 1-4. This may have happened because of an oversight during the interview or that a strategy wasn't identified until the data was analyzed. In these situations, I used the context of the answer to apply a rating. For example, if a student says, "I might [do this]", I interpreted this as *seldom* and applied a rating of 1. Whereas "sometimes" was coded as *occasionally* and applied a rating of 2.

Some initial segments or passages of the data were highlighted to code at a later time to benefit from greater researcher coding experience. I was the sole reviewer of the data and, at times, had to make decisions between two related codes and students' reported use of self-regulation. Fortunately, in decision making, choosing between two options is the simplest (Kadlec, 2010). In these situations, I weighed each alternative by again reviewing the definition, examples, and characteristics of the self-regulation skill in the context of the data. For example, a common SRL strategy for a student to mention is that they chose to record the due date of homework. Using the 14 a priori codes, this response could be coded as either OT (*organizing and transforming*) or GOAL (*goal-setting and planning*). To avoid arbitrarily choosing a code, I reviewed the response in context and if necessary, used both the student stories before and after the response to

determine the appropriate SRL strategy. For example, if the student response indicated the due dates were recorded in some way *to improve learning* [emphasis added] then the a priori code was marked as (OT). If the context of the response was for sequencing, timing and completing activities then the a priori code was marked as (GOAL). In other words, I asked myself: "Is the student responding to the task metacognitively by pacing themselves or planning to do better, recognizing this is a benefit to learning?" "Or was the task cognitive, knowing a due date and planning for a completion of the task at hand?"

I also applied notes to sections on the transcript including assumptions made, personal meaning based on prior experiences, unanswered questions and personal reflections. I also highlighted instances when inflection of either my voice or student voice was detected for further analysis. This was particularly important to note due to the power imbalance of researcher and student. Notes were also added in instances that contradicted the ideal interview including: asking students leading questions, leading statements, and interrupting student responses. This contradicts the purpose of the interview by not allowing students to talk freely. While every attempt was made to remain neutral and unbiased during the interview, I discovered anomalies to this when listening to the recorded interviews. My overall lack of interview experience was noted, and in these cases, I relied on additional sources of data and the context of the interview to interpret the students' response. It should be noted that transcripts were evaluated multiple times, both individually and against the others, to ensure consistency and application of a priori codes. Memo writing was performed throughout the process in

which I recorded significant details, concerns, choices, definitions of codes, problems, or personal bias).

Data Display and Thematic Analysis

All qualitative data coded with one of the 14 a priori codes were subsequently categorized into broader self-regulation categories as in the Pintrich (1999) MSLQ instrument including; metacognitive strategies (processes that include thinking, monitoring, or managing one's own learning), cognitive strategies (cognitive organization or critical thinking about the task objective for learning), resource management strategies (seeking information for learning) and motivation (managing effort and structuring the environment for learning). These overarching groups of specific SRL strategies can be viewed in Table 6. These categories assisted the researcher in subsequent analysis.

Table 6 A Priori Codes Categorized as Metacognitive, Cognitive, Resource Management or Motivation types of Self-Regulation Strategies

Metacognitive	Cognitive	Resource Management	Motivation
Self-Evaluation (SelfEv)	Organizing and Transforming (OT)	Seeking Information (SEEK)	Environmental Structuring (ENV)
Goal-Setting and Planning (GOAL)	Rehearsing and Memorizing (RM)	Seeking Social Assistance (peer) (SPA)	Self-Consequences (SC)
Keeping Records and Monitoring (RECORDS)		Seeking Social Assistance (teacher) (STA)	
Reviewing Online Homework (REV_OHW)		Seeking Social Assistance (adult) (SAA)	
Reviewing Notes (REV_N)			
Reviewing Textbook (REV_Txt)			

Predominant codes, direct quotes, and summary of responses identified at the conclusion of coding cycles and were assembled in several matrices for analysis and to

serve as data display (see Chapter 4). Development of findings and thematic analysis permitted students' perceptions to remain contextualized within their interaction with OHW. Thematic analysis was framed using a series of questions with the following serving as examples:

- What SRL skills are reported for each of the six scenarios?
- When, where, why, and how does this SRL skill occur?
- With what consequences does the SRL skill occur?
- Is the SRL skill understood?
- What themes are similar or different? (Boeije, 2002)

The displays served to organize a compressed amount of assembled information to draw conclusions by revealing visual patterns of reported SRL strategies either by groups of students or by question. (Miles & Huberman, 1994, p. 11). The creation of the matrices not only offered the opportunity for thematic analysis of the data, but it also prompted additional opportunities to ensure the data was coded using an emic perspective. The research design did not include performing a quantitative statistical analysis based on the frequency of codes.

Summary

The interest in SRL research has propagated ever increasing methods of assessing the complex components of SRL indicators in students (Roth et al., 2016). Yet, self-report surveys, frequently used to measure SRL, are often not the best choice and are subject to debate (e.g., SRL misaligned to achievement levels, actual SRL behavior may vary from reported behavior, students may over or underestimate actual SRL skills, or surveys positioned to be administered to students in post-secondary environments)

(Boekaerts & Corno, 2005; Cazan, 2014; DiFrancesca et al., 2016; Roth et al., 2016; Vandevelde et al., 2013). In other words, there is a shortage of developed survey instruments which comprehensively measure all elements of SRL among primary students (Vandevelde et al., 2013). Data in this study were collected using the SRLIS instrument which provides consistency of student reported SRL strategies in *naturalistic* settings. In this study, this refers to students learning with OHW outside of school. Use of a validated instrument in the interview procedures adds credibility to these findings because they are repeatable and consistent with related studies.

This descriptive case study uses a convenience sample of 10 middle school students from an academically high-performing middle school. Findings draw upon data collected through modified structured interviews and protocol coding with 14 SRL strategies (a priori) from Zimmerman and Martinez-Pons SRLIS validation study (1988). The research design included triangulation of the data and member checking procedures. The reported data was organized into matrices for display to be examined, compared, and further analyzed to show how the types of data relate to each other and among two achievement groups (low and high).

CHAPTER FOUR: FINDINGS

In this chapter, I present themes emerging from the analysis of the qualitative data collected from student interviews using Zimmerman and Martinez-Pons (1986) Self-Regulated Learning Interview Schedule (SRLIS)—a validated instrument developed to assess students' use of self-regulated learning strategies. The chapter addresses the study's two research questions and discusses similarities and differences within each of the broader categories of self-regulation including metacognition, cognition, resource management and motivation.

[RQ1] What self-regulation strategies do students report using while learning mathematics with OHW?

[RQ2] What are differences or similarities of reported self-regulation strategies among students in different achievement groups (low or high) while learning mathematics with OHW?

Participants were asked six structured interview questions in the form of scenarios which were modified from the original instrument for the context of online homework (OHW). In addition to answering the research questions, the open-ended interviews illustrate specifically how students implemented SRL strategies in completing OHW. Data from this descriptive case study was coded and analyzed using 14 pre-established (a priori) SRL strategies as code categories (*self-evaluation*, *organizing and transforming*, *goal-setting and planning*, *seeking information*, *keeping records*, *self-monitoring*, *environmental structuring*, *self-consequences*, *rehearsing and memorizing*, *seeking peer,*

teacher or adult assistance, and *reviewing notes, tests or textbooks*), along with one category, *other* (see Table 5 and Table 6). The frequently used SRL strategies that emerged were subsequently organized within four broader self-regulation categories for discussion. Pintrich's (1999) SRL conceptual framework defines these categories as either metacognitive, cognitive, resource management, or motivation type strategies. In this chapter, identifying information for achievement groups of individual students will be identified as either the low-achievement group (Group 1) and represented by (L) or the high-achievement group (Group 2) and represented by (H) (see Table 2).

Findings - Research Question 1

What self-regulation strategies do students report using while completing OHW in mathematics?

Students reported a wide range of use of each of the predefined SRL strategies among the four self-regulation categories: metacognitive, cognitive, resource management, and motivational strategies (see Table 7). Moreover, SRL strategies included in the two categories, metacognitive and resource management, were frequently reported by all students (over 13 times in total). I will address findings related to both of these categories and offer descriptions of students' reported use from the data as examples to support the findings.

