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This dissertation, A PRELIMINARY STUDY ON THE EFFECTIVENESS OF THE DRIVE MY BRAIN MODEL ON ENGLISH LANGUAGE LEARNERS' METACOGNITION, was prepared under the direction of the candidate's Dissertation Committee. It is accepted by the committee members in partial fulfillment of the requirements for the degree of Doctor of Education in the School of Education, Concordia University Irvine.

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A PRELIMINARY STUDY ON THE EFFECTIVENESS OF THE DRIVE MY BRAIN MODEL ON ENGLISH LANGUAGE LEARNERS' METACOGNITION

by

Kaylie Michele Gomez

A Dissertation

Presented in Partial Fulfillment of
Requirements for the
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in
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School of Education
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ABSTRACT

For nearly four decades, research has documented positive correlations between metacognitive abilities and student growth. Teachers who wish to cultivate metacognitive thinking should encourage their students to plan, investigate, and expand on the concepts they learn in class (Fisher, Frey, & Hattie, 2016; Flavell, 1979). This mixed-methods study sought to investigate the effects of the Drive My Brain Model ([DMB], Gomez, 2016) on English language learners' (ELLs) metacognition. The sample for the quantitative portion of this study was comprised of 54 fifth-grade ELLs from a public elementary school located in Orange County, California. The qualitative sample consisted of 12 students that represented a proportional sample of the students at the school, and two teachers. A quasi-experimental design was used for this study. The treatment group received roughly 30 minutes of Drive My Brain (DMB) Model activities each day over eight weeks, receiving a total of 1,155 minutes of intervention. Two pre-developed, validated surveys were used as pre-test/post-test for both groups. Survey scores for both groups were compared using a Chi-square test. Results indicated that statistically significant growth was achieved by the treatment group. Additional quantitative measures included an observation checklist, student task rubrics, and a student Likert survey questionnaire. Results indicated that students, who felt the DMB Model was easy to use, performed better on content tasks. Qualitative analysis supported quantitative findings. Student task artifacts revealed that students in the treatment group used more metacognitive and cognitive strategies. Additionally, student and teacher interviews found the DMB Model to be easy to use.

Keywords: metacognition, metacognitive strategies, cognitive strategies, Drive My Brain Model, English language learners

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DEDICATION

To Ms. Sara Gomez, Dr. Stephanie Glaze, Professor Joan Baca, and Mr. Alberto Giron for being the role models I always needed.

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CHAPTER 1: INTRODUCTION

This chapter begins with the background of the study, providing a review of metacognition. It is followed by the problem statement, the purpose of the study, the significance of the study, theoretical framework, and research questions. Lastly, definitions of terms, limitations, delimitations, assumptions, and the organization of the study are discussed.

Background of the Study

For nearly four decades, research has documented the importance of metacognition in the learning process. However, the nature of the human mind, and the idea that humans can engage in deep and meaningful thinking has been studied throughout the centuries. Early contributions included Socrates, Plato, and Aristotle, who believed students learn best when asking good questions and reflecting (Bransford, Brown, & Cocking, 2001). Their work set "the context for modern explorations into the emerging science of learning" (Campbell, 2006, p. 4). Thorndike, Binet, Piaget, and Vygotsky also understood the importance of what is now known as metacognition (Baker & Beall, 2009; Barrouillet, 2015; Bransford et al., 2001). Flavell (1979) officially coined the term and is responsible for its emergence in educational and psychological literature. He originally defined metacognition as "one's knowledge concerning one's own cognitive processes or anything related to them" (Flavell, 1979, p. 232). The concept of metacognition has since evolved. It has been used in various ways and has many subdisciplines (Baker & Beall, 2009; Dunlosky & Metcalf, 2009; Wilson & Conyers, 2016).

Studies involving metacognition generally have unambiguous definitions of the term, closely aligning it to Flavell's (1979) original description. For example, Cross and Paris (1988) define metacognition as "the knowledge and control children have over their own thinking and learning activities" (p. 131). Similarly, Kuhn and Dean (2004) provide the following definition:

"awareness and management of one's own thoughts" (p. 270). Simply, metacognition can be defined as "thinking about thinking." This definition is one of the most straightforward and popular definitions. Another commonality in literature is the belief that metacognition involves planning, monitoring, and evaluating (Baker, 2002; Cross & Paris, 1988; Fisher, Frey, & Hattie, 2016; Paris & Winograd, 1990; Schraw & Moshman, 1995). Further, metacognition has regularly been linked to constructs including critical thinking, motivation, self-regulation, self-directed learning, and executive functioning, which are essential to student achievement (Baker & Beall, 2009; Lai, 2011).

Intervention studies involving metacognition have reported on students' ability to become aware of the processes involved in thinking (Baker & Beall, 2009; Fisher et al., 2016). A study conducted by Block and Pressley (2002) found that students as young as eight could describe the decisions they made about their learning. This shows that even young students can engage in metacognitive thinking. Students who participated in programs that taught metacognition explicitly have been shown to be most successful. Based on these findings, it is imperative that teachers exercise their power to influence their students' learning process. Students, with the right support, can eventually contribute as much as their teachers do to their learning (Baker & Beall, 2009).

Statement of the Problem

Though a considerable amount of research has centered on metacognition, little attention has been devoted to providing a means for students and teachers to access tools that explicitly teach metacognitive skills. "Metacognition is an essential, but often a neglected, component of a 21st century education that teaches students *how* to learn" (Wilson & Conyers, 2016, p. 7). Teacher training and professional development often include the teaching of cognitive strategies, but lack how to explicitly teach students when, how, where, and why to use the strategies effectively (Wilson & Conyers, 2013, 2016). For example, an expectation of the Common Core State Standards, the national requirements for student learning, is for students to develop and use metacognitive strategies to monitor and direct their thinking and learning (Common Core State Initiative, 2017; National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010). The assumption is that "teachers are teaching students to think-the most difficult and important literacy skill of all" (Billings & Roberts, 2013, p. 72). However, a study conducted by Bostic and Matney (2014) found that even after nine hours of professional development on the new Standards of Mathematical Practices (SMPs), a set of eight approaches for deep thinking, teachers did not provide students time to engage with the practices on their own. Another study by Howell and Wilson (2014) found that teachers rarely posed questions that would foster deep, mathematical thinking while using the SMPs. Although many teachers and students can identify the SMPs, they often fail to use these standards as intended (Common Core State Standards Initiative, 2016; Howell & Wilson, 2014). The Common Core State Standards for English language arts provide equally rigorous expectations for students, promoting college and career readiness. Educators are required to instill creativity, collaboration, communication, and critical thinking. "To be competent and capable in the 21st century requires a completely different set of skills" (Crockett, Jukes, & Churches, 2011, p. 1). With this expectation, teachers and students are constantly given overwhelming amounts of new information. Effective change, needed to implement deep thinking and metacognitive strategies, requires robust training and the use of best instructional practices.

Test scores confirm that more needs to be done. The National Assessment of Educational Progress (NAEP) is the largest national representative assessment for students' academic abilities in various subject areas (National Center for Education Statistics, 2017). In 2015, only 36 percent of fourth-graders and 34 percent of eighth-graders performed at or above the proficiency levels in NAEP reading. In NAEP mathematics, only 40 percent of fourth-graders and 33 percent of eighth-graders performed at or above proficiency (National Center for Education Statistics, 2017). The Smarter Balanced assessment that is based on the new Common Core State Standards for English language arts (ELA) and math, found similar results (California Department of Education, 2017). Smarter Balanced testing results from 2017 indicated that only 48.56 percent of students in Grades 3 to 11 exceeded or met ELA standards (20.12 percent exceeded; 28.44 percent met). Figure 1.1 displays Smarter Balanced area achievement levels (level 1 = *standard not met*; level 2 = *standard nearly met*; level 3 = *standard met*; level 4 = *standard exceeded*) to provide a more detailed look at student performance.

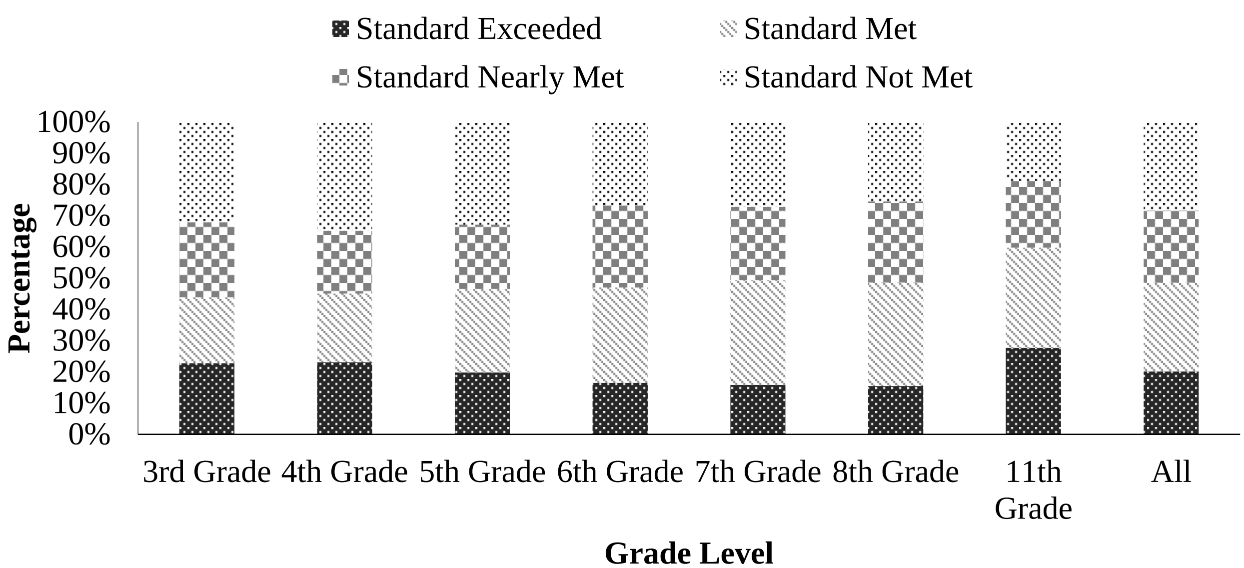


Figure 1.1. Smarter Balanced 2017 results of student ELA achievement.

The 2017 Smarter Balanced results of student achievement in mathematics were even lower with only 35.56 percent of students in Grades 3 through 11 exceeding or meeting standards

(17.60 percent exceeded; 19.96 percent met). Figure 1.2 displays the Smarter Balanced area achievement levels for student performance in mathematics.

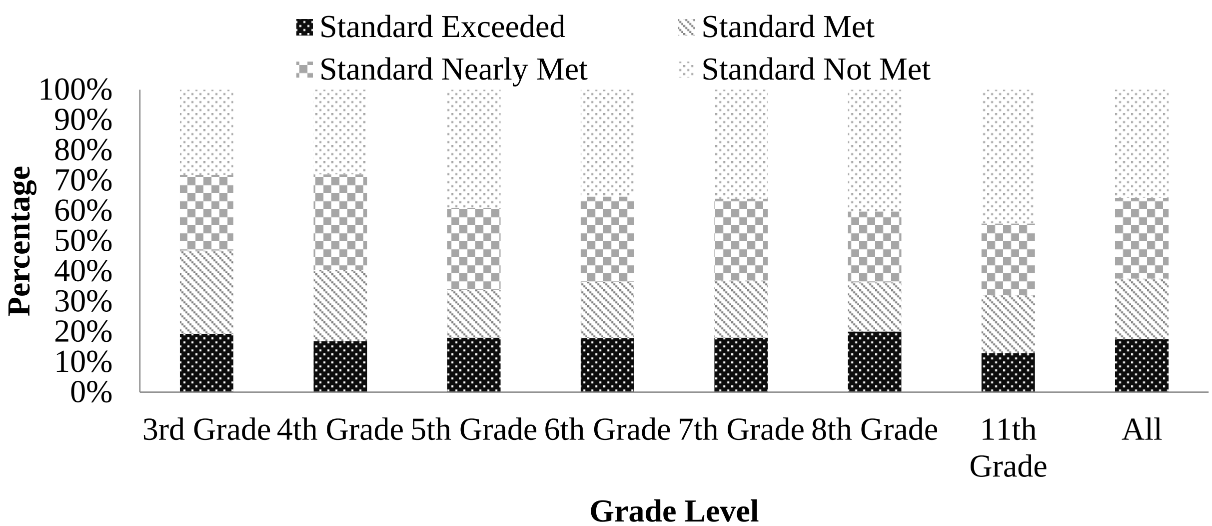


Figure 1.2. Smarter Balanced 2017 results of student mathematics achievement.

English language learners' (ELLs) scores are represented as part of the NAEP assessment scores, and the differences in achievement between ELLs and non-ELLs have been significant for over a decade (see Figures 1.3 and 1.4). This achievement gap has been reported to be 36 percentage points for fourth graders and 44 percentage points for eighth graders. Research has shown a smaller gap between former ELLs or Reclassified Fluent English Proficient (RFEP), and non-ELLs. However, intervention is a necessary element in closing the gap.

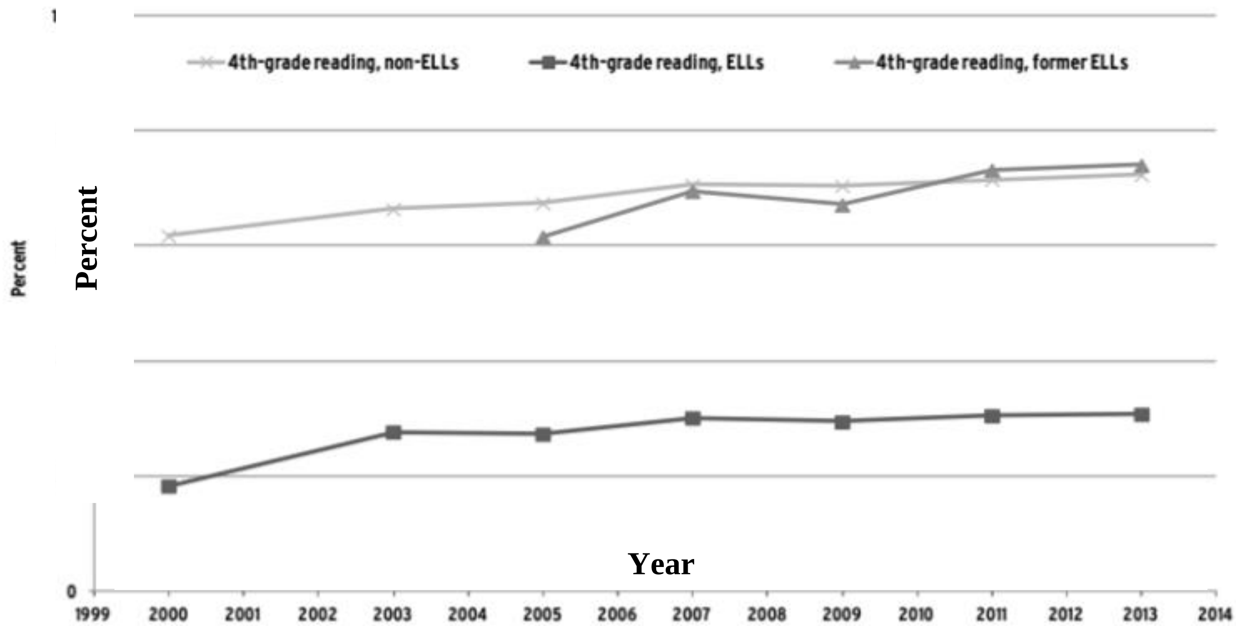


Figure 1.3. Academic Achievement Gap in Reading from the year 2000 to 2014. Reprinted from U.S. Department of Education Institute of Education Sciences National Center for Education Statistics, 2017. (https://nces.ed.gov/nationsreportcard/studies/gaps/).

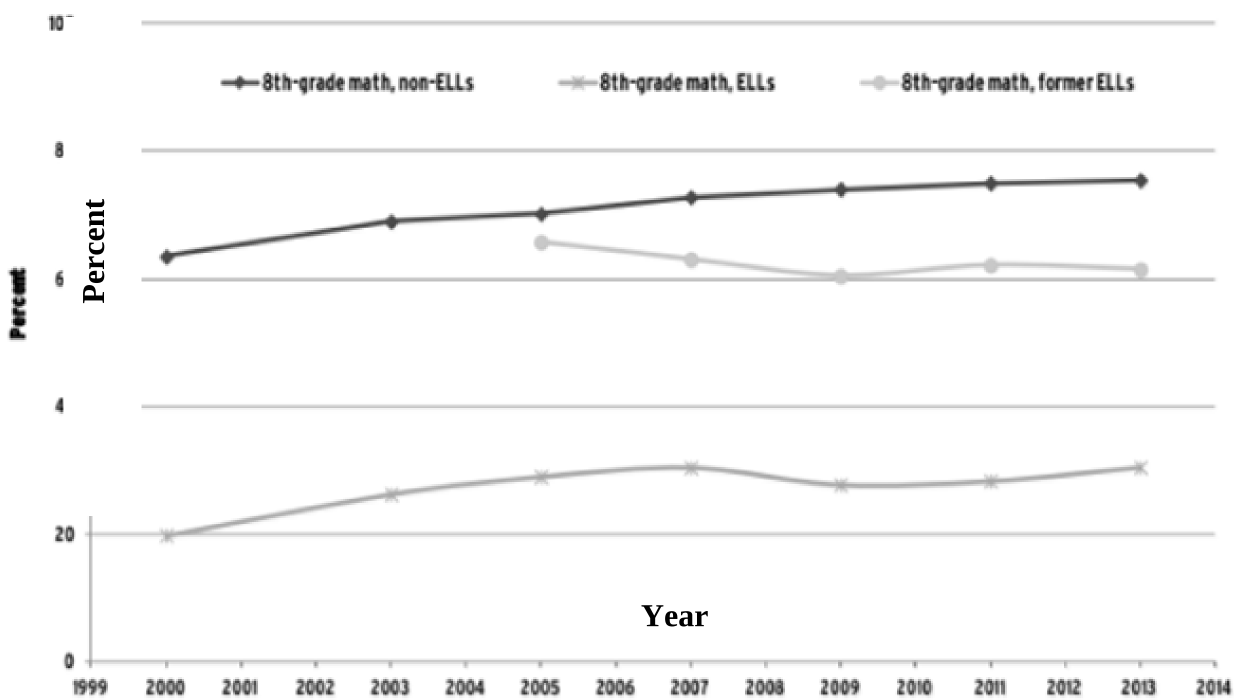


Figure 1.4. Academic Achievement Gap in Math from the year 2000 to 2014. Reprinted from U.S. Department of Education Institute of Education Sciences National Center for Education Statistics, 2017, (https://nces.ed.gov/nationsreportcard/studies/gaps/).

As schools move further into the 21st century, students and educators are confronted with new, challenging realities, and it is no longer enough to simply teach standards (Casey, 2011; Crockett et al., 2011; Humphries & Ness, 2015). O'Malley, Chamot, and Küpper (1989) discovered that "learners without metacognitive approaches are essentially learners without direction and ability to review their progress, accomplishments, and future learning directions" (p. 6). Students need practical tools that will help them meet today's rigorous expectations, especially ELLs. The current demands will not be met by the alteration of curriculum alone; the key lies in *how* educators teach our students to learn and think (Crockett et al., 2011; Dunlosky & Metcalf, 2009; Tarrant & Holt, 2016). Overall these results suggest that there is a need for the development of effective metacognitive tools to teach ELLs about their thinking process.

Purpose of the Study

The purpose of this study was to determine the effectiveness of the Drive My Brain Model (Gomez, 2016), an intervention tool developed by the researcher of this study, on English language learners' metacognition. The goal was to explicitly teach fifth-graders metacognitive strategies across the curriculum using the Drive My Brain Model (DMB). Providing students with "explicit [metacognitive strategies] instruction alongside core subject lessons will help develop their abilities to become self-directed learners who are better able to improve their academic performances…and effectively transfer and apply what they have learned" (Wilson & Conyers, 2016, p. 8).

The DMB Model is a conceptual model that utilizes a graphic organizer to cultivate deep learning in students by encouraging them to plan, monitor and reflect on their thinking and learning. Metacognitive strategies, or approaches to learning that help students reach a goal, can provide students with versatile tools that improve learning and academic performance (Wilson &

Conyers, 2016). Teaching students how to think about their learning is equally as important, if not more, than teaching the curriculum (Dunlosky, 2013). The eight-week intervention was developed for this dissertation to "enhance instruction that uses routines, embed redundancy in lessons, provide an explicit discussion of vocabulary and structure, and teach students metacognitive skills" (Linan-Thompson & Vaughn, 2007, p. 2). The DMB Model is further discussed in Chapter 3.

Significance of the Study

This study aims to strengthen the pedagogy of metacognition, assist with the demands of the new Common Core State Standards, and lower the achievement gap by explicitly teaching English language learners (ELLs) metacognitive strategies.

Pedagogy of Metacognition

Metacognition was originally studied to determine its development in children (Baker & Brown, 1984; Flavell, 1985). Bransford et al. (2001) synthesized decades of research on how metacognition can be taught to students in *How People Learn*. Effective instruction was found to be a key contributor. Students can start learning about metacognition at a young age and apply it to all core subjects, but they must be taught (Dunning, Johnson, Ehrlinger, & Kruger, 2003; Pintrich, 2002; Wilson & Conyers, 2016). Dunning et al. (2003) found that students who lack metacognitive strategies are unable to know when their answers, or the answers of others, are correct or incorrect. As one might assume, students who are aware of thinking strategies are more likely to utilize them. This research suggests that further studies exploring metacognitive strategy instruction are needed (Pintrich, 2002).

Over the past few years, the pedagogy of metacognition has been further researched. Tanner (2012) investigated metacognitive strategies instruction for biology students, offering four questions to foster metacognition including:

1. What do I already know about this topic that could guide my learning?
2. What is most confusing to me about the material explored in class today?
3. How is my thinking changing or not changing over time?
4. What about my exam preparation worked well that I should remember to do next time and what did not work well that I should change? (p. 116)

Weimer (2012) offered recommendations to improve students' metacognitive awareness by teaching the difference between surface and deep learning. She suggested that "sometimes our understanding of deep learning isn't all that deep" (Weimer, 2012, p. 1). Weimer (2012) liked the idea of dividing metacognitive strategies into two general categories: (a) cognitively passive, and (b) cognitively active student behaviors (Stanger-Hall, 2012). Students who are made aware of their ability to think, use higher levels of critical thinking (Stanger-Hall, 2012). These examples illustrate the importance of students being explicitly taught the concept of metacognition.

Metacognition instruction, however, still needs to be embedded within all content areas. Students' ability to think deeply is essential to every subject area. Furthermore, metacognitive strategy instruction should be easily accessible to all students "rather than being something that happens mysteriously or that some students 'get' to learn and others struggle and don't learn" (Pintrich, 2002, p. 223). In the United States, higher-order thinking is often reserved for high achieving or gifted students (Wilson & Conyers, 2016). Correspondingly, metacognitive strategies are not commonly observed in typical primary or secondary classrooms (Baker, 2013).

Pianta et al. (2007) discovered that fifth-graders received an average of 500% more instruction involving basic skills than metacognitive strategies. First and third graders only received one hour of metacognitive strategies instruction for every 10 hours of basic skills instruction. Lastly, teachers who were interviewed demonstrated limited knowledge about metacognition and how to teach metacognitive strategies to students (Pianta et al., 2007). These discouraging results further prove the need for effective metacognitive strategies instruction. The DMB Model was created to be easy for teachers and elementary school students to use across all content areas. This study will determine if the DMB Model is an effective tool for metacognitive strategies instruction.

The Demands of Common Core State Standards

The Common Core State Standards (CCSS) were created by a group of state leaders who were members of the National Governors Association Center for Best Practices in 2009 (Common Core State Standards Initiative, 2017). The CCSS standards promote rigor and higher-order thinking skills but do not specifically address metacognition (Kurzer, 2015). In the document *Application of Common Core State Standards for English Language Arts,* the term metacognition is not used. The same is true for *Application of Common Core State Standards for English Language Learners*. The documents are vague about how teachers should promote and assess higher-order thinking. This quote from *Application of Common Core State Standards for English Language Learners* provides an example: “ELLs, like English-speaking students, require regular access to teaching practices that are most effective for improving student achievement” (n.d., p. 2). ELL and English only (EO) students are addressed as two groups; however, the CCSS do not account for differentiation. The documents provide the same guidelines for both groups of students. These examples indicate a greater need for teacher training and instructional best practices to apply to CCSS. Using metacognitive strategies that have been shown to be highly effective can provide concrete instructional practices (Wilson & Conyers, 2013, 2016). This study will provide new information on teachers assisting students, especially ELLs, with the CCSS by explicitly teaching students how to use their thinking. Educators have often reported that teaching metacognition transforms their philosophy, attitude, and instruction because metacognitive strategies teach students how to become successful with difficult tasks (Wilson & Conyers, 2013, 2016).

The Achievement Gap

For over a decade, ELLs have scored significantly lower than non-ELLs, a disparity known as the achievement gap (National Center for Educational Statistics, 2017). ELLs receive language assistance to "help ensure that they attain English proficiency and meet the same academic content and achievement standards that all students are expected to meet" (National Center for Education Statistics, 2017, p. 1). However, NAEP reported the achievement gap between ELL and non-ELL students to be 36 points for fourth graders and 44 points for eighth graders (see Figure 1.3 and Figure 1.4). This number has shown a negligible difference since 2000 (Child Trends, 2014). There are approximately 4.5 million ELLs in United States public schools; this makes up roughly 9.4 percent of the total student population. Also, some states have higher populations; California has the most ELL students, who compose 29 percent of the student population (National Center for Education Statistics, 2017). Moreover, the population of ELLs has continued to increase. These statistics indicate the effort needed to promote equity among ELL and non-ELL students.

Learning strategies play an important role in ELLs' academic success. Researchers have found strong correlations between metacognition and second language learning (Raoofi et al., 2014). In fact, of the many types of learning strategies (i.e., cognitive, metacognitive, socioaffective), metacognitive strategies have been shown to have a stronger impact on successful language learning (Dörnyei, 2006; Pintrich, 2002). Metacognitive strategies are helpful for ELLs because they teach students what to do when they are struggling. ELLs benefit from knowing what strategies to use, practicing choosing appropriate and relevant strategies, and reflecting on strategies (Dörnyei, 2006). Though the DMB Model was not designed solely for ELLs, this study will determine if it provides a means to impart metacognitive strategies to ELLs. Wilson and Conyers (2016) believe teaching metacognitive strategies "may help [struggling learners] catch up in academic performance and recognize that they can succeed in achieving learning goals" (p. 10).

Theoretical Framework

The theoretical framework for this study is rooted in three theories from educational psychology and cognitive science: (a) Flavell's Theory of Metacognition, (b) Zimmerman's Self-Regulated Learning Theory, and (c) Perkins, Jay, and Tishman's Dispositional Theory of Thinking. These theories guided the design of the Drive My Brain Model. For reference, while reading this section, see Figure 1.5 which shows the Drive My Brain Model.

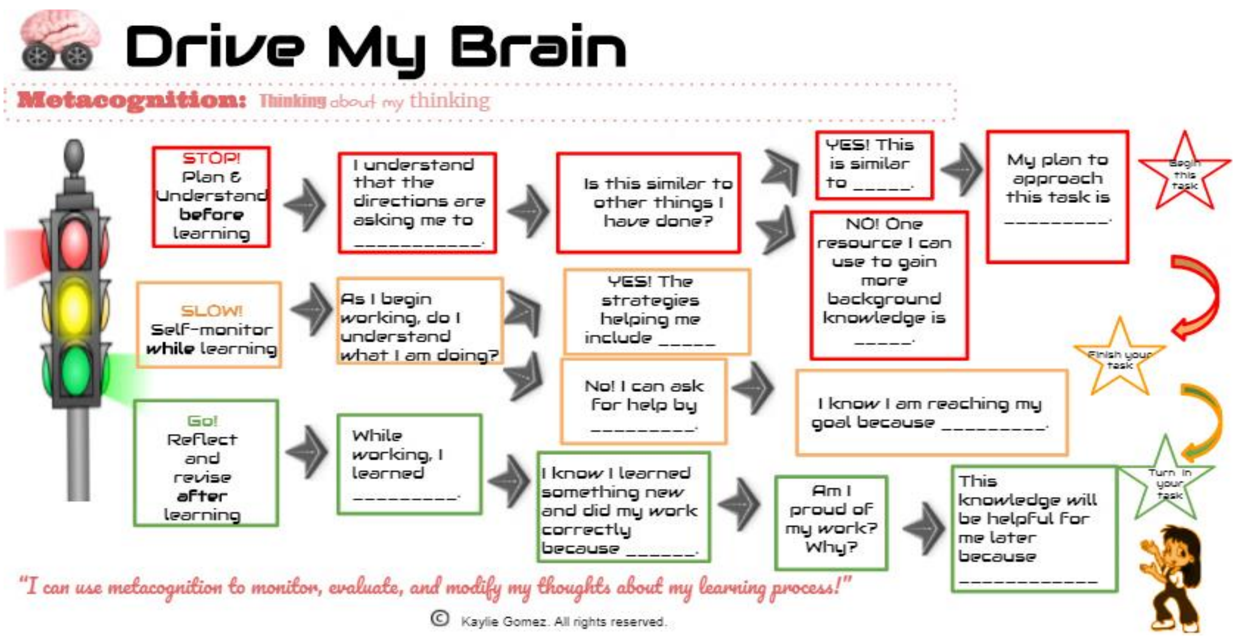


Figure 1.5. The Drive My Brain Model.

Flavell's Theory of Metacognition

Flavell was the first researcher who described the metacognitive abilities in children. His first study (1963-1965) involved examining children's memory use. He was interested to see if children were aware of how their memory could help them perform tasks. After two years of studying children in kindergarten, second grade, and fifth-grade, Flavell concluded that older children were more capable of using their memories to help them. Older students understood the importance that rehearsing played in memorization (Van Velzen, 2013).

Flavell (2004) continued to study metamemory, or the "knowledge about variables affecting memory performance and, especially, knowledge and use of memory strategies" (p. 275). As he continued to study students' thinking, he also introduced the terms 'metacognitive knowledge' and 'metacognitive experiences' under the umbrella of metacognition. Metacognitive knowledge, now also referred to as metacognitive awareness, has three main components: (a) knowledge of self, (b) knowledge of task, and (c) knowledge of strategies

(Flavell, 1979; Livingston, 2003). Knowledge of self involves knowing how one learns best. For example, studying in a quiet environment is more productive than in front of the television. Students have different learning preferences and styles and understanding that is the first step in recognizing how one learns. Knowledge of task involves understanding the learning objective. For example, students with high levels of metacognitive knowledge will understand that solving a math problem is far different than writing an essay. Lastly, knowledge of strategies is the ability students have to choose appropriate strategies for the learning task. In a math problem, for example, students might determine that they are better able to understand a problem by drawing a picture. Similarly, students who are writing an essay may use pre-writing strategies such as outlining or brainstorming (Flavell, 1979, 1986). Metacognitive experience often called metacognitive regulation, involves the actual use of metacognitive strategies. According to Livingston (2003) metacognitive strategies “are sequential processes that one uses to control cognitive activities, and to ensure that a cognitive goal (e.g., understanding a text) has been met” (p. 3). Metacognitive regulation consists of planning, monitoring, and evaluating (Schraw & Moshman, 1995). The DMB Model incorporates questions that intend to foster both metacognitive knowledge/awareness and metacognitive experiences/regulation. For example, the DMB Model poses questions that require learners to understand the directions or learning goal of a task. It also has students select strategies that will help them achieve that task (metacognitive awareness). Further, the DMB Model requires students to plan, monitor, and reflect as they learn (metacognitive regulation).

Pathway Project. The use of cognitive strategies plays an important role in metacognition. An intervention called the Pathway Project focused on using cognitive strategies to enhance metacognitive levels for English language learners (ELLs) in reading and writing.

The project aimed to "help students develop the academic literacy necessary to succeed in advanced educational settings" (Olson & Land, 2007, p. 275). Over 2000 ELLs participated in this project throughout eight years. Schools now have the opportunity to use the research behind the study.

A toolkit of cognitive strategies was used to introduce students to declarative (what), procedural (how), and conditional (when) knowledge (Olson & Land, 2007). As students became familiar with practicing the cognitive strategies and determining their level of knowledge, metacognition was introduced. With the use of think-aloud, students used Play-Doh to create an animal. As they created the animal, they discussed which cognitive strategies they were using; they verbalized aloud what their brain was thinking. According to Olson and Land (2007), "This introductory workshop sets the stage for ongoing invitations for students to metacognitively reflect upon their reading, thinking, and writing throughout the year" (p. 281). Figure 1.6 shows the cognitive strategies toolkit used in the Pathway Project (Olson & Land, 2007). The researcher utilized cognitive strategies from the Pathway Project in the creation of the DMB Model. Chapter 3 provides more information on the DMB Model's use of cognitive strategies.

Figure 1.6. Cognitive Strategies Toolkit. Reprinted from "The reading/writing connection: Strategies for teaching and learning in the secondary classroom", by C. Olson and R. Land, 2007, *Research in the Teaching of English, 41*(3). https://www.nwp.org/cs/public/download/nwp_file/8538/Booth_Olson,_Carol,_et_al.pdf ?x-r=pcfile_d

Zimmerman's Self-Regulated Learning Theory

One closely related construct to metacognition is self-regulation, a concept originally studied by Zimmerman in the early 1980s (Zimmerman, 2015). Self-Regulated Learning (SRL) involves behaviors that are under the control of the learner. Many educational psychologists believe the SRL falls under metacognitive regulation. Some researchers even claim self-regulation to be the heart of metacognition (Paris & Oka, 1986; Borkowski, 1992; Baker & Beall, 2009).

Zimmerman and Reisemberg (1997) officially defined SRL after considering students' behavior, environment, and self-belief. His definition described SRL as, "the degree to which students are metacognitively, motivationally, and behaviorally active participants in their own learning process" (Zimmerman, 2013, p. 73). As Zimmerman (2013) began to study regulation processes in students, he developed a set of 15 categories for SRL strategies. Table 1.1 explains these categories.

Table 1.1

Zimmerman's (2013) Categories of SRL Strategies

Categories of Strategies	Examples
1. Self-evaluation	I check over my work to make sure I did it correct.
2. Organizing and transforming	I make an outline before I write my paper.
3. Goal-setting and planning	First, I start studying 2 weeks before exams, and I pace myself.
4. Seeking information	Before beginning to write the paper, I go to the library to get as much information as possible concerning the topic.
5. Keeping records and monitoring	I keep a list of the words I got wrong. I took notes on the class discussion.
6. Environmental structuring	I isolate myself from anything that distracts me. I turned off the radio, so I could concentrate on what I am doing.

7. Self-consequences	If I do well on a test, I treat myself to a movie.
8. Rehearsing and memorizing	In preparing for a math test, I keep writing the formula down until I remember it.
9.-11. Seeking social assistance	If I have problems with math assignments, I ask a friend for help.
12.-14. Reviewing records	When preparing for a test, I review my notes.
15. Other: Behavior initiated by others	I just do what the teacher says.

Note. Reprinted from "*From cognitive modeling to self-regulation: a social cognitive career path,* by B.J. Zimmerman, 2013, *Educational Psychology*, *48*(3), p. 543. doi: 10.1080/00461520.2013.794676

Zimmerman's research on SRL strategies was conducted with high school students. He found that students taking higher level courses were able to articulate more SRL strategies than students taking lower level courses (Zimmerman, 2013). Later research by Zimmerman included the development of the Cyclical Phase Model of SRL. The goal was to determine the relationship between SRL and learning outcomes. According to the model, the learning process can be divided into three phases of self-regulation: (a) forethought phase, (b) performance phase; and (c) the self-reflection phase (Zimmerman, 2013). Figure 1.7 shows the Cyclical Phase Model of SRL.

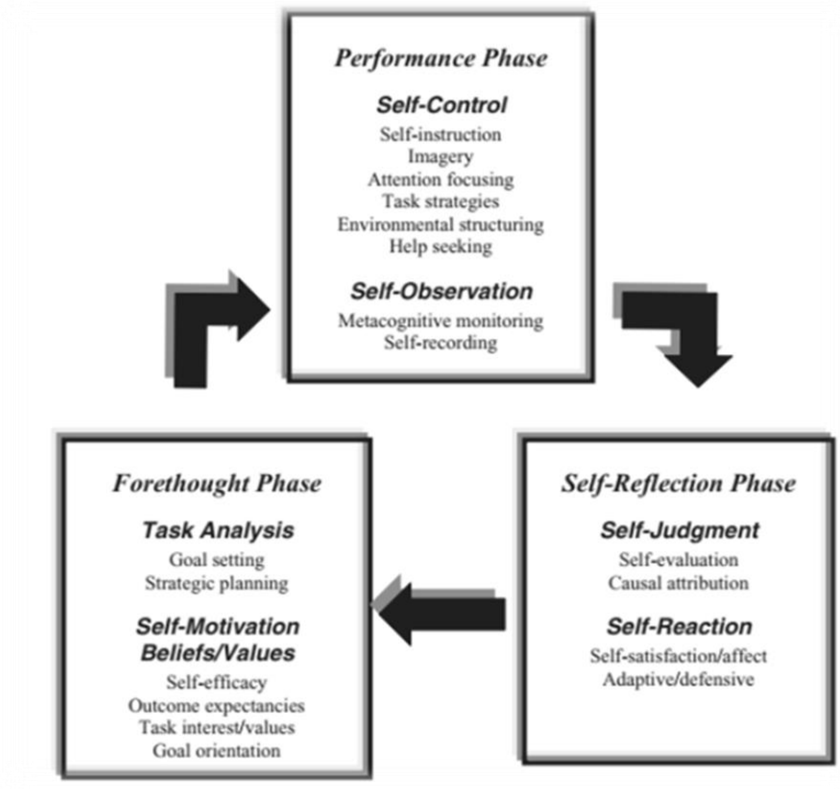


Figure 1.7. Cyclical Phase Model of SRL. Reprinted from "*From cognitive modeling to self-regulation: a social cognitive career path,"* by B. J. Zimmerman, 2013, *Educational Psychology*, *48*(3), p. 544. doi: 10.1080/00461520.2013.794676

The first phase, the forethought phase, intended for self-regulated learners to prepare to learn. Preparing to learn often enhances the learning experience. The performance phase comes next. The forethought phase is the phase where students implement the plan they developed. Students in this phase have self-control and monitor their performance. Lastly, the self-reflection phase occurs after a student has completed his or her learning. This phase helps students improve their outcomes if needed. The reflection phase can then be used during the initial forethought phase in future learning experiences. This model demonstrates that self-regulated learners make repeated efforts to learn (Zimmerman, 2013).

The Cyclical Phase Model was used with athletes. Four different training conditions were used to determine effective elements of the model: (a) no SRL training, (b) forethought phase training, (c) forethought and performance phase training, and (c) forethought, performance, and self-reflection phase training. There was a positive correlation between the number of phases taught to students and athletic performance. For example, basketball players who were trained in the forethought and performance phases were able to successfully shoot more free throws. The participants that received training in all three of the phases had the most athletic improvement (Zimmerman, 2013). The DMB Model, like the Cyclical Phase Model, has three phases. The DMB Model, however, is intended for students to interact with. The Cyclical Phase Model was a visual for students to look at; the DMB Model is a conceptual diagram for students to interact with (i.e., write in).

Self-Regulated Strategy Development. Self-Regulated Strategy Development (SRSD) was created by Graham and Harris (1989) based on Zimmerman's Self-Regulated Learning Theory. In a meta-analysis involving 40 SRSD studies whose participants included elementary students, an SRSD approach was reported to have had "the strongest impact of any strategies instruction approach to writing" (Harris et al., 2009, p. 142). An SRSD approach to learning involves instruction that purposefully reflects on students' affective, behavioral, and cognitive strengths. Additionally, an SRSD instructional approach should interpret learning as a complex process in which a student's success is contingent on their ability to employ strategies that involve many aspects of metacognition (Harris, Graham, & Mason, 2008; Harris, Graham, Brindle, & Sandemel, 2009).

SRSD was originally developed to meet the needs of students with learning difficulties, including learning disabilities. More recently, SRSD has been used with all students that struggle with writing, whether they have a learning disability or not (Harris et al., 2008). SRSD provides students not only with strategies to address difficulties while writing, but also a philosophy about writing. SRSD aims to motivate struggling writers and provide them with higher levels of self-efficacy by using structured and explicit instruction on self-regulation strategies (Harris et al., 2008).

In the classroom setting, SRSD involves explicitly teaching students specific strategies for various writing genres (i.e., narrative, informational, opinion). In general, SRSD involves six instructional steps: (a) develop background knowledge, (b) discuss it, (c) model it, (d) memorize it, (e) support it, and (f) independent performance. The goal of SRSD is mastery; therefore, certain stages may take longer amounts of time or may be revisited when necessary (Harris et al., 2008).

Similarly, to SRSD, the DMB Model was designed for elementary school students but is meant to be used with all subjects, not just writing. Additionally, although the theory behind SRSD is comparable to that of the DMB Model, the DMB Model uses one conceptual diagram rather than various sets of strategies (i.e., different strategies for different writing genres). Nevertheless, as Harris's work is internationally recognized, this study greatly considered characteristics of SRSD during the creation of the DMB Model.

Perkins, Jay, and Tishman's Dispositional Theory of Thinking

Thinking dispositions, or habits about thinking, have been used by several educational researchers (Costa & Kallick, 2000; Marzano, Brandt, Hughes, Jones, Presseisen, Rankin, & Suthor, 1988; Perkins, Jay, & Tishman, 1993). Perkins, Jay, and Tishman (1993, cited in Ritchhart, 2002, p. 23) developed seven thinking dispositions based on "cultural intuitions about good thinking". The seven thinking dispositions are as follows: (a) be broad and adventurous, (b) sustained intellectual curiosity, (c) clarify and seek understanding, (d) plan and be strategic, (e) intellectually careful, (f) seek and evaluate reasons, and (g) be metacognitive (Perkins, Jay, &

Tishman, 1993; Ritchhart, 2002). The original article on the Dispositional Theory of Thinking argued the importance of dispositions, rather than solely the ability to think well. Thinking dispositions involve a person not only knowing how to think better, but knowing how to use that ability. Perkins, Jay, and Tishman (1993) suggested three general elements involved in thinking dispositions. First, inclinations involve how a person feels about thinking, and more specifically, their opinion about what good thinking entails. For example, someone who believes in the power of being open-minded is more likely to think about being open-minded when the opportunity presents itself. Secondly, sensitivity involves an awareness of when to use certain types of thinking. For instance, a person that is sensitive to open-minded thinking will be more likely to notice narrow-minded thinking, including prejudices and biases. Lastly, ability involves following through with tasks. Therefore, a person who believes and is aware of open-minded thinking will employ that type of thinking regularly. This could include considering different viewpoints and resisting making quick assumptions. Perkins, Jay, and Tishman (1993) argued that an ideal thinker demonstrates these thinking behaviors appropriately. Table 1.2 displays descriptions for the seven dispositions of thinking.

Table 1.2

Perkins, Jay, and Tishman's (1993) Seven Thinking Dispositions

Thinking Disposition	Inclinations	Sensitivity	Ability
Broad and Adventurous	Tendency to be open-minded; desire to play with new ideas; generate many opinions; explore multiple interpretations.	Alertness to binaries, dogmatism, and sweeping generalities; narrow thinking.	Identify assumptions; empathetic thinking; flexible thinking; brainstorming.
Sustained Intellectual Curiosity	Zest for inquiry; tendency to wonder; questioning.	Alertness to unasked questions, anomalies, and hidden facts; detection of gaps in one's understanding.	Observe closely; identify and challenge assumptions; persist in inquiry.

Clarify and Seek Understanding	Desire to apprehend things clearly; impulse to anchor ideas to experience; seek connections.	Alertness to unclarity and superficiality; discomfort with vagueness.	Ask pointed questions; apply and exemplify ideas; identify and classify details.
Plan and Be Strategic	Urge to set goals and plans; tendency to approach tasks with a step-by-step fashion.	Alertness to aimlessness, lack of direction, and off-task thinking.	Formulate goals and evaluate alternative motives; execute plans; predict possible outcomes.
Intellectually Careful	Urge for precision; desire to be thorough.	Alertness to possibility of error, disorder, and disorganization.	Ability to process information precisely; construct order out of disarray.
Seek and Evaluate Reasons	Healthy skepticism; question the given; pursue and demand justification.	Alertness to evidential foundations; wariness of gaps in knowledge.	Ability to distinguish cause and effect; weigh and assess reasons.
Metacognitive	Urge to be cognitively self-aware; desire to self-challenge.	Alertness of control of one's thinking; detection of complex thinking situations.	Exercise executive control of mental processes; conceive the mind as active; self-evaluative; reflective.

Perkins, Jay, and Tishman's theory specifies why and how thinking is good, arguing that the seven dispositions presented in their article "constitute necessary and sufficient elements for a broad, normative characterization of good thinking" (Perkins, Jay, & Tishman, 1993, p. 9). Several taxonomies of thinking dispositions have emerged, emphasizing the importance of using thinking dispositions in educational settings. For example, Visible Thinking, a project also deeply considered in this study, emerged from thinking dispositions.

Visible Thinking. Visible Thinking is deeply rooted in the Dispositional Theory of Thinking. It stresses that "skills alone are not sufficient but that one must also have the inclination to use those skills and an awareness of occasions when those skills need to be deployed," (Ritchhart et al., 2006, p. 1). Student thinking dispositions are highly dependent on classroom cultures that support and nurture meaningful thinking routines (R. Ritchhart, personal communication, May 21, 2018). Additionally, making visible "what an effective learner/thinker might do in a [learning] situation to facilitate their thinking" is the primary goal of Visible Thinking (R. Ritchhart, personal communication, May 21, 2018).

Visible Thinking was developed under Harvard's Project Zero, a research organization founded in 1967. Visible Thinking "refers to any kind of observable representation that documents and supports the development of an individual's or group's ongoing thoughts, questions, reasons, and reflections" (Tishman & Palmer, 2005, p. 2). Some examples of Visible Thinking could include diagrams, worksheets, or maps. Anything that displays what a learner is thinking throughout a problem or topic can be considered Visible Thinking (Tishman & Palmer, 2005). The Cyclical Phase Model, for example, is not considered Visible Thinking because it does not visually present the thoughts of the learner. A good example of Visible Thinking is a KWL chart. The chart is divided into three categories: (a) know, (b) want to know, (c) learned. The chart is meant to be filled out, and students can see how their thinking changes over time. The DMB Model is also an example of Visible Thinking because students must write out their thinking when they use it.

A Visible Thinking approach believes teaching students to think should not be the end-all. Students should be able to see their thinking. Furthermore, Visible Thinking should be more than just a strategy or set of strategies, but rather it should involve the use of thinking routines that continuously happen and become part of the classroom culture. Thinking routines can be "simple structures, for example, a set of questions or a short sequence of steps that can be used across various grade levels and content" (Visible Thinking, n.d., p. 1).

A set of seven core routines were established for teachers to implement Visible Thinking in the classroom: (a) what makes you say that?, (b) think puzzle explore, (c) think pair share, (d) circle of viewpoints, (e) I used to think…now I think, (f) see think wonder, and (g) compass points. These routines have been implemented differently by educators to help students reflect on their thinking (Visible Thinking, n. d.). The seven thinking routines were developed using a design-research approach. Classroom thinking routines were investigated and considered in the design efforts of the seven Visible Thinking routines. Ritchhart et al. (2006) also discovered eight characteristics about thinking routines in general: (a) routines are explicit, (b) routines have only a few steps, (c) routines are goal directed, (d) routines get used over and over again, (e) thinking routines are useful across a variety of contexts, (f) thinking routines are both individual and group practices, (g) thinking routines should be flexible, and (h) thinking routines depend on precise language.

Visible Thinking has shown to have positive results. First, it can be used as a diagnostic assessment by providing teachers with insight into a child's mind. Visible Thinking allows teachers to see what students know and do not know. Of course, the students can also be made aware of this. Visible Thinking is an effective way for students to organize their thoughts (Tishman & Palmer, 2005). The DMB Model did not use the seven Visible Thinking routines but instead used a sequence of thinking habits that make the natural thinking process of the brain inherent for students in an educational setting.

Summary

Three theories were referenced during the creation of the DMB Model. Flavell's Theory of Metacognition, Zimmerman's Self-Regulated Learning Theory, and Perkins, Jay, and Tishman's Dispositional Theory of Thinking led the researcher to create a tool that intends to (a) foster metacognitive awareness and metacognitive regulation, (b) promote self-regulated learning, and (c) make thinking visible for students and teachers. Figure 1.8 illustrates these three theories.

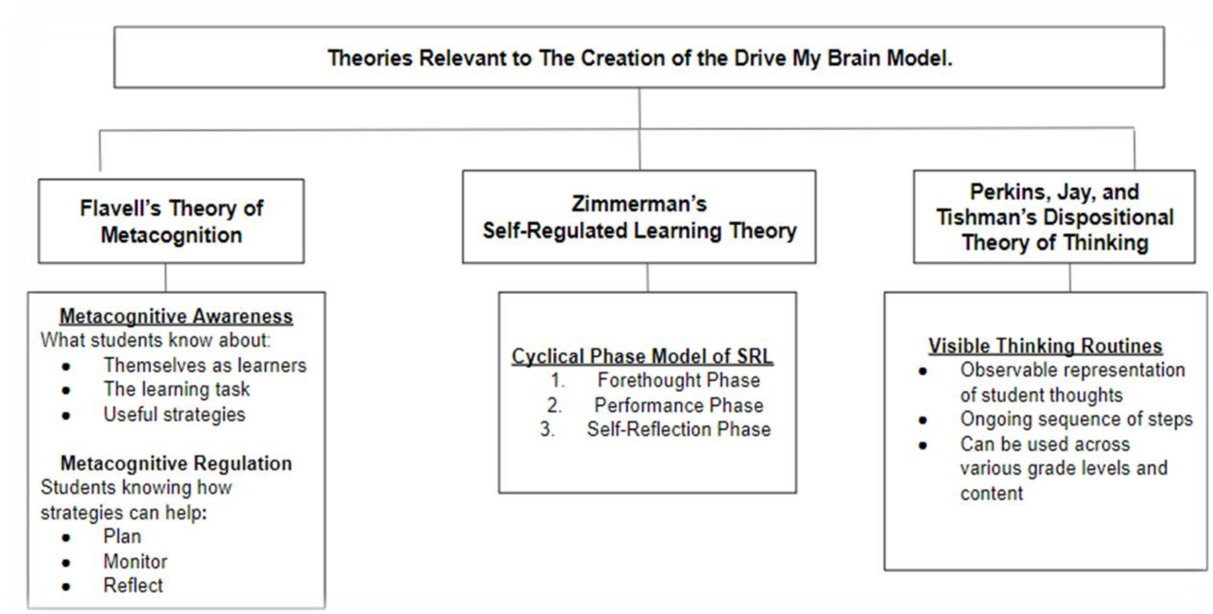


Figure 1.8. Theories that guided the creation of the DMB Model.

Research Questions

In order to determine the effectiveness of the Drive My Brain Model on English language learners' metacognition, four specific research questions were addressed:

1. Does the Drive My Brain Model increase English language learners' metacognitive awareness and metacognitive regulation?
2. What is the effect of the Drive My Brain Model on the use of cognitive strategies?
3. To what degree does the Drive My Brain Model give English language learners language to describe their metacognitive abilities?
4. Is the Drive My Brain Model easy for teachers and students to use?

Definitions of Terms

The following are definitions of key terms significant to this research, which are:

Brain-Based Education: According to Jensen (2008) brain-based education, "is the engagement of strategies based on principles derived from an understanding of the brain" (p. 4).

Cognitive Strategies: Livingston (1997) describes cognitive strategies as thinking tools, "used to help an individual achieve a particular goal" (p. 2).

Conceptual Diagram: Eppler (2006) defines conceptual diagrams as a "systematic depiction of an abstract concept in pre-defined category boxes with specified relationships, typically based on a theory or model" (p. 203).

Drive My Brain Model: A three-phased conceptual diagram that visually represents students' thinking about thinking as they plan, monitor, and reflect (Gomez, 2016).

Intervention: Instructional interventions refer to "specific programs or a set of steps to help a child improve in an area of need" (Lee, 2014, p. 1).

Metacognition: Flavell (1979) defined metacognition as, "one's knowledge concerning one's own cognitive processes or anything related to them" (p. 232).

Metacognitive Awareness (MA): According to Schraw (1998) metacognitive knowledge or awareness refers to, "what individuals know about their own cognition or about cognition in general" (p. 114).

Metacognitive Regulation (MR): Metacognitive regulation "refers to how someone employs metacognitive knowledge to regulate or control cognition" (Schraw & Moshman, 1995, p. 352).

Metacognitive Strategies: According to O'Malley et al. (1989), "metacognitive strategies involve thinking about the learning process, planning for learning, monitoring of comprehension or production while it is taking place, and self-evaluation after the learning activity has been completed" (p. 8).

Neuro-Plasticity: Jensen (2008) states, "neuroplasticity is a significant quality that allows for a change in the structure, topology, mapping, or function of the brain" (p. 199).

Self-Reflected Learning: Self-Reflected Learning is "the degree to which students are metacognitively, motivationally, and behaviorally active participants in their own learning process" (Zimmerman, 2013, p. 137).

Visible Thinking: Visible Thinking "refers to any kind of observable representation that documents and supports the development of an individual's or group's ongoing thoughts, questions, reasons, and reflections" (Tishman & Palmer, 2005, p. 2).

Visual Metaphor: According to Eppler (2006) a visual metaphor is a "graphic structure using the shape or elements of a familiar natural or manmade artifact of an easily recognizable activity to organize content meaningfully" (p. 203).

Limitations

Factors that were out of the researcher's control included that the participants were limited to one school site. Data derived from this study, therefore, may not be representative of all English language learners in the United States. Additionally, the two groups (i.e., control and treatment) were unequal regarding of English and academic abilities. For example, the control group had more gifted identified and RFEP students. The two groups also received instruction from two different teachers; the teacher of the control group had more teaching experience. Due to the year-round schedule of the school site, the data collection was limited to eight weeks. Lastly, the surveys used in this study produced ordinal data, limiting the use of parametric tests.

Delimitations

The delimitations utilized by the researcher of this study were determined by a desire of promoting high levels of metacognition for ELLs. First, the researcher developed the DMB Model specifically for this dissertation. The model was intended to be versatile and used in a wide range of academic situations, giving the participating students a way to systematize deep thinking while learning. A two-group quasi-experimental design was used (i.e., treatment group received the DMB Model and the control group did not) to determine what the outcome of not using the DMB Model might be. The participants of this study were as closely related as possible in relation to socio-economic status, race, and language abilities. Additionally, the student participants engaged in the same academic content, as well as at the same time of day, throughout the duration of the study. The treatment group's only difference was the use of the DMB Model. The researcher did not use her own students; however; the nature and closeness of the relationship between the researcher and her colleagues positively impacted the outcome of this study. Lastly, for comprehension purposes, the Jr. Metacognitive Awareness Inventory and Cognitive Strategies Use Survey (i.e., pre-tests and post-tests) were administered verbally in English by the participating teachers.

Assumptions

The study included the following assumptions: (a) participating teachers will respond positively to the DMB Model, (b) student participants that used the DMB Model correctly will have higher levels of metacognitive awareness and regulation, (c) most participating students will find the Drive My Brain Model easy to use, (d) student participants will improve in their post-test survey scores, and (e) student participants will obtain more language to describe their cognitive and metacognitive abilities.

Logic Model

The researcher designed a logic model to illustrate the goals and expectations of this study. The logic model consists of the goals, rationales, resources, activities, outputs, and outcomes of this study. Figure 1.9 shows the logic model.

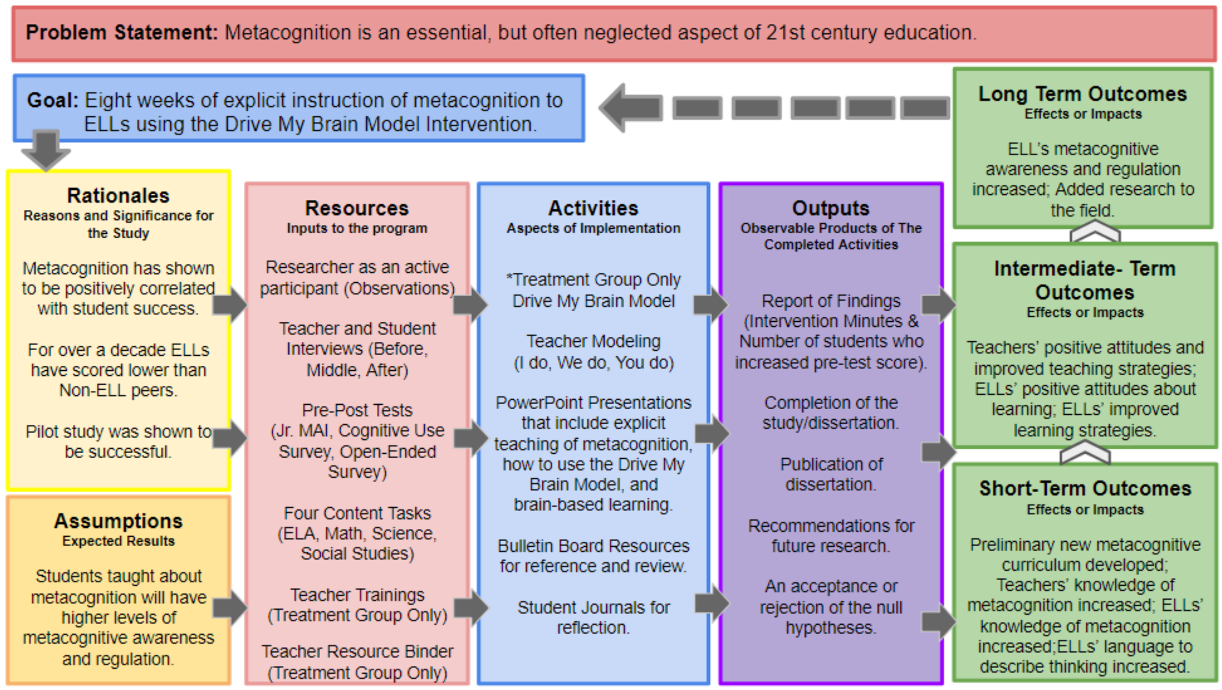


Figure 1.9. Logic model showing the goals and expectations of this study.

Organization of the Study

This research study is presented in six chapters. Chapter 1 includes the background of the study, the statement of the problem, the purpose of the study, the significance of the study, theoretical framework, definitions of terms, research questions, limitations, delimitations, and the assumptions of the study.

Chapter 2 presents a review of the literature, which includes an overview of the brain-based education, metacognitive theories, metacognitive components, and metacognition in the classroom. Lastly, ELLs and the importance of intervention and metacognitive strategies instruction is discussed.

Chapter 3 describes the creation of the Drive My Brain Model. Additionally, steps on how to use the model are described.

Chapter 4 presents the methodology used for this research study. It includes the participants, procedure for selection of participants, research design, instrumentation, data collection, data analysis, and ethical guidelines.

Chapter 5 presents the study's findings. The results of both the quantitative and qualitative data analysis are discussed to answer the research questions.

Chapter 6 provides a summary of the entire study, discussion of the findings, implications of the findings for theory and practice, recommendations for further research, and conclusions.

CHAPTER 2: LITERATURE REVIEW

This chapter will present the rationale for researching on the effectiveness of the Drive My Brain Model on English language learners' metacognition. The review of literature will include important findings about brain based-education, metacognitive theories, metacognitive approaches to teaching, and English language learners. Part 1 provides an overview of brain-based education by reviewing essential components of cognitive neuroscience that led to a better understanding of the science of learning. Part 2 provides significant research regarding two initial metacognitive theories. Successively, an overview of metacognitive knowledge and metacognitive regulation are discussed in Part 3. Part 4 provides information regarding metacognition in the classroom, including metacognitive strategies for learning. Lastly, Part 5 discusses English language learners and the importance of intervention and metacognitive strategies instruction.

Part 1: Brained-Based Education

Brain-based education involves using what is known about the brain to inform instructional decisions. Jensen (2008) defines brain-based education as "learning in accordance with the way the brain is naturally designed to learn" (p. 4). It arose as a new field of study in the 1980s. Neurobiology and cognitive neuroscience became possible through the use of new technology. Magnetic resonance imaging (MRI), for example, allowed scientists to analyze living brains through the detailed images they developed. Access to this information led scientists to investigate how knowledge about the brain could contribute to education (Jensen, 2008). For instance, Hart (1983) emphasized the importance of teachers understanding students' brains. She claimed that ignoring how the brain develops and works is a disservice to students (Hart, 1983; Jensen, 2008). Since its inception, brain-based education has been thoroughly studied and divided into countless subcategories. In teaching, it is a philosophy about instruction and learning. It can involve any instructional practices that account for the brain and how it learns best (Carry, 2015; Jenson, 2008; Ramon y Cajal, 1988a, Ramon y Cajal, 1988b).

How the Brain Learns

The human brain contains up to 100 billion nerve cells, known as neurons. Each of these neurons can connect with 1,000 to 10,000 other neurons, forming synapses. These synapses are where most neuroscientists believe learning occurs. Therefore, in theory, the more connections you have, the more you have learned (Carry, 2015; Jensen, 2008; Bransford et al., 2001; Sousa, 2011). Thinking plays an important role in the brain's formation of synapses, as research has found that brains in stimulating environments show larger neural networks (Bransford et al., 2001). Additionally, advances in the science of learning have shown that the brain can reorganize synaptic connections, a concept referred to as neuroplasticity. Therefore, the once commonly thought idea that people have predetermined intellectual abilities has been disproven (Bransford et al., 2001; Wilson & Conyers, 2013; Wilson & Conyers, 2016). Wilson and Conyers (2016) argue that "advances in the science of brain plasticity show that virtually all students can improve their academic performance when their schooling is characterized by effective teaching approaches…explicit instruction on metacognitive and cognitive strategies that allow them to become self-directed learners" (p. 28). When students are taught metacognitive strategies, they are essentially able to begin controlling their learning (Bransford et al., 2001; Wilson & Conyers, 2016).

Metacognition and the learning brain. Cognition involves actions or processes that the brain uses to acquire knowledge. It comes from the Latin word *cognosco,* meaning "with know." Cognition, in short, is the knowledge one has (Bransford et al., 2001). Metacognition, often defined as thinking about thinking, occurs in the brain when a learner becomes conscious of his or her thinking, self-examining and self-analyzing their thoughts (Flavell, 1979; Fleming & Frith, 2013). Metacognitive thinking allows students to optimize the synaptic connections in their brains. According to Wilson and Conyers (2016), students have the ability to think about their thinking during three main learning phases: (a) input, (b) processing, and (c) output (see Figure 2.1).

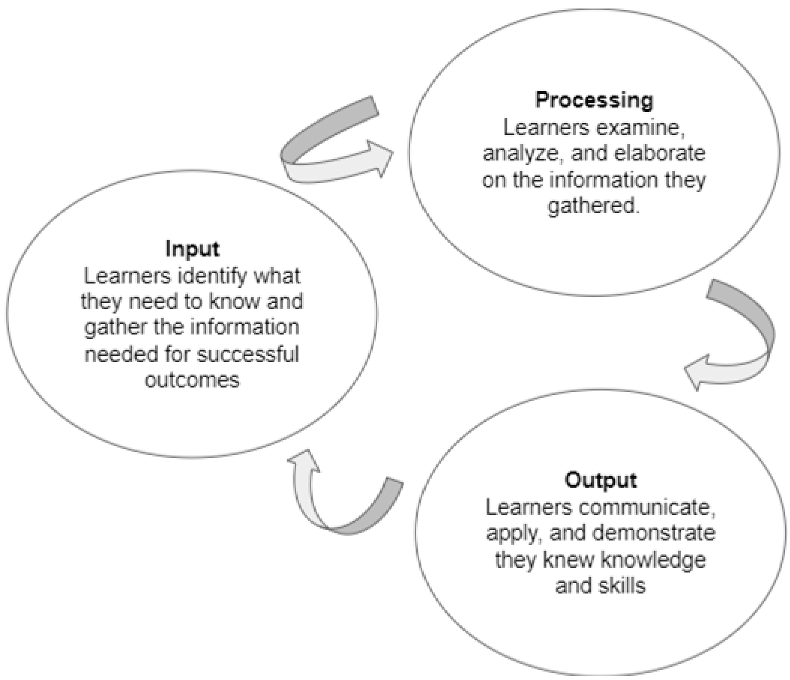


Figure 2.1. Phases of Learning. Adapted from "*Teaching students to drive their brains: Metacognitive strategies, activities, and lesson ideas*," by D. Wilson and M. Conyers, 2016, Alexandria, VA: Association for Supervision and Curriculum Development.

When students perceive the learning process in segments, they can determine which phase they are in or should be in at that moment. Moreover, a metacognitive approach to learning enables students to identify the phases more accurately. This neuroscientific evidence supports the need for equipping students with thinking strategies throughout their learning process (Wilson & Conyers, 2016). To better understand metacognition, the next section reviews metacognitive theories.

Part 2: Metacognitive Theories

The first person to give a detailed description of the concept of metacognition was an American developmental psychologist named Flavell (1979). In fact, he coined the term, defining it as "one's knowledge concerning one's own cognitive processes or anything related to them" (Flavell, 1979, p. 232). Since its origin, the term has been defined in multiple ways, though the definitions have remained comparable to the original (Martinez, 2006; Schraw & Moshman, 1995). The most popular and simple definition remains 'thinking about thinking' (Brown, 1987; Flavell, 1979; Jacobs & Paris, 1987; Lai, 2011; Schraw & Moshman, 1995).

Flavell's Theory of Metacognition

Flavell's research, over the years, was greatly influenced by Jean Piaget, a Swiss psychologist who was known for pioneering the field of child cognitive development (Alic, n. d.). Before the 1920s, children's cognitive development was not a well-studied topic. Flavell (1996) stated that "theories of cognitive development can be divided into B.P. (Before Piaget) and A.P. (After Piaget) because of the impact of his theory" (p. 202). Piaget agreed with the current stance on learning: intelligence is not a fixed trait. As a constructivist, he believed children could construct their own knowledge and provided early evidence that children had conscious regulation of their thoughts (Baker & Beall, 2009). Flavell was interested in expanding on Piaget's work, and in 1979 he published his first account of metacognition (Barrouillet, 2015; Lai, 2011; Schraw & Moshman, 1995). Flavell's (1979) original model of metacognition consisted of four main components: (a) metacognitive knowledge, (b) metacognitive experiences, (c) goals/tasks, and (d) actions/strategies (see Figure 2.2).

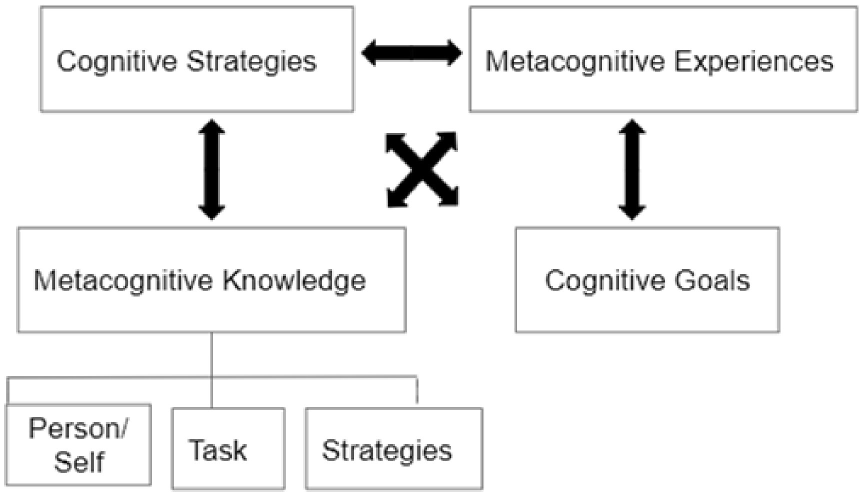


Figure 2.2. Flavell's Model of Metacognition. Reprinted from "Using metacognitive strategies to improve reading comprehension and solve a world problem," by T. Djudin, 2017, *Journal of Education Teaching and Learning*, *2*(1), p. 67.

Metacognitive knowledge entails one's understanding of their strengths and weakness about themselves, their knowledge of tasks, and their knowledge of strategies. First, knowledge of self involves knowing what one knows and does not know, as well as recognizing what may come easy or not so easy to a learner. Secondly, knowledge of tasks involves understanding the objective of a lesson, or what one is trying to accomplish. It also involves knowing that different tasks often require different approaches. Lastly, knowledge of strategies includes knowing how to correctly use various strategies, or methods of learning (Lai, 2011; Schraw & Moshman, 1995).

Metacognitive experiences follow metacognitive knowledge, involving the actual implementation of strategies. Someone who exhibits metacognitive experiences will monitor and regulate while they learn (Lockl & Schneider, 2002; Schraw & Moshman, 1995). Lastly, goals/tasks entail the work that needs to be completed for learning to occur, and actions/strategies include techniques that ensure one reaches his or her goals (Djudin, 2017). As metacognition has continued to be studied; various frameworks have been developed to further define and explain its components.

Brown's Metacognitive Model

Another significant researcher who contributed to the current understanding of metacognition was Brown (1987). Brown's (1987) model of metacognition included two components: (a) knowledge of cognition, and (b) regulation of cognition. Knowledge of cognition, similar to Flavell's metacognitive knowledge, refers to the information learners have about themselves. However, Brown expanded Flavell's model by categorizing knowledge of cognition into declarative, procedural, and conditional knowledge (Brown, 1987; Jacobs & Paris, 1987). Figure 2.3 illustrates Brown's model of metacognition (Brown, 1987).

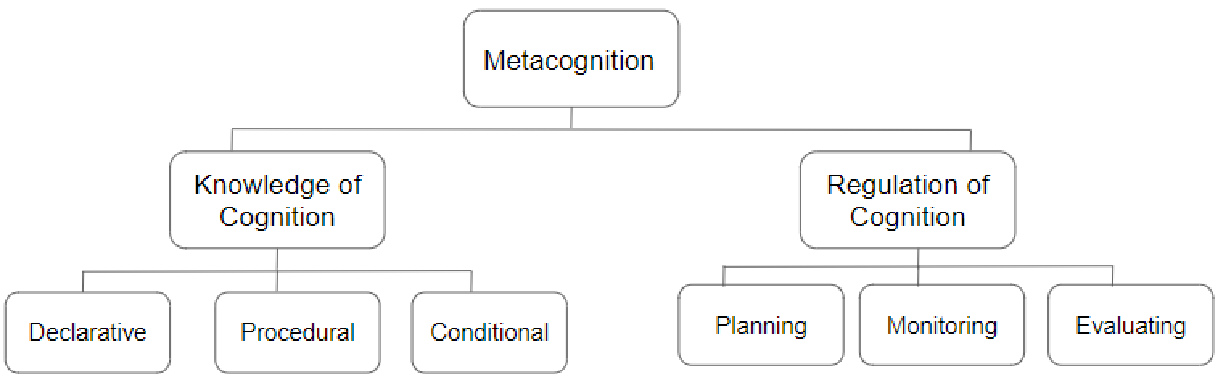


Figure 2.3. Brown's Model of Metacognition

Declarative knowledge often refers to what information is known about oneself and the factors that can influence performance. For example, students might recognize that they can memorize information fairly quickly. Other students who may have trouble memorizing information may use mnemonics to help them with the recall. Procedural knowledge involves an understanding of how certain strategies are used. Therefore, if a student knows they benefit from memorizing information, they can perform the necessary steps to ensure they memorize what they need. Lastly, conditional knowledge refers to knowing when to apply certain strategies. An example could be a student using memorization strategies to study for a test or prepare for a speech (Brown, 1987; Jacobs & Paris, 1987; Schraw & Moshman, 1995). Simply put, declarative knowledge is often referred to as the *what*, procedural as the *how*, and conditional as the *when* and *why* (Dunlosky & Metcalfe, 2009; Paris, Lipson & Wixson, 1983).