Table 7 Summary of Reported Frequency of SRL Strategies by Self-Regulation Categories

	Frequency
Metacognitive Strategies	15
Cognitive Strategies	8
Resource Management Strategies	13
Motivational Strategies	4
Total SRL Strategies Reported	**40**

Metacognitive strategies are related to the students attention and awareness of their own (cognitive) actions and their outcomes for learning (Pintrich, 1999). Metacognitive SRL strategies include *goal-setting and planning*, *keeping records and monitoring*, *reviewing records* (OHW/notes/textbook), and *self-evaluation*. *Goal-setting and planning* was coded when students reported that they initiated efforts to set educational goals and then plan, sequence and complete activities to reach those goals (e.g., "I make sure to work on my OHW nightly so I can have it completed by the due date"). Similarly, other metacognitive SRL strategies, *keeping records and monitoring*, *reviewing records* (OHW/notes/textbook), and *self-evaluation* include student-initiated efforts to record results and evaluate the quality or progress of their work to improve learning.

Resource management strategies are related to student-initiated efforts to seek help or secure further information to complete the task and are essential self-regulation strategies. Schunk (2005) suggests that "all students require assistance at times, to understand material and when confused about what to do" (p. 89). Two predefined SRL strategies, *seeking assistance* or *seeking information*, were coded for students reporting

use of seeking help from social sources (e.g., teachers, adults, peers) or nonsocial sources (e.g., reading directions, using titles as context clues), respectively.

Among all the self-regulation categories, students report using as few as two types of SRL strategies to as many as six (see Table 8). Students did not report any use of two SRL specific strategies, *seeking information* and *reviewing records* (textbooks). Findings will be presented for occurrences when "no strategy" was reported. Thematic analysis of the matrix illustrates widespread reported students' use of specific strategies, notably *goal-setting and planning* and *seeking assistance.*

Table 8 Matrix of Summary of A Priori Codes and Reported Frequency by Question and Participant

Scenario Do you have a method to...	**Participant / Student Reported Strategies/Rating**									
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Q1. Learn/Remember …help you learn and remember what is discussed in class?	STA/4	OT/4	REV_N/4	OT/4	REV_N/4	No Strategy	SPA/2	OT/4	OT/4	No Strategy
Q2. Planning HW **…**help you plan your homework?	OT/3	OT/4	GOAL/3	Self_EV/4	GOAL/3	GOAL/4	GOAL/4	OT/4	GOAL/4	No Strategy
Q3. Plan/Complete OHW: When do you plan to complete/submit OHW?	GOAL/3	No Strategy	GOAL/3	GOAL/4	RECORDS/4	No Strategy	No Strategy	GOAL/4	R_OHW/4	GOAL/4
Q4. OHW and Tests … using the online homework to prepare for your math tests?	No Strategy	No Strategy	REV_OHW/4	No Strategy	RM/2	No Strategy	No Strategy	No Strategy	RM/4	RM/4
Q5. Motivation … motivate yourself to complete your homework?	No Strategy	OTHER (Parents)	ENV/-	OTHER (Parents)	OTHER (Parents)	SC/3	SC/-	OTHER	GOAL/4	ENV/-
Q6. Seeking Help [a] **…**understand and finish assignments at home?	SAA/3	SAA/4	REV_OHW/4	S0A/3, SKAA/2, SPA/2	SKAA/4,SPA/2	SPA/4	SPA/2, SAA/2	SAA/2	OT/4	No Strategy

Note. See Table 5 (a priori codes), Table 6 (SRL categories) and Table A.1 (SRLIS Questions) for descriptions. a Seeking Online Assistance (SOA) and Seeking Khan Academy (SKAA) are student reported strategies and were added to the original 14 a priori codes for seeking help.

Goal-Setting and Planning

Creating a plan for sequencing, timing and completing OHW to reach a student's personal learning goal was described by a majority of students. In fact, the specific SRL strategy of *goal-setting and planning* was the most reported metacognitive strategy (reported 11 times). In general, students reported that having flexibility to complete OHW throughout the week was important. Students reported using the weekend to complete work since they may have extra homework, classes, family, sport or other personal obligations that prevent them from working during the course of the week (Monday to Thursday).

When analyzing responses among the higher and lower academic achievement groups, both groups were equally likely to report using this strategy. This SRL skill was reported by all ten students (9 total) with the exception of one student (H) (see Table 8). The higher achievement group (Group 2) reported *goal setting and planning* 5 times while the lower achievement group (Group 1) reported *goal setting and planning* 6 times. These findings are consistent with research; with differences that high-achieving students set more specific goals (DiFrancesca et al., 2016). This strategy was typically mentioned in response to SRLIS question 2 (5 students) and SRLIS question 3 (5 students) which asked students to discuss their strategies related to planning and completing homework. The one student that did not report any use of goal setting stated that they "learn as they go." The other students reported:

- "I plan to submit them [OHW] as early as possible." (H)
- "I just never allow myself to get behind on the work, so I always...whatever I'm learning about that day, I do the homework." (H)

- “I try to do one everyday...So then I just don’t stuff it all in on Sunday.” (L)
- “I do one homework on Thursday, another homework on Friday, and two on Saturdays...giving me more time to do my other homework.” (L)
- “I have everything written down [in] my planner. I have [when] specific assignments are due on and on what day and I do what assignments are due first.” (L)
- “I write everything down in a planner...and I do what assignments are due first.” (L)

Low-achievement students most often reported setting goals to complete OHW with reports and intention to regulate their emotions. For example, students suggested that they just wanted to “get it over with” (L) or “I don’t [want to] have to deal with it later.” (L) In contrast, one student (H) reflected on how they learned to set goals after their previous pattern of submitting assignments failed. They shared, “I thought like I could just do them all [on Sunday]. Well, that didn’t really work out very well. So, I started doing it one-a-day.” Two Students (L) reported having to work through procrastination and emotions of failure when their intentions or plans failed. They expressed frustration suggesting, for example: “It’s the weekend. Like I shouldn’t be working.” (L)

Students communicated that planning to complete OHW before the due date was often used in an effort to utilize the feature of allowing students multiple attempts for mastery and a better score. Students remarked that the computer-generated feedback alerted them to the possible need to seek help. Two students (H) specifically address the fact that achieving perfect scores were important.

- “Most of the time it takes me like two attempts. I get like 100% every homework because I go back and redo it if I get it wrong.” (H)

- "I have to keep my perfect score." (H)

Nearly all students, 9 total (5 (H) & 4 (L)), suggested that they set goals to finish their OHW early so that they could use one of their attempts to retake the homework for improving scores or to know if they need to seek assistance.

Keeping Records & Monitoring

The SRL strategy *keeping records & monitoring* was only infrequently mentioned by students. Keeping records refers to student-initiated efforts to record events or results such as maintaining a list of problems they get wrong. In fact, in this study, this was only reported by one student (H). While students generally discussed strategies of OHW reattempts, one student provided a specific response when asked about submitting and completing assignments (Question 3). The student identified that knowing the mistake, for example, like "just like calculating the [wrong] answer," doesn't need to be reworked because "just knowing is okay."

Reviewing Records

Reviewing records (OHW/Notes/Textbook) was an SRL strategy reported by three students. Reviewing records refers to student-initiated efforts to review missed problems, textbook examples or their own notes. Two of the students (one from each achievement group) reported that they reviewed records including student generated notes, worksheets/packets and the textbook to remember what was discussed in class to help complete the online math homework (Question 1). One student remarked "I copied down whatever my teacher is writing on the board. And so, when I get to the homework, I get out that piece of paper and a new piece of paper to show all my work so...I don't have to do it in my head" (H). While also adding that it usually helped them to look and

go over the notes “from the start to the finish… [so that] I can compare and contrast what I did” (H). While another student from the lower achievement group stated they review records while the material is “fresh in my mind” (L) to correct their work.

Self-Evaluation

Specific reports of students using the SRL strategy, *self-evaluation*, was limited to one student in the high-achievement group. This was the only student who didn’t report setting goals and planning as a SRL strategy. Yet, this student recounted that “when I do the homework—I like try.” The student said “if I get like a bad score on it...I have like several attempts. So I’m like, do it again or like get the answer wrong.” Students possessing high self-efficacy, report being confident to complete OHW without having been taught the skill or knowing if they fully understand the lesson. In contrast, one student from the low-achievement group stated, “I don’t want to waste all my attempts and then when I finally understand it, then won’t be able to answer it then” (L). This student reported seeking help after two unsuccessful attempts in order to meet the goal of earning a good grade.