Regulation of cognition, similar to Flavell's metacognitive experiences, refers to a learner's ability to self-monitor. Brown (1987) also expanded this idea, categorizing regulation of cognition into planning, monitoring, and evaluating. Brown discussed the idea that regulation of cognition could sometimes be an automatic process because some strategies develop without someone being aware of it. Brown also believed that regulation of cognition was highly dependent on the learner's age. Young children, for example, may not always have the ability to monitor and regulate the strategies they use. Moreover, although adults may have the capacity to monitor and regulate, they might not always be conscious of their decisions (Brown, 1987; Nazarieh, 2016). Therefore, these skills need to be directly taught for students to describe them (Jensen, 2008).

Both Brown and Flavell believed that metacognition involved awareness and regulation of cognition. According to Baker and Beall (2009), "this two-component conceptualization of metacognition has been widely but not exclusively used since that time" (p. 783). Throughout the work of various metacognitive studies, several terminology and criteria have been suggested to classify and explain metacognitive knowledge and regulation. Additionally, many terms are used interchangeably throughout the research as well as in this paper (i.e., metacognitive knowledge and metacognitive awareness, metacognitive regulation and regulation of cognition, etc.). Table 2.1 provides a synthesis of major metacognitive frameworks found in research gleaned from a literature review conducted by Lai (2011). The constituent elements of metacognition (i.e., metacognitive knowledge and metacognitive regulation) are further discussed in the subsequent section.

Table 2.1

Typologies of Metacognitive Components

Metacognitive Component	Definition	Terminology	Reference
Knowledge of Cognition	Knowledge about oneself as a learner	Person Knowledge Task Knowledge	Flavell, 1979
		Self-appraisal of cognition	Jacobs and Paris, 1987
		Declarative Knowledge	Brown, 1987 Jacobs and Paris, 1987
		Epistemological understanding	Kuhn and Dean, 2004
	Awareness of cognition, including knowledge of strategies	Strategy Knowledge Procedural Knowledge	Flavell, 1979 Brown, 1987 Jacobs and Paris, 1988
		Metacognitive Awareness	Schraw, 1998
	Understanding when to use strategies	Conditional Knowledge	Brown, 1987 Jacobs and Paris, 1987
Regulation of Cognition	Identifying appropriate strategies	Planning	Brown, 1987 Cross and Paris, 1988 Schraw and Moshman, 1995
	Implementing strategies	Monitoring Regulating	Brown, 1987 Cross and Paris, 1988 Paris and Winograd, 1990 Schraw and Moshman, 1995
	Assessing, monitoring, and evaluating the process of learning	Evaluating	Brown, 1987 Paris and Winograd, 1990
		Metacognitive Regulation	Schraw and Moshman, 1995 Whitebread et al., 2009

Note. Adapted from “Metacognition: A literature review,” by E. Lai, 2011, Research Report, Retrieved from http://images.pearsonassessments.com/images/tmrs/Metacognition_Literature_Review_Final.pdf

Part 3: Metacognitive Knowledge and Regulation

Metacognitive Knowledge

Many studies have classified metacognitive knowledge as Brown (1987) did, distinguishing between the elements of declarative, procedural, and conditional knowledge (Cross & Paris, 1988; Paris & Winograd, 1990; Schraw & Moshman, 1995; Whitebread et al., 2009). Jacobs and Paris (1987), for example, divided metacognition into similar categories as Flavell and Brown: (a) self-appraisal of cognition, and (b) self-management of thinking. The self-appraisal of cognition category included elements of declarative, procedural, and conditional knowledge. They defined self-appraisal as "the static assessment of what an individual knows about a given domain or task" (Jacobs & Paris, 1987, p. 258). Thus, self-appraisal could entail what a learner knows about his or her own abilities or a learning task, but does not involve how to manage those skills (Jacobs & Paris, 1987). Additionally, Kuhn and Dean (2004) further described declarative knowledge by associating it with an epistemological understanding. Epistemology, or the theory of knowledge, is often concerned with how people change throughout their learning. Epistemological development, for example, is often seen as a progression because knowledge is always changing (Baxter Magolda, 1992; King & Kitchener, 1994). Therefore, Kuhn and Dean (2004) disagreed with Jacobs and Paris's (1987) idea that metacognitive knowledge is unchanging. Conversely, they believed that metacognitive knowledge is dependent on an individual's reflection of subjective and objective knowledge. Metacognitive knowledge involves learners realizing the importance of knowing how one knows something, and that precision of knowledge requires some degree of evidence (Kuhn & Dean, 2004; Hofer, 2010). Therefore, epistemic metacognition, also called epistemological meta-knowing, requires learners to not only think about thinking but to know about knowing (Hofer, 2010). Lastly, Van Velzen (2013) studied the assessment of metacognitive knowledge. He believed that learners demonstrate metacognitive knowledge when "selecting, evaluating, revising, and abandoning cognitive tasks, goals, and strategies about one's personal abilities and interests," (Van Velzen, 2013, p. 16). Assessing metacognition is discussed further in Part 4.

As researchers have studied the concept of metacognitive knowledge, they have found that many people, adults included, struggle to explain what they know about themselves as learners, a given task, or strategies. Furthermore, although articulating metacognitive knowledge seems to improve with age, explicitly stating what one thinks about what they know is not necessary for obtaining or using it (Schraw & Moshman, 1995; Baker & Beall, 2009; Lai, 2011).

Metacognitive Regulation

The second component of metacognition is referred to as regulation of cognition or metacognitive regulation. Most research agrees that regulation of cognition involves planning, monitoring, and evaluating as Brown first suggested (Cross & Paris, 1988; Paris & Oka, 1986; Paris & Winograd, 1990; Schraw & Moshman, 1995). Metacognitive regulation is often associated with Self-Regulated Learning (SRL), a concept first introduced by Zimmerman (1986). Zimmerman, however, believed SRL involves much more than metacognition; SRL also involves motivational and behavioral factors (Zimmerman, 2015). Nonetheless, many researchers studying metacognitive regulation use an SRL approach, training learners to become more involved in their learning process. Furthermore, research on the science of learning has highlighted the importance of people taking control over their learning. In neuroscience fields, the term active learning is often used. Most approaches that support the idea of active learning have incorporated metacognitive regulation (Bransford et al., 2001; Wilson & Conyers, 2016). "Teaching practices congruent with a metacognitive approach to learning include those that focus on sense-making, self-assessment, and reflection on what worked and what needs improving" (Bransford et al., 2001, p. 12). In research, therefore, it is common to see metacognitive regulation associated with constructs such as critical thinking, motivation, self-regulation, self-directed learning, self-assessment, reflection, and executive functioning (Baker & Beall, 2009; Lai, 2011).

Metacognitive regulation and reading comprehension. The majority of studies involving metacognitive regulation have a focus on reading comprehension. The goal of many of the initial studies was to improve students' reading comprehension by increasing their metacognitive abilities (Baker & Beall, 2009). Fogarty, Cretchley, Harman, Ellerton, and Konki (2001) for example, believed planning before reading, monitoring during reading, and evaluating after reading were prerequisites for successful reading comprehension (see Figure 2.4).

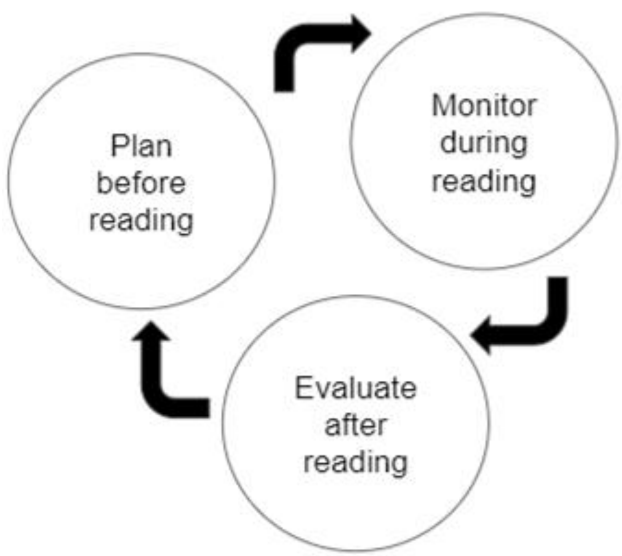


Figure 2.4. Metacognitive regulation to improve reading comprehension.

Studies that involved the teaching of metacognitive strategies for reading comprehension found that struggling readers did not engage in metacognitive thinking. Baker and Brown (1984) even argued, "ineffective monitoring of one's cognitive processes during reading is the cause of poor comprehension," (p. 44). Later studies, however, found that even young students could evaluate their thinking and understanding of text while reading. As a result of these findings, many interventions (i.e., studies) began to incorporate metacognitive strategies instruction (Baker & Beall, 2009). Similar to Fogarty et al., O'Malley, Chamot, and Küpper (1989) stated, "metacognitive strategies involve thinking about the learning process, planning for learning, monitoring of comprehension or production while it is taking place, and self-evaluation after the learning activity has been completed" (p. 8). Metacognition strategies are further discussed in Part 4.

Schraw and Moshman's Metacognitive Theories

Schraw and Moshman (1995) aimed to explain further concepts related to metacognition. They defined three distinct theories or methods for explaining how students obtain metacognitive awareness and regulation. They described metacognitive theories as "systematic frameworks used to explain and direct cognition, metacognitive knowledge, and regulatory skills" (p. 351). The description of such metacognitive theories was about an individual's understanding of his or her metacognitive awareness and regulation. Three types of metacognitive theories were proposed: (a) tacit; (b) explicit but informal; and (c) explicit and formal (Schraw & Moshman, 1995, p. 358). Figure 2.5 displays the three theories.

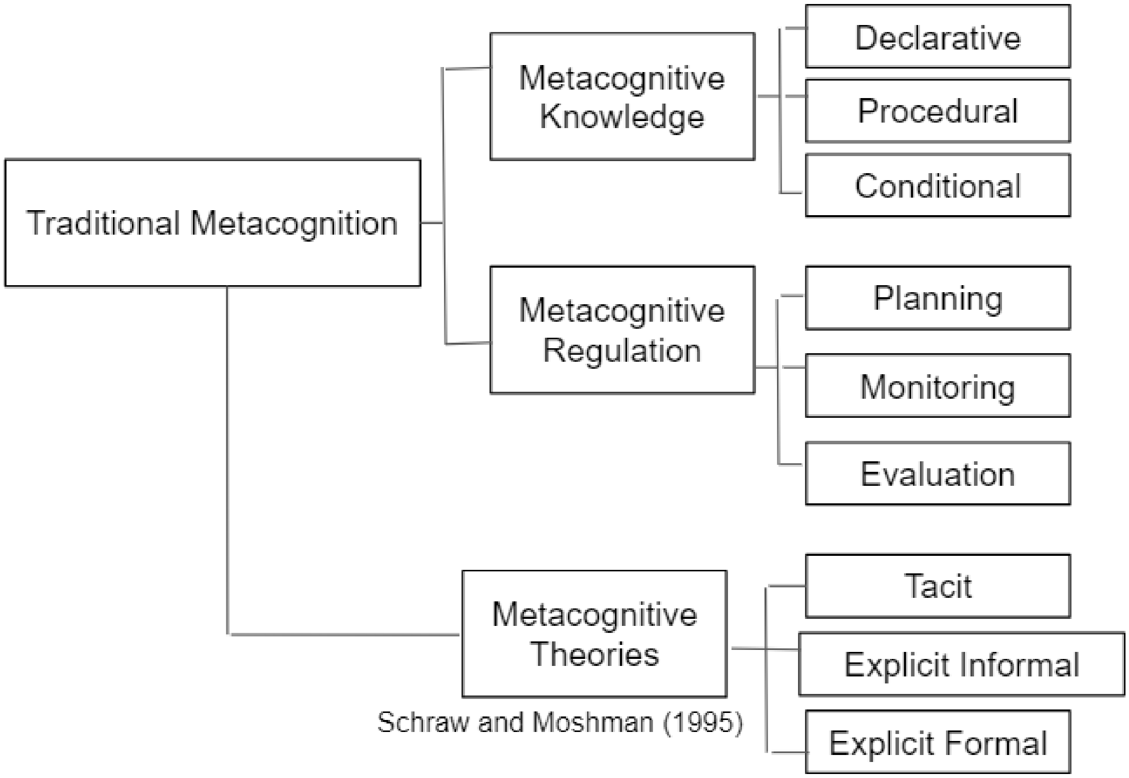


Figure 2.5. Schraw and Moshman's Metacognitive Theories.

Tacit theories, as the name suggests, consist of metacognitive knowledge and regulation that cannot be made explicit. For example, some students have unspoken knowledge about their intelligence that can impact their learning and behavior in the classroom (Dweck & Legget, 1988; McCutcheon, 1992; Schraw & Moshman, 1995). Tacit theories support the idea that children may have certain understandings about what they know even if they are unable to articulate them (Baker & Beall, 2009; Lai, 2011; Schraw & Moshman, 1995). Schraw and Moshman (1995) even argued: "that a child's implicit beliefs about intelligence constitute a theory because they allow the child to synthesize observations about the nature of intelligence and make predictions based on those observations" (p. 358). Tacit theories, therefore, can develop over time based on a learner's interaction with parents, peers, teachers, or even cultural factors (Paris & Byrnes, 1989; Schraw & Moshman, 1995).

Explicit, but informal theories involve learners being aware of some of their beliefs about learning; however, the beliefs are just starting to develop. Informal theories relate more to metacognitive knowledge/awareness than metacognitive regulation. Schraw and Moshman (1995) believed this emerging awareness was the first step in a learner's ability to modify or improve their metacognitive awareness. Finally, formal theories include explicit frameworks for a learner's awareness and regulation of cognition. Individuals that have formal theories about learning have higher levels of metacognitive awareness and regulation (Schraw & Moshman, 1995). Schraw and Moshman (1995) believed that instructional programs should promote metacognitive theorizing among their students. To do this, educators should begin having their students focus on the process of learning and provide ways to develop metacognitive theories (Schraw & Moshman, 1995).

In conclusion, over 30 years of research has been conducted on metacognition, specifically analyzing and explaining its two components of metacognitive knowledge and metacognitive regulation. Baker (2002) summarizes the significance of the two components perfectly

> Metacognition is a term that is now widely used to refer to the knowledge and control we have of our own cognitive processes. The knowledge component of metacognition is concerned with the ability to reflect on our own cognitive processes, and it includes knowledge about ourselves as learners, about aspects of the task, and about strategy use. The control component is concerned with self-regulation of our efforts, evaluating our

> progress, remediating difficulties that arise, and testing a revising our strategies for learning. (p. 77)

Metacognition studies and reports unanimously agree on its importance; however, there has been little attention dedicated to providing consistent metacognitive programs for teachers and students to apply across the curriculum (Lai, 2011; Wilson & Conyers, 2016). In fact, Wilson and Conyers (2016) argue: “Metacognition is an essential, but often a neglected, component of a 21st century education that teaches students *how* to learn” (p. 7). Although there is still much room for improvement, the following section provides a review of classroom programs that involve deep learning and metacognitive components.

Part 4: Metacognition in the Classroom

Metacognition requires time to develop, practice, and improve. Teachers can model their own thinking process, scaffold their students’ thinking processes, and provide opportunities for students to notice their own thinking (Tarrant & Holt, 2016; Wilson & Conyers, 2016). Students can avoid using ineffective approaches if they “monitor and direct their own progress, ask questions such as ‘What am I doing now?’, ‘Is it getting me anywhere?’, or ‘What else could I be doing instead?’ This general metacognitive level [or ability] helps students avoid persevering in unproductive approaches” (Perkins & Salomon, 1989, p. 1).

Metacognitive Development in Children

Though metacognition and the concepts related to it can be deeply complex, the action of using the skills is somewhat common, even among children (Dunlosky & Metcalfe, 2009; Kuhn, 2000). Many students use metacognition without knowing it. Those who can use metacognition, regardless of their awareness, have a good understanding of how they learn. For example, students with high metacognitive skills are aware of what they know and do not know well

(Kuhn, 2000; Weimer, 2012). Additionally, they have the "will to think effectively and the skill of being able to think about one's thinking with the goal of steadily improving learning and taking advantages of the brain's plasticity" (Wilson & Conyers, 2016, p. 25). The ability to think about one's thinking is a central skill to students' learning, and it must be fostered in the classroom. Additionally, students need the time to practice strengthening their deep thinking skills (Weimer, 2012; Wilson & Conyers, 2016).

Metacognition in the Classroom

There have been several attempts to bring metacognitive thinking into educational settings. Some involve hierarchical levels of knowledge (i.e., Bloom's Taxonomy, Bloom's Revised Taxonomy, Depth of Knowledge), and others include routines or habits involved with deep thinking (i.e., Metacognitive Teaching Framework, Habits of Mind, Depth and Complexity Icons). In a classroom setting, metacognition should encompass "children knowing themselves as learners, having an understanding of how they learn, and being more aware of the process and actions that they use during learning to achieve the outcome of a lesson" (Tarrant & Holt, 2016, p. 1). As mentioned previously, curriculum involving explicit teaching of metacognition across the curriculum is non-existent; however, there have been efforts to promote deep learning in classrooms (Tarrant & Holt, 2016; Wilson & Conyers, 2016).

Tools for Deep Learning

Deep learning is often divided into two categories: (a) deep acquisition, and (b) deep consolidation (Fisher et al., 2016). The goal of deep learning "is to foster self-regulation and self-talk" (Fisher et al., 2016, p. 76). Deep learning requires that students have time to practice thinking deeply and to become more metacognitively aware. Research has found that if educators do not teach and expect deep learning in the classroom, it is likely not to occur (Jensen, 2008; Fisher et al., 2016).

Cognitive and metacognitive strategies. Deep learning is often the result of intentional use of cognitive abilities. Cognitive strategies, for example, can include any "acts of the mind, or thinking tools, such as planning and goal setting, tapping prior knowledge, making connections, monitoring… [that students] use to construct [deeper] meaning" (Olson, 2011, p. 8). A cognitive strategies approach to teaching often involves students being introduced to a set of skills they can use while learning. Paris et al. (1984), for example, introduced students to Informed Strategies for Learning (ISL). These strategies were intended to improve students' reading comprehension by having students understand the assignments (i.e., directions), and by having teachers provide immediate feedback. Students that participated in the ISL project were found to have significantly higher levels of both reading comprehension and metacognition with $r(90) = .40$, $p < .001$ (Paris et al., 1984).

Self-Regulated Strategy Development. Self-Regulated Strategy Development (SRSD), previously mentioned in Chapter 1, involves explicitly teaching students strategies for each of the various writing genres (i.e., narrative, opinion, informational). SRSD has been used with individual students, small groups, or entire classes. The SRSD approach is designed "to promote students' ownership and independent use of the writing and self-regulation strategies" (Harris et al., 2008, p. 5). Table 2.2 shows SRSD strategies for the various writing genres. Many of the strategies use acronyms, which are further discussed below.

Table 2.2

Self-Regulation Strategies Development for Writing Genres

Narrative, expository, and persuasive writing strategies	POW, TREE, STOP, DARE, PLANS
Word Choice	Vocabulary Enrichment
Revising	SCAN, REVISE
Reading and Writing Informational Text	TWA + PLANS
Writing Competency Tests	PLAN and WRITE

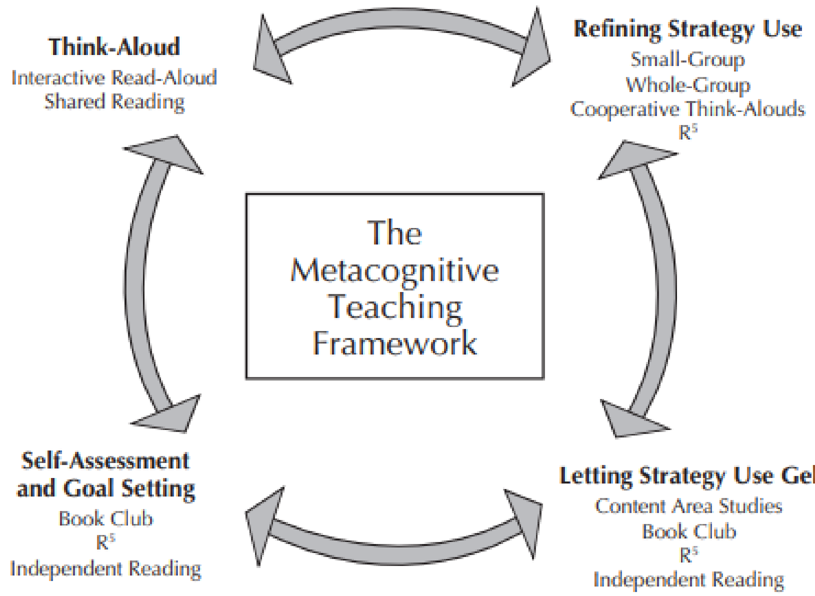
The SRSD strategies were developed for elementary students who struggle with writing. The strategies are clear and easy to follow. Additionally, many include acronyms for the students to promote retention. For example, POW stands for pick my idea, organize my notes, write and say more. TREE stands for topic sentence, reasons, ending/explain reasons, and examine (Harris et al., 2008). Many templates, including graphic organizers, tables, cue cards, and certificates have been made involving each of the strategies listed above. These templates are found in many of Harris's books.

The Pathway Project. The Pathway Project, previously mentioned in Chapter 1, also focused on using a set of cognitive strategies to enhance metacognitive thinking. The goal of the project was to assist English language learners (ELLs) in developing skills that could help them advance academically. Over 2000 ELLs participated in this project throughout eight years (Olson & Land, 2007).

Students were first taught a set of 15 cognitive strategies. Once students practiced with the cognitive strategies, they were introduced to the concept of metacognition. Introduction to metacognition was achieved by having the students engage in a think-aloud activity. As they thought aloud, their teacher noted the cognitive strategies they used (Olson & Land, 2007). According to Olson (2007), "This introductory workshop sets the stage for ongoing invitations for students to metacognitively reflect upon their reading, thinking, and writing throughout the year" (p. 281). Figure 1.6 shows the cognitive strategies toolkit used with the Pathway Project.

Figure 1.6 Cognitive Strategies Toolkit. Reprinted from "The reading/writing connection: Strategies for teaching and learning in the secondary classroom", by C. Olson and R. Land, 2007, *Research in the Teaching of English, 41*(3), p. 278. https://www.nwp.org/cs/public/download/nwp_file/8538/Booth_Olson,_Carol,_et_al.pdf ?x-r=pcfile_d

Metacognitive Teaching Framework. Another example of a cognitive strategies approach is the Mkelleyetacognitive Teaching Framework (MTF). The MTF was a reading comprehension model that supported the idea of visible thinking (Kelley & Clausen-Grace, 2013). Visible Thinking, previously mentioned in Chapter 1, "refers to any kind of observable representation that documents and supports the development of an individual's or group's ongoing thoughts, questions, reasons, and reflections" (Tishman & Palmer, 2005, p. 2). The MTF Model sought to teach metacognition using the model and a set of cognitive strategies. Because metacognition often occurs at an abstract or subconscious level, the MTF intended for teachers to make their thinking visible while introducing the concept of metacognition to students. The MTF Model (see Figure 2.6) used six cognitive strategies with a four-phased model.



Note. R^5 is our structured independent reading block, called Read, Relax, Reflect, Respond, and Rap.

Figure 2.6. The Metacognitive Teaching Framework Model. Reprinted from "Comprehension shouldn't be silent: From strategy instruction to student independence" by M.J. Kelley & N. Clausen-Grace. Newark, DE: International Reading Association.

One of the cognitive strategies, for example, was predicting. Students were introduced to making predictions as their teacher used the MTF Model. First, the teacher engaged in a think-aloud activity about predictions. This could have included talking about how to make predictions based on a cover or title page of a book. Next, the strategy was refined. In this phase, teachers had their students also engage in think-aloud activities and discuss what they knew about the strategy (i.e., predicting). Lastly, the two final phases had the students practice using the strategy and reflect on how well they used that strategy. In addition to predicting, the students also learned to make connections, question, visualize, and summarize using the MTF Model. Research involving the model's effectiveness is still needed (Kelley & Clausen-Grace, 2013).

Knowledge classification systems. Other tools that foster deep learning include the classification of knowledge. A variety of taxonomies have developed throughout the years.

Some have included the capacity people have to learn, while others have been concerned with lesson objectives for instructional planning. Knowledge classification systems help teachers and students understand and acquire knowledge in feasible steps (Carson, 2004).

Bloom's Taxonomy and Revised Taxonomy. Bloom (1956) developed a framework to categorize learning into phases. His model, referred to as Bloom's Taxonomy, included six different categories, moving from lower-level thinking skills to higher-level thinking skills. His model acted like a continuum, allowing students and teachers to recognize which phase of learning they were in, or should be in (Armstrong, 2018). Each of the six categories described a cognitive domain; they included knowledge, comprehension, application, analysis, synthesis, and evaluation. Each of these cognitive domains, aside from application, was divided further into subcategories. For example, knowledge consisted of knowledge of specifics, knowledge of ways and means of dealing with specifics, and knowledge of universals and abstractions in a field (Krathwohl, 2002). Table 2.3 shows the cognitive domains and their subcategories.

Table 2.3

Bloom's Taxonomy Cognitive Domains and Subcategories

Domains	Categories	Subcategories
Knowledge	Knowledge of specifics	Knowledge of terminology Knowledge of specific facts
	Knowledge of ways and means of dealing with specifics	Knowledge of conventions Knowledge of trends and sequences Knowledge of classifications and categories Knowledge of criteria Knowledge of methodology
	Knowledge of universals and abstractions in a field	Knowledge of principles and generalizations Knowledge of theories and structures
Comprehension	Translation Interpretation Extrapolation	
Application	N/A	
Analysis	Analysis of elements Analysis of relationships Analysis of organizational principles	
Synthesis	Production of unique communication Production of a plan, or proposed set of operations Derivation of a set of abstract relations	
Evaluation	Evaluation in terms of internal evidence Judgments in terms of external criteria	

Note. Structure of the original taxonomy. Reprinted from "A revision of Bloom's taxonomy: An overview," by D. R. Krathwohl, 2002, *Theory into Practice*, *41*(4), 212-218, p. 214.

The knowledge phase of Bloom's Taxonomy is closely associated with Flavell's metacognitive knowledge and Brown's knowledge of cognition. The remaining phases, however, are more closely related to metacognitive experiences, or metacognitive regulation (Tarrant & Holt, 2016). Since its creation, Bloom's Taxonomy has been used in many classrooms to promote deeper levels of thinking. Additionally, in 2001, one of Bloom's students sought to revise the phases, making the framework even more applicable to classroom settings (Anderson & Krathwohl, 2001).

The revised taxonomy, similar to the original, contained six learning phases. However, the new version also contained a second domain. The cognitive domains shifted from being nouns (i.e., knowledge) to verbs (i.e., remembering), and knowledge was added as a separate domain (Anderson & Krathwohl, 2001). Figure 2.7 displays the two versions of Bloom's Taxonomy.

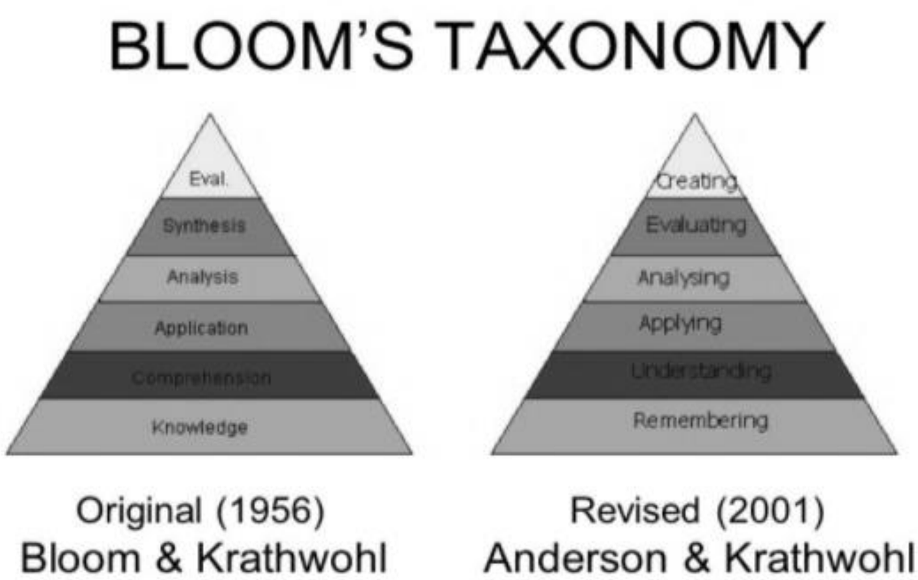


Figure 2.7. Original and revised Bloom's Taxonomy. Reprinted from "Bloom's taxonomy", by A. Serrano, & J. Dewar, 2007, Loyola Marymount University Center for Teaching Excellence. http://slideplayer.com/slide/10856543/

The original taxonomy broke the cognitive knowledge process into three subcategories, as shown in Table 2.2. The revised taxonomy contained four knowledge dimensions: (a) factual knowledge, (b) conceptual knowledge, (c) procedural knowledge, and (d) metacognitive knowledge. The first dimension, factual knowledge, referred to basic information students had (i.e., facts). Conceptual knowledge, similar to declarative knowledge, referred to what students knew about strategies or concepts related to the area being studied. Procedural knowledge, as Brown originally suggested, focused on *how* to do something. Lastly, metacognitive knowledge encompassed both metacognitive awareness and regulation. The knowledge dimensions in Bloom's Revised Taxonomy have many similarities to early research on metacognition. Ironically, the original framework (1956) was developed before metacognition was deliberately studied (Anderson & Krathwohl, 2001; Tarrant & Holt, 2016).

Depth of Knowledge. The concept of Depth of Knowledge (DOK) was created with the purpose of helping teachers and students become aware of the depth of their assignments. Webb (1997) introduced the concept to create a criterion that would align with both curriculum and teacher expectations. Additionally, a primary goal of implementing the DOK Model (see Figure 2.8) was to improve student performance in reading, writing, science, and social studies (Webb, 2002).

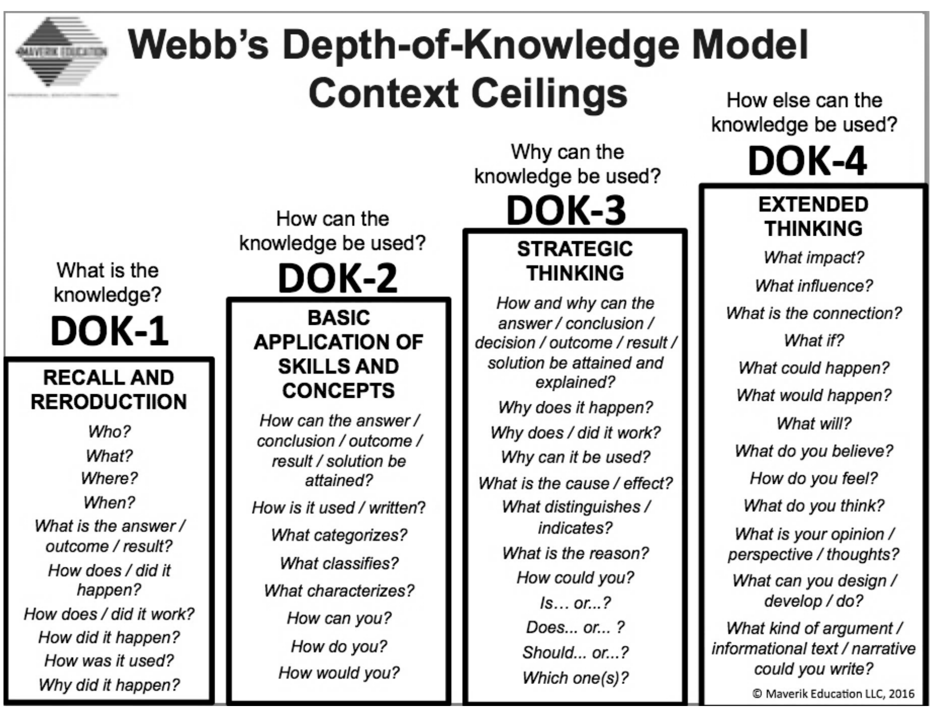


Figure 2.8. Webb's Depth of Knowledge Model Reprinted from "What exactly is depth of knowledge?" by Francis, E. (2017). http://edge.ascd.org/blogpost/what-exactly-is-depth-of-knowledge-hint-its-not-a-wheel

The DOK Model describes how deeply students need to know and understand what they are learning to be successful. In accordance with his tool, the four levels include knowledge acquisition (i.e., recall and reproduction), knowledge application (i.e., skills and concepts), knowledge analysis (i.e., strategic thinking) and knowledge augmentation (i.e., extended thinking). Unlike Bloom's Taxonomy or Revised Taxonomy, the levels of DOK were not intended to determine what students should be able to demonstrate; conversely, the levels of DOK aimed to describe the depth of the learning experiences in which students participated. Filling out a worksheet, for example, would fall under the first DOK level. There have been several attempts to compare the DOK and Bloom's Taxonomy. Some have even argued that the DOK was an attempt to simplify Bloom's Taxonomy. Nevertheless, the DOK levels are used in classrooms as a way for teachers to monitor rigorous expectations (Mississippi State University Research & Curriculum Unit, 2009).

Thinking prompts. Thinking prompts are great tools to engage students in deep thinking as well as deep conversation. They can range from video clips, works of art, photographs, or even individual words. Anything that can provoke deep and powerful thinking could be considered a thinking prompt (Knight, 2014).

Habits of Mind. The Habits of Mind (HoM) were developed by Costa and Kallick (2000) to provide teachers with a tool for improving the learning environment and promoting deeper levels of thinking (Campbell, 2006). The HoM consist of 16 attributes high performing students should attain to engage in deeper levels of thinking. The goal of the HoM was to teach students how to behave and think intelligently (Costa & Kallick, 2000). Each HoM contains an icon, or thinking prompt, along with a description (see Table 2.4).

Table 2.4

The 16 Habits of Mind developed by Costa and Kallick (2000)

Habit	Icon	Definition
Persisting		Following through to completion.
Managing Impulsivity		Thinking before speaking or acting.
Listening with Understanding and Empathy		Paying attention to a person's thoughts, feelings, and ideas; putting yourself in the other person's shoes.
Thinking Flexibly		Being able to change perspectives and consider the input of others.
Metacognition (Thinking about Thinking)		Being aware of your own thoughts, feelings, intentions, and actions.
Striving for Accuracy		Checking for errors.
Questioning and Posing Problems		Considering what information is needed and choosing strategies to get that information.
Applying Past Knowledge to New Situations		Use what is learned; consider prior knowledge and experience.
Thinking and Communicating with Clarity and Precision		Striving to be clear when speaking and writing; avoiding generalizations.
Gathering Data through All Senses		Stopping to observe what I see, hear, smell, taste, and feel.
Creating, Imagining, Innovating		Thinking about how something might be done differently from the "norm."
Responding with Wonderment and Awe		Being intrigued by the world's beauty.
Taking Responsible Risks		Willing to try something new and different; not letting mistakes stop me from finishing my task.
Finding Humor		Willing to laugh appropriately; laugh at myself when I can.
Thinking Interdependently		Willing to work with others and welcome their input and perspective.
Remaining Open to Continuous Learning		Open to new experiences to learn from; proud and humble to admit when I don't know something.