Seeking Social Assistance

The structured interview instrument asks the same six scenarios to each student. Students open-ended responses to each question, along with student responses from additional researcher questions to probing for more details or clarification are collected to assess 14 classes of self-regulated learning strategies. Three of the 14 SRL strategies consider students’ reported use of seeking social assistance from peers, adults, and teachers. The strategy of *seeking assistance* was reported by students in both achievement level groups with students relying on a variety of social sources for help (teachers, adults

or peers). This SRL strategy was reported about as often as the SRL strategy of *goal-setting and planning*. Yet, while students reported their frequency of setting goals *most of the time*, reports of seeking social assistance ranged in frequency from *occasionally* to *most of the time,* and students often used varied sources of assistance. These findings of the present study align with those of Schunk (2005) which observe that wide individual differences in students' frequency, amount, and type of help seeking. A majority of the students (6 out of 10) described seeking help from adults and peers.

- "If I don't understand something, I'll usually get help from my parents" (H).
- "My dad's really good at math so I have him help me" (L).
- "[Most of the time] I always have friends to call" (L).
- "I usually text a friend and wait until they reply. If they don't know I'll keep on asking other people who have either the same teacher or knows [*sic*] how to do it" (L).

Meanwhile, only three students (L) reported seeking help from a teacher, one of which sought help from a teacher who was a mentor - rather than the course instructor. One other student (L) mentioned they would seek teacher help though it was "very rarely...very, very." The only student in the high-achievement group who reported seeking teacher assistance did so only if they had made multiple attempts at their OHW and recognized that they were still having difficulties. This student was the only student who initiated the SRL strategy of keeping records of their work *and* the strategy of rehearsing and memorizing as they reported, "I do over like two or...a couple of times to make sure that I was correct." Similarly, Zimmerman and Martinez-Pons (1988) found

that student reports of seeking teacher assistance were noted but not statistically significant as predictors of academic achievement upon validating the SRLIS instrument.

In general, this study found that students reported seeking assistance as a secondary SRL strategy and most often as they chose to figure their OHW out themselves. This is in contrast to findings of Zimmerman and Martinez-Pons (1986), who found that high-achieving students relied more heavily on social sources of assistance, relying heavily on the assistance of teachers, peers, and adults.

Non-Social Assistance (Emergent Codes)

Students reported trying to complete work at home by first using online resources or by attempting each question multiple times before seeking assistance from an adult. Three students (2H and 1L) reported using non-social sources of assistance in the form of online resources (e.g., Google, Khan Academy). For example, a student (H) reported, "If I don't understand it and I didn't really pay attention in class, I like Google the problems and see like...how to do...like linear equations for example...and then I can just watch a video on it [and it] kind of helps me." Similarly, another student (H) reported, **"[**Most of the time] when I need help on something, I'll go to Khan Academy." This student detailed their non-social help-seeking by saying that they search by using keywords from the description of the assignment name as a resource—"All our online homework has different titles of what we're learning [sic] and so I'll just [look] up the title." Furthermore, one low-achievement student (L) reported that "I will search [online] on how to complete a problem." However, the report from this student lacks specificity when compared to those of the high-achieving students. It also does not describe how the assistance benefits their learning. I highlighted a key phrase used by the student which

read “For this student, learning just sinks-in,” and added that their use of SRL strategies for learning might be context-dependent (i.e., not just arising when completing math homework).

No SRL Strategy

Participants were sometimes not able to mention a single strategy in response to a question or scenario (see Table 9). For example, when asked what motivates them to complete OHW, one student responded “[OHW is] just the exact same thing, going from pencil to papers but just on a screen.” Similarly, the scenario of planning OHW (Question 3) resulted in students sharing their process without reference to a predefined SRL strategy:

- “I just open them [OHW] up” (L).
- “I’ll try to do them, [if] not that day, maybe like the next day” (L).
- “I just submit them as soon as I finish...Cause like if I wait until Sunday, I might forget.” (L).

Meanwhile, responses were also coded “No Strategy” when students reported suggestions of strategies rather than actual reported use of an SRL strategy. For example, statements such as “the math book [would] *probably* help” (L) is likely a suggestion rather than a reported use of a SRL strategy. However, “No Strategy” should only be interpreted that the student simply didn’t disclose a SRL strategy in the interview, not necessarily that they don’t use a strategy.

Table 9 Summary of Responses with "No Strategy" by Question and Participant and Achievement Groups (High to Low)

Scenario: Do you have a method to…	Group 2 (High-Achievement)					Group 1 (Low-Achievement)				
Q1. Learn/Remember …help you learn and remember what is discussed in class?							No Strategy			No Strategy
Q2. Planning HW …help you plan your homework?										No Strategy
Q3. Plan/Complete OHW: …when do you plan to complete/submit OHW?			No Strategy			No Strategy	No Strategy			
Q4. OHW and Tests … using the online homework to prepare for your math tests?	No Strategy		No Strategy	No Strategy		No Strategy	No Strategy	No Strategy		
Q5. Motivation … motivate yourself to complete your homework?								No Strategy		
Q6. Seeking Help …understand and finish assignments at home?										No Strategy

Table 9 reveals that data coded as *No Strategy* occurs much more frequently in the lower achievement group than the high-achievement group, 10 times and 4 times respectively. In general, students in the low-achievement group would often offer less specific responses or a response that referenced will-power with statements such as "I just do it" (L). One student (L) remarked "I just like...take my best guess and try again"

while providing additional statements referencing hope or luck. This same student then went on to say: "I hope [what I learned in class] helps me like...know the answers, adding that "I just like...take my best guess and we get like...four attempts" (L).

Notably, *No Strategy* was most often noted when students were asked about having any particular methods for using OHW to prepare for tests (Question 4).

- "I don't usually study for any math test." (H)
- "I think I usually...I know what I'm doing [by that point of taking the test.]" (L)
- "I kind of just use online homework for like, oh, it's just for good practice." (L)
- "I actually don't use the math online homework for preparing for math tests." (L)

Similarly, when asked if they have any methods to learn and remember, two students did not mention any use of SRL strategies and stated that they "usually know like what we're doing" (L) or that they relied on their "pretty good memory...it kind of just like sinks into my head" (L).

Findings - Research Question 2

What are differences or similarities of reported self-regulation strategies among students in different achievement groups (low or high) while completing mathematics OHW?

One finding of research question 1 (RQ1) is that all students reported a wide range of use of each of the predefined SRL strategies among the four self-regulation categories: metacognitive, cognitive, resource management, and motivational strategies. To answer research question 2 (RQ2), I disaggregated the data from the "Summary of Reported Frequency of SRL Strategies by Self-Regulation Categories" (see Table 7) and analyzed the reported SRL among low- and high-achievement groups. Comparing the

total reported frequency of SRL strategies between two groups resulted in similarities, with 19 reports (low-achievement group) and 21 reports (high-achievement group). Yet, I noted differences between two of the categories—cognitive strategies and motivational strategies (see Table 10).

Table 10 Summary of Reported Frequency of SRL Strategies by Self-Regulation Categories by Achievement Group

	Achievement Group	
	Group 1 (Low-Achievement)	Group 2 (High-Achievement)
Metacognitive Strategies	7	8
Cognitive Strategies	2	6
Resource Management Strategies	6	7
Motivational Strategies	4	0
Total SRL Strategies Reported	**19**	**21**

Cognitive strategies are ones that are student-initiated efforts to increase learning by overt or covert practice or rearrangement of instructional materials. Two cognitive strategies were pre-defined in this study and students reported using both: *organizing and transforming* and *rehearsing and memorizing*. Students report initiating OHW in efforts to learn by memorizing or practicing with repeated efforts or to rearrange instruction or materials with the goal to improve their ability to learn.

While there are many motivational processes that are important for learning, this study identified students reported use of two predefined SRL strategies, *environmental structuring* and *self-consequences*. When initiating a task, students perceive the level of difficulty of the learning and exhibit self-regulation skills when they control contextual

factors or regulate their own behavior or effort (Schunk, 2005). The difference between these two SRL strategies can be characterized through examples of reports from two students (L) and how each student chose to initiate control and complete OHW. In one report, a student described the phone as a distraction and chose to self-initiate control by removing the phone from their proximity. This effort to control the environment to support learning was coded under the a priori category, *environmental structuring*. Meanwhile, a second student chose to create a reward for themselves and allowed themselves on their phone only *after* they completed their OHW. They reported, "I just don't have my phone near me. I just keep it somewhere else so I don't get distracted and I just complete it." (L) This SRL strategy was coded under the a priori category, *self-consequences*.

The differences between achievement groups are further highlighted in the "Matrix of A Priori Codes and Reported SRL Strategies Reported by Participants and Achievement Groups (High to Low)." (see Table 11) This matrix helps illustrate the finding that students reported a wide range of SRL strategies between achievement groups. Additionally, the matrix helps visualize the differences among specific SRL strategies, namely, *organizing and transforming, environmental structurin*g, and *self-consequences*.