Note. Reprinted from "*Discovering & Exploring Habits of Mind*," by A. Costa & B. Kallick, 2000, Alexandria, VA: ASCD.

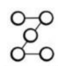
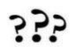
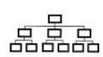
Costa and Kallick (2000) believed that intelligence was a direct result of using strong thinking routines. Use of the HoM requires learners to have metacognitive awareness and regulation, as they are intended for students to “apply their abilities when they become aware of what they are supposed to be doing” (Campbell, 2006, p. 4). Although there are elements of metacognition throughout the HoM, one of the thinking routines specifically addresses metacognition. Costa and Kallick (2000) provide the simple definition of metacognition as thinking about thinking (Flavell, 1979). Additionally, the metacognition HoM entails being aware of one’s own thoughts, feelings, intentions, and actions (Costa and Kallick, 2000). This highly correlates to metacognitive awareness (i.e., thoughts, feelings, intentions) and metacognitive regulation (i.e., actions). Another HoM that seems to encompass elements of metacognition is questioning and posing problems. Asking ‘How do I know?’ is similar to describing declarative knowledge using an epistemological understanding (Kuhn, 2000; Kuhn & Dean, 2004). Many schools and districts have implemented the HoM to foster deep thinking in the classroom (Anderson, 2010). The HoM website offers free training for teachers as well as some free resources (i.e., posters).

Depth and Complexity Icons. The Depth and Complexity Icons were developed by Kaplan (2009) as an instructional tool to increase deep thinking and rigor in all classroom settings; however, the thinking prompts are usually recognized in Gifted and Talented Education (GATE) classrooms. For example, GATE conferences, and GATE certification programs often embrace the icons (Colorado Department of Education, n.d.).

The Depth and Complexity Icons were designed to have teachers explicitly teach each icon to the students and provide opportunities for the students to practice using them. As the students become more familiar with this way of thinking, less prompting is required from the teacher (McIntosh, 2015). Of the 11 icons, eight of them involve depth, and three of them involve complexity (see Table 2.5). The icons are generally used across various subjects. Additionally, it is suggested to use more than one icon at a time (McIntosh, 2015).

Table 2.5

Kaplan's Depth and Complexity Icons

	Name	Icon	Description
	Language of the Discipline		Learning the specific specialized and technological terms associated with a specific area of study.
	Details		The learning of the specific attributes, traits, and characteristics that describe a concept, theory, principle, and even a fact.
	Patterns		Recurring events represented by details.
	Trends		The factors that influence events.
Depth Icons	Unanswered Questions		The ambiguities and gaps of information recognized within an area or discipline under study.
	Rules		The natural or man-made structure or order of things that explain the phenomena within an area of study.
	Ethics		The dilemmas or controversial issues that plague an area of study or discipline.
	Big Ideas		The generalization, principles, and theories that distinguish themselves from the facts and concepts of the area or discipline under study.
Complexity Icons	Changes Over Time		The understanding of time as an agent of change and recognition that the passage of time changes our knowledge of things.
	Multiple Perspectives		The concept that there are different perspectives and that these perspectives alter the way ideas and objects are viewed and valued.
	Across the Disciplines		Integrated and interdisciplinary links in the curriculum made within, between, and among various areas of study of disciplines.

Note. Reprinted from "Theorizing habits of mind as a framework for learning," by J. Campbell, 2006, *PB Works*, p. 26, and "*The grid: A model to construct differentiated curriculum for the gifted,"* S. N. Kaplan, 2009, pp. 116-117, Mansfield Center, CT: Creative Learning Press.

Assessing the Metacognitive Development of Children

Research has provided evidence that metacognitive awareness and metacognitive regulation are teachable. Additionally, instructional practices with a focus on deep, metacognitive thinking (i.e., cognitive and metacognitive strategies, instructional and knowledge classifications, thinking prompts) have been implemented in classrooms. There are not many assessments for determining metacognitive development in children; however, a couple of tools have been created for this purpose.

Metacomprehension Strategies Index

The Metacomprehension Strategies Index (MSI) was developed to measure how well students use a certain set of strategies while reading narrative text (Schmitt, 1990). The assessment consists of multiple choice questions that can be administered aloud to students. Additionally, some educators have changed the wording of the questions to assess students' strategy use with expository text.

The MSI tests students on a certain set of strategies, which include: (a) predicting and verifying; (b) previewing; (c) self-questioning; (d) drawing from background knowledge; (e) summarizing and apply fix-up strategies (Schmitt, 1990). The test consists of 25 questions, of which 10 questions are related to what students did before they read, ten questions are related to what students did while reading, and five questions are related to what students did after reading. The test contains an answer key, describing which multiple-choice item students would have selected to have used a metacomprehension strategy. Table 2.6 contains some example questions.

Table 2.6

Metacomprehension Strategies Index Sample Questions

Question	Metacomprehension Response
Before I begin reading, it's a good idea to A. See how many pages are in the story B. Look up all of the big words in the dictionary C. Make some guesses about what I think will happen in the story D. Think about what has happened so far in the story	C
While I am reading, it's a good idea to A. Read the story very slowly so that I will not miss any important parts B. Read the title to see what the story is about C. Check to see if the pictures have anything missing D. Check to see if the story is making sense by seeing if I can tell what's happened so far	D
After I've read a story it's a good idea to A. Count how many pages I read with no mistakes B. Check to see if there were enough pictures to go with the story to make it interesting C. Check to see if I met my purpose for reading the story D. Underline the causes and effects	C

Jr. MAI Inventory

The original Metacognitive Awareness Inventory (MAI) was created by Schraw and Dennison (1994). This assessment was mostly administered to college level students. Sperling et al. (2002) created a children's version of the MAI, which they named the Jr. Metacognitive Awareness Inventory (Jr. MAI). The purpose of this measure was to evaluate the effectiveness of interventions involving metacognitive strategies or instruction (Sperling et al., 2002).

The Jr. MAI has two versions. One of the versions is for students in Grades 3 through 5; whereas, the other is for older students in Grades 6 through 9. Both versions contain a set of statements that students respond to using a Likert scale. The statements are divided into two categories. Some questions relate to knowledge of cognition or metacognitive awareness, and the other half of the questions correspond to the regulation of cognition, or metacognitive regulation. Over 100 studies have used the Jr. MAI to measure metacognitive awareness and regulation in young children (Sperling et al., 2002).

In summary, metacognitive strategies/tools help students enhance their metacognitive skills (i.e., metacognitive awareness and metacognitive regulation). The best strategies lead students to discover *what* they know, *how* to use what they know, *when* to use what they know, and *why* to use what they know (i.e., strong declarative, procedural, and conditional knowledge). Though there have been attempts to promote deeper levels of thinking in the classroom setting (i.e., cognitive and metacognitive strategies, knowledge classifications, and thinking prompts), assessing students' metacognitive abilities is also a huge component (Dunlosky & Metcalfe, 2009; Wilson & Conyers, 2016). Students and teachers should use metacognitive assessments as starting points, as well as to determine growth. Additionally, metacognitive interventions should be developed and used alongside assessment tools (Weimer, 2012; Tanner, 2012).

Part 5: English Language Learners

Over the years, many families have immigrated to the United States. As a result, our foreign-born population continues to grow. Additionally, our schools contain higher levels of English language learners (ELLs). ELLs consist of students who have a primary language other than English. Some ELLs even come from households where English is not spoken at all. Many ELLs, therefore, have experiences with different cultures and education (National Council of Teachers of English, 2008; National Center for Education Statistics, 2017.

There are currently about 4.5 million ELLs in United States public schools. This statistic accounts for roughly 10 percent of our total student population (National Center for Education Statistics, 2017). ELLs in public schools receive language assistance to “help ensure that they attain English proficiency and meet the same academic content and achievement standards that all students are expected to meet” (National Center for Education Statistics, 2017, p. 1). However, there are still many challenges ELLs must face.

Challenges Faced by ELLs

Generally, ELL students may have remarkably different academic experiences compared to their non-ELL peers. Therefore, ELLs may face distinct challenges when it comes to their own learning when compared to other groups of students. For example, ELLs must not only learn academic content but must acquire the language to encode and decode academic concepts into intelligible and meaningful information resources (Perez & Morrison, 2016). As was mentioned in Chapter 1, ELLs have performed significantly lower than their non-ELL peers in both national and state-wide assessments. This disparity is known as the achievement gap; intervention is necessary to close this gap (National Center for Education Statistics, 2017).

Considering the biopsychosocial understanding of students, it is imperative that educators note that ELLs also experience challenges outside of the educational setting that may affect their academic performance. These include socio-emotional challenges, socio-economic status, immigration status, parental involvement, and academic resources (Perez & Morrison, 2016). The National Education Association (NEA) highlights that approximately two-thirds of the ELLs come from low socio-economic backgrounds, indicating that they may have limited resources outside of school (NEA Education Policy and Practice Department, 2008). With many educational tasks now requiring technology, this presents a significant challenge for ELLs who do not have the access or means to obtain these resources. Also, the majority of the parents of ELLs are monolingual, which could affect the level of parental involvement in educational tasks at home (NEA Education Policy and Practice Department, 2008). While educators have limited reach to address all challenge areas for ELLs, teachers can intervene in the problems that arise in academia by implementing appropriate tools and engaging in best practices when teaching ELLs (Casey, 2011; Kerr, 2012; Perez & Morrison, 2016).

Various interventions have been implemented to address the growing population of ELLs For instance, The No Child Left Behind Act (NCLB) of 2002 set forth a requirement for ELLs to participate in yearly assessments to test their knowledge of language and content (Perez & Morrison, 2016). California specifically requires ELLs to take the California English Language Development Test (CELDT) as established by the California Department of Education ([CDE], 2014). Additionally, ELLs receive instructional minutes mandated by federal laws. School districts, for example, must provide all ELLs in their schools with instruction at their English proficiency level, measured by the CELDT. Instruction is required to take place during the school day and be devoted specifically to language development, separate from ELA, math, social studies, and science (National Center for Education Statistics, 2017). Even with these mandates in place, intervention is most beneficial at the classroom level. Differentiating instruction allows ELLs to advance and reach complete academic potential (Kerr, 2012).

Classroom Interventions for ELLs

According to Lee (2014) “instructional intervention is a specific program or set of steps to help a child improve in an area of need” (p. 1). Effective interventions consider the learner, the learning environment, and where learning takes place. Response to Intervention (RtI) is a well-known, three-tiered model for intervention. The RtI model was founded on the principle that all children are capable of learning (Echevarria, Vogt, & Short, 2008). Tier I is designed for students in general education classes who may need extra support (i.e., ELLs). Many students can catch up to their peers with a little bit of extra support from the teacher. Tier II is designed, for students who require even more support. Examples of Tier II interventions may include "small-group or individualized instruction, family involvement, primary language support, explicit teaching of learning strategies for students who need assistance in learning how to learn, and/or more intensive English language development" (Echevarria et al., 2008, p. 198). Lastly, Tier III is designed to provide special education services to students. There are many benefits of using RtI in the classroom, as it provides a safe learning environment and useful information that monitors the student progress. ELLs, depending on English proficiency levels and academic abilities, could benefit Tier I, II, or III interventions (Casey, 2011; Echevarria et al., 2008).

Effective interventions, however, require more than good instruction. Teachers must also understand and know their students, maintain a positive classroom environment, and have good classroom management skills (Casey, 2011; Kerr, 2015). Additionally, it is important to teach ELLs how their brain naturally processes information. According to Kerr (2015), "In order to help these [ELL] students take ownership of their learning and develop new strategies for comprehending lessons, it is first necessary that instructors understand what their initial thought processes are" (p. 8).

Metacognition and ELLs

Effective ELL intervention should aim "at fostering self-regulated learning [with a] focus on the development of metacognitive awareness" (Lopez, 2014, p. 8). Research has documented strong correlations between metacognition and second language learning (Danuwong, 2006; Hansen, 2014; Raoofi et al., 2014). Metacognition strategies, in fact, have shown to have a stronger impact on successful learning that other strategies (i.e., cognitive, metacognitive, socioaffective). Metacognitive strategies are helpful for ELLs because they teach students what to do when they are struggling (Arslan, 2014; Dörnyei, 2006; Pintrich, 2002).

ELLs benefit from knowing what strategies to use, practicing choosing appropriate and relevant strategies, and reflecting on strategies (Dörnyei, 2006). For example, it is often common to notice ELLs avoiding or ignoring unfamiliar terms instead of asking for clarification. Depending on their English proficiency levels, this may occur fairly often throughout the school day even without teachers noticing. Given metacognitive skills, however, it is more likely for ELLs to reread or look for resources to help them (i.e., peers, text, and teacher). Metacognitive skills give ELLs tools to succeed better (Kerr, 2015).

Students can be extremely influential in their education depending on the decisions they make. McCombs and Marzano (1990) believe students are "creative agents with the power of choice" (p. 63). Based on this idea, it is likely that appropriate intervention that provides students with a step-by-step process to understand their thinking could instill confidence, thus promoting self-directed learning (Mahdavi & Tensfeldt, 2013). Overall, interventions should allow students opportunities to regulate their learning, giving them a tool to support future learning (McCombs & Marzano, 1990). Giving students metacognitive tools can assist students in recognizing that they can achieve their learning goals (Wilson & Conyers, 2016). Tanner (2012) suggested four simple procedures for intervention to ensure high levels of metacognitive development in children. They included pre-assessments to determine students' current metacognitive levels, reflection activities to address students' confusion, post-assessments to measure student growth, and reflective journals that describe what worked and did not work. The following section describes the intervention used for this study.

CHAPTER 3: THE DRIVE MY BRAIN MODEL

The Drive My Brain (DMB) Model (Gomez, 2016) was developed by the researcher specifically for this dissertation. The DMB Model is a three-phased conceptual diagram that visually represents students' thinking about thinking as they plan, monitor, and reflect. It was designed for elementary school students in grades two through six to use in all subject areas. The purpose of the model was to expose students to their metacognitive abilities by explicitly teaching metacognitive strategies using a specific Visible Thinking map. For reference, while reading this chapter, Figure 1.5 displays the Drive My Brain Model.

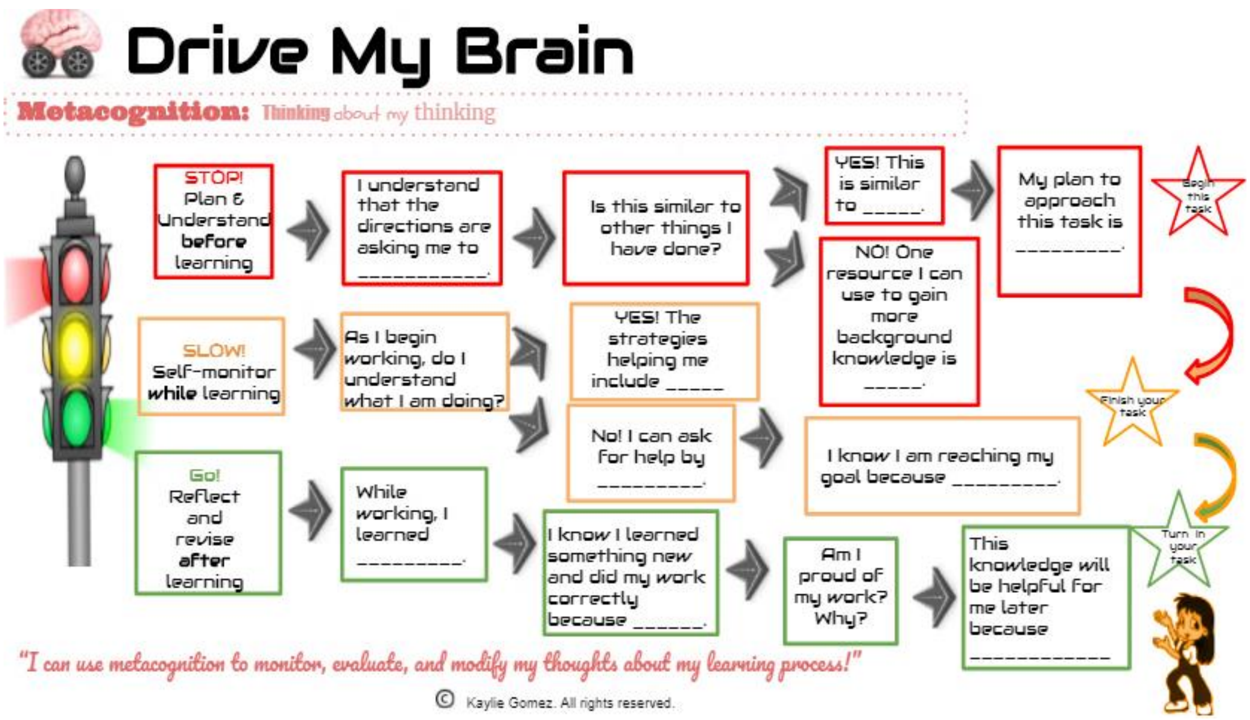


Figure 1.5. The Drive My Brain Model

The Drive My Brain Model Design

The DMB Model is composed of three phases which include the planning phase, the self-monitoring phase, and the reflecting phase. The planning phase promotes metacognitive awareness through the use of active cognitive strategies that require students to think about what the problem or goal is and what needs to be considered to achieve the goal. The self-monitoring phase encourages students to practice metacognitive regulation by requiring students to actively monitor their thoughts and strategies used as they move through a concept or problem. The reflecting phase encompasses both regulation and awareness by requiring the students to thinking about their entire thought process as they completed the original problem or concept.

Creation of The Drive My Brain Model

The DMB Model was designed to equip students with the necessary tools for deep thinking about any curriculum area. It was intended to be easy for teachers and students to learn how to use. According to Fisher et al. (2016) "deep learners are able to think metacognitively, take action, discuss ideas, and see errors as a necessary part of learning," (p. 75). Teachers who wish to cultivate deep learning in the classroom should encourage their students to plan, investigate, and expand (Fisher et al., 2016; Flavell, 1979). The DMB Model was intended for students to plan, monitor, and reflect using a visual graphic organizer. Graphic organizers provide students with a tool that helps them take ownership of the concepts they learn as they arrange their thoughts (Fisher et al., 2016). Additionally, the researcher referenced three theories during the creation of the DMB Model in hopes of generating a tool that (a) fosters metacognitive awareness and metacognitive regulation, (b) promotes self-regulated learning, and (c) makes thinking visible for students and teachers. These theories were discussed in Chapter 1.

Metacognitive Strategies

The researcher of this study designed The DMB Model for students to think about their thinking and utilize metacognitive strategies. Cognitive strategies aid students in achieving a particular goal (i.e., reading comprehension); whereas, metacognitive strategies assure that students understand how to reach that particular goal (i.e., through self-questioning or taking notes to evaluate one's comprehension). However, metacognitive and cognitive strategies sometimes overlap; for example, "questioning could be regarded as either a cognitive or metacognitive strategy depending on what the purpose for using the strategy may be" (Livingston, 1997, p. 2). If a student uses questioning to gain information, they would be using a cognitive strategy. Questioning might also be used to monitor what has been read or understood. In this case, it would be a metacognitive strategy (Livingston, 1997; Sarvari, Lavicza, & Klincsik, 2010). Students using the DMB Model self-question and monitor themselves and their thinking as they learn; therefore, they engage in active use of metacognitive strategies.

Metacognitive strategies can help promote higher levels of metacognitive awareness and regulation. Metacognitive awareness involves understanding a learning task and what metacognitive strategies are available to help complete the task. It also involves knowing how to use the strategies correctly. Metacognitive regulation involves the student who is using the metacognitive strategies (Livingston, 2003). The DMB Model incorporates metacognitive strategies with each phase that intend to foster both metacognitive awareness and metacognitive regulation. For example, in the planning phase, "I understand that the directions are asking me to ____," is an example of metacognitive awareness (i.e., knowledge of task). "My plan to approach this task" (i.e., knowledge of strategies) and "While working, I learned _____" (i.e., knowledge of self) are also examples of metacognitive awareness. An example of a metacognitive regulation strategy would be, "As I begin working, do I understand what I am doing?" or "Am I proud of my work?" Both sentence frames require the students to perform an action. For example, these sentence frames require the students to clarify and summarize.

Students use four general types of metacognitive strategies while using the DMB Model: (a) planning, (b) monitoring, (c) evaluating, and (d) reflection. Dignath, Buettner and Langfeldt

(2008) meta-analyzed over 40 studies to determine the effect sizes of training first through six graders in various strategies. Table 3.1 displays the effect sizes for metacognitive strategies.

Table 3.1

Effect Sizes for Metacognitive Strategies

Metacognitive Strategy Training	Effect Size
Training in planning and monitoring	1.50
Training in planning and evaluating	1.46
Training on metacognitive reflection-knowledge about and value of strategies	0.95

An effect size "is the magnitude, or size, or a given effect" (Fisher et al., 2016, p. 5). Effects sizes can help researchers determine what things work. Fisher et al. (2016) discuss the zone of desired effects to be anything above 0.40 because it can be concluded that the strategy helped students exceed the amount they would have learned just from being in school for a year. These metacognitive strategies, therefore, have shown to be successful in past research.

Cognitive Strategies

Cognitive strategies were considered during the creation of the DMB Model. The researcher utilized the successful work of Carol Booth Olson. An extensive study done by Olson and Land (2007) indicated consistent positive outcomes for English language learners who used a set of cognitive strategies. In the study, a treatment group of students were explicitly taught cognitive strategies and were then tested on their reading and writing abilities. The students that participated in this study were from a low socio-economic school district and, 93% of the participants spoke English as a second language. The treatment group outperformed students who were not given instruction with cognitive strategies (Olson & Land, 2007). The participants of this DMB Model study, discussed in detail later in Chapter 4, were of similar demographics. To further the research done by Olson, the researcher of this study developed the DMB Model with the following 10 cognitive strategies in mind: (a) planning and goal setting, (b) tapping prior knowledge, (c) making connections, (d) monitoring, (e) evaluating, (f) asking questions, (g) clarifying, (h) summarizing, (i) forming interpretations, and (j) reflecting and relating (Olson & Land, 2007). The students used these cognitive strategies metacognitively. Table 3.2 provides a graphic representation of the ten cognitive strategies embedded in the Drive My Brain Model.

Table 3.2

Cognitive Strategies Embedded in The Drive My Brain Model

Cognitive Strategy	Abbreviation	Examples
Planning and goal setting	PGS	Understanding directions, creating and setting goals, determining a purpose, setting priorities.
Tapping Prior Knowledge	TPK	Searching existing schemata, mobilizing knowledge, relating to previous learning.
Making Connections	MC	Connecting knowledge to self, other learning experiences, or the world.
Monitoring	MN	Knowing when to stop and reread, confirming that one understands and is reaching a goal, implementing other strategies for help when needed.
Evaluating	EV	Reviewing, assessing quality, formulating criticisms.
Asking Questions	AQ	Generating questions about a topic, fostering forward momentum, predicting what will happen next.
Clarifying	CL	Making sense of what was learned, thinking about what more can/needs to be learned in the future
Summarizing	SM	Addressing key information, stating what was accomplished.
Forming Interpretations	FI	Understanding what the learning means to the learner, addressing how this learning may be useful later.
Reflecting and Relating	RR	Stepping back, rethinking what one knows, formulating guidelines for the future.

Note. Reprinted from "The reading/writing connection: Strategies for teaching and learning in the secondary classroom", by C. Olsen and R. Land, 2007, *Research in the Teaching of English, 41* (3). Retrieved from https://www.nwp.org/cs/public/download/nwp_file/8538/Booth_Olson,_Carol,_et_al.pdf ?x-r=pcfile_d

Olson's cognitive strategies were embedded into the DMB Model; therefore, the names of the actual strategies do not appear on the model itself. However keywords address some of the strategies (i.e., plan, goal, ask). Additionally, students described thinking processes that involved the use of the strategies while filling out the model. For example, a student would be evaluating when he or she says, "I am proud of my work because _____." However, the student may not have used the word evaluate even though that is what he or she was doing. The DMB Model was created to directly teach students how to actively plan, monitor, and reflect on their thinking. The cognitive strategies embedded in the model were designed to help them do this. However, the names of cognitive strategies were not explicitly taught. Figure 3.1 shows where Olson's cognitive strategies were embedded into the DMB Model. The full names for the abbreviations of the cognitive strategies can be found above in Table 3.2.

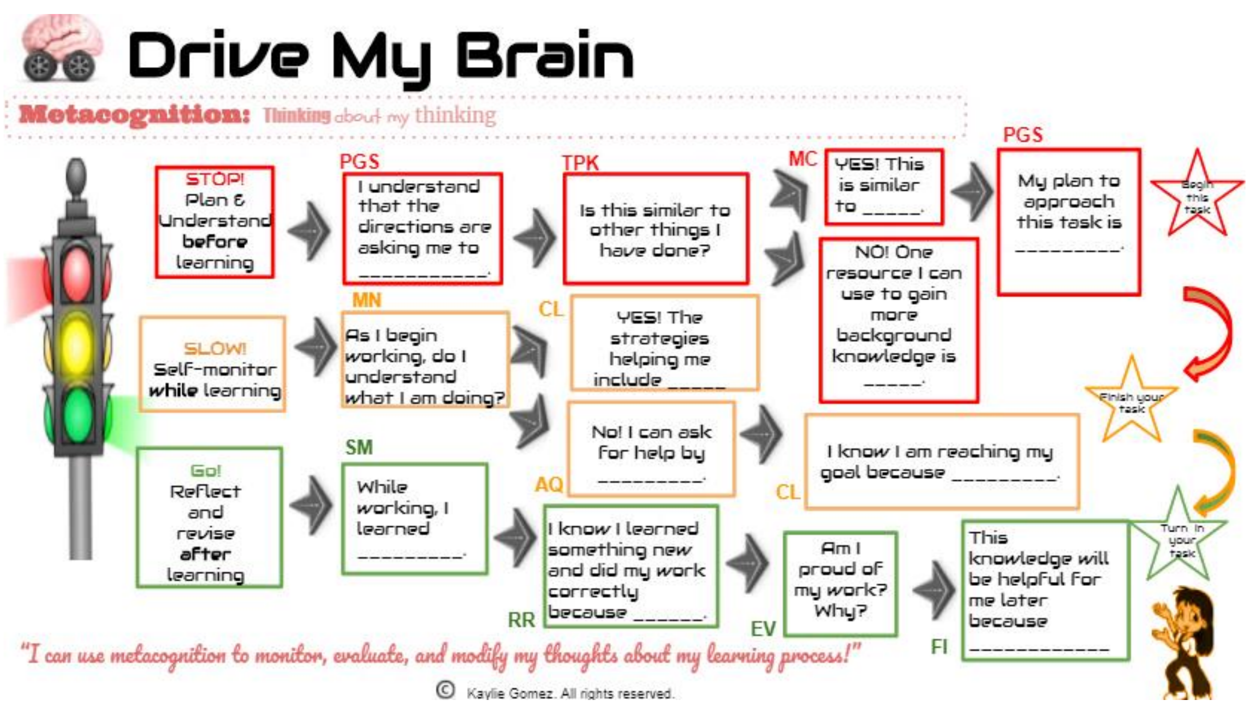


Figure 3.1. Cognitive strategies embedded in The Drive My Brain Model.

Olson's cognitive strategies have previously been used to teach students about metacognition; metacognition was introduced to students in the Pathway Project (Olson & Land, 2007). Once students had become familiar with cognitive strategies, they participated in a think aloud while making a Play-Doh animal. As they spoke, their teacher recorded their thoughts and labeled cognitive strategies they used. Table 3.3 shows some examples of how students' thoughts were labeled.

Table 3.3

Using Cognitive Strategies Metacognitively

Student Thoughts	Teacher Label
"Hmm. I think I'll make an elephant that looks like Dumbo."	Planning and Goal Setting Visualizing
"Whoops! That looks more like a mouse than an elephant."	Evaluating Revising Meaning Visualizing

Note. Adapted from "The reading/writing connection: Strategies for teaching and learning in the secondary classroom", by C. Olsen and R. Land, 2007, *Research in the Teaching of English, 41* (3). Retrieved from https://www.nwp.org/cs/public/download/nwp_file/8538/Booth_Olson,_Carol,_et_al.pdf ?x-r=pcfile_d

As you can see, the student responses did not contain the names of the actual strategies; however, the students demonstrated their abilities to use strategies as they thought. Chapter 5 will discuss how the participants of this study were able to use the cognitive strategies listed in Figure 3.2.

Self-Regulated Learning

Self-regulated learning (SRL) involves the behaviors that are under the control of the student. SRL is sometimes regarded as a component of metacognitive regulation. Others believe self-regulation to be the heart of metacognition (Borkowski, 1992; Baker & Beall, 2009). The DMB Model was created with Zimmerman's Self-Regulated Theory in mind. The DMB Model was taught to students with a gradual release of responsibility. The goal was for students to eventually be able to use the model on their own.

Scaffolding instruction with gradual release has been shown to be successful; it helps move classroom instruction from teacher-centered to student-centered (Levy, 2007). Table 3.4

describes the gradual release of responsibility used for this study (Duke & Pearson, 2002; Levy, 2007).

Table 3.4

Levin's (2007) Gradual Release of Responsibility

Degree of Responsibility	Teacher	Student
I do it	Provides direction instruction Models Think Aloud	Activity listens Takes notes Asks for directions
We do it	Interactive instruction Works with students Checks, prompts, clues	Asks and responds to questions Completes an assignment alongside others
You do it independently alone	Provides feedback Evaluates Determines levels of understanding	Works alone Takes full responsibility for the outcome
You do it independently together	Moves among groups Clarifies confusion Provides support	Collaborates on an authentic task Completes process in a small group

Through the gradual release of responsibility, the teacher starts having the more prominent role during the “I do” phase. However, as students begin to practice, they take on the responsibility of the “we do” phases (Duke & Pearson, 2002). Figure 3.3 displays Fisher and Frey's (2007) graphic on the interaction between the student and the teacher responsibility.

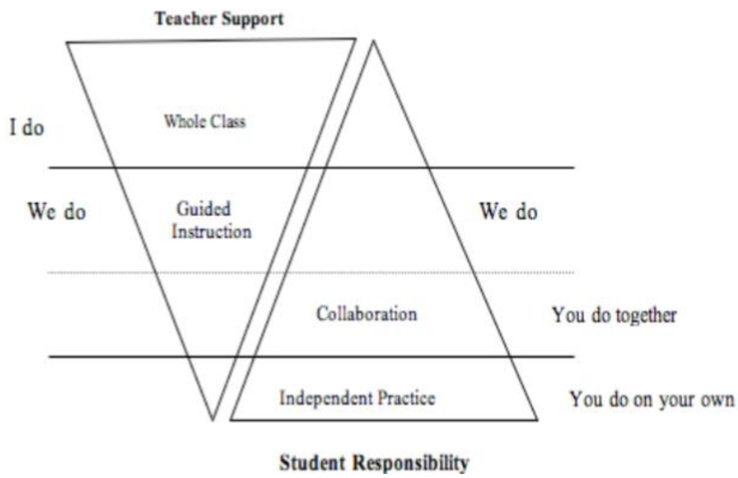


Figure 3.2. The interaction between teacher and student during gradual release. Reprinted from "Pre-service teacher preparation for international settings*",* by J. Levy, 2007, In M. Hayden, J. Levy and J. J. Thompson, *The Sage Handbook of Research in International Education* (pp.213-222), Thousand Oaks, CA: SAGE.

The triangles demonstrate the amount of responsibility the teacher and student have throughout the phases of gradual release. This instructional model provides an instructional plan that includes modeling, support, and practice so that students can eventually become independent learners (Levy, 2007).

Visible Thinking

The DMB Model is a special type of graphic organizer students are trained to use to systematize their thinking. The model has three main phases: (a) plan and understand before learning; (b) slow down and monitor while learning and; (c) stop to reflect and revise after learning. These phases, or building blocks, were intended to provide a visual structure for thinking and to aid students in becoming more metacognitively aware. Making students' thinking visible "requires some sort of organizing structure to guide learners' thought processes" (Tishman & Palmer, 2005, p. 2). The researcher intended for The DMB Model to engage students in thinking routines that would allow them to be deliberate when planning for a learning task, monitoring their progress, and evaluating their growth. Students need more guidance understanding what learning tasks demand and determining the best strategies to complete their tasks successfully (Flavell, 1979; Fisher et al., 2016). The DMB Model aims to assist students in becoming familiar with knowing when and how to self-monitor and self-regulate. Furthermore, The DMB Model promotes active processing because it "encourages students to actively engage with a topic by asking them to think with and beyond the facts they know-asking questions, taking stock of prior knowledge, probing the certainty of their ideas, and visibly connecting new knowledge to old" (Tishman & Palmer, 2005, p. 2).

Visual mapping methods. Visual mapping methods that represent student thinking have been shown to have numerous benefits in helping students achieve higher levels of deep thinking (i.e., metacognition) when they meet two requirements: "(a) the learner's specific existing relevant conceptual and propositional knowledge must be identified, and (b) appropriate organization and sequencings of new knowledge to be learned must be planned in such a way as to optimize the learner's ability to relate the new knowledge to the concepts and propositions already held" (Novak, 1998, p. 80). The DMB Model was designed with these two requirements in mind. The researcher used a combination of visual methods to promote students to connect new learning to previous learning and organize their thought process while completing a task.

The DMB Model is a mixed-mode visualization, combining the advantages of conceptual diagrams and visual metaphors. Table 3.5 discusses the benefits of using these two mapping methods.

Table 3.5

Definitions of and Benefits of Using Conceptual Diagrams and Visual Metaphors

	Conceptual Diagram	Visual Metaphor
Definition	A systematic depiction of an abstract concept in pre-defined category boxes with specified relationships, typically based on a theory or model	A graphic structure using the shape or elements of a familiar natural or man-made artifact of an easily recognizable activity to organize content meaningfully
Benefits	1. Provides a concise overview of a topic or theory 2. Structures learning into systematic building blocks 3. Can be applied to a variety of situations in the same manner	1. Serves as a mnemonic aid 2. Facilitates understanding by triggering functional associations

Note. Reprinted from "A comparison between concept maps, mind maps, conceptual diagrams, and visual metaphors as complementary tools for knowledge construction and sharing", by M. J. Eppler, 2006, *Information Visualization, 5*(3). doi: 202-210. 10.1057/palgrave.ivs.9500131

The DMB Model condensed Flavell's Theory of Metacognition (1979) in a way students can access, understand, and use metacognition at the elementary level. The conceptual diagram (boxes and arrows) makes students' thinking visible and allows them to self-regulate, or become "metacognitively, motivationally, and behaviorally active participants in their own learning process" (Zimmerman, 2013, p. 137). The visual metaphor (traffic light) reminds students when to stop, slow down, or go back and reflect. While using The DMB model, students fill in pre-determined boxes from left to right and top to bottom. Each box provided students with an opportunity for self-questioning. These questions remind students about the metacognitive practices needed to enhance learning (Fisher et al., 2016). More details on how to use The DMB Model are presented in the next section of this chapter.

Using The Drive My Brain Model

For this study, the researcher created Google Slide presentations for the participating teacher of the treatment group. This was intended to make implementing the study easier and more realistic within the busy school day schedule. The participating teacher used these slide presentations to model and to teach how to use The DMB Model. Appendix D has slide presentation examples.

The Traffic Light

The first part of The DMB Model introduced students to the visual metaphor: the traffic light signal with three colored circles in a vertical line. The colors, red, yellow, and green, and meanings for those colors were explained. The traffic light allowed students to put their thoughts into three distinct categories and begin to visualize a systematic thinking process of their mind; it gave them a way to structure unstructured, unconscious thinking (Baldwin, 2002). The traffic light metaphor was meant to be simple, visual, easy to teach, and easy to communicate for English language learners. Figure 3.3 demonstrates the use of the traffic light with the Drive My Brain Model.