Table 11 Matrix of A Priori Codes and Reported SRL Strategies Reported by Participants and Achievement Groups (High to Low)

A Priori Code		Group 2 (High-Achievement)					Group 1 (Low-Achievement)				
Metacognitive	Self-evaluation (Self_EV)	Self_EV/4									
	Goal Setting and Planning (GOAL)	GOAL/4	GOAL/4		GOAL/4	GOAL/3	GOAL/4	GOAL/4	GOAL/3	GOAL/3	GOAL/4
	Keeping Records and Monitoring (RECORDS)					RECORDS /4					
	Reviewing OHW (REV_OHW)		R_OHW /4							R_OHW/ 4	
	Reviewing Notes (REV_N)					REV_N/4				REV_N/4	
	Reviewing Text (REV_Txt)										
Cognitive	Organizing and Transforming (OT)	OT/4	OT/4	OT/4	OT/4				OT/3		
	Rehearsing and Memorizing (RM)		RM/4			RM/2					RM/4
Resource Management	Seeking Information (SEEK)										
	Seeking Peer Help (SPA)	SPA/2				SPA/2	SPA/2	SPA/4			
	Seeking Teacher Help (STA)								STA/4		
	Seeking Adult/Other Help (SAA)			SAA/4	SAA/2		SAA/2	SAA/1	SAA/3		
	Seeking Online Assistance (SOA)a	SOA/3									
	Seeking Khan Academy (SKAA)a	SKAA/2				SKAA/4		SKAA/2			
Motivation	Environmental Structuring (ENV)									ENV/-	ENV/-
	Self-Consequences (SC)						SC/-	SC/3			
	Other	OTHER (Parents)		OTHER (Parents)	OTHER	OTHER (Parents)					

Note. See Table 5 (a priori codes) and Table A.1 (SRLIS Questions). [a] Seeking Online Assistance (SOA) and Seeking Khan Academy (SKAA) are student reported strategies and were added to the original 14 a priori codes for seeking help.

Organizing and Transforming

The OHW in this study was programmed to correspond to teacher direct instruction in class. In other words, Monday's lesson will correspond to skills students will practice in the first homework of the week, Tuesday's lesson will correspond to the second OHW and it continues in this pattern for each day of the week, week after week. However, students can choose to complete OHW in any order and at any time during the week. Typically, students reported efforts to match the teacher-led instruction with OHW completion. For example, students reported that they would choose to delay completing homework if the teacher pacing did not align to the OHW for that day. One student from the low-achievement group specifically reported that their goals change because "sometimes he still hasn't gone over the assignment." Similarly, almost all the students (four of the five) in the high-achievement group reported that they learn as they go – implying they sequence the completion of OHW with the corresponding lesson taught in class. For example, one student (H) reported, "If there's like a homework assignment that we haven't done in class, like I don't do it and I wait until we do it in class," adding: "I learn [material] in class and then I hope that helps me."

Reports of the SRL skill *organizing and transforming* was the most reported cognitive strategy by the higher academic group. A study conducted by Nandagopal and Ericsson (2012) similarly found that high-achieving students specifically use the SRL strategy, *organizing and transforming*, while studying.

When students in the high-achievement group worked on OHW without regard as to whether the corresponding lesson had been provided in class, they reported an increase in their learning. One notable advantage of OHW is the opportunity it provides for

multiple student attempts. This feature in OHW can encourage students to achieve mastery (Magelhães et al., 2020). One student suggested that "Most of the time I start my math homework earlier…[then] after I learn it, I understand it more" (H). This student mentioned that it was important to have multiple opportunities to earn credit, to be able to attempt it once on their own (before the lesson) and then try again after the lesson. While another student reported taking similar intellectual risks, saying, "[I'll] see how far I get" (H). This same student reported a strategy to monitor their work adding, "and [I'll] see if tomorrow's homework and the lesson we learn tomorrow matches with [the homework I complete early]."

Moreover, students reported include overt methods of reorganizing OHW to make learning easier, including making use of parental assistance and resources (online help) at home, taking breaks and organizing work around other learning tasks. For example, one student (H) reported that they structure their harder homework to complete at home rather than at school. Similarly, *organizing and transforming* were reported from two students in response to questions 5 and 6 which asked about strategies to complete and submit OHW at home.

- "I get like five wrong on the homework out of 10. I'm just going to close it [computer]... put it away, go do something for 30 minutes, come back to it...with a fresh mind" (H).
- "[For homework] I want to start with longer [assignments] and then end with a short part" (H).

Another student (H) reported use of this SRL strategy in conjunction with printing out the OHW assignments. The student found that the printed copy was beneficial to

maintaining focus, getting help, and learning. The student remarked, “I’ll print all my homework and I’ll go through them...I can concentrate more so that will help me [learn] - most of the time” (H).

In contrast, reports from low-achievement students revealed limited or no overt or covert plans to complete OHW earlier. These students only attempted their OHW after it was preceded by the lesson and teacher-directed instruction. These students mentioned not wanting to “waste attempts” and to “know what they are doing” and to “make life easier” in undertaking their OHW.

Rehearsing and Memorizing

While the use of the SRL cognitive strategy, *organizing and transforming,* was found among students in the high-achievement group, the cognitive SRL strategy, *rehearsing and memorizing,* was limited within both groups. Data from three students (2H and 1L) referred to using this strategy when responding to question 4, which asked students to describe how they used OHW to study for tests.

- “It’s like I already have the best score possible on [OHW]...I *might* do it again for just more practice” (H).
- “Most of the time I do [the OHW] a couple of days before [the test] so I can remember all the information. I keep it in a small compact part [i.e., practicing 1-2 days prior to the test instead of starting homework early]” (H).
- “I go over them. I go to that attempt, then I just look at it. But because like, I’ve already completed it, so I just look at it” (L).

Environment Structuring

An SRL strategy similar to the cognitive self-regulation strategy *organizing and transforming*, is the motivation self-regulation strategy, known as *environmental structuring*. While *organizing and transforming* refers to student-initiated rearrangement of materials, *environmental structuring* refers to student-initiated efforts to arrange the physical setting. Reports of students utilizing either of these two SRL strategies, *environmental structuring* or *self-consequences*, were limited to students in the low-achievement group.

Two students (L) in this study reported use of SRL and *environmental structuring* specific strategies to counteract problems dealing with distractions and procrastination in completing OHW. These reports were generally associated with Question 5 which asked students to discuss strategies on motivating yourself to work on OHW. In addition to the example of the report of a student avoiding distractions by removing their phone, one student (L) reported the importance of structuring their environment with breaks to ensure they returned to their work with a *fresh* mind to finish the OHW: "If I'm not like in the mood to do it, I at least do half of it or three quarters of it." (L) Students may attempt to control their anxiety, such as by not ruminating on test questions that they cannot answer when they are not in the mood to study (Schunk, 2005).

Self-Consequences

Learners also may make positive outcomes contingent on academic performance (e.g., rewarding oneself with a movie after studying). Two students (L) reported student-initiated efforts to regulate their effort by establishing self-consequences (e.g., delay of

immediate gratification such as watching YouTube, going to sleep, or playing with friends).

- "I'm like a really, really bad procrastinator and so always go on my phone, but I'm like, okay, if I finish [writing all these notes], I can [just go on my phone]." (L)
- "I like to get my homework done so on the weekends I can do something else like have fun. And then so that was it [*sic*] motivates me to do it." (L)

In terms of methods for motivating oneself to complete homework (Question 5), three students mentioned motivating factors labeled as "Other" which include factors outside the students' self, such as meeting parents' expectations or possessing a belief that the study of math will be valuable to them in the future. One student regarded doing schoolwork as his job: "my parents, like they taught me like I have to do homework, it's like a job" (L). One student (H) did not indicate any strategy for motivation. Three students (H) disclosed that their motivation for doing OHW came from parental pressure on them to get good grades.

A common theme among all students in both achievement groups are reports that they typically did not use OHW specifically to prepare for math tests (Question 4). Most of the student responses to this question were coded as *No Strategy*. Students reported that the OHW that they completed either was (1) enough to practice for the test or (2) was likely the only time they practiced skills necessary to show mastery on the test. In other words, OHW was typically not used beyond the primary purpose of one-time practice. One student said that *Most of the Time* "I do [the OHW] a couple of days before [the test] so I can remember all the information" (H). another student describes "just look[ing] at it" (L). While not common, one student (H) discussed that they *might* consider doing

practice if OHW scores were low or below a percentage. Some students commented they know OHW is good to study and several had peers that used it, but they didn't. One student commented that on the test, "I think I usually know what I'm doing [by that point]" (L). Another student said, "because like I've already completed it, so I just look at it" (L) and "I'm too lazy to get onto the computer" (H).

Summary

This chapter presents findings of this research study: middle school students reported use of SRL strategies when completing OHW. In summary, a total of four findings are presented and discussed to address RQ1: What self-regulation strategies do students report using while completing OHW in mathematics?

First, in this study, students were found to use a variety of SRL strategies (see Table 7). Data shows students reporting as few as two or as many as six strategies (see Table 8). Second, of the 14 SRL strategies, students consistently reported use of two specific SRL strategies; *goal-setting and planning* (metacognitive) and *seeking social assistance* (resource management) without regard to their level of academic achievement. Third, two new codes emerged from the data related to seeking assistance from non-social sources (i.e., internet resources). In general, students reported a preference of working out problems on their own before asking for help. Furthermore, these same students were also likely to use videos and online resources to support their learning. Lastly, "no strategy" was a common coding label from the data collected from student responses to scenario 4 which asked, "One reason that teachers give math homework is to help students practice skills for tests. Do you have a particular method for using the online homework to prepare for your math tests?" All students responded to this question

similarly, highlighting the report that while students would utilize different SRL strategies to complete OHW, students did not transfer the use of OHW or exhibit self-regulation strategies beyond completing homework to prepare for math tests. Moreover, while students in both groups were classified as having "no strategy," the high-achievement group had 4 instances of this result, while the low-achievement group had 10 (see Table 9). None of the students in this study reported use of the SRL strategies seeking information or specifically using the textbook for learning (reviewing records).

Three findings were presented to address RQ2: What are differences or similarities of reported self-regulation strategies among students in different achievement groups (low or high) while completing mathematics OHW? First, among achievement groups, the sum of the reported strategies among the four broader self-regulation categories (metacognitive, cognitive, resource management, and motivation strategies) were relatively the same (see Table 10). However, cognitive and motivation SRL strategies differed between academic groups (see Table 11). The second finding is that students in the high-achievement group reported organizing and transforming their environment to improve learning more often (a total of 7 times) than the low-achievement group (1 time). Finally, the high-achievement group did not report use of any predefined motivation strategies whereas the low-achievement group reported use of both *environmental structuring* and *self-consequences*. The high-achievement group typically reported "other" and parental involvement, including parents setting academic expectations and controlling the study environment for academic success. Alternatively, some high-achieving students believed that the study of math will be valuable to them in

the future. The low-achievement group, by way of contrast, reported strategies to regulate processes to control their behavior, mood or anxiety.

CHAPTER FIVE: CONCLUSION

This qualitative study explored students' reported use of self-regulation strategies using frameworks of self-regulation theory (Pintrich, 1999; Zimmerman, 2000). This research utilizes a descriptive case study design and the context of an online math homework program developed by the researcher. I conducted this study to examine how OHW related to the support and development of students' self-regulated learning (SRL).This chapter offers general observations and interpretations in an effort to deepen understanding of the data discussed in the findings chapter, with the hope of informing and enriching teaching practice. It also shows how this study's findings fit into the current literature on SRL and online homework. Given the value of self-regulation in student learning, the purpose of this study was to add to the body of knowledge regarding what self-regulation skills middle school students report in completing online homework in mathematics. This study departs from much of the research on OHW in that its purpose was not to establish the efficiency or effectiveness of online homework in comparison to traditional forms of homework. This chapter will conclude with a discussion of the limitations of the present study and opportunities for future research.

Assessing components of SRL is complex and findings of previous studies is limited to reports that components of OHW (e.g., automatic feedback, flexibility, multiple attempts for completing OHW) aids learning (Gutierrez, 2017). The present study used Zimmerman and Martinez-Pons' (1986) Self-Regulated Learning Interview Schedule (SRLIS) developed to provide reliable evidence and validated to assess

students' use of self-regulated learning (SRL) strategies. The original interview instrument asks students to recall strategies used in specific scenarios identified from various learning contexts (in classrooms, home, outside of class, preparing for tests, and motivation) and identifies 14 reported SRL skills (*self-evaluation*, *organizing and transforming*, *goal-setting and planning*, *seeking information*, *keeping records*, *self-evaluation*, *environmental structuring*, *self-consequences*, *rehearsing and memorizing*, *seeking peer, teacher or adult assistance*, and *reviewing notes, tests or textbooks*), along with one category, *other*. The present study modified these interview questions to specifically assess SRL in the context of learning with OHW.

Research Question 1

What self-regulation strategies do students report using while completing mathematics with OHW?

Students Use of a Variety of Self-Regulation Strategies

We draw from the findings that all students in this study used self-regulation strategies to varying degrees and that students reported using a variety of the 14 pre-defined SRL strategies in completing OHW in math. This is consistent with the literature that determined all students' adjust to demands of their environment, using self-regulation to monitor and control their learning (DiFrancesca et al., 2016). Moreover, the findings of this study are consistent with Ramdass and Zimmerman's (2011) suggestion that self-regulation and homework are related and their assertion that "skilled learners [are] engaged in self-regulatory behaviors during homework activities" (p. 195). Specifically, Ramdass and Zimmerman (2011) suggest that students may engage in various forms of self-regulation during homework completion, including *goal-setting and*

planning, *self-evaluation*, *environmental structuring*, and use of *self-consequences*. This study found that students reported utilizing each of these four SRL strategies, in addition to cognitive strategies (e.g.., *organizing and transforming*, *rehearsing and memorizing*)—all in addition to and *seeking assistance* from peers, adults, and teachers.

Frequently Used SRL Strategies: Goal-Setting and Seeking Assistance

Nine of the ten students specifically reported using the SRL strategy *goal-setting and planning* and *seeking social assistance* around planning, completing, and submitting their OHW. Students may set goals to study more often using OHW and prior studies on OHW attribute this to the use of automatic feedback, grading, multiple attempts afforded by OHW (Gutierrez, 2017; Richards-Babb et al., 2015).

Goal-Setting and Planning

In general, OHW affords more flexibility over traditional homework in the sense that traditional paper-and-pencil is highly controlled. For instance, a teacher gives an assignment for a student to complete at home which is to be collected the next day in class and later graded by the teacher. Next, at some future instance, the work is subsequently returned back to the student. Alternatively, the OHW used in this study was designed for the weeks' assignments (four total) to open up for student access on Monday morning and closed on the due date, Sunday evening. This flexibility provided opportunities for students to utilize SRL strategies to sequence, time, rearrange, and complete their work to meet their learning goals.

Flexibility was appreciated by the students who possessed the necessary SRL skills to set goals and organize their materials to improve learning. Schubert (2012) using a structured interview with nine high school students, found that OHW contributed

students working at one's own pace. Schunk & Usher (2013) suggests this flexibility provides choice and invites students to be their own agents of learning. As an example, some students chose to sequence the completion of their OHW around busy schedules during the week while others purposely planned to complete work so as to not have work to do on the weekends. Students who struggled with the flexibility of the OHW suggested reasons of why they might forget to complete their work. Students report, for example, that they had trouble managing this work with their other work, or that OHW becomes harder the longer they waited to complete the work after the lesson was taught.

Other students may benefit from a reminder system for task completion within a specified timeframe. Yet, when given choice students can learn. A student reported "I thought like I could just do them all [week of homework on] Sunday. Well, that didn't really work out very well. So, I started doing one [homework] a day." If possible, it is recommended to coordinate the assignment due dates with other instructors (for example, have all assignments across all the classes be due at a specific time). It is clear from some student comments that they experimented with and structured their OHW activities around the known frequency and patterns of deadlines. The familiar repetition of OHW, its structure (re: attempts) and deadlines thus facilitate SRL, with evidence suggesting that it reduces stress and increases self-efficacy (Brewer, 2009; Magelhães et al., 2020).

Seeking Social Assistance

Seeking out information and help when necessary is a widely recognizable characteristic of self-regulated behavior (Schunk, 2005; Zimmerman & Martinez-Pons, 1988). Consequently, *seeking assistance* was also reported by most students in this study seeking a variety of help from adults, parents, peers and online resources (e.g., Khan

Academy, Google). Similarly, Zimmerman and Martinez-Pons (1988) found that the SRLIS instrument correlated students seeking peer and adult assistance with attributes of self-regulated learners (i.e., learners who are not passive). The use of automatic feedback not only offered students an opportunity for multiple attempts on learning with OHW, but encouraged students to monitor their learning. Students reported this OHW feature sometimes influenced them to seek help using various methods. One student reported that after opening all the homework, they would attempt to answer as many questions as possible. Their learning was furthered by listening to the teacher in class. If they still didn't understand [by a certain day], they would seek the teachers help later that week. Students that worked ahead to complete OHW before the lesson reported self-monitoring and initiating efforts to seek help (e.g., seek assistance using non-social resources (Kahn Academy/Google) or from social resources such as teachers, peers, adults) to complete OHW.