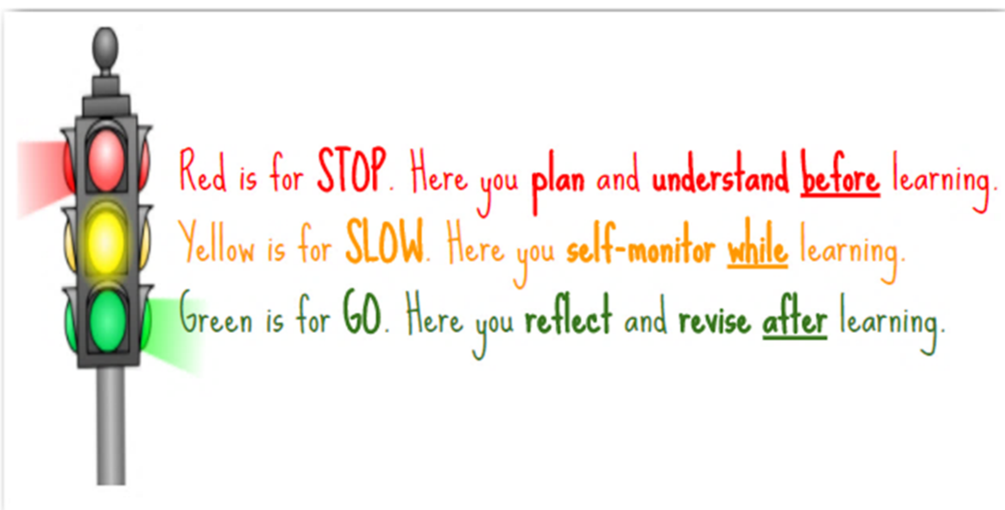


Figure 3.3. The Drive My Brain Model traffic light

It could have been possible that students used the visual metaphor of the traffic light in previous learning situations. For example, the traffic light analogy has been used with writing instruction, behavior plans, and physical education activities. To avoid any confusion, students first understood what the colors of the traffic light represented specifically for The DMB Model.

Conceptual Diagram

Next, students were introduced to the conceptual diagram. The DMB Model, just like the visual metaphor, was broken into three categories, or phases. These phases were color-coded and contained pre-filled in boxes that prompted students to self-question. During the first level, students were asked to restate directions, tap into their existing knowledge, make connections, and set realistic goals. In Level 2, students monitored their cognitive processes by clarifying and asking questions. Lastly, Level 3 allowed students to summarize and reflect on what they learned, evaluate the quality of their work, and form interpretations about how this knowledge will be useful later (Olson & Land, 2007).

The DMB Model is not simply a visual, conceptual diagram, but one that students interact with. Students used one DMB Model that was filled out, shown earlier in this chapter with Figure 3.1, and one DMB Model that was empty. Using the filled out DMB Model to guide them, students wrote on the empty DMB Model to complete the necessary thinking steps involved. The empty DMB Models were printed on A3 paper and laminated. Students used Expo vis-à-vis Wet-Erase markers while filling them out. Figure 3.4 shows the filled out and empty DMB Models.

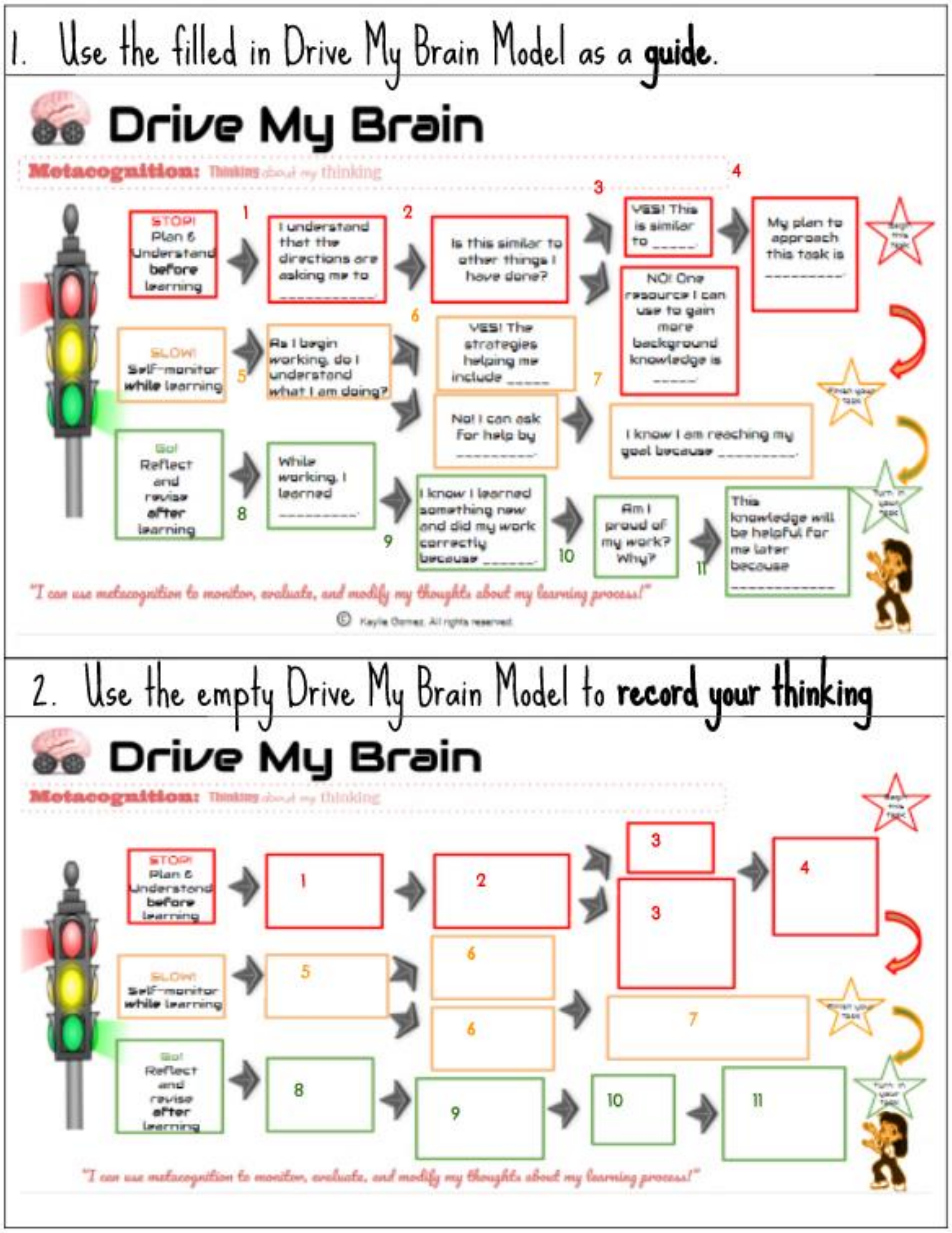


Figure 3.4. Filling out The Drive My Brain Model.

A Preliminary Study Using the Drive My Brain Model

This was the first time The DMB Model was used by teachers and students. Before beginning the study, the participating teacher of the treatment group received two hours of training. The training sessions taught the participating teacher about metacognition, The DMB

Model, how to use The DMB Model, and the design of the study. Additionally, the teacher training included a discussion of the negotiables and non-negotiables of the study. The researcher provided ample resources for the duration of the study; however, not all were required to be used. Table 3.6 shows the negotiables and non-negotiables of the study. Furthermore, examples of these resources may be found in Appendix B through Appendix N.

Table 3.6

Negotiables and Non-Negotiables of The DMB Preliminary Study

Negotiables	Non-Negotiables
• Drive My Brain Model Journals • Google Slide Presentation Videos • Bulletin Board Resources	• IRB Forms • Pre-Tests and Post Test • Student Interviews • Four Content Tasks • Explicit Teaching of The Drive My Brain Model • Intervention Minutes Sign-off Sheet

The treatment group received an average of 30 minutes of DMB Model activities each day for eight weeks, receiving a total of 1,155 minutes of intervention. Before the intervention began, students took a pre-test; after the intervention had concluded, students took a post-test. The DMB Model activities were created by the researcher with Google Slides presentations, as stated earlier. The presentations contained information related to metacognition, The DMB Model, how to use The DMB Model, neuroplasticity, the parts of the brain and their functions, curiosity, and content knowledge for the student tasks. The majority of information contained in Google Slides presentations, aside from how to use The DMB Model, included curriculum the participating teacher already planned to teach. The DMB Model was intended to be a tool that could be used with any curriculum; therefore, the curriculum that was developed for this study (i.e., Google Slide presentations) was not intended for all interventions involving The DMB Model (i.e. future studies). The methodology for this study is discussed in the following chapter.

Furthermore, the pilot that assisted the Designed Based Research (DBR) for this study is discussed in the following section.

Designed-Based Research: A Pilot Study Using The Drive Your Brain Model

Designed-based Research (DBR) aims to narrow the gap between theory and practice. In education, DBR is often used to investigate how, when, and why certain educational innovations or interventions work in educational settings (i.e., classrooms). This study used a DBR methodology to employ a pilot, or trial run, using the original DMB Model, previously named The Drive Your Brain Model. The pilot study allowed the researcher to prepare for the actual study by determining how the outcome of the intervention would look. Additionally, improvements to the design of the model and overall study were explored using a cycle of evaluation (Design-Based Research Collective, 2003; Trujillo, Anderson, & Pelaez, 2016). Figure 3.5 shows the DBR methodology the pilot study applied.

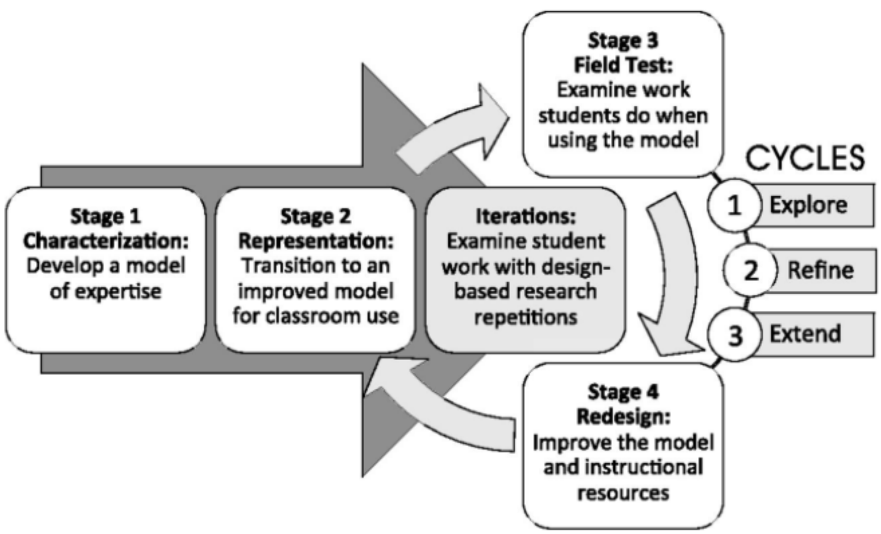


Figure 3.5. Designed-based research methodology. Adapted from "An instructional design process based on expert knowledge for teaching students how mechanisms are explained.", by C. Trujillo, T. Anderson, & N. Pelaez, *Advances in Physiology Education*, *40*(2), p. 266. doi: 10.1152/advan.00077.2015

The pilot study consisted of roughly 25 fifth-grade ELLs who used the model. The original model was termed The Drive Your Brain Model (see Figure 3.6). Students interacted with this model for eight weeks.

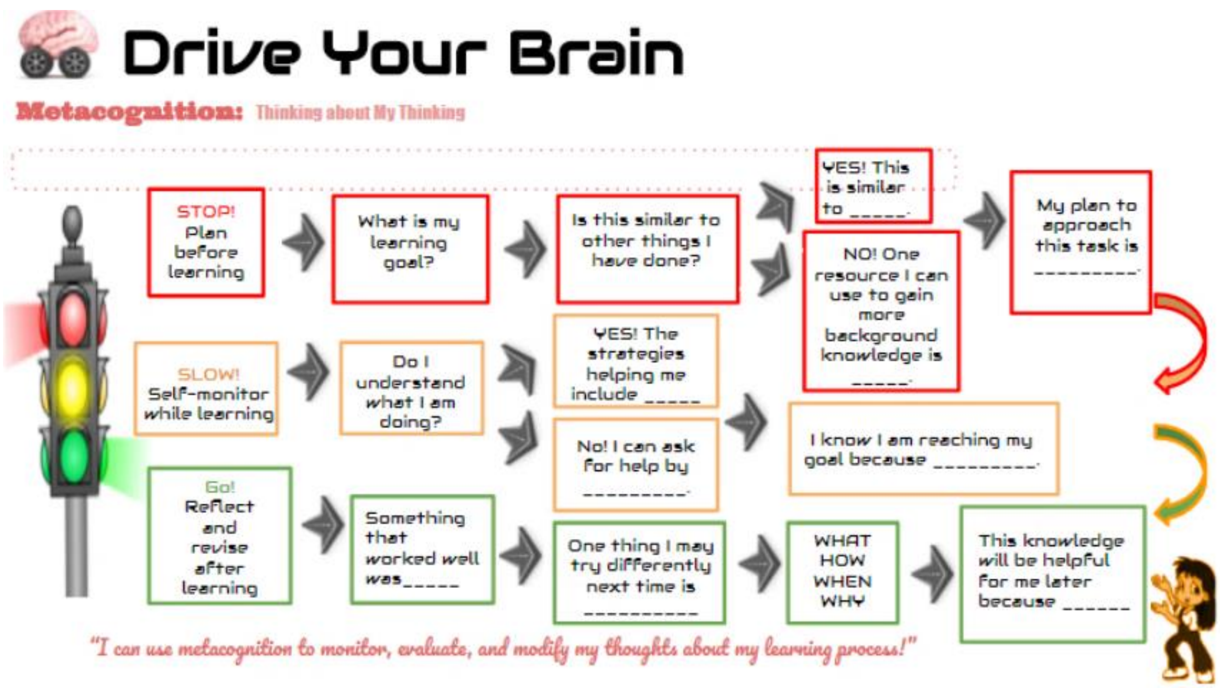


Figure 3.6. The Drive Your Brain Model

Similar to the design of the actual study, large models were printed on A3 paper and laminated for students to fill out using vis-à-vis Wet-Erase markers. The pilot study found this to be an adequate way for the students to utilize the model successfully. Some elements on the model, however, were improved as a result of the pilot's findings. The first phase of the model was enhanced to consist of both planning and understanding. Therefore, the first box in the red row changed from "What is my learning goal?" to "I understand the directions are asking me to ___." This change was supported by the observation of students in the pilot being unaware that their learning goal was specific to the activity they were completing at the time. Changes to the third phase were also made. This was due to feedback given by the students who participated in the pilot. The overall goal of reflecting and revising was maintained, but the wording in the boxes slightly changed. Another improvement included the adding of stars to the ends of the rows to assists students with knowing when to start and finish their work. Lastly, the model's name was changed from "Drive Your Brain," to "Drive My Brain." This was a decision made by the researcher so that students took more ownership over their learning.

Changes to the Google Slides PowerPoint presentations were not made, as the activities presented in those presentations were found to be easy to go through. Furthermore, the lessons connected to the school's curriculum and fifth-grade content standards. In total, the pilot study consisted of 1,155 minutes of intervention using the model. The participating students found the model enjoyable to use and continued using it (i.e., the improved version of the model) after the pilot study had concluded.

CHAPTER 4: METHODOLOGY

The primary goal of this chapter was to determine the effectiveness of The Drive My Brain (DMB) Model on English language learners' metacognition, as stated in Chapter 1. Several instruments were utilized to test the research questions, which included: (a) Does The Drive My Brain Model increase English language learners' metacognitive awareness and regulation?, (b) What is the effect of The Drive My Brain Model on the use of cognitive strategies?, (c) To what degree does The Drive My Brain Model give English language learners language to describe their metacognitive abilities?, and (d) Is The Drive My Brain Model easy for teachers and students to use? This chapter describes the participants, procedure for the selection of the participants, research design, instrumentation, data collection, data analysis, researcher, and ethics.

Student Participants

The student sample of this study consisted of 54 fifth-grade students from a public elementary school located in Orange County, California. For this study, the public school will be referred to as Public School A. Two distinct samples comprised of six students each, for a total of 12 participants, were used for the qualitative portion of this study. Each represented a proportional sample of the fifth-grade students at Public School A. For each of the samples, three students were from the control group, and three were from the treatment group. The number of participants in this study was supported by Lunenburg and Irby (2009) who suggest the use of 1-20 participants for qualitative research.

Public School A

At the time of the study, Public School A consisted of 975 students in grades K-6. The demographics of School A were as follows: 96 percent Hispanic, two percent Caucasian, and one percent Asian, Pacific Islander, Filipino, American Indian/Alaska Native, or African American.

Two or more races were not represented (Great Schools, 2017). The student population of Public School A consisted of 65 percent ELLs, and 95 percent of students came from low-income households. Students at Public School A were reported to have made less academic progress each year in comparison to students at other schools in the state. Test scores indicated 14 percent of students to be proficient in math and 16 percent of students to be proficient in English language arts (ELA). Due to low progress and test scores, Public School A was reported to possibly have large achievement gaps, though 26 percent of the student population was identified as Gifted and Talented (Great Schools, 2017).

Student Participant Demographics

The control group consisted of 27 students, 15 females and 12 males. The English-speaking status of each of these students was as follows: 5 English Only (EO) students, 18 Reclassified Fluent English Proficient (RFEP), and 4 English language learners (ELLs). The average score on the California English Language Development Test (CELDT) for the ELLs was a three. A total of 23 students classified themselves as Hispanic; four students classified themselves as not Hispanic. Lastly, one student had an Individual Education Plan (IEP), and 21 students were identified as gifted.

The treatment group consisted of 27 students, 15 females and 12 males. The English-speaking status of each of these students was as follows: one EO, seven RFEP, and 19 ELLs. The average score on the CELDT for the English learners was a 2.85. A total of 26 students classified themselves as Hispanic; one classified as not Hispanic. Lastly, five students had IEPs. The demographic characteristics of the overall sample are shown in Table 4.1.

Table 4.1

Demographic Characteristics and Criteria for Overall Sample

Variable	*N*	Percentage
Number of Participants	54	100%
Gender		
Male	24	44%
Female	30	56%
Ethnicity		
Latino/Hispanic	49	91%
Non-Latino/Non-Hispanic	5	9%
English Language Level		
English Only (EO)	6	11%
Reclassified Fluent English Proficient	25	46%
(RFEP)	23	43%
Learners (R)		
English Language Learner (ELL)		
California English Language Development Test Level (CELDT) for ELL		
Beginning	0	0%
Early Intermediate	5	22%
Intermediate	17	74%
Early Advanced	1	4%
Advanced	0	0%
Individualized Education Plan	6	11%
Gifted (GATE)	21	38%
Socio-economic Status (SES) based on Free and Reduced Lunch	50	93%

Teacher Participants

The teacher sample of this study consisted of two fifth-grade general education classroom teachers. At the time of the study, the teacher of the control group had been teaching for 21 years, and the teacher of the treatment group had been teaching 13 years. The teacher of the control group had obtained her Gifted and Talented Education (GATE) Certification. Both teachers identified as Caucasian and both reported being in the 40-45 age group.

Procedure for Selection of Participants

The target population for this study was fifth-grade ELLs within the United States. For the quantitative portion of this study, opportunity sampling was used to select a subset group of the target population; the participants of this study were easily accessible to the researcher. Participant recruitment occurred after the researcher obtained access to the school site and acquired approval from the university's Institutional Review Board (IRB). The recruitment process involved the researcher giving a formal letter to students and their parents. The letter contained information about the study, researcher contact information, and participants' rights (Creswell, 2013). Of the 59 students invited, 54 could participate. Both student assent and parent consent were obtained before the study began.

For the qualitative portion, purposeful sampling was used to select two distinct samples that met a set of specific criterion ($N = 12$). Patton (2002) provides specific reasons to explain why purposeful sampling was utilized in the following quote

> The logic and power of purposeful sampling lie in selecting information-rich cases for study in depth. Information-rich cases are those from which one can learn a great deal about issues of central importance to the purpose of the inquiry, thus the term purposeful sampling. Studying information-rich cases yields insights and in-depth understanding rather than empirical generalizations. (p. 230)

The recruitment process for the first sample involved the participating teachers selecting three students from their class (i.e., one above grade level, one at grade level, one below grade level). The recruitment process for the second sample involved the researcher selecting students based on the criteria that the students had completed all areas of the study (Lochmiller & Lester, 2017).

Research Design

This study used a mixed methods convergent parallel design, which helped with data triangulation. Conducting both quantitative and qualitative research methods provides "a better understanding of the research problem and questions than either method by itself" (Creswell, 2008, p. 225). Mixed method studies also allow for more assurance in a study's findings and outcomes (Dixon-Woods et al., 2004).

The researcher utilized both quantitative and qualitative research methods to address each of the four research questions listed above. The five measures used for quantitative research included: (a) Jr. Metacognitive Awareness Inventory, (b) Cognitive Strategies Use Survey, (c) observation checklist, (d) student task rubrics, and (e) a Likert student questionnaire. The three qualitative research instruments included: (a) student tasks artifacts, (b) student interviews, and (c) teacher interviews. Information on how each instrument was used to answer the research questions is detailed later in this chapter; some instruments addressed more than one research question. Equal weight was given to both quantitative and qualitative data, and the researcher collected both types of data simultaneously, making use of a convergent parallel design (see Figure 4.1). Furthermore, quantitative and qualitative data were used to conclude whether they each provided similar or different results (Creswell, 2008; Lester & Lochmiller, 2017).

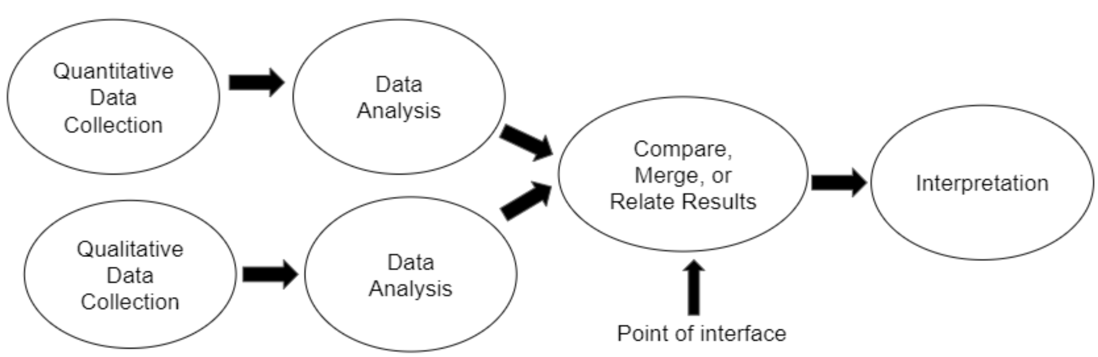


Figure 4.1. Mixed methods convergent parallel research design.

Quantitative

This study used a quasi-experimental design. Quasi-experimental research designs test causal hypotheses by identifying “a control group that is as similar as possible to the experimental group in terms of baseline (pre-intervention) characteristics” (Shadish, Cook, & Campbell, 2002, p. 1). Two groups were used: a treatment group that received the intervention and a control group that did not receive the intervention. The control group allowed the researcher to examine what an outcome without intervention might look like (Shadish et al., 2002). Each of the four research questions was addressed using at least one quantitative measure. Table 4.2 shows the quantitative measures used to address the research questions for this study.

Table 4.2

Quantitative Research Measures

Research Question	Instrument
1: Does the Drive My Brain Model increase English language learners’ metacognitive awareness and regulation?	Jr. MAI
2: What is the effect of the Drive My Brain Model on the use of cognitive strategies?	Cognitive Strategies Use Survey
3: To what degree does the Drive My Brain Model give English language learners language to describe their metacognitive abilities?	Observation Checklist
4: Is the Drive My Brain Model easy for teachers and students to use?	Likert Survey Questionnaire Student Task Rubrics

Both the Jr. MAI and the Cognitive Strategies Use Survey were given to the control and experimental groups as pre/post-tests. Chi-square tests of independence were conducted to determine if any statistically significant differences existed between the participating groups; an alpha level of $p < .05$ was used to determine statistical significance. The Chi-square test of independence determined the frequency of occurrences within the student responses from pre-test to post-test scores (Sprinthall, 1997). Classroom observations were conducted four times using an observation checklist. The researcher observed both groups for an equal amount of time on the same dates. During the observations, students were engaged in the same learning tasks. Bar graphs were created to show frequencies of the checklist's variables and student growth over time to determine any differences between groups. Four tasks were given to both groups involving the four main content areas (English Language Arts, Math, Science, and Social Studies). The tasks were scored using a 12-point rubric. Lastly, a brief Likert survey questionnaire was included in the four student tasks for the experimental group upon completion of each task with the purpose of exploring the functional ease of The DMB Model. Correspondingly, the Likert survey questionnaire was not included in the student tasks for the control group because they did not receive The DMB Model intervention. A Spearman's rank-order correlation was utilized to determine the strength and direction between student task rubric scores and the ease of use of The DMB Model. The Jr. MAI, Cognitive Strategies Use Survey, observation checklist, task rubrics, and Likert survey questionnaire, as well as the data analysis involving these instruments, will be discussed in more detail later in this chapter.

Qualitative

The qualitative methodology for this study focused on a phenomenological research design. The purpose was "to produce clear, precise, and systematic descriptions of the meaning that constitutes the activity of consciousness" (Polkinghorne, 1989, p. 45). This study focused on the essence of experience by examining the overall experience of the involved participants (Lester & Lochmiller, 2017). The phenomenon that was examined was how fifth-grade English language learners' (ELLs) planned, monitored, and reflected during content tasks and how the experimental group experienced the implementation of The DMB Model.

Each of the four research questions was analyzed using at least one qualitative measure. All qualitative measures were used to support quantitative findings. Table 4.3 shows the qualitative measures used to address the research questions for this study.

Table 4.3

Qualitative Research Measures

Research Question	Instrument
1: Does the Drive My Brain Model increase English language learners' metacognitive awareness and regulation?	Student Task Artifacts
2: What is the effect of the Drive My Brain Model on the use of cognitive strategies?	Student Task Artifacts
3: To what degree does the Drive My Brain Model give English language learners language to describe their metacognitive processes?	Student Task Artifacts
4: Is the Drive My Brain Model easy for teachers and students to use?	Student Interviews Teacher Interviews

As stated earlier, four tasks were given throughout eight weeks. These student tasks were given to both the control and experimental group. The experimental group used the DMB Model while completing the tasks; whereas, the control group did not. Student tasks were analyzed using Colaizzi's (1978) method of descriptive phenomenological data analysis. The analysis included coding the data for significant phrases and determining meaning among the phrases to develop themes. Student and teacher interviews were conducted three times throughout the eight-week intervention: (a) once before the start of the study, (b) once in the middle of the study, (c) once after the study had concluded. All interviews were recorded and transcribed. Similarly, interviews were analyzed using Colaizzi's method of analysis. The observation notes, student task artifacts, student interviews, and teacher interviews, as well as the data analysis for these measures, will be discussed in more detail later in this chapter.

Figure 4.2 illustrates the research design employed for this study. The study lasted a total of eight weeks. Before the study began, both groups participated in pre-tests which included the Jr. MAI and the Cognitive Strategies Use Surveys. Additionally, a total of six students (i.e., three from the control group and three from the treatment group) were interviewed before the study began. Both groups participated in four tasks that the researcher observed (Weeks 3, 5, 6, and 7). Students and teachers were interviewed in the middle of the study (Week 4) and again upon the completion of the study (Week 8). The treatment group received an intervention, which included a total of 1,155 minutes of instruction (19.25 hours) using The DMB model, as described in Chapter 3.

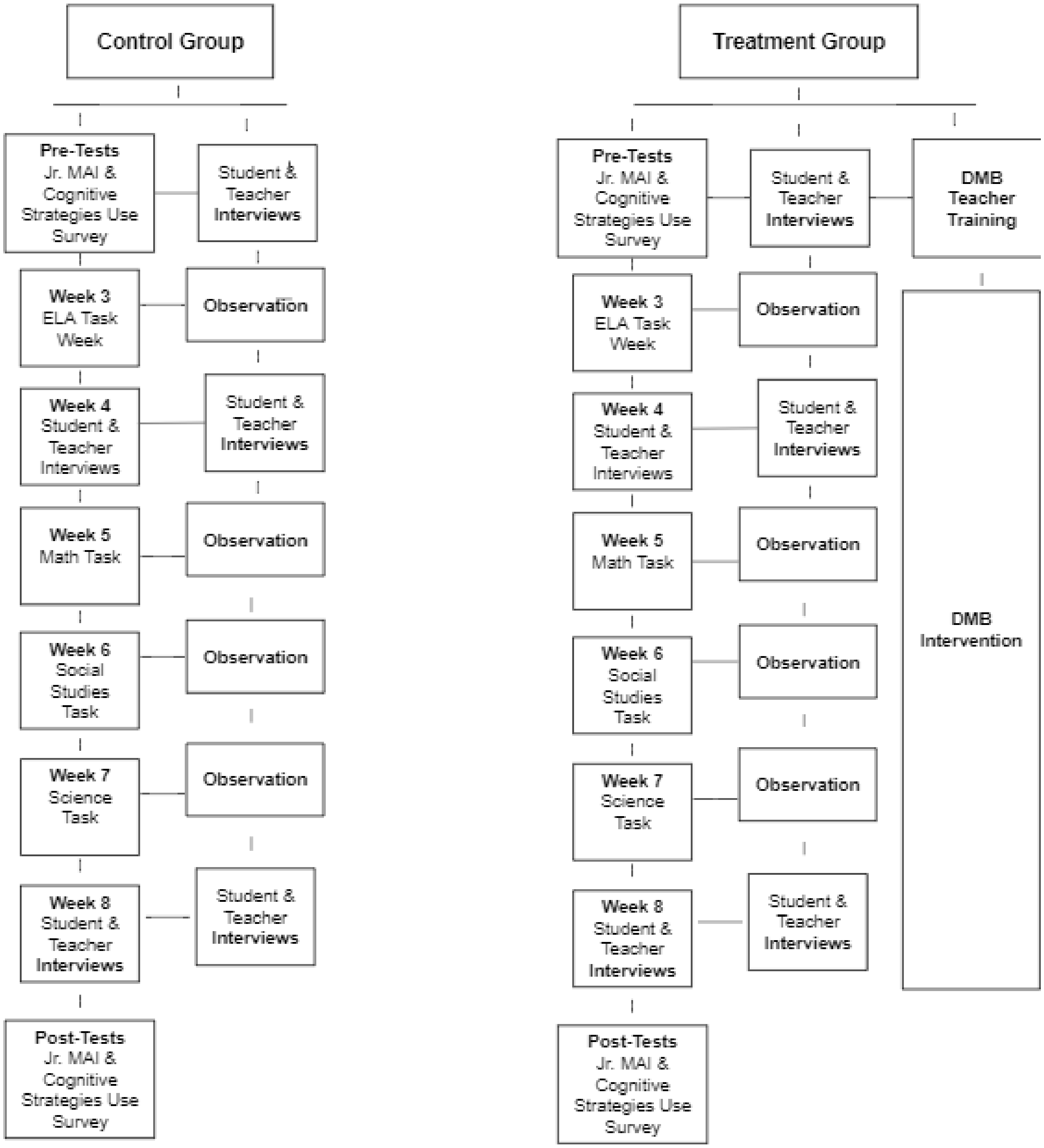


Figure 4.2. Research design.

Instrumentation

As previously mentioned, the instruments used in this mixed-methods research study consisted of (a) the Jr. MAI, (b) the Cognitive Strategies Use Survey, (c) observation checklist; (d) student Likert survey questionnaire, (e) student task rubrics, (f) student task artifacts, (g) teacher interviews, and (h) student interviews. The various ways of collecting data were used to supplement one another (i.e. qualitative data supplemented quantitative data). The instruments for this study will be further examined in this section. Table 4.4 provides a brief description of the quantitative and qualitative measures for this study, as well as the variables they aimed to address/test.

Table 4.4

Quantitative and Qualitative Instrument Descriptions

Instrument	Description	Variable(s)	Type
Jr. MAI	18 statements related to metacognitive awareness and metacognitive regulation on a 5-point Likert scale.	MA & MR	Quantitative
Cognitive Strategies Survey	46 statements related to what students do when they read and what students do when they write about what they read on a 4-point Likert scale.	CS	Quantitative
Observation Checklist	A checklist designed by the researcher to show evidence of verbal and written metacognitive student language.	L	Quantitative
Likert Survey Questionnaire	5-point Likert scale based on how easy using the DMB Model with each task was.	EU	Quantitative
Student Task Rubrics	A 12-point rubric used to grade the content tasks on completion, metacognitive awareness and regulation, and cognitive strategies.	EU	Quantitative
Student Tasks	Content Tasks in the four main content areas, English language arts, math, social studies, and science.	MA, MR, CS, L	Qualitative
Teacher Interviews	Semi-structured interviews completed before, in the middle, and at the end of the intervention.	EU	Qualitative
Student Interviews	Semi-structured interviews that were completed before, in the middle, and at the end of the intervention.	EU	Qualitative

Note. MA = metacognitive awareness; MR = metacognitive regulation; CS = cognitive strategies; L = language; EU = ease of use.

Quantitative Instruments

The quantitative methodology for this study was focused on a quasi-experimental design. According to Lochmiller and Lester (2017), "Experimental designs seek to identify a cause and effect between an independent and dependent variable" (p. 121). The independent variable for this study was The DMB Model. The researcher sought to conclude that The DMB Model was the cause of increased performances on the Jr. MAI, Cognitive Strategies Use Survey, student tasks, and metacognitive language.

Junior Metacognitive Awareness Inventory. The original Metacognitive Awareness Inventory (MAI) was created by Schraw and Dennison (1994). Sperling et al. (2002) created the Jr. MAI as a measure of children's metacognition in Grades 3 through 9. The Jr. MAI is a survey that has been tested for reliability and was found to be a valid measure of metacognition for children. The survey was designed to be used as an assessment tool in determining the effectiveness of metacognitive or cognitive strategy interventions involving elementary school students (Sperling et al., 2002). The researcher consulted with Sperling to obtain ample information about both the MAI and Jr. MAI, as well as to obtain permission to use the Jr. MAI as part of this study. Two versions of the Jr. MAI were discussed. The first version was created for students in grades three through five. The second version, which included an additional six statements from Version 1, involved the assessment of students in grades six through nine. This study utilized Version 2 (see Figure 4.3), as recommended by its creator (R. Sperling, personal communication, May 7, 2017).

We are interested in what learners do when they study. Please read the following sentences and circle the answer that relates to you and the way you are when you are doing school work or home work. Please answer as honestly as possible.

1 = Never 2 = Seldom 3 = Sometimes 4 = Often 5 = Always

1. I know when I understand something.	1	2	3	4	5
2. I can make myself learn when I need to.	1	2	3	4	5
3. I try to use ways of studying that have worked for me before.	1	2	3	4	5
4. I know what the teacher expects me to learn.	1	2	3	4	5
5. I learn best when I already know something about the topic.	1	2	3	4	5
6. I draw pictures or diagrams to help me understand while learning.	1	2	3	4	5
7. When I am done with my schoolwork, I ask myself if I learned what I wanted to learn.	1	2	3	4	5
8. I think of several ways to solve a problem and then choose the best one.	1	2	3	4	5
9. I think about what I need to learn before I start working.	1	2	3	4	5
10. I ask myself how well I am doing while I am learning something new.	1	2	3	4	5
11. I really pay attention to important information.	1	2	3	4	5
12. I learn more when I am interested in the topic.	1	2	3	4	5
13. I use my learning strengths to make up for my weaknesses.	1	2	3	4	5
14. I use different learning strategies depending on the task.	1	2	3	4	5
15. I occasionally check to make sure I'll get my work done on time.	1	2	3	4	5
16. I sometimes use learning strategies without thinking.	1	2	3	4	5
17. I ask myself if there was an easier way to do things after I finish a task.	1	2	3	4	5
18. I decide what I need to get done before I start a task.	1	2	3	4	5

Figure 4.3. The Jr. Metacognitive Awareness Inventory

Version 2 of the Jr. MAI consisted of two constructs: (a) metacognitive awareness (MA), also referred to as knowledge of cognition; and (b) metacognitive regulation (MR), also referred to as regulation of cognition (Brown, 1978). Of the 18 statements on the survey, nine related to metacognitive awareness and nine related to metacognitive regulation. The metacognitive awareness construct included declarative, procedural, and conditional knowledge of cognition (i.e., statements 1, 2, 3, 4, 5, 12, 13, 14, and 16). The metacognitive regulation construct included statements related to planning, monitoring, and evaluation of cognition (i.e., statements 6, 7, 8, 9, 10, 11, 15, 17, and 18). Students responded to the survey's statements using a 5-point Likert scale (i.e. 1 = *never*, 2 = *seldom*, 3 = *sometimes*, 4 = *often*, and 5 = *always*). Therefore, this survey produced ordinal data or data that was categorized in a ranking order format. For example, the Jr. MAI ranked student responses from smallest (i.e. *never*) to largest (i.e. *always*).

The Jr. MAI was given to both the treatment and control group as a pre-test before the intervention began and a post-test after the intervention had concluded. It was used to address the first research question, which stated: Does The Drive My Brain Model increase English language learners' metacognitive awareness and regulation? A Chi-square test of independence was used to determine if there were statistically significant differences in student responses in relation to the 5-point Likert scale (Sprinthall, 1997). For example, the test determined if students who answered "never" in the pre-test also answered "never" in the post-test. The hypotheses for these tests included:

1. H_0: MA answers pre-test = MA answers post-test
2. H_A: MA answers pre-test ≠ MA answers post-test
3. H_0: MR answers pre-test = MR answers post-test
4. H_A: MR answers pre-test ≠ MR answers post-test

The researcher aimed to reject the null hypothesis and conclude that the treatment group's answers to the pre-test did not match their answers on the post-test, hence assuming the difference was a result of The DMB Model.

Cognitive Strategies Use Survey. The Cognitive Strategies Use Survey (see Appendix C) was developed and validated by Olson (2007). It was created to test the use of her 15 cognitive strategies, aforementioned in Chapter 1 (see Figure 1.6). The researcher spoke to Olson and obtained permission to use the survey for this study (C. Olson, personal communication, February 21, 2017).

The survey consisted of two constructs: (a) what I do when I read; and (b) writing about what I've read. These two constructs will be referred to as R (read) and W (writing). The first construct included 25 statements; whereas, the second construct consisted of 21 statements.

Students responded to the survey's statements using a 4-point Likert scale (1 = *I never or almost never do this*, 2 = *I do this only occasionally or once in a while*, 3 = *I usually do this*, and 4 = *I always or almost always do this*). Similarly, this survey produced ordinal data ranking student responses from smallest (*I never or almost never do this*) to largest (*I always or almost always do this*).

As with the Jr. MAI, the Cognitive Strategies Use Survey was given to both the treatment and control group as a pre-test before the intervention began and a post-test after the intervention had concluded. It was used to address the second research question, which stated, "What is the effect of the Drive My Brain Model on the use of cognitive strategies?" A Chi-square test of independence was used to determine if there were statistically significant differences of student responses in relation to the 4-point Likert scale. For example, the test determined if students who answered "I never or almost never do this" in the pre-test had the same response to the post-test. The hypotheses for these tests included:

1. H_0: Cognitive Strategies Use Survey R pre-test results = Cognitive Strategies Use Survey R post-test results
2. H_A: Cognitive Strategies Use Survey R pre-test results ≠ Cognitive Strategies Use Survey R post-test results
3. H_0: Cognitive Strategies Use Survey W pre-test results = Cognitive Strategies Use Survey W post-test results
4. H_A: Cognitive Strategies Use Survey W pre-test results ≠ Cognitive Strategies Use Survey W post-test results

The researcher aimed to reject the null hypothesis and conclude that the treatment group's answers to the pre-test did not match their answers on the post-test, hence assuming the DMB Model gave English language learners a stronger ability to use cognitive strategies.

Observation checklist. An observation checklist (see Appendix G) was created by the researcher to note the verbal and written language of the participants. The researcher observed each classroom (control and treatment) a total of four times. The observations occurred during the students' engagement in the four student tasks and lasted roughly 20 minutes, for a total of 80 observational minutes with each group.

The observation checklist consisted of four components: (a) metacognitive awareness verbal language, (b) metacognitive regulation verbal languages, (c) metacognitive awareness written language, and (d) metacognitive regulation written language. The observations gave the researcher a deeper insight into students' language because there was an opportunity to hear the language being used during discussion and participation. The researcher used tally marks to record each time the metacognitive language was heard (i.e. verbal) or seen (i.e. written). The criteria for determining whether students produced metacognitive language was based on if students wrote or stated: (a) statements related to declarative, procedural, or conditional knowledge; or (b) statements related to planning, monitoring, or evaluating knowledge.

The observation checklist was used to answer the third research question, which stated: To what degree does The Drive My Brain Model give students the language to describe their metacognitive abilities? The hypotheses tested included:

1. H_0: Metacognitive Language Control Group = Metacognitive Language Treatment Group

2. H_A: Metacognitive Language Control Group ≠ Metacognitive Language Treatment Group

The researcher aimed to reject the null hypothesis and concluded that the treatment group's higher levels of metacognitive language were a result of using The DMB Model. Observation checklist tallies were represented with bar graphs created in Excel to determine differences in metacognitive language between groups.

Likert survey questionnaire. The Likert survey questionnaire was developed by the researcher as a means to assess the ease of use of The DMB Model. The survey questionnaire consisted of one question: How easy was it to use The DMB Model when you completed this task? The survey questionnaire was given to the treatment group four times, once after the completion of each task. Students responded to the survey based on a 5-point Likert scale (1 = *not easy at all*; 2 = *not too easy*; 3 = *kind of easy*; 4 = *easy*; and 5 = *very easy*). Students' responses were totaled for each task and percentages for each category were calculated. Additionally, student task rubrics were used to determine if there was a correlation between the ease of use and the task scores. This process is further discussed in the next section, student task rubrics.

Student task rubrics. The student task rubrics (see Appendix F) were created by the researcher as a means of assessing the four tasks that the participants completed throughout the study. Four rubrics were developed for each of the four tasks (Task 1 = English language arts, Task 2 = math, Task 3 = social studies, Task 4 = science). The four tasks are described in detail in the qualitative instruments section later in this chapter.

The rubric evaluated students' performance expectations for each task. The rubrics were divided into three components: (a) content standard, (b) metacognitive awareness and regulation, and (c) cognitive strategies. The content standard component measured if the student correctly completed the assignment. Each of the four tasks involved activities from the participants' usual curriculum, thus including fifth-grade content standards. The metacognitive awareness and regulation component involved the questions students asked themselves while completing the task. Lastly, the cognitive strategies component involved students listing strategies that help them complete the task.

Each of the three rubric components was divided into four grading categories (1= *poor*, 2= *below average*, 3= *average*, and 4= *above average*). Detailed descriptions of the criteria associated with each of the four grading categories were listed on the rubrics. For example, for a student to receive a graded score of above average for the cognitive strategies component, they would have had to list a minimum of three strategies they used. Students were able to earn a total of 12 points on each task.

The researcher graded the student tasks for both groups of students, resulting in a total of 108 rubric scores for each class. The rubrics were used to address research question 4, which stated: Is The Drive My Brain Model easy for teachers and students to use? Student rubric scores for each task were compared between groups. Bar graphs representing students' rubric scores were created in Excel to determine if there were any differences among the groups. Additionally, the treatment groups' scores were compared to their responses on the student Likert questionnaire to determine if there was a correlation between ease of use and their rubric scores on each of the four tasks. A Spearman rank-order correlation was run to test the following hypotheses:

1. H_0: Higher scores on Ease of Use scale ≠ higher scores on the tasks
2. H_A: Higher scores on Ease of Use scale = higher score on the tasks.

The researcher aimed to reject the null hypothesis and conclude that the DMB Model helped students obtain higher scores on their content tasks.

Qualitative Instruments

The qualitative methodology for this study was focused on a phenomenological design. The purpose was to describe English language learners' experience with the phenomena of the DMB Model. The qualitative instruments (i.e. semi-structured interviews and student task artifacts) were used to study the overall experience the participants had with the DMB Model.

Semi-structured interviews. Semi-structured interviews (see Appendices K through L) were conducted a total of three times throughout the duration of the study (once before, in the middle, at the end). Two teachers and six students were interviewed; both the treatment and control groups were represented. The semi-structured interviews allowed the researcher to ask open-ended questions and probe for more information when needed (Lochmiller & Lester, 2017). Furthermore, they allowed the researcher "the flexibility to conduct the interview in a more conversational manner, and for unexpected understandings to emerge" (Lochmiller & Lester, 2017, p. 151). The interviews helped answer research question 4, which stated, "Is The Drive My Brain Model easy for teachers and students to use?"

All of the interviews were conducted by the researcher and took approximately 30 minutes to complete. The participants were provided with a printed copy of the interview questions; all interviews were completed in English. The participants' responses were recorded with an Olympus WS-853 digital voice recorder. All interviews were transcribed verbatim within two weeks of the interview date and kept in a locked portable file tote (Creswell, 2013). The transcripts were coded after the study had concluded using Colaizzi's (1978) process for phenomenological data analysis (see Figure 4.4). This process included becoming familiar with the data, extracting significant themes related to the phenomena (i.e. the interaction with DMB Model), sorting the themes into clusters, and defining and describing the emergent themes

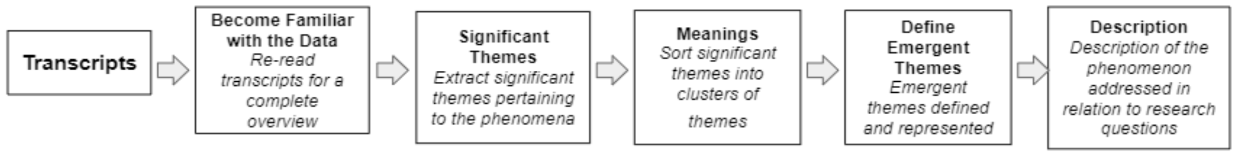


Figure 4.4. Colaizzi's (1978) process for phenomenological data analysis.

Student task artifacts. Student work samples were collected from both groups throughout the study. Samples included the student response sheets from the four content tasks (see Appendix E), and the filled-out DMB Model of the treatment group. In addition to questions related to the content standards, the student tasks addressed two main questions: (a) what strategies did you use while completing this task, and (b) what questions did you ask yourself while completing this task? Student responses to these two questions helped answer research questions one, two, and three.

All completed student samples were collected; however, a total of six tasks were extracted based on a criterion that the students completed all necessary parts of the study (i.e. pre-tests, post-tests, tasks). Participants were instructed to refrain from providing any identifiable information on the tasks; each participant was provided with a student identification number from their teacher to ensure confidentiality. The researcher kept a log of the items collected, which included: (a) the item's name, (b) the date, and (c) the student identification number. All hard copies of the documents were stored in a locked file tote; DMB models were scanned and converted to PDF files within 48 hours of being collected. Electronic copies of student task artifacts were stored on a password-protected laptop (Lochmiller & Lester, 2017). Data was analyzed upon completion of the study, using Colaizzi's (1978) process for phenomenological data analysis.

Data Collection

This study utilized several protocols for the collection of quantitative and qualitative data. The steps involved included obtaining permission from the university and school site, receiving participant consent and assent, and the collection and safeguarding of the study's instruments.

Before data collection began, the researcher obtained permission from the university's Institutional Review Board (IRB). This process involved the researcher successfully completing a three-hour training and earning a National Institute of Health (NIH) Certificate. The training assured that the researcher understood the obligation to protect participants' rights and welfare (National Institute of Health, n. d.). Additionally, the researcher obtained permission from the principal of Public School A to conduct the study. The principal and participants were informed of their rights upon their invitation to participate in the study (Lochmiller & Lester, 2017).

A formal letter was sent to student and teacher participants informing them of the purpose of the study and inviting them to participate. The invited participants were made aware of their rights, including their choice to not participate or stop participating in the study at any time. Both parent consent and child assent forms were collected from the participants who agreed to participate. Identification numbers were given to the student participants to ensure confidentiality and avoid teacher bias; no names or personally identifiable information was collected. Student participants were given a letter and number (i.e. 1A, 2B) for the purpose that the researcher knew what group they belonged in (control or treatment). Consent and assent forms were reviewed for completion by the researcher before the study began. Lastly, all paperwork was stored in a locked file tote for seven years (Creswell, 2013).

Surveys

The surveys collected throughout this study included the Jr. MAI, the Cognitive Strategies Use Survey, and the student Likert survey questionnaire. All surveys were administered by the participating teachers, not the researcher. Before the surveys began, the participating students were reminded of their rights, including their choice not to participate in any aspect of the study. The participating teachers read the surveys aloud to the students to avoid any misunderstanding. Participating students completed the surveys using a paper and pencil method. The surveys were collected by the researcher and stored in a locked portable tote. The student responses to the surveys were entered into an Excel spreadsheet. Later, these datasets were uploaded into R Software for analysis. All digital files were kept on a password protected computer (Creswell, 2013).

Observation Checklist

The observational checklists (i.e. one version used with multiple observations) were completed by the researcher four times throughout the study. The researcher used a paper and pencil method to fill out the checklists. Once completed, the hard copies were stored in a locked portable tote. Tallies from the checklists were input into an Excel spreadsheet. Additionally, the documents were scanned within 24 hours and saved as PDF files. All digital copies were stored on a password-protected computer, and original copies were secured (Creswell, 2013).

Student Task Artifacts

All student task artifacts were collected by the researcher. Identification numbers were used to maintain the confidentiality of the students. The artifacts included: (a) student responses to the content task sheet, and (b) the filled out DMB Model for the treatment group. The student task sheets were stored in a portable locked tote. A total of 24 responses sheets (six from each class) were scanned for analysis and saved as PDF filed on a password-protected computer. Due to size, all collected DMB Models were stored in a locked file cabinet in the researcher's classroom. They were scanned within one week, and student responses were erased for reuse (Creswell, 2013).

Semi-Structured Interviews

Semi-structured interviews were conducted by the researcher. Correspondingly to other data collection protocols, identification numbers were utilized to uphold student confidentiality. An Olympus WS-853 digital voice recorder was used to gather participants' responses to the interview questions. All digital voice recordings were uploaded to a password-protected computer, and the digital voice recorder was stored in a locked portable tote. The voice recordings were transcribed by the researcher after the study had concluded. For accuracy and credibility, the researcher performed member checks for the teacher interviews (Lochmiller & Lester, 2017).

The researcher utilized and maintained various protocols involving high standards of quality to ensure the data collection of the study was valid and reliable. All forms of collected data were analyzed after the completion of the study. The multiple sources of data collection allowed for triangulation (Lochmiller & Lester, 2017; Creswell, 2013). Figure 4.5 illustrates the triangulation of data collection.

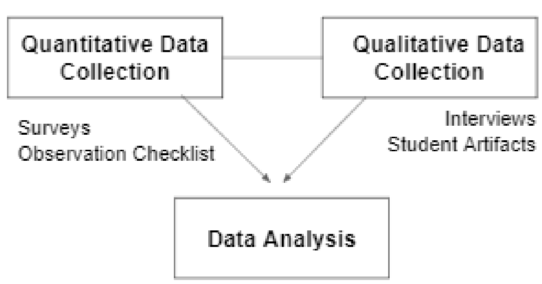


Figure 4.5. Triangulation of data collection.

Data Analysis

Quantitative

Quantitative data analysis was completed through a variety of phases to gain a deep understanding of each dataset (Lochmiller & Lester, 2017, p. 190). The following steps were implemented: (a) prepare the datasets, (b) become familiar with the datasets, (c) test the datasets for normality, and (d) evaluate the datasets (Lochmiller & Lester, 2017). Preparing the dataset consisted of structuring the dataset and selecting the assigned variables. Additionally, the researcher ensured that all variables were entered correctly and missing variables were accounted for and handled appropriately. Once the dataset was reviewed, it was uploaded into Microsoft Excel and R Software. Lastly, the researcher became familiar with the dataset before conducting any statistical tests (Creswell, 2013).

Differential Statistics were not used due to the nature of the data being ordinal (Sprinthall, 1997). Inferential Statistics were used to test the hypotheses of the study. An alpha level of $p < .05$ was used for all statistical tests determine significance. The main tests used to examine the data were a Chi-square test of independence, a residual plot Analysis, a contingency plot analysis, and a Spearman rank-order correlation. These tests were used in combination to draw meaningful conclusions and complement each other. The quantitative results of this study are discussed in the next chapter.

Qualitative

For the qualitative portion of this study, the employed Colaizzi’s (1978) process for phenomenological data analysis (see Figure 4.4). First, texts (i.e. transcribed interviews and student task responses) were read several times to gain an overall idea of the document. During this step, the researcher made marginal notes, or codes, to record initial thoughts and feelings.

Next, the researcher re-read through the text to extract significant themes related to the phenomena (i.e. using the DMB Model). These themes were clustered together based on similar characteristics. These clusters were then labeled, or defined, and determined as emergent themes. Lastly, a description of the findings was created in relation to the research questions. These findings are further discussed in the next chapter.

Researcher

This study had one researcher. The researcher of this study collected, and analyzed both the quantitative and qualitative data. Additionally, the researcher reported the findings. Due to the many interactions with the participants, the researcher served as a fundamental part of this study (Lochmiller & Lester, 2017). Trusted relationships among participants were obtained and potential biases were addressed. For example, as The DMB Model's creator, the researcher's predispositions were considered as limitations.

Due to the researcher's active role in the study, Shipman's (1988) questions about quality research were referred to. The questions are as follows: (a) If the investigation had been carried out again by different researchers using the same methods, would the same results have been obtained?; (b) Does the evidence reflect the reality under investigation?; (c) What relevance do the results have beyond the situation investigated?; and (d) Is there sufficient detail on the way evidence was produced for the credibility of the research to be assessed? The researcher held high ethical expectations for the total duration of the study.

Ethics

The researcher considered American Educational Research Association's ethical guiding research principles (2011) to ensure professional competence and integrity. Societal and scholarly responsibilities of designing a valid and reliable study were well-thought-out. External audits were employed by having outsiders review the study and provide their perspectives (Creswell, 2013). Additionally, the researcher used triangulation to verify and authenticate the results of the study (Lochmiller & Lester, 2017).

Conclusion

This chapter explored what the study aimed to investigate (i.e. testing of the research questions) the participants of the study, instrumentations, and how data was collected and analyzed. Additionally, researcher's ethical considerations were addressed. The following chapter presents the results, grounded in the methodology discussed in this chapter.

CHAPTER 5: FINDINGS

The purpose of this study was to determine the effectiveness of The Drive My Brain (DMB) Model on English language learners' metacognition. This chapter presents the results of the study organized by research question. For quantitative data, all statistical tests were run with R Software. Additionally, Excel was used to create graphs and charts. Results were analyzed to determine statistical significance at an alpha level of $p < .05$. For the qualitative portion, data collected from interviews and student artifacts was analyzed and coded by the researcher.

Research Questions

As previously mentioned, four specific research questions were addressed:

1. Does The Drive My Brain Model increase English language learners' metacognitive awareness and metacognitive regulation?
2. What is the effect of The Drive My Brain Model on the use of cognitive strategies?
3. To what degree does The Drive My Brain Model give English language learners language to describe their metacognitive abilities?
4. Is The Drive My Brain Model easy for teachers and students to use?

Quantitative Findings for Research Question 1

The statistical tool used to evaluate the data for the first research question included a Chi-Square Test of Independence. The Chi-square was used for association. The Chi-square analysis helped determine whether there was a statistical difference between English language learners' initial and final metacognitive awareness (MA) and regulation (MR) skills as measured by the Jr. Metacognitive Awareness Inventory (Jr. MAI). Additionally, response patterns from pre-test to post-test on individual questions were evaluated. The hypotheses were:

1. H_0: MA answers pre-test = MA answers post-test

2. H_A: MA answers pre-test ≠ MA answers post-test

3. H_0: MR answers pre-test = MR answers post-test

4. H_A: MR answers pre-test ≠ MR answers post-test

The Jr. MAI was first scored to assess the test-retest reliability of the measure. The MA portion of the Jr. MAI pre-test and post-test for both the control and the treatment groups were plotted (see Figure 5.1) to look for deviations from normality, or distributional differences between the control and the experimental condition. All four scored distributions appeared to be reasonably normal, and besides a slightly larger range in the treatment group, the differences between the control and the treatment group were minimal.

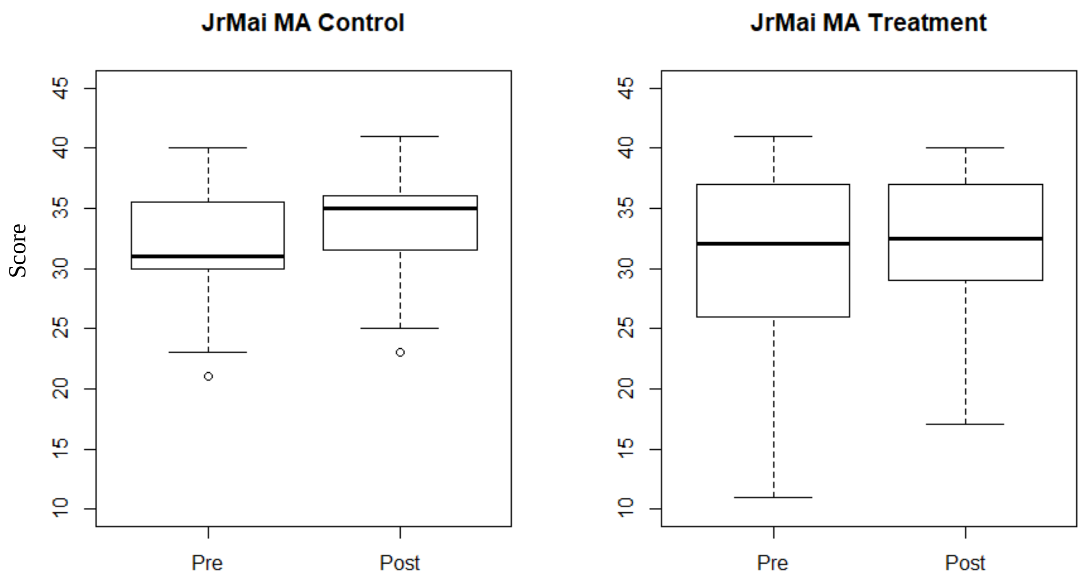


Figure 5.1. Box plot distribution MA portion for both groups.

Similarly, the MR portion of the Jr. MAI was scored, and the results were plotted (see Figure 5.2). The distributions for the pre-test and post-test conditions of both the control group and the treatment group appeared reasonably normal, with minimal differences between groups.

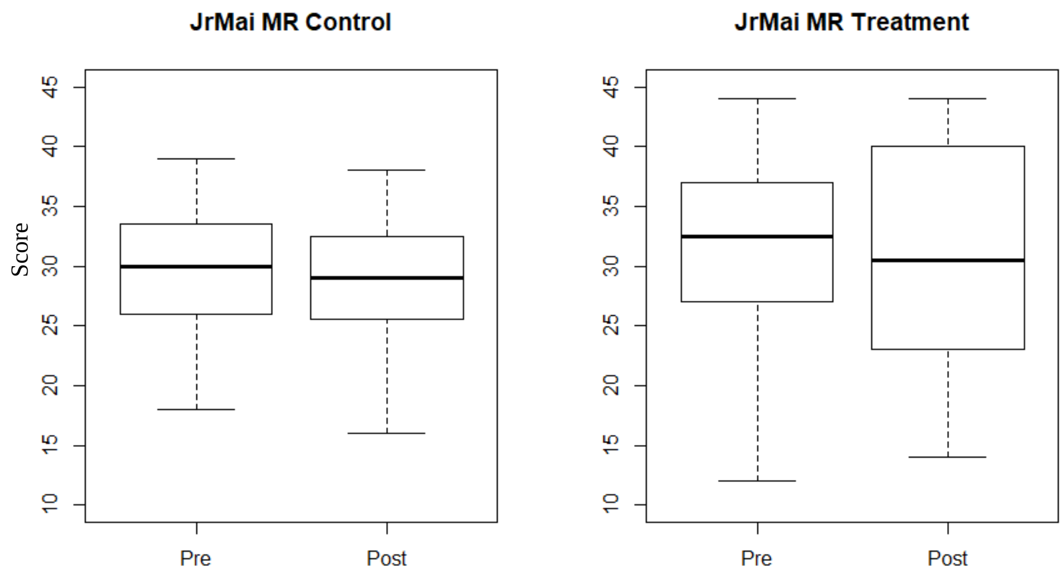


Figure 5.2. Box plot MR portion for both groups.

Jr. MAI Validity and Reliability

The researcher assessed test-retest reliability of the Jr. MAI using the control group. Since the group took the same inventory twice, without the intervention in between testing, it was expected that the scores on the pre-test and post-test would be highly correlated. Indeed, the results indicated this to be the case in both the MA condition (r = .79, df = 25, p < .05) as well as the MR condition (r = .78, df = 25, p < .05). This correlation is strong evidence that the inventory is consistent with what it is measuring. The questions from the inventory were informally reviewed for face-validity, and appear to measure both MA and MR. The Jr. MAI has also been used and validated in previous studies (Sperling et al., 2002).

MA Results of the Jr. MAI

Control group. A contingency plot between the pre-test and post-test for the control group in the MA portion of the Jr. MAI revealed patterns within the responses (see Figure 5.3). In this figure, each line represents the marginal distribution of a pre-test response. By tracking a single line, it can be determined what the response pattern was for all questions that were similarly marked in the pre-test. For example, the purple line represents the pre-test “always” response. The first column of the figure reveals that zero questions were selected “always” in the pre-test and then “never” in the post-test. The rightmost column (post-test always) reveals there were 38 questions which had an “always” response in both the pre-test and post-test condition.

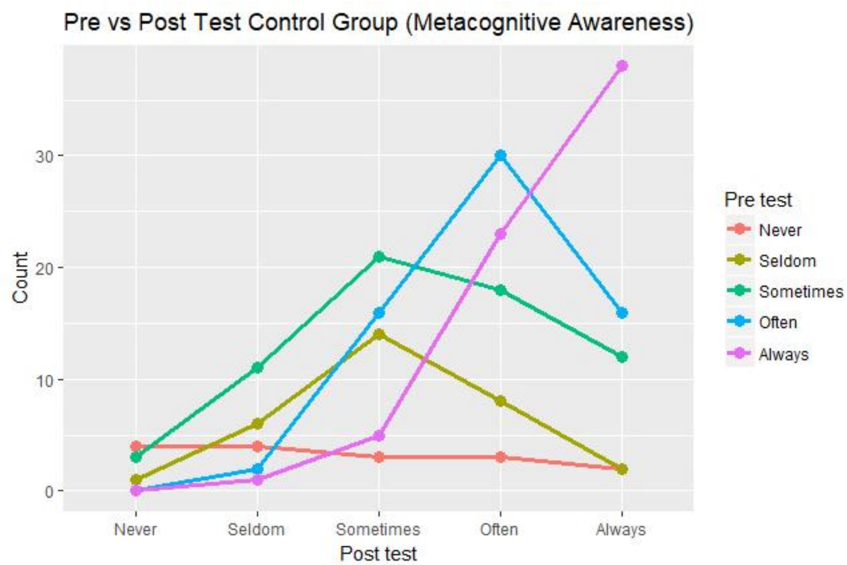


Figure 5.3. Contingency plot MA results for the control group.

Given strong reliability, it was expected that the mode of each marginal distribution would match the pre-test response selection. In other words, it would not be expected for a student to switch from “always” to “never” on any given question without any changes between tests. That exact behavior was observed in the conditions “always”, “often”, “sometimes”, and “never” which all had modes that matched their pre-test condition. The marginal distribution for these responses was thus centered on the expected response. The only mode change was detected in “seldom” responses which moved to “sometimes” in the post-test; however, it is possible that this movement was due to chance. To evaluate if the effect was due to chance, the researcher compared pre-test responses with the post-test responses using a Chi-Square Test of Independence. The test affirmed that there were no significant differences between the proportions of responses in the pre-test condition when compared to the post-test condition (χ^2 = 6.13, df = 4, p < .05).

Treatment group. Following the same procedure, the contingency plot of the treatment condition was evaluated and revealed a strong movement in the responses from less frequent to more frequent compared to the control condition (see Figure 5.4); the marginal distribution of every pre-test response increased by one position except for the "always" condition. Since "always" was the strongest possible response, it was concluded that the observed mode for each pre-test response was increased by one position in the post-test responses when possible. A Chi-square test of independence revealed a significant difference between the categories in the pre-test and post-test condition of the treatment group (χ^2 = 17.78, df = 4, p < .05), signaling that the results were not due to chance.

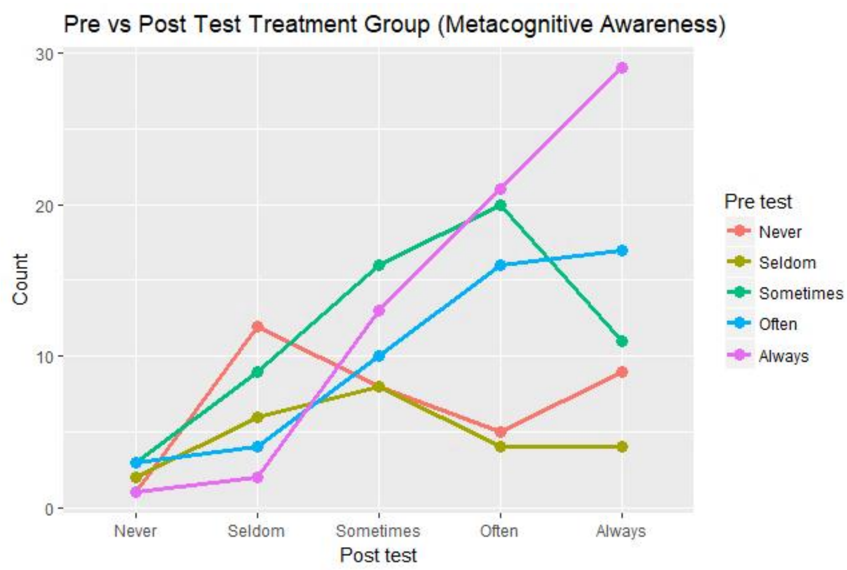


Figure 5.4. Contingency plot of the MA results of the treatment group.

The residuals of the differences between the expected values and the observed values were standardized to z scores (see Figure 5.5). The number of "never" responses in the pre-test condition was significantly higher from the number of "never" responses in the post-test condition of the treatment group ($p < .05$), thus rejecting the null hypothesis that the control and treatment response categories had the same proportions.

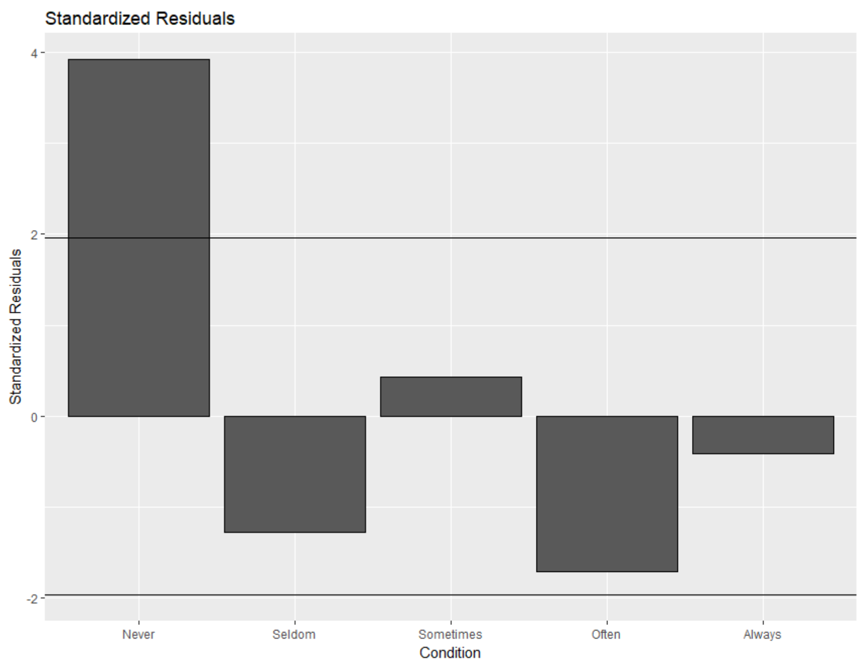


Figure 5.5. Standardized residuals for MA of the treatment group.

MR Results of the Jr. MAI

Control group. The MR contingency plot for the control group revealed a similar pattern to the MA control group (see Figure 5.6). There were no clear trends in either direction, with the marginal of two pre-test conditions ("never" and "always") centered on the expected mode. The marginal of two pre-test conditions ("seldom" and "sometimes") centered on a mode that is one ordinal step higher, and a single pre-test condition ("often") which was centered on a mode that was one ordinal step lower. It is probable that these adjustments were due to the variance in the test inventory being larger than the MA. The Chi-square test of independence for the MR control condition found no statistically significant differences ($\chi^2 = 1.37$, $df = 4$, $p > .05$). It was then concluded that there were no statistically significant differences in the response counts between the pre-test and post-test conditions.

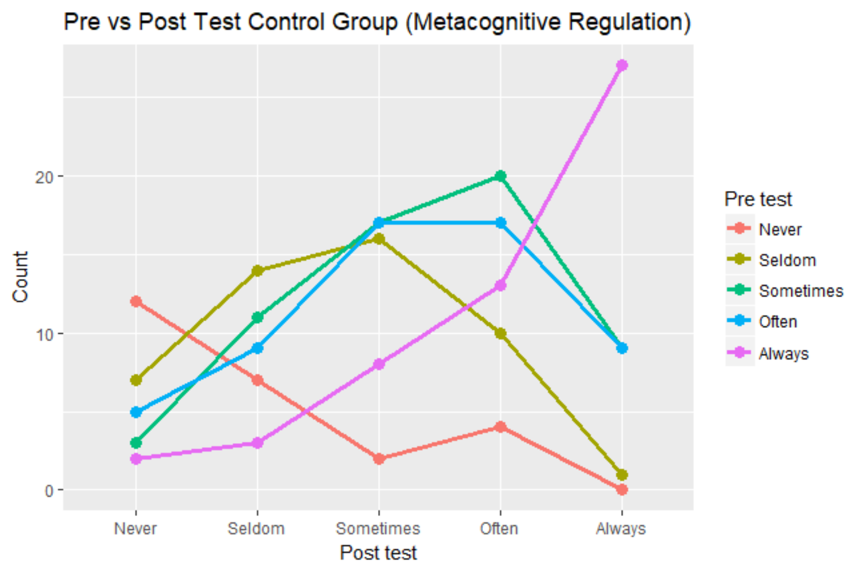


Figure 5.6. Contingency plot, MR results of the control group.

Treatment group. The contingency plot for the MR condition for the treatment group once again showed the systematic improvement from the pre-test responses to the post-test responses (see Figure 5.7). The mode of the marginal distribution of all pre-test responses increased by one ordinal step except the "always" condition; which was the highest possible answer. A Chi-square test of independence revealed this association was not statistically significant ($\chi^2 = 0.32$, $df = 4$, $p > .05$). The predefined analysis then concluded that no effects were found in the MR condition, thus failing to reject the null hypothesis.