While the original SRLIS instrument validation study by Zimmerman and Martinez-Pons (1986) noted differences between achievement groups and the high-achievement group seeking help more often, the automatic feedback programmed in OHW may reduce students' need to seek help from others as they can control their own learning (Parker & Loudon, 2013; Schubert, 2012; Trussell, 2020). The two essential features in OHW, multiple attempts and automatic feedback, provide students' opportunities not only for learning, but mastery of mathematical skills. Students can be encouraged by this evidence of mastery in OHW; thereby producing gains in students' belief in their own capabilities and improve students' self-efficacy (Brewer, 2009).

Students Seek Resources and Assistance Online

In 1986, Zimmerman and Martinez-Pons constructed the Self-Regulated Learning Interview Schedule (SRLIS). This instrument was not only developed well before the popular advent of the internet but also before frameworks to adapt self-regulation theory in a computer-supported environment had been developed (e.g., Winne & Hadwin, 2008). Contemporary SRL theorists recognize Winne and Hadwin's work (2008) which considers self-regulated students as active learners—managing and researching their learning (Panadero, 2017). Given students' active role in managing and investigating their own learning, it should not be surprising that students are also innovative in their own learning. This study identified two new coding possibilities that could be added to update the existing SRLIS instrument (*seeking online assistance*, SOA and *seeking Khan Academy assistance,* SKAA). The findings from this study also suggest that students prefer to control their own learning process rather than involving a third party (i.e. an adult) in it unnecessarily.

Occurrences of "No (Self-Regulation Learning) Strategy"

Overall, the both high- and low-achievement groups produced similar reports of consistent use of a variety of SRL strategies. While all students used frequent and varied SRL strategies, more often, low-achievement students had scenarios coded as "No Strategy". Specifically, the occurrence of data coded as *No Strategy* occurs twice as frequently (10 times) in the low-achievement group than in the high-achievement group (5 times). This finding is consistent with self-regulation research, high-achieving students set more specific goals (DiFrancesca et al., 2016). Ramdass and Zimmerman (2011)

suggest that with repeated practice, one can gradually increase self-regulation behaviors over time.

Findings in this study were similar to Magelhães et al. (2020) in that most students reported *No Strategy* for using OHW to study for tests. Magelhães et al. (2020) write "the majority of the studies [re: OHW] do not refer to the purpose of underlying the assignment of homework; the few that do highlight the purpose of practicing concepts and skills" (P.12). The programmed OHW assignments in this study could be described similarly. For context, only a limited number of students reported specifically reviewing OHW problems for the sake of learning rather than redoing the assignment for the benefit of an improved score.

Research Question 2

What are differences or similarities of reported self-regulation strategies among students in different achievement groups (low or high) while completing mathematics with OHW?

Similar Frequency of SRL Strategies between Achievement Groups

In answering the first research question (RQ1), this report emphasized that all students in this study adjusted to the demands of the OHW with the use of self-regulation strategies to varying degrees. Moreover, the reported use of SRL strategies between achievement groups (low and high) was relatively similar. The low-achievement group reported using 19 SRL strategies, and the high-achievement group reported using 21 SRL strategies. While this finding is not statistically significant, it stands in contrast to other self-regulation research in general that reports high-achieving students using a wider

variety of strategies over low-achieving students while learning (DiFrancesca et al., 2016).

Frequently Used SRL Strategy: Organizing and Transforming - High Achievement Group

Differences were found between achievement groups and the cognitive strategy *organizing and transforming*. The high-achievement group reported utilizing this SRL strategy more often than the low-achievement group. When analyzing responses in academic achievement groups, Group 2 (high-achievement) referred to using the strategy *organizing and transforming* seven times while Group 1 (low-achievement) only mentioned this strategy once. Zimmerman and Martinez-Pons (1986) observed a similar finding between their two diverse academic groups using the SRLIS instrument.

The sequence of OHW assignments used in this study was programmed in such a way that students relied on the dissemination of information by the teacher in the form of lessons during class. There was a strong sense of students trying to make a connection between organizing OHW and sequencing of class to improve learning. Yet, students were fundamentally influenced as they reported relying on teacher-directed instruction and recommendations in setting goals. For example, one student reported would choose to delay completing homework if the teacher suggested they hadn't dealt with the material in class. Whereas some students reported completing assignments prior to the lesson and reported knowing that their efforts were afforded multiple attempts. The OHW used in this study allowed students to resubmit OHW and use up to four attempts with the highest score being recorded for a grade. Research indicates that repeated attempts can result in an increase in mastery and academic achievement (Magelhães et al., 2020).

Students specifically reported using the SRL strategy *organizing and transforming* as this option helped them complete homework at home and feel successful. One student said, “you get several attempts that tell you [if] you’re wrong or right. In the book, just like it doesn’t, it’s just like you’re like wondering if I got it right.” Meanwhile, another student connected the SRL skill of *reviewing records* and multiple attempts as they explained “I like to get my score right away so then I remember the information as well.” Moreover, students who attempted the homework before it was taught reported being able to “learn it better” after the lesson was taught.

However, Magelhães et al. (2020) suggests that one disadvantage of online homework is that the trial-and-error submissions could reinforce lazy behaviors. In other words, students do not improve upon their self-regulation skills when goals are based more on task completion rather than for learning (Schunk & Greene, 2018). A study by Richards-Babb et al. (2011) found that students sometimes guess rather than rework answers to OHW questions. They reported that 39% of post-secondary students in their Organic Chemistry course admitted to guessing after obtaining feedback of an incorrect response. Similar findings were noted in this study, in which some students may not make the most advantageous use of the opportunity to make multiple attempts provided by OHW. For example, one student noted they used this attribute of OHW to compare answers between a submitted and scored homework with a new one opened in a second tab. Eliminating extra attempts or marking students’ scores down with each successive attempt are options, but Magelhães et al. (2020) points to research that this may discourage students from trying and they will avoid homework altogether.

Students that initiated homework before the lesson also reported experiencing an emotional response to whether or not they already had learned the material in the homework. Students that set goals to complete OHW before the lesson and subsequently realized they already knew the skill or concept before it was taught, reported feeling a sense of "comfort" and "confidence." Nonetheless, students reported desires to want to know "how they are doing?" when completing OHW or in other words, feel confident. In contrast, students in the low-achievement group proceeded through OHW and reported *hope*. For example, one student they "hoped" that what they learned in class would help them to "like know the answers." Having confidence was important and influenced their decision to try the OHW. One student said, "I want to be confident" and avoids trying to do homework they haven't learned. They went on to say, "I just don't want to be like, uhhh what is this?" While another student mentioned they stop if the teacher says, "we haven't learned it" and "I don't want to waste the [number of] attempts." In particular, Linnenbrink & Pintrich (2003) suggest that students who possess a positive mood about learning are more inclined to work towards goals, rather than avoid them.

Frequently Used SRL Motivation Categories of SRL Strategies - Low-Achievement Group

Students in the low-achievement group reported overt planning to complete of OHW to avoid distractions. Low-achieving students reported the use of student-initiated use of SRL motivation strategies, including *environmental structuring* and use of *self-consequences*. Whereas, students in the high-achievement group reported parent-initiated involvement, including parents setting academic expectations and controlling the study environment for academic success.

Students are likely to have distractions completing OHW especially when computers are used for both academic and other more engaging purposes (Magelhães et al., 2020). Some students were able to identify distractions to their learning such as a phone, wanting to play with friends, or even the noise associated with normal household activities. In a study on web-based OHW, Schubert (2012) reported that low-achievement groups found that OHW allowed them to stay organized and focused while avoiding distractions. Essentially no students in this current study reported on the format of OHW and that it helped them stay organized and focused while avoiding distractions.

Motivation and self-regulation is directed at student-initiated efforts to control their environment (*self-consequences*) or arranging their space to make learning easier (*environmental structuring*). However, four high-achieving students did not report using either SRL strategy. Instead, they reported that their parents controlled their learning environment (e.g., moving the computer to the family room to monitor work) or parent-initiated consequences (e.g., not allowing friends over or playing video games) until after OHW was submitted. While parent-initiated involvement can set high academic expectations for their children; this may limit the opportunities available for students to practice student-initiated self-regulation.

Implications for Practitioners

As early as 1986, Zimmerman and Martinez-Pons stated that student use of self-regulated learning (SRL) strategies is "crucial to academic achievement" and that students can profit from specific training in self-regulation (p. 615). Specifically, they believe that success in school is highly dependent on student self-regulation as it is necessary for students to be agents of their own learning. Unstructured "naturalistic"

(outside of the classroom) is one such setting that provides students a degree of choice and they can utilize diverse SRL strategies and routines. Ramdass and Zimmerman (2011) suggest that homework activities that are adequately challenging for students help acquire self-regulation skills.

Educators may be able to contribute to an increased use of students' SRL strategies in OHW by establishing flexible and routine patterns of due dates for students to set personal goals, allowing multiple attempts for learning, embedding resources directly into OHW, modelling test taking behavior, and encouraging motivation and engagement in OHW by helping students develop strategies for success and failures and opportunities for them to identify their reactions and self-reflect on motivation strategies.

Considerations and Limitations for Research

The SRLIS instrument used in this study provided both reliability and validity due to the fact it was a validated and structured interview instrument. However, the SRLIS instrument could be modified and validated specifically for the context of OHW; to more accurately reflect scenarios to fit the context of OHW and incorporate more recent research SRL theory and models. Moreover, further revisions could be made to scenarios that prompt students to respond to multiple questions requiring students to think about both when, and how students plan to submit their OHW. I noted that academically challenged students often needed clarification of the questions in order to respond. Zimmerman and Martinez-Pons (1986) also concluded that improvements could be incorporated with respect to the SRL strategy of *self-evaluation* by improving the learning context or the scenario description where this specific skill can be reported by students. In other words, the general lack of students reporting self-evaluation strategies

in this study may be due to the lack of specific questioning rather than students not possessing this valuable SRL skill.

Throughout this study, I remained aware of areas of potential bias and how my interactions with participants might be influenced by my professional background, experiences and prior assumptions. Specifically, if my experience as a teacher has any impact on a student's willingness to share, speak candidly or may have influenced the story told by the student. A reflexive journal was maintained to ensure the researcher's awareness of the possibility of this influence. Entries in this journal noted things such as "student eager to please" and "student describing examples of what's expected of him - not what he has actually done" as potential factors. In addition, some students in this study either knew me or knew of me, as a former math teacher at the school site. While the triangulation of data sources and reflexive journaling diminish the potential difficulties this presents, some personal bias (both on the part of the researcher and the participants) may have remained.

This research involved adolescents, and it was recognized that an unequal power dynamic existed between a researcher/teacher and the student. Procedures were put in place to position the lives of participants as experts and to elevate their status in the process of member-checking. However, it was challenging to schedule students before and after the school day. Only a limited number of participants gave assent and were available for both the initial interview and for member checking using the I-poem. In future studies, further steps could be taken to accomplish this goal. Providing further opportunities for collaboration may allow students to gain a greater sense of

empowerment, self-acknowledgement, self-awareness (Adler & Adler, 2001; Corbin & Morse, 2016; Eder & Fingerson, 2001).

The researcher made every attempt to probe students without unnecessary influence in the interviews understanding that neutrality must be maintained between observer and observed, in keeping with certain objectivity to produce reliable, factual, and confirmable data (Lincoln & Guba, 1985). Yet, accounts of an uplifted tone of my voice (e.g., surprised and giving affirmation) were noted a few times during the transcription process in reaction to a student response or through additional questioning. These isolated occurrences did not appear to alter or contribute to a change in findings. Further refinements to researcher/participant interviewing skills would benefit future similar studies.

Lincoln and Guba (1985) state that research findings can be *bent* by the researcher possessing a personal agenda or in the case of potential bias from a single researcher. Having additional researchers independently code data may have offered additional validity to these findings. Specifically, in this research study, I am privileged to know the inside details of teaching the course using OHW, the demographics of student enrollment, and the academic expectations for this group of students. I acknowledge that I made a long-term personal commitment in order to create and implement a year's worth of standards aligned online math homework. Initially, the pursuit of this endeavor came about from witnessing improved motivation from groups of my most academically challenged students. The process of program improvement occurred in Year 2 and Year 3 of implementation prior to my position as a researcher in this study. My interest in this study has been consistently to elicit feedback from a broad range of students. I recognize

that students may form favorable or unfavorable views of the OHW which is not a reflection on me or on OHW in general. It is also important to note that such views are not to be privileged or denigrated in comparison to those of other students.

Lastly, it should be noted that there was no attempt or purpose to validate research findings against students' actual performance on their online math homework itself (e.g., OHW grades, reattempts, effort to complete, mastery of skills or concepts).

Recommendations for Future Research

This study was limited by the number of participants and by the convenience sampling of those enrolled in it. Future studies may benefit from more participants and the use of purposive sampling to achieve a broader representation of demographic and performance variations. While every attempt was made to ensure the findings were valid, a larger study and a study with more than one researcher could present a range of advantages for future research.

In addition, the use of a validated interview instrument led to consistent reports of the use of SRL strategies by students, but future studies may choose to revise or update this instrument. This is especially the case regarding findings related to the student reported SRL skill of *self-evaluation*. One limitation of this study was that there was no attempt to correlate findings with student outcomes—only with past student performance. A long-term or a mixed method study could reveal different results.

Further research is also needed to determine the particular SRL skills students need to succeed in OHW. Future studies may consider how students can best acquire these skills by implementing a curriculum of SRL skills themselves and monitoring their

effectiveness in regards future student academic achievement and long-term overall success in learning.

Nonetheless, this study has made it clear that students, both lower and higher performing, make appreciable use of SRL strategies. Although the study did not set out to answer this question, it appears that the instant feedback and the multiple attempts offered by OWH actually afford and encourage the development of SRL strategies among students. The development of such strategies, research shows, will help these students' academic performance not only in mathematics, but likely also in other areas of academic endeavor, regardless of the specific subject matter. Moreover, the specific strategies used in many cases included all major strategy groups as identified in previous research in SRL. The fact that two additional strategy types were further identified suggests that ongoing technological changes and improvements in online services will continue to assist students further and also provide still more opportunities for research in this area.

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APPENDIX A

Data Collection Instruments

Table A.1 Original and Adapted Version of SRLIS Questions

ORIGINAL INTERVIEW INSTRUMENT	ADAPTED INTERVIEW INSTRUMENT FOR CONTEXT OF OHW (MATH)
Assume a teacher is discussing a topic with your class such as the history of the civil rights movement. He or she says that the class will be tested on the topic. Do you have a method to help you learn and remember what was discussed?	Your teacher has assigned OHW assignments due later this week. Do you have a method to help you learn and remember what is discussed in class to help you complete your online math homework?
Teachers often assign their students the task of writing a short paper outside of class on the topic such as family history. They also often use the score as a major part of the grade. In such cases, do you have a particular method to help you plan and write your paper?	Your teacher has assigned the task of completing 4 online math assignments to be completed as homework. In total, 36 assignments contribute to a major part (30%) of your overall grade. Do you have a particular method to help you plan your homework?
Is there any particular method you use for completing your math assignments?	Your four online math homework assignments are due at the end of the week. When do you plan to submit them? Do you have any particular method you use for completing them?
Most teachers give a test at the end of a marking period, and these tests greatly determine the final grade. Do you have a particular method for preparing for a test in classes like English or history?	One purpose that teachers give math homework is to help students practice skills for tests. Do you have a particular method for using the online homework to prepare for your math tests?
Many times students have problems completing a homework assignment because there are other more interesting things they would rather do. Do you have any particular method for motivating yourself to complete your homework under these circumstances?	Many times students have problems completing homework assignments because there are other more interesting things they would rather do. Do you have any particular method for motivating yourself to complete your homework under these circumstances?
Most students find it necessary to complete some assignments or prepare themselves for class at home. Do you have any particular methods for improving your study at home?	Most students have to complete and submit their OHW from home. Do you have any particular methods for understanding and finishing assignments at home?

Note. From "Construct validation of a strategy model of student regulated learning," by Zimmerman and Martinez-Pons, 1988, *Journal of Educational Psychology*, *90*(3) p. 285.