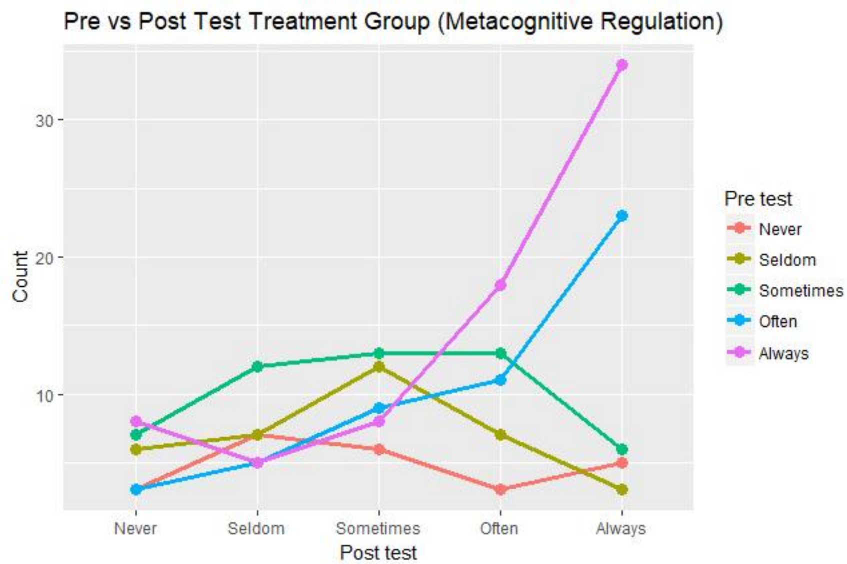


Figure 5.7. Contingency plot MR results of the treatment group.

Hypothesis Selection

The results from the MA portion of the Jr. MAI produced statistically significant evidence that allowed the rejection of the null hypothesis, hence accepting the alternative hypothesis as supporting evidence that the DMB Model had an effect on English language learners' MA. Furthermore, the evidence from the contingency plot and standardized residuals indicated the direction of change was towards an improvement (see Figures 5.4 and 5.5).

The results for the MR portion of the Jr. MAI, however, failed to produce statistically significant results to reject the null hypothesis. Based on this finding, the researcher concluded that there was no evidence that the DMB Model helped English language learners develop MR. Regardless, the contingency plot revealed an interesting trend of systematic improvement (see Figure 5.7). This trend could have been the result of English language learners beginning to develop and internalize MR; although at this point there is not enough evidence to support this assumption.

Qualitative Findings for Research Question 1

As a complement to the quantitative data analysis, this research sought to provide qualitative data as a means to obtain additional insight on the effects of the DMB Model on English language learners' MA and MR. The researcher selected a sample of three students from each class and evaluated their work; the students were selected among those who completed all activities correctly. Students 5, 10 and 18 were selected from the control class and students 3, 6 and 19 from the treatment class. To answer research question 1, the researcher utilized the student responses to the statement, "What questions did you ask yourself while completing this task?" (see Table 5.1 and 5.2). The questions each student listed were counted for both the treatment and control groups.

Table 5.1

Treatment Group ELA Task Responses

Student	Responses
	Question: *What questions did you ask yourself while completing this task?*
Student 3	Do I understand what I am reading?
	Have I done this before?
	What's my plan to approach this task?
	Am I reaching my goal?
	Am I reflecting and revising after learning?
Student 6	As I begin working, do I understand what I am doing?
	Is this similar to other things I have done?
	Am I proud of my work?
	While working, I learned?
	I know I am reaching my goal?
Student 19	Did I understand the question?
	Did I go back and check my work?
	Did I go back and correct my mistakes?
	Am I proud of my work?
	Am I learning something new today?
	Did I need help or knowledge for my work?

Table 5.2

Control Group ELA Task Responses

Student	Responses
	Question: *What questions did you ask yourself while completing this task?*
Student 5	I asked myself was I going to get this wrong or right? But then I just didn't pay attention to that.
Student 10	I asked myself what do I know? Do I understand what I am reading?
Student 18	I didn't ask myself any questions I just went through it.

For the English language arts (ELA) task, students from the treatment group listed a total of 16 questions, while the control group listed a total of only three questions (see Figure 5.8). It is also worth pointing out that student 18 did not list any questions, which could be an indication of multiple variables such as limited metacognitive skills, or lack of motivation.

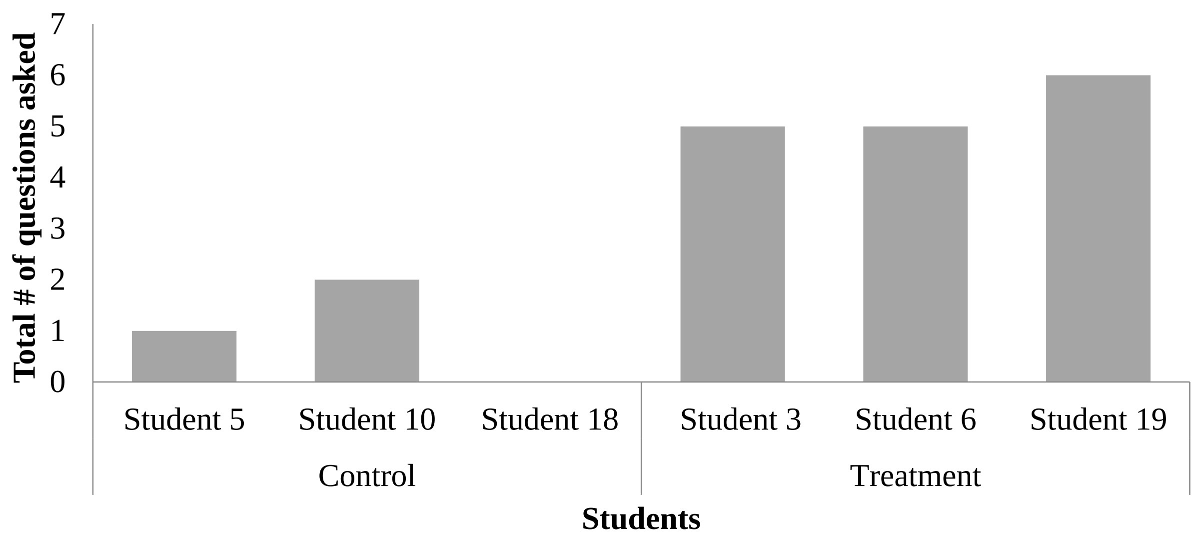


Figure 5.8. ELA task total number of questions.

Furthermore, the researcher categorized the responses into two categories, MA and MR. For that purpose, the researcher used the following criteria for MA and MR as presented below.

MA: What students know about what they know, what students know about the task, and what students know about how to use strategies.

MR: Students monitoring how they are using the strategies, and making changes if needed to control or improve what they know.

Table 5.3

Treatment Group ELA Task MA and MR Categories

Student	Responses	Category
	Question: *What questions did you ask yourself while completing this task?*	
Student 3	Do I understand what I am reading?	MR
	Have I done this before?	MA
	What's my plan to approach this task?	MR
	Am I reaching my goal?	MR
	Am I reflecting and revising after learning?	MR
Student 6	As I begin working do I understand?	MR
	What I am doing?	MR
	Is this similar to other things I have done?	MA
	Am I proud of my work?	MR
	While working, I learned?	MA
	I know I am reaching my goal?	MR
Student 19	Did I understand the question?	MA
	Did I go back and check my work?	MR
	Did I go back and correct my mistakes?	MR
	Am I proud of my work?	MR
	Am I learning something new today?	MA
	Did I need help or knowledge for my work?	MR

Table 5.4

Control Group ELA Task MA and MR Categories

Student	Responses	Category
	Question: *What questions did you ask yourself while completing this task?*	
Student 5	I asked myself was I going to get this wrong or right? But then I just didn't pay attention to that.	MR
Student 10	I asked myself what do I know?	MA
	Do I understand what I am reading?	MR
Student 18	I didn't ask myself any questions I just went through it.	N/A

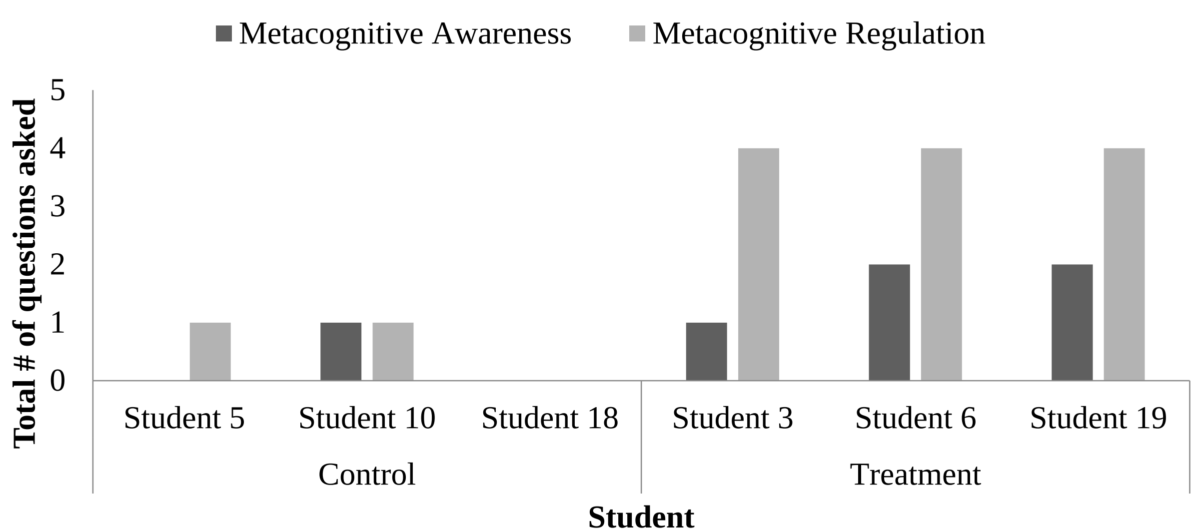


Figure 5.9. ELA task total number of questions for the MA and MR.

For the math task, the same set of students' responses was used, and the questions listed in the student task artifacts were recorded by the researcher (see Table 5.5 and 5.6). Inspection of the data revealed that the control group only listed three questions; where student 18 again failed to list any questions. The treatment group total amount of responses matched that of the ELA task with 16 questions asked, with a minor change in the distribution of questions per student.

Table 5.5

Treatment Group Math Task Responses

Student	Responses
	Question: *What questions did you ask yourself while completing this task?*
Student 3	Is this similar to things I have done? Did I plan and understand the question? Did I self-monitor? Did I reflect and revise? What resources did I use?
Student 6	As I begin working do I understand what I am doing? Is this similar to other things I have done? I know I am reaching my goal? While working I learned? Am I proud of my work? This knowledge will be helpful for me later?
Student 19	Am I proud of my work? Did I check my work? What strategies did I use? Did I look careful at my work? Did I understand the question?

Table 5.6

Control Group Math Task Responses

Student	Responses
	Question: *What questions did you ask yourself while completing this task?*
Student 5	Will I get this wrong or right?
Student 10	How should I solve this? Different strategies?
Student 18	I didn’t ask myself any questions except the math problem.

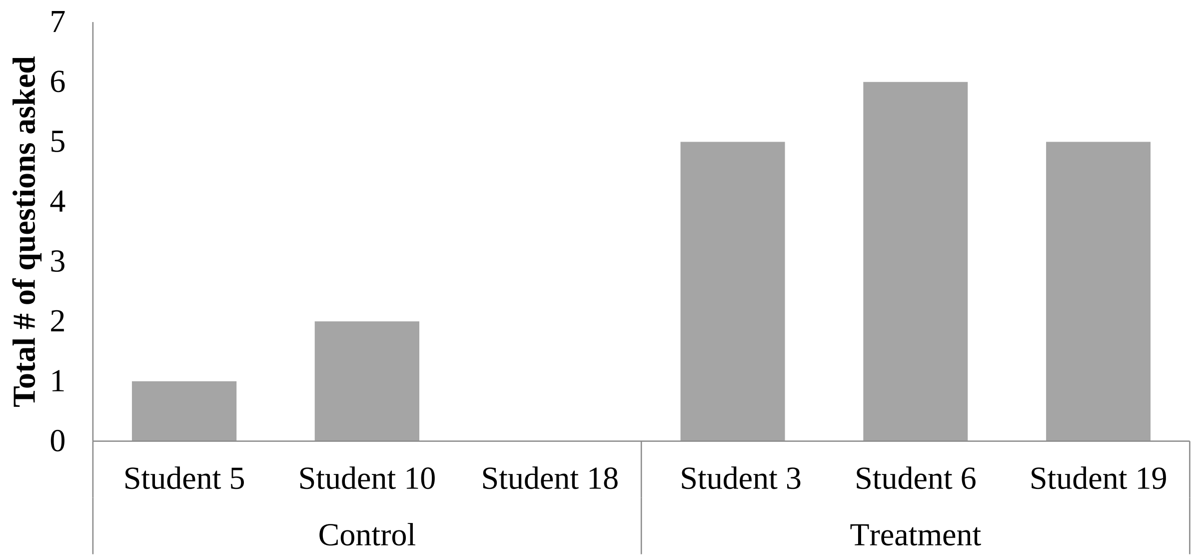


Figure 5.10. Math task total number of questions asked.

Once again, the questions were divided into two categories: MA and MR. The results (see Table 5.7 and 5.8), unlike the quantitative data findings, indicate that English language learners listed more MR strategies than MA strategies. Higher listing of MR questions could be explained by the intrinsic definition of metacognitive regulation being directly tied to an action or behavior, while awareness is a more abstract concept and possibly more difficult to explain by the participants.

Table 5.7

Treatment Group Math Task MA and MR Categories

Student	Response	Category
	Question: *What questions did you ask yourself while completing this task?*	
Student 3	Is this similar to things I have done?	MA
	Did I understand the question?	MA
	Did I self-monitor?	MR
	Did I reflect and revise?	MR
	What resources did I use?	MR
Student 6	As I begin working do I understand what I am doing?	MR
	Is this similar to other things I have done?	MA
	I know I am reaching my goal?	MR
	While working I learned?	MA
	Am I proud of my work?	MR
	This knowledge will be helpful for me later?	MR
Student 19	Am I proud of my work?	MR
	Did I check my work?	MR
	What strategies did I use?	MR
	Did I look careful at my work?	MR
	Did I understand the question?	MA

Table 5.8

Control Group Math Task MA and MR Categories

Student	Response	Category
	Question: *What questions did you ask yourself while completing this task?*	
Student 5	Will I get this wrong or right?	MR
Student 10	How should I solve this?	MR
	Different strategies?	MA
Student 18	I didn’t ask myself any questions except the math problem.	N/A

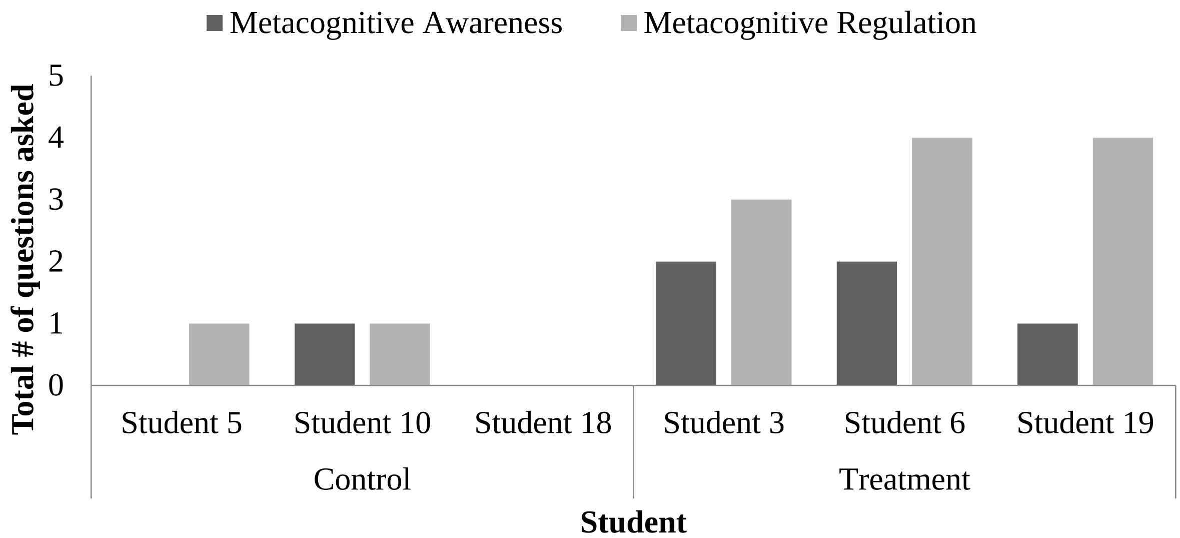


Figure 5.11. Math task total number of questions for the MA and MR.

The third task focused on social studies. The procedure to evaluate the student responses, and the student sample used, was the same as the previous tasks. Students in the control group failed to list any MR or MA strategies, while students in the treatment group listed a total of 14 strategy questions; a small decrease as compared to the first two tasks (see Table 5.9 and 5.10).

Table 5.9

Treatment Group Social Studies Task Responses

Student	Responses
	Question: *What questions did you ask yourself while completing this task?*
Student 3	Did I plan? Did I reflect and revise? Did I self-monitor? Did I understand? Did I check my work?
Student 6	While working I learned? As I begin working, do I understand what I am doing this? This knowledge will help me for later? Am I proud of my work?
Student 19	Do I understand? I checked my work? Am I reaching my goal? Am I proud of my work? Do I work hard?

Table 5.10

Control Group Social Studies Task Responses

Student	Responses
	Question: *What questions did you ask yourself while completing this task?*
Student 5	I didn’t ask any questions to myself.
Student 10	
Student 18	I did not ask any questions to myself.

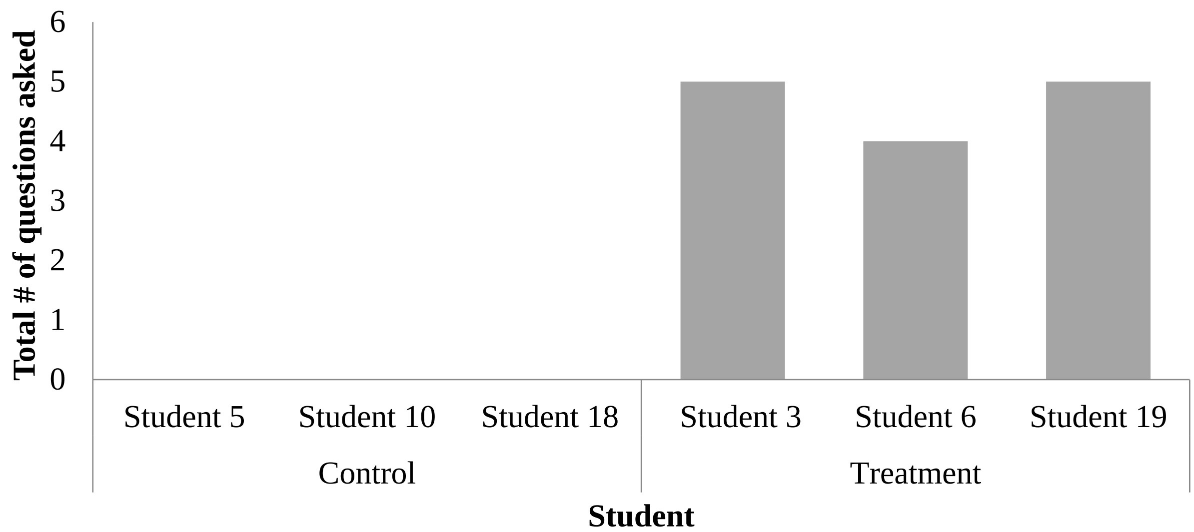


Figure 5.12. Social Studies task total number of questions

The results from the breakdown between MA and MR strategy questions of the Social Studies Task (see Table 5.11 and 5.12) indicated once again that the treatment group outperformed the control group. The results match the trend observed during the math task, as students showed signs of faster growth in MR based on a number of responses. As previously mentioned, it can be assumed that MR was an easier concept to express as it relates to a specific action, as compared to the more abstract nature of MA.

Table 5.11

Treatment Group Social Studies Task MA and MR Categories

Student	Responses	Category
Question: *What questions did you ask yourself while completing this task?*		
Student 3	Did I plan?	MA
	Did I reflect and revise?	MR
	Did I self-monitor?	MR
	Did I understand?	MA
	Did I check my work?	MR
Student 6	While working I learned?	MA
	As I begin working, do I understand what I am doing this?	MR
	This knowledge will help me for later?	MR
	Am I proud of my work?	MR
Student 19	Did I understand?	MA
	I checked my work?	MR
	Am I reaching my goal?	MR
	Am I proud of my work?	MR
	Do I work hard?	MR

Table 5.12

Control Group Social Studies Task MA and MR Categories

Student	Responses	Category
Question: *What questions did you ask yourself while completing this task?*		
Student 5	I didn’t ask any questions to myself.	N/A
Student 10		N/A
Student 18	I did not ask any questions to myself.	N/A

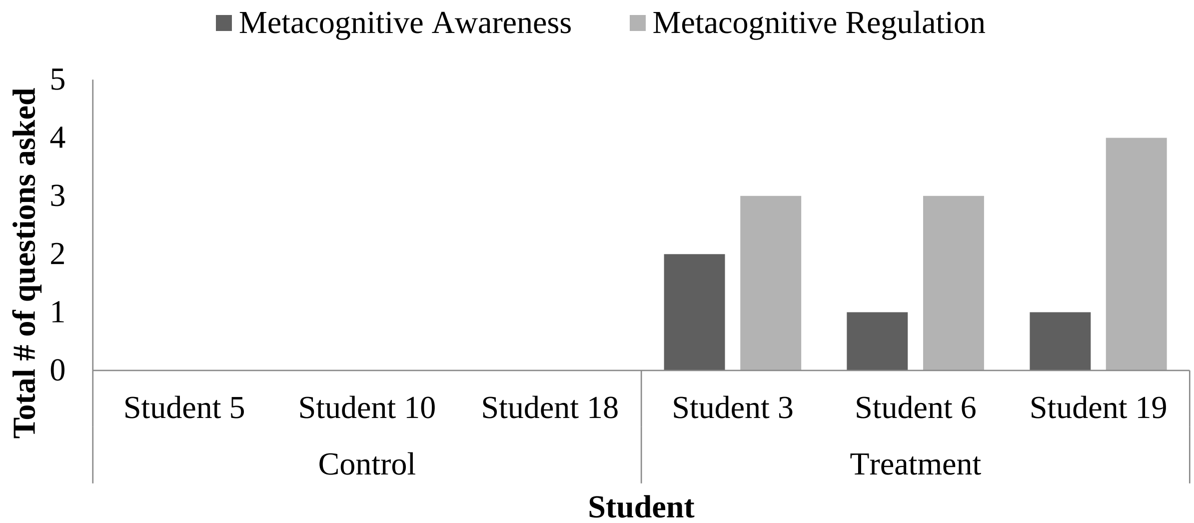


Figure 5.13. Social studies task total number of questions for the MA and MR.

The final task pertained to science, where the same procedure and student sample was used as all previous tasks. The total amount of questions listed by both groups increased significantly as compared to all previous tasks (see Table 5.13 and 5.14). The reason behind this increase in questions listed could be explained by the nature of the task, the preference to perform it, and even the difficulty of the task.

Table 5.13

Treatment Group Science Task Responses

Student	Responses
Question: *What questions did you ask yourself while completing this task?*	
Student 3	Did I plan? Did I reflect and revise? Did I plan and understand? Did I self-monitor? Did I imagine? How did I improve?
Student 6	Is this similar to another thing I have done? As I begin working do I understand what I am doing? While working, I learned? Am I proud of my work? I know I am reaching my goal? I wonder why? What if? How come? Is this correct? Will we understand?
Student 19	Did I understand what I did? Did I learn something new? Can the air resistance hold? Am I happy what I did? Can I improve my work?

Table 5.14

Control Group Science Task Responses

Student	Responses
Question: *What questions did you ask yourself while completing this task?*	
Student 5	Is this going to go fast because we want it to go slow?
Student 10	How long will it take to fall to the ground? What design will take long to fall down?
Student 18	I asked myself how do I make my parachute slower?

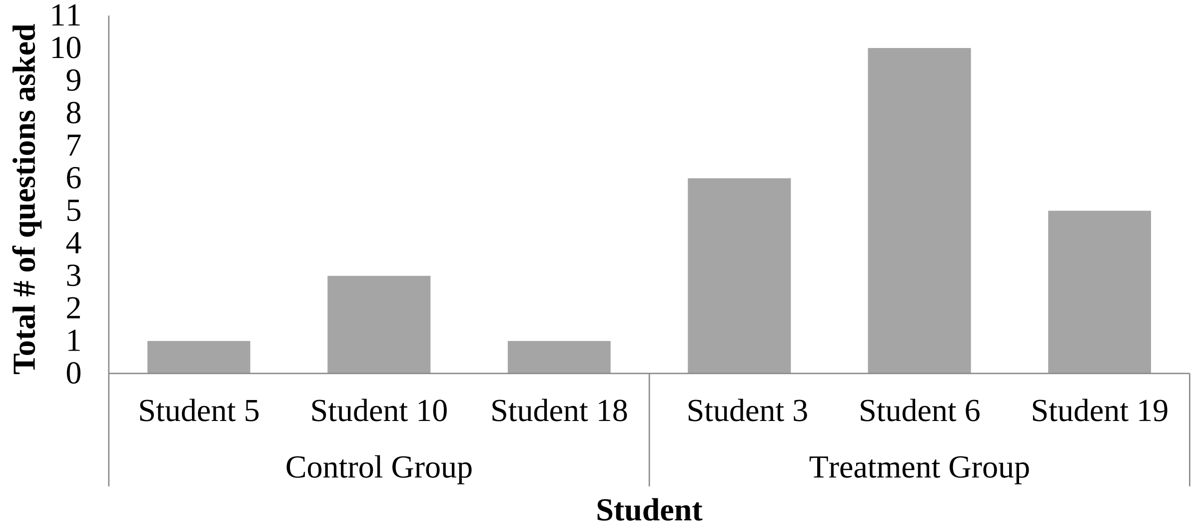


Figure 5.14. Science task total number of questions.

In the final task, the trend of listing more MR questions than MA was maintained (see Table 5.15 and 5.16). This trend once again was believed to have been the result of a more complex MA concept as compared to the MR questions.

Table 5.15

Treatment Group Science Task MA and MR Categories

Student	Response	Category
	Question: *What questions did you ask yourself while completing this task?*	
Student 3	Did I plan?	MA
	Did I reflect and revise?	MR
	Did I plan and understand?	MA
	Did I self-monitor?	MR
	Did I imagine?	MR
	How did I improve?	MR
Student 6	Is this similar to another thing I have done?	MA
	As I begin working do I understand what I am doing?	MR
	While working, I learned?	MA
	Am I proud of my work?	MR
	I know I am reaching my goal?	MR
	I wonder why?	MR
	What if?	MR
	How come?	MR
	Is this correct?	MR
	Will we understand?	MR
Student 19	Did I understand what I did?	MA
	Did I learn something new?	MA
	Can the air resistance hold?	MR
	Am I happy what I did?	MR
	Can I improve my work?	MR

Table 5.16

Control Group Science Task MA and MR Categories

Student	Response	Category
	Question: *What questions did you ask yourself while completing this task?*	
Student 5	Is this going to go fast because we want it to go slow?	MR
Student 10	How long will it take to fall to the ground?	MR
	What design will take long to fall down?	MR
Student 18	I asked myself how do I make my parachute slower?	MR

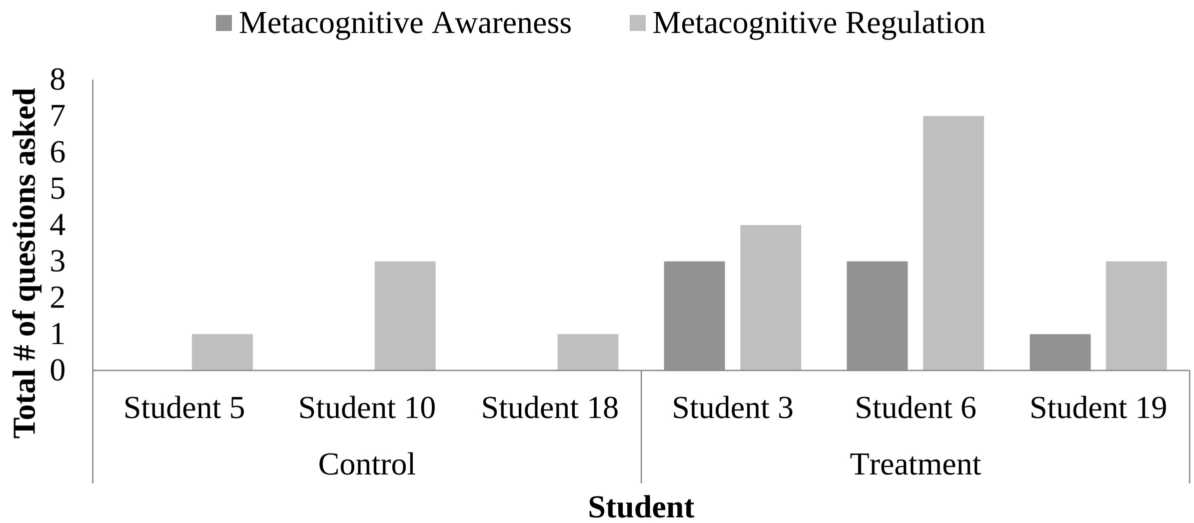


Figure 5.15. Science task total number of questions for the MA and MR

Quantitative Findings for Research Question 2

The second research question evaluated the effect of the DMB Model on the use of cognitive strategies as measured by the Cognitive Strategies Use Survey. The survey was composed of two separate sections, which were evaluated independently as reading (R) and writing (W). The same procedure to evaluate survey question 1 was used for the analysis of research question 2. Response patterns from the pre-test to the post-test were tested and then examined for trends between the categories of responses. The statistical tool included a Chi-square. The hypotheses for these tests were:

1. H_0: Cognitive Strategies Use Survey R pre-test results = Cognitive Strategies Use Survey R post-test results
2. H_A: Cognitive Strategies Use Survey R pre-test results ≠ Cognitive Strategies Use Survey R post-test results
3. H_0: Cognitive Strategies Use Survey W pre-test results = Cognitive Strategies Use Survey W post-test results

4. H_A: Cognitive Strategies Use Survey W pre-test results ≠ Cognitive Strategies Use Survey W post-test results

Both sections of the Cognitive Strategies Use Survey were scored to measure test-retest reliability and deviations from normality. Box plots of each condition revealed only slight deviations from normality (see Figures 5.16 and 5.17). Once again, non-parametric analysis was used, and these deviations can safely be ignored. Nevertheless, the scored survey was a useful measure of the overall performance between the control group and the treatment group in the reading and writing categories.

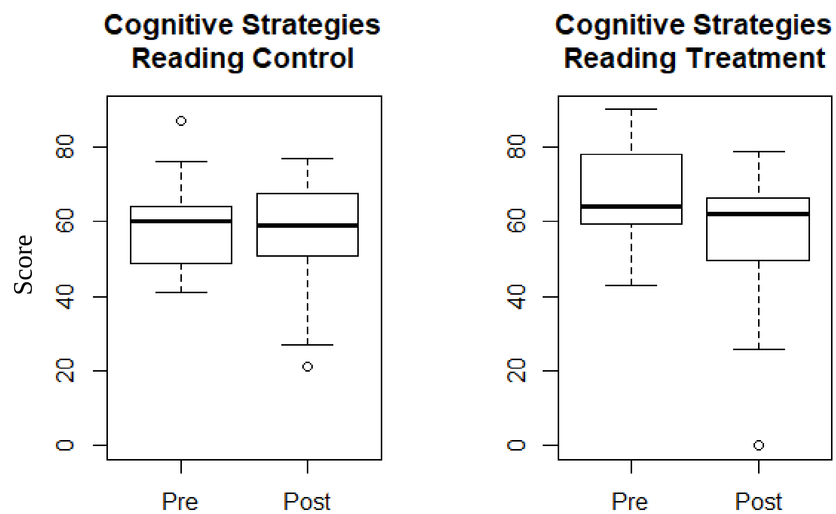


Figure 5.16. Box plot of reading distribution.

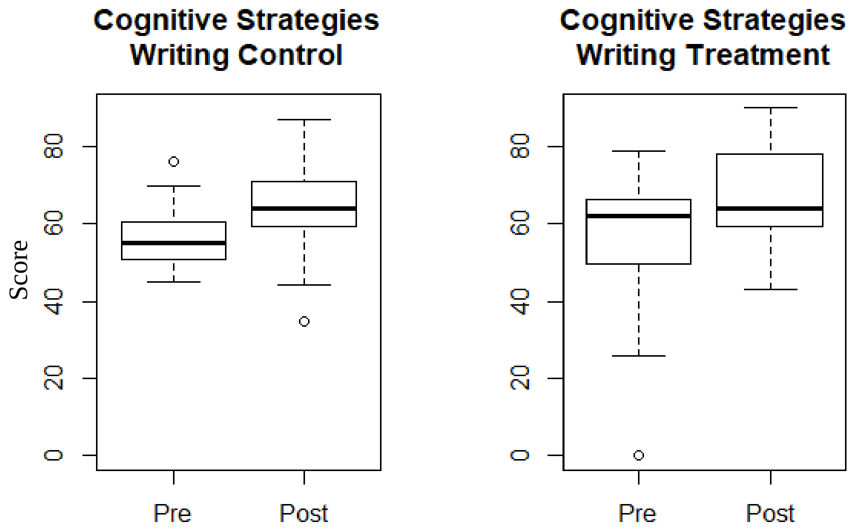


Figure 5.17. Box plot of writing distribution.

Cognitive Strategies Use Survey Validation and Reliability

Test-retest reliability of the Cognitive Strategies Use Survey was measured using the control group. A moderate correlation was found between the pre-test and post-test measures of the reading strategies condition (r = .54, df = 25, p < .05). A significant correlation was not found between the pre-test and post-test measures of the writing strategies condition (r = .35, df = 25, p = .08). Even at α = .01 this correlation would be considered small and did affect the interpretation of the results. A moderate and small correlation gave little confidence that the inventory measured cognitive strategies consistently. This finding does not preclude the follow up non-parametric analysis, but was kept in mind while interpreting the results.

Reading portion. A contingency plot for the cognitive strategies reading group revealed a much wider variance in responses than in the Jr. MAI MA and Jr. MAI MR inventories (see Figure 5.18). The post-test responses, conditioned on the pre-test, did appear to cluster around their original response. The mode of the conditional responses changed for every category except for “never.” These changes did not appear systematic and could have been due to the random noise introduced by the inventory.

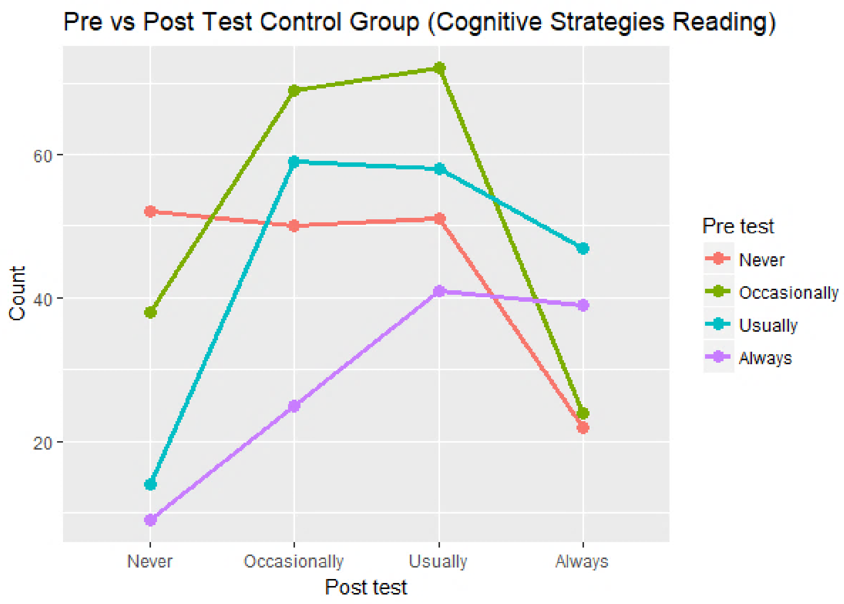


Figure 5.18. Contingency plot reading portion of the control group.