Table A.2 Post-Interview Online Student Questionnaire

1. When did you think about starting your homework? How were you able to get started?
2. Did you plan to complete your homework? Did anything distract you or get in the way of your plan?
3. Did you complete this homework alone or with other people? Can you tell me why?
4. Do you use the online homework to prepare for a math test? Will you explain how you used it or provide suggestions on how you could use it?
5. Complete the sentence "Compared with other activities I do after school, online homework is _____. 6. When you work on your online math homework, what may prevent you from completing it? 7. Do you try to find ways to make doing your homework more interesting?
8. Did you seek any source of help to complete this assignment? Parents, friends, teachers or resources (books, online, Google)

APPENDIX B

Adolescent Member Checking Guide: I-Poem Process

The Listening Guide

- Listen for student to document personal reactions and responses to interview questions.
- Listen for the Self or Voice of the "I".
- Underline every participant's use of the "I" along with verbs and pertinent words or phrases.
- Listen for SRL skills identified within the interview.
- Listen for the interplay of voices.
- Position I-statements on a separate line of a poem in the same sequential order of the text.

Member Checking Process

- Student reads and reflects on I-poem.
- Student titles I-poem.
- Highlight any disagreements
- Establish conversation around I-poem.
- Put in order and numbered from the one that represented them the most to the one that represented them the least; followed by an explanation

Note. Adapted from "Member checking process with adolescent students: Not just reading a transcript," by Simpson and Quigley, 2016, *The Qualitative Report*, *21*(2), p. 380.

Construction of an I-Poem Example

Step 1: Listen to Student Response (Sample Excerpts):

Q1. [Student] I start the homework on Monday, even though I know it is due at the end of the week. I don't really know how I remember for the homework, but I go back to the work we did in class and see if that helps. Sometimes I just guess and I know that is ok because I can ask my teacher or try again.

Q2. [Student] I know that the homework is due on Sunday. I don't really think about this homework as being different than other classes, I just do it. It's easy and I like it. [Researcher] How likely is that you complete the OHW on Sunday? [Student] Actually, I make sure that I get a 100 and use all my chances when it gets due on Sunday. [researcher notices student animated and smiling]

Q3. [Student] I usually try my best and sometimes I guess. But I see what I have right and wrong and I go back through and correct my work.

Q4. [Student] Well I make sure and do all my homework. Especially the ones right before a test. Sometimes they say review on the title. I make sure to do those and understand. It really helps me.

Q5. [Student] I am involved in a lot of sports, so I make sure and set a deadline. I have a busy schedule. So, I tell myself that I can't go play my games with friends until I'm done. Math has always been hard for me and I'm trying to get better. Sometimes I do it at the last minute because I put it off (Researcher notes "New Voice").

Q6. [Student] I do homework at my desk. I work on it when my little sister can't bother me. I try to do what I can, but sometimes I have to ask my mom for help. My friends also call me when they think an answer is wrong.

Step 2: Researcher looks through interview for Self or Voice of "I"

- I plan early to complete my online math homework.
- I use my work in class to help me on hard problems.
- I like online homework, it is easy because I don't get penalized for making mistakes.
- Math has been hard for me, I make sure that I use all my chances to get the best grade.
- Online homework is fun because I can make it into a game to get 100%.
- I can ask for help from my mom or the teacher when I need them.
- I review important assignments and use mistakes to help me learn.
- I am busy after school with sports so I plan ways to get it done.
- I want to do my best and it is important to get an A in math

Step 3: Student Reviews I-Poem together with Researcher

Easy and Hard

I believe that procrastinating is wrong.

I don't make OHW my after-school priority even though I think I should.

I am upset at myself when OHW is hard and I have procrastinated.

I am relieved when I do my OHW at the last minute and I know the "kind" of math it is.

I am a student that will keep trying in order to get it right and I will use multiple attempts to figure out my mistakes.

I get annoyed when I procrastinate and should do OHW that would have helped me prepare for an earlier test that week.

I ask my dad for help with math homework on Sundays because he is good at math.

I am a student that prefers book homework, because we are led.

I think OHW in math is easy because I have time to do it.

I am caught between wanting to do my math homework and getting it done.

I think OHW in math is both easy and hard.

APPENDIX C

Sample Audit Trail Notes

Table C.1 Researcher Notes and Purpose by Document Type

Purpose	Researcher Notes	Document
To maintain a focus on the research questions during coding	In other words, the purpose of this qualitative study is to explore students' use of an online mathematics homework (OHW) program and to improve our understanding of factors contributing to associated student self-regulation learning (SRL) strategies. Given the potential proliferation of OHW in mathematics and other school subjects, this study offers a greater: 1) understanding what aspects of OHW may be contributing to effective SRL; 2) what aspects should perhaps be subject to improvement. In this study, it is my desire to design and implement qualitative empirical research in order to further uncover, compare, contrast and disclose the meaning of my earlier teacher innovations.	Coding Notes
Possible Findings	OHW contributes to SRL by invoking different strategies for success.	Memo
Reports that a student records the due date of homework, is this OT or GOAL?	Organizing and Transforming (Cognitive Process) when sequencing completion of OHW to learn. Goal-setting and planning (Metacognitive Process) when sequencing completion of OHW for learning.	Coding/Notes
New Information - Seeking Help Online	Students seek help using technology not available when the instrument was created in 1986. Did not consider this prior.	Memo
What SRL strategy (if any) is used when a student reports using all attempts to "score" a grade of 100%?	Determined this is not a use of SRL but rather using the option of multiple attempts to FORCE a good score (for purposes other than learning).	Coding/Notes
What SRL strategy (if any) is used when a student reports "hope"?	Review context of interview and member check to validate findings. Hope is not a SRL strategy; SRL is a purposeful student-initiated to learn.	Coding/Notes
Student Excerpt: "he shows us where to find in the math book to *probably* help you explain it."	I interpret the use of the word "probably" as the student may be reporting what I wished to hear rather than what they actually did. Action: review context of the entire interview and member check to validate responses.	Coding/Notes

Possibly led student/interruptions [Student]...the OHW list like what we're going to be doing... [Researcher] So when you said like they show you where it is, does that mean like on the front page before you start the assignment? [Student] Yes...It kind of tells you what the lesson's about or what the pages are.	I feel that I led this student to "Like on the front page" student admits to only occasionally needing to refer to the assignment names	Interview Notes
[Student] That means basically he teaches us and I do stuff when I get home. Like I think about A, should I do it? And I'll just wait tomorrow to see if tomorrow's homework and the lesson we learn tomorrow matches with tonight's homework.	By reviewing this one line, code of ENV is would seem reasonable since student may be transforming the environment (keyword "matching") in order to make learning easier. However, the context of the interview suggests the student is clearly thinking about order using a cognitive approach to completing work and therefore categorized this SRL strategy as OT.	Coding/Notes
[Student] Yeah, I usually open in another tab and compare the answers.	"Usually" coded as *Most of the Time*	Coding/Notes
[Student] If I get one wrong and it's like out of ## points, I'm okay with that. But if it's like if I get like seven out of 10, I'm going to Redo it.	My insider knowledge of how assignments are built is important to this interview. Later he explains he doesn't like to re-enter the answers for ones he has already got correct in a 2nd attempt. He remarks that he doesn't want to re-enter 9 questions but will re-enter 6 questions. Mentions a cursory look "see" what I got wrong. I get the feeling he is multiple attempts at OHW to force (good) score rather than learning. They positioned themselves as a student that was expected to get good grades above all else. (only a cursory "see" what I got wrong." Note: getting a good grade is a big motivator.	Reflexive Journal Notes

[Student] I'm just going to close it, turned my computer off, put it away, go do something for 30 minutes, come back to it. Okay. with a refresh[ed] mind.	Coming back with a "fresh. mind" could be using ENV strategy to make learning it easier. However, ENV is rearrangement of physical objects to make learning easier. Coded as OT which includes rearrangement of task to improve learning.	Coding/Notes
[Student] [to complete OHW] I basically [use] what I learned in class and then I hope that helps me like know the answers. And if there's like a homework assignment that we haven't done in class, like I don't do it and I wait until we do it in class. And then I do the homework.	Student appears to be trying to understand or learn the skill before completing the homework. When asked, they have completed 2 of 3 assignments of the week by Thursday they use words including "hope" and "guessing" and bring up that they get 4 attempts. Evidence of limited SRL strategy (OT), but may be limited as they are relying on chance to get a good score after 4 attempts. He goes on to say "I just like take my best guess and we get like four attempts"	Reflexive Journal Notes
Coding Notes: Conceptual values, attitudes, and beliefs may not always be directly stated by participants.	Phrases such as "It's important that," "I like," "I love," or "I need" alert you to what may be valued, believed, thought, or felt, along with such obvious cluing phrases as "I think," "I feel," and "I want." Saldana (p. 111)	Memo
Written student summaries after coding.	Ex. Grades are important to this student and parents. He rearranges tasks to improve learning and initiates review of homework for learning. He is aware of and seeks multiple forms of resources for help.	Memo