The treatment group had a similar pattern to the control group, making it difficult to disentangle changes due to random noise from changes due to the experimental manipulation (see Figure 5.19). The movement of the modes affected all groups, causing the “always” to decrease one ordinal step, while “never” and “occasionally” increased one ordinal step, and “usually” to remain in place.

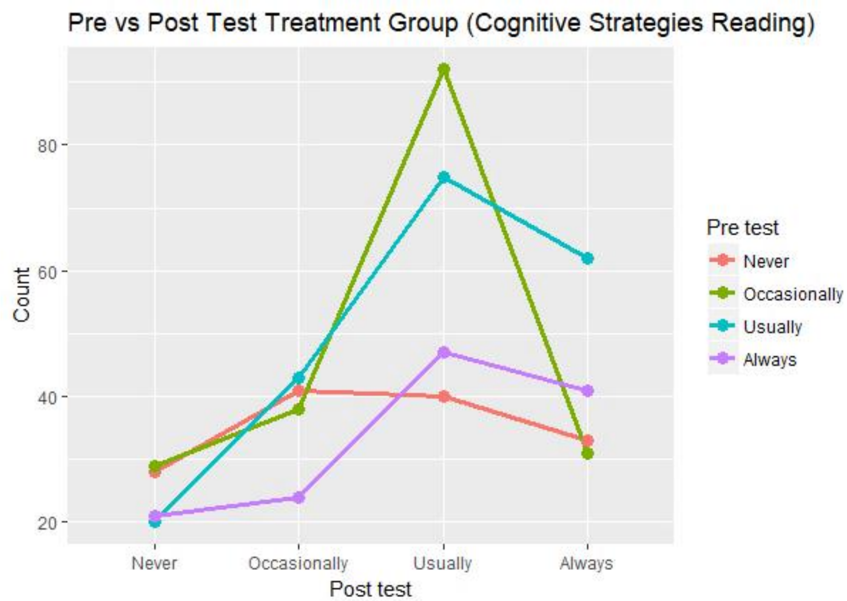


Figure 5.19. Contingency plot reading portion of the treatment group.

A Chi-Square Test of Independence on the control group found significant differences between the responses of the pre-test and post-test conditions ($\chi^2 = 20.07$, $df = 3$, $p < .05$). A residual analysis showed that the number of "never" responses were significantly greater and the number of "usually" responses were significantly lower in the pre-test as compared to the post-test conditions (see Figure 5.20).

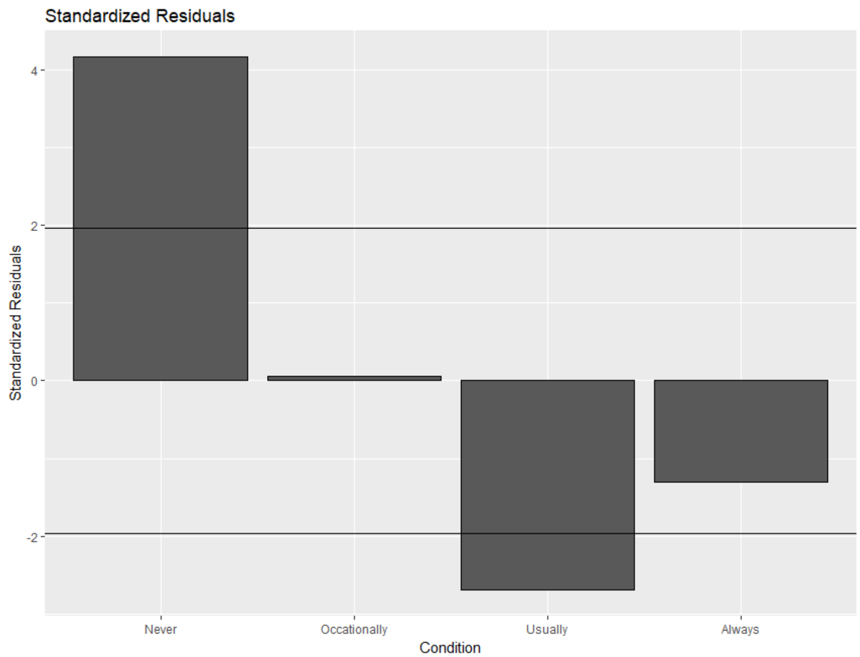


Figure 5.20. Standardized residuals reading portion of the control group.

The same Chi-square test of independence was run on the treatment group and also found significant differences between the responses of the pre-test and post-test conditions ($\chi^2 = 25.09$, $df = 3$, $p < .05$). A residual analysis showed that both the number of "never" and "occasional" responses were significantly higher in the pre-test condition as compared to the post-test condition. Additionally, the number of "usually" and "always" responses were significantly lower in the pre-test condition (see Figure 5.21). The residuals of the treatment group looked promising, and indeed the observed ratios differ from the expected ratios in a way that would be expected if the treatment increased the score in reading. However, since the test was underpowered, it could not be concluded with certainty the direction of the change (beyond the "never" and "always" responses which only had one direction to go), or the difference between the control and the treatment change, since both are significant.

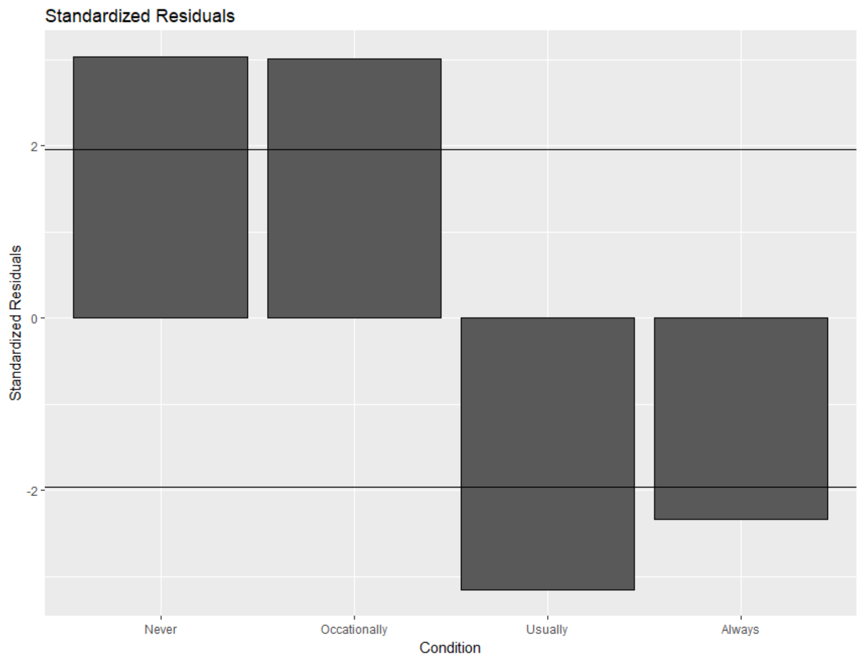


Figure 5.21. Standardized residuals reading portion of the treatment group.

Writing portion. The contingency plots for the cognitive strategies writing portion displayed a stark contrast between the control and the treatment groups (see Figure 5.22 and 5.23). The control group post-test responses, much like the reading section, generally clustered around the expected values conditioned on the pre-test. This is with the exception of a second mode in the "never" response from a pre-test at "usually", and a shift of the "occasionally" pre-test response. The treatment group, however, saw a positive shift from the conditional distributions of "never" and "occasionally" to "usually."

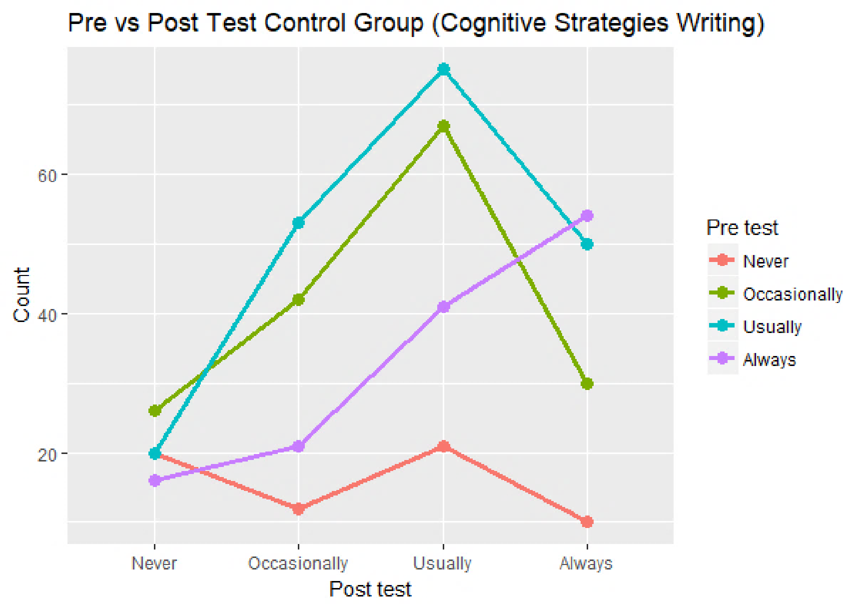


Figure 5.22. Contingency plot writing of the control group.

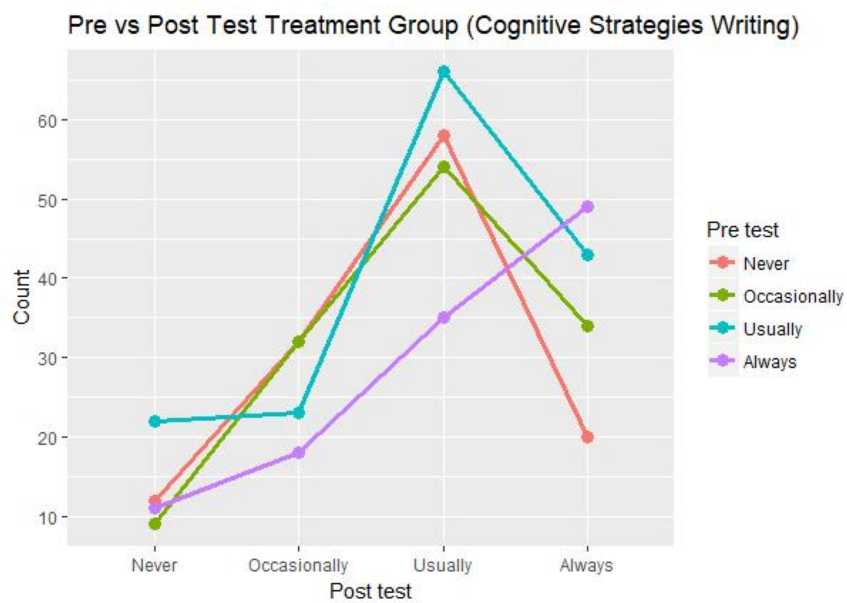


Figure 5.23. Contingency plot writing of the treatment group.

A Chi-square test of independence on the control group was significant ($\chi^2 = 8.59$, $df = 3$, $p < .05$). A residual plot shows that the number of "occasionally" responses were significantly higher for the pre-test condition than the post-test (see Figure 5.24). A Chi-square test of independence on the treatment group was also significant ($\chi^2 = 32.69$, $df = 3$, $p < .05$). The residual plot shows that the “never” response was significantly higher in the pre-test condition, and the “usually” and “always” condition were lower in the pre-test condition (see Figure 5.25). These results were again promising; however, the analysis was unable to evaluate the quantitative improvements from the treatment group as compared to the control group. More sophisticated methods and more powerful tests should be implemented in future studies.

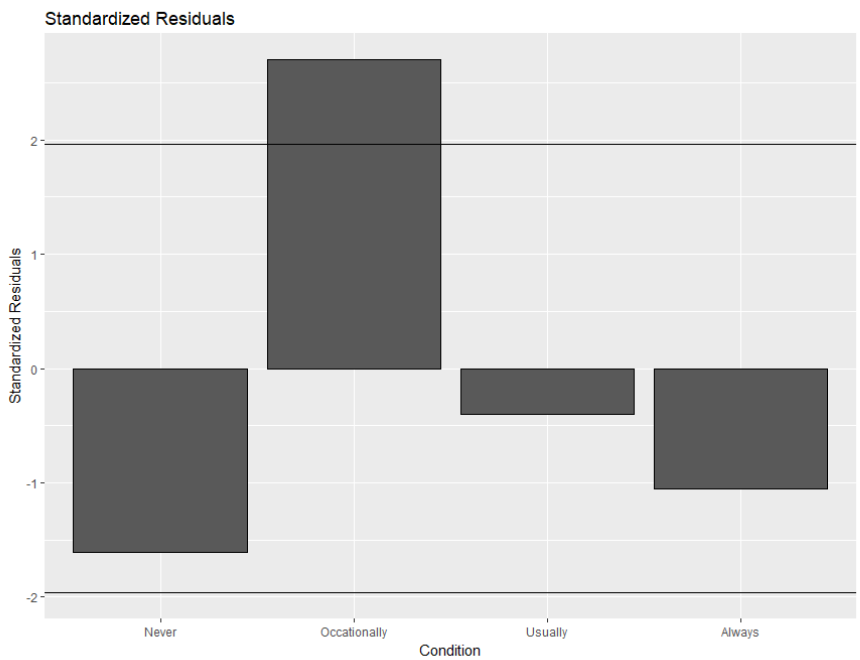


Figure 5.24. Standardized residuals control.

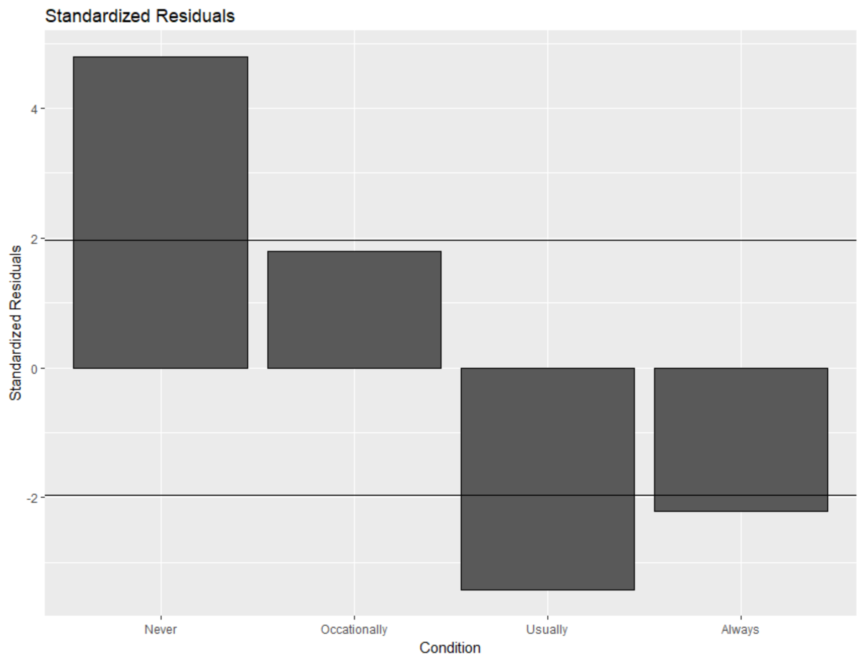


Figure 5.25. Standardized residuals treatment.

Hypothesis Selection

As discussed at the beginning, the test-retest reliability of the Cognitive Use Strategy Survey was found to be weak, which reduced the confidence in the results obtained. Despite that, a systematic improvement was observed within the treatment group for both the reading and writing areas. Such results were promising and should be further explored in future research, nevertheless within the limitations of this study and the instruments used, both null hypotheses fail to be rejected.

Qualitative Findings for Research Question 2

As a complement to the quantitative analysis, the researcher sought to provide qualitative data to further analyze the effect of The DMB model on English language learners' use of cognitive strategies. The researcher used the students' task artifacts, and analyzed results based on answers to the statement "What strategies did you use while completing this task?" The student responses were coded based on specific cognitive strategies defined in Chapter 3 (see Table 3.2). Tables 5.17 and 5.18 show students' responses below.

Table 3.2

Cognitive Strategies Embedded in The Drive My Brain Model

Cognitive Strategy	Abbreviation	Examples
Planning and goal setting	PGS	Understanding directions, creating and setting goals, determining a purpose, setting priorities.
Tapping Prior Knowledge	TPK	Searching existing schemata, mobilizing knowledge, relating to previous learning
Making Connections	MC	Connecting knowledge to self, other learning experiences, or the world.
Monitoring	MN	Knowing when to stop and reread, confirming that one understands and is reaching a goal, implementing other strategies for help when needed.
Evaluating	EV	Reviewing, assessing quality, formulating criticisms
Asking Questions	AQ	Generating questions about a topic, fostering forward momentum, predicting what will happen next
Clarifying	CL	Making sense of what was learned, thinking about what more can/needs to be learned in the future
Summarizing	SM	Addressing key information, stating what was accomplished
Forming Interpretations	FI	Understanding what the learning means to the learner, addressing how this learning may be useful later
Reflecting and Relating	RR	Stepping back, rethinking what one knows, formulating guidelines for the future

Note. List of targeted Cognitive Strategies identified in the DMB Model. (source: reprinted from "The reading/writing connection: Strategies for teaching and learning in the secondary classroom", by C. Olsen and R. Land, 2007, *Research in the Teaching of English*, *41* (3). Retrieved from https://www.nwp.org/cs/public/download/nwp_file/8538/Booth_Olson,_Carol,_et_al.pdf ?x-r=pcfile_d).

Table 5.17

Control Group Cognitive Strategies Used

Task	Student 5	Student 10	Student 18
EAL	Going back and forth to read the text (MN)	I asked myself questions (AQ)	I used what I know (TPK) and what I read (MN)
Math		I used multiplication to check (CL)	I used what I know about division (TPK)
Social Studies	Using numbers to number my list (MN)	Thought what people would like to have and important stuff (AQ)	
Science	Worked together and use all of our plans (PGS)	Using as less heavy things as possible (MC)	

Table 5.18

Treatment Group Cognitive Strategies Used

Task	Student 3	Student 6	Student 19
EAL	Highlighting (SM), reading (MN) and annotating. (SM)	I read (MN), highlighted and take notes. (SM)	The strategies I used re-read, highlighting (MN), analyzing (RR), checking my work (CL), if I am proud of my work, did I do my work correctly (EV)
Math	I checked my work by multiplying (CL)		Estimated (PGS), draw pictures (RR), solved the problem and then check my work. (CL)
Social Studies	Highlighting (SM) and re-read my task (MN)	I thought about it (AQ) and I checked my work (CL)	Brainstorm (PGS). Checked my work (CL) Thinking like the bill of rights (N/A)
Science	Some strategies was used was brainstorm (PGS), ask (AQ), imagine, plan (PGs) and create, also improve (RR)	We used the materials to put it on top so that the parachute could go slower (PGS)	Asking questions (AQ), collecting data (FI), testing the models (CL), planning and setting goals (PGS).

The researcher then counted the number and variety of strategies used in the treatment and control groups (see Figure 5.26). The data indicated that the treatment group outperformed the control group based on amount and type of strategies selected. As hypothesized, the number of strategies used was drastically different between groups. The treatment group demonstrated having knowledge and understanding of a larger variety of strategies. The colors in Figure 5.26 illustrate the variety of strategies used, while the overall height of the bar indicates the total amount of strategies used.

The qualitative data collected matched the expected results based on the trends observed in the quantitative data. Regardless, the data was self-reported which made the data susceptible to the use of buzzwords or copying strategies straight out of The DMB Model. Hence, the data obtained showed promising trends yet no conclusive results.

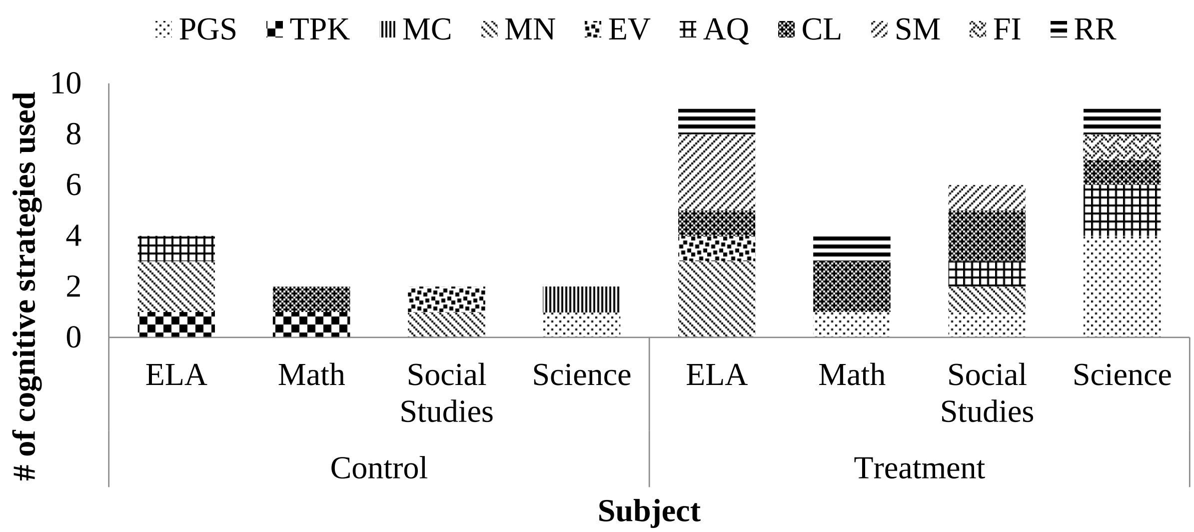


Figure 5.26. Self-reported use of cognitive strategies

Quantitative Findings for Research Question 3

Research question 3 sought to find to what degree The Drive My Brain Model gave English language learners the language to describe their metacognitive abilities. To address this question, the researcher observed both the treatment and control class for 20 minutes while students worked on each of the tasks. The objective of these observations was to record the number of times that students demonstrated metacognitive language use both verbally and in writing. Each time the students accurately expressed a metacognitive concept, the researcher recorded the observation with a tally mark and kept track of the type of concept that was expressed (MA or MR).

The results for verbal and written expressions of metacognitive language were then compounded and represented in Figure 5.27, and Figure 5.28. The observations supported the results from research question 2 based on the student tasks.

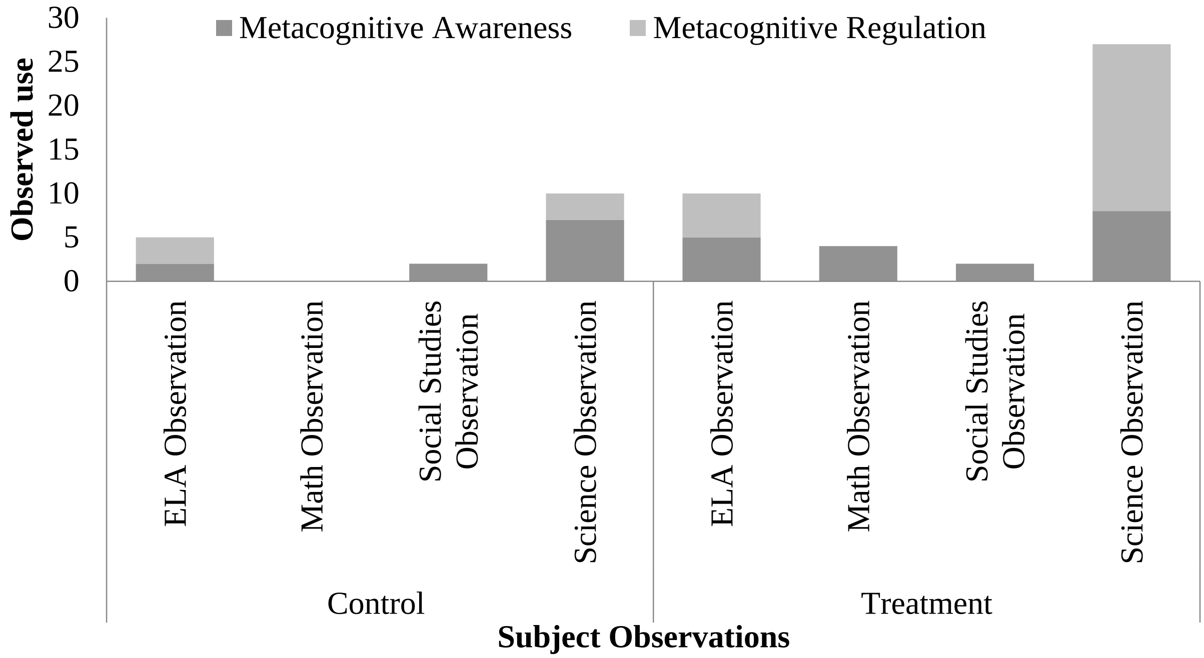


Figure 5.27. Verbal use of relevant language.

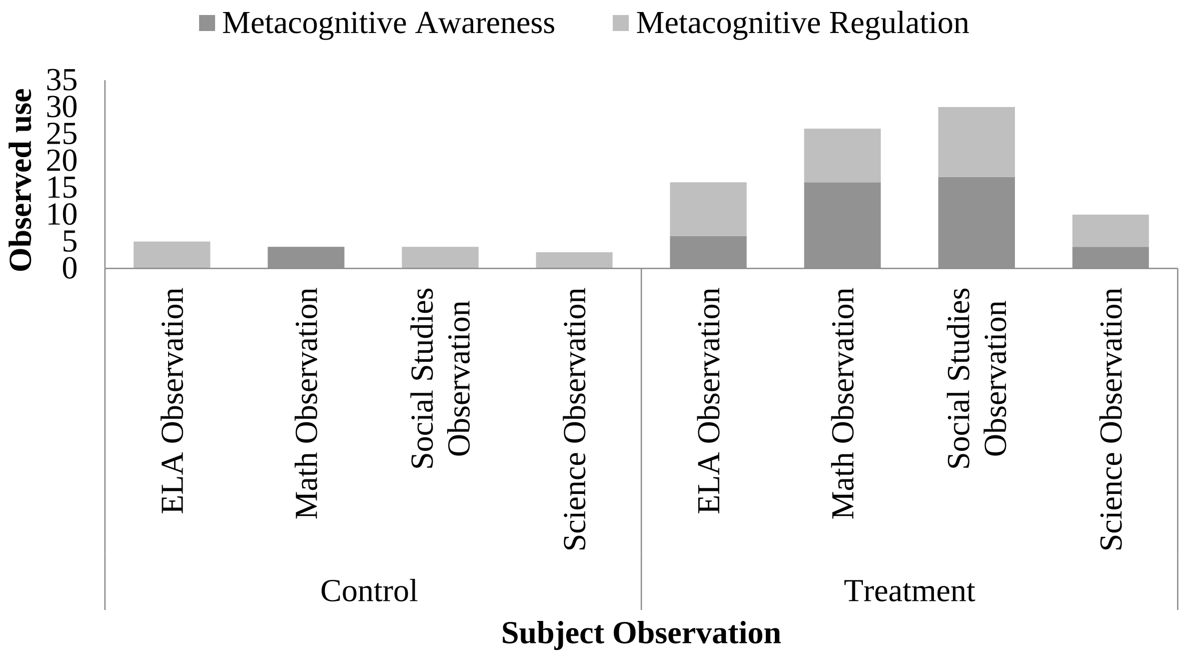


Figure 5.28. Written use of relevant language.

The results for language use observed by the researcher depicted clear differences between the control and experimental group; such difference matched all previous analysis performed, and served as a confirmation that the findings through multiple different tools and methods converged to the same answers. The data collection method utilized for this research question had limited capability to discern between students using buzzwords and actual understanding of the underlying concepts, to address that limitation additional qualitative data were collected by the researcher.

Qualitative Findings for Research Question 3

Qualitative analysis of the student task artifacts for research question 3 included the use of examining student responses to the following question: “What strategies did you use while completing this task?” As with previous research questions, responses were separated and analyzed in two groups: Metacognitive Awareness (MA) and Metacognitive Regulation (MR). Students’ responses to this question (see Table 5.1 to Table 5.16) were counted and then separated into their respective groups, MA and MR. To answer research question 3, these groups of questions were further analyzed to determine emergent patterns.

Throughout multiple revisions of the data, a pattern of response utilized by students in the MA and MR groups was revealed. Response pattern indicated that students primarily expressed metacognitive language by copying directly from The DMB Model, rewording statements from The DMB Model, or providing responses that were based on the model but not explicitly found within The DMB Model. Based on these findings, response patterns were categorized as follows: word for word statements, corresponding to direct quotations of strategies from the model; paraphrased statements, corresponding to statements that were reworded to express strategies found in the model; and new statements, which corresponded to statements that were newly developed and not found within The DMB Model.

Table 5.19

Analysis of Metacognitive Language Differences in Frequency and Form of Expression

	Overall Language of Expression			Descriptive Language Expression	
Language Type	Word for Word	Paraphrased	New	Paraphrased New	Total
MA	5	13	0	13	18
MR	17	16	12	28	45
MA*MR	22	29	12	41	63

Note. MA and MR were made in reference to the metacognitive language that was used by the participants. The overall language expression refers to how the participants expressed metacognitive language. Descriptive language was based on the number of combined responses from paraphrased and new statements. Differences between categories were analyzed through observed disparities between the type of metacognitive language used and the form of language expression.

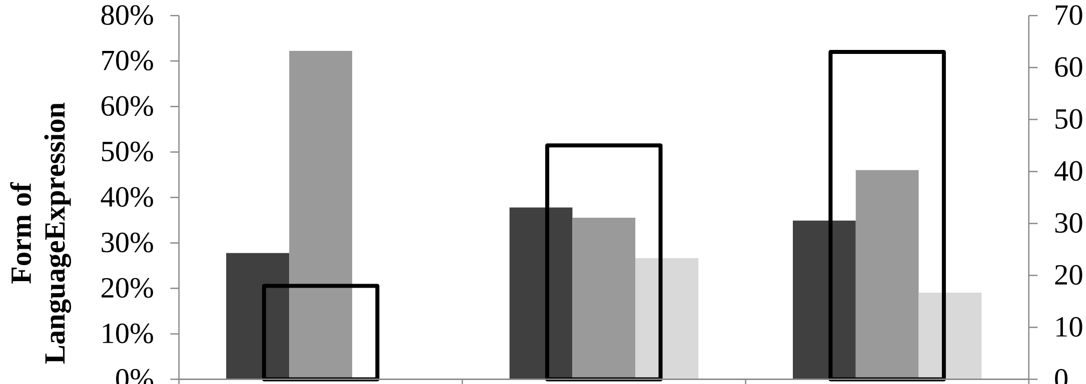
The researcher examined questions that demonstrated a written description of statements that fell within the MA group. A total of 18 MA questions from all the tasks were coded; this was done by looking at student responses and searching for keywords and repetition. Analysis of repeated statements and keywords in the MA group revealed three themes, which included task comprehension, prior knowledge, and knowledge reflection. These were noted based on whether the students described thinking about understanding the task, finding similarities to previous tasks, or thinking about what they learned. Task Comprehension was developed due to recurrent student statements focused on being aware of whether they understood the task (i.e., "Do I understand the question?"). Prior knowledge was coded based on recurrent responses showing students accessing past knowledge through identification of similarities between current tasks and past tasks. Knowledge reflection was coded due to student repetition of key strategy requiring them to reflect on what they have learned.

The word for word questions mostly included questions related to the theme of prior knowledge. The paraphrased questions, however, included questions related to task comprehension and knowledge reflection. These indicated that the participants were not engaging in buzzwords repetition, but rather understood and internalized the concepts enough to paraphrase. It was also apparent that the students' questions were catered to the nature of the task, further indicating that the students had begun to internalize the concepts.

Questions that demonstrated a written description of MR were then examined. A total of 45 MR questions from all the tasks were coded. To code the MR student responses, the researcher looked for keywords and repetition. The three themes that emerged included monitoring progress, revising, and evaluating. Monitoring was coded based on statements that indicated the student used strategies to check their progress as they completed the task. Revising was coded based on the repeated statements related to students revising, going back, or re-checking their work throughout the task. Evaluating was coded based on statements indicating the students reviewed their work when the task was completed.

The word for word questions mostly included questions related to evaluating. The paraphrased questions were related to monitoring. New questions students asked included a combination of all three themes. Some new questions included, “Did I look carefully at my work?”, “Did I work hard on this?”, and “How can I improve?” These results indicate that this concept was further along in the process of being internalized. In particular, the new questions indicated that students had a good understanding of the concept and could take it outside of the frame of reference provided by The DMB Model and apply the necessary adjustments.

The word for word statements showed that students were able to use the language to state metacognitive abilities; however, they fail to show depth in the degree of descriptive ability. The description of metacognitive abilities would require students to take conceptual strategies from the model and discuss these strategies in their own words. Having observed questions that indicated that students were able to truly describe metacognitive abilities in the categories of paraphrased statements (i.e. putting concepts from the model in one’s own words) and new statements (i.e. developed concepts beyond those in the model), the researcher sought to review the relation between the type of answers further. Overall, students used word for word statements 35 percent of the time, paraphrased statements 46 percent of the time, and developed new statements 19 percent of the time.



	MA	MR	MA+MR
Word For Word	28%	38%	35%
Paraphrased	72%	36%	46%
New	0%	27%	19%
total questions asked	18	45	63

Metacognitive Language Use

Figure 5.29. Frequency of metacognitive language use and form of expression.

Analysis of the data found more language use in group questions addressing metacognitive regulation than those regarding metacognitive awareness (MR = 45 > MA = 15). Conversely, there was a higher degree of descriptive language used in the MA as compared to MR. Students were more likely to paraphrase MA statements (72%) than MR statements (35%) and were more likely to discuss metacognitive abilities through paraphrased statements overall (46%). However, the MR category showed that students were able to find new ways to describe their metacognitive abilities (27%) by developing or expanding responses beyond those found in the DMB Model, whereas the MA category did not find a similar trend (0%).

Lastly, when combining paraphrased statements and new statements, which indicated depth of descriptive language, students engaged in descriptive language 72 percent of the time when discussing MA abilities, 62 percent of the time when discussing MR abilities, and 65 percent of the time when discussing metacognitive abilities overall.

Quantitative Findings for Research Question 4

This research was a preliminary study evaluating The DMB Model, developed by the researcher. The model aimed to help students and teachers develop and practice their metacognitive skills, which required the tool to be easy and intuitive to use. For that reason, the final research question of this research focused on evaluating if The DMB Model is easy to use and teach. The goal was to understand the relationship between student perceived difficulty of the DMB and the scores attained for each task. The hypothesis formulated that the easier the DMB, the better the performance on each of the tasks:

1. H_0: Higher scores on Ease of Use scale ≠ higher scores on the tasks
2. H_A: Higher scores on Ease of Use scale = higher score on the tasks.

ELA Task

The difficulty of the DMB task as perceived by the students was measured on a 5-point Likert scale from "*not easy at all*" to "*very easy.*" Compounding all the responses across all four tasks, a total of 43 percent of the students indicated that The DMB Model was "easy" or "very easy" (25% for ELA task, 58% for math task, 34% for social studies task, and 57% for science task). When considering the students that rated the model as "kind of easy" or higher the percentage increased to 76 percent (66% for ELA task, 83% for math task, 74% for social studies task, and 82% for science task). The initial results indicated that the students' overall perception of The DMB Model was positive. The researcher then reviewed The DMB Models as filled by the students after each task, and graded them based level of completion and correctness of use. The score was then used to evaluate the relationship between the perceived difficulty of The DMB Model, the proficiency to complete the model as measured by the DMB score, and the score attained on each the task.

The ELA task scores had a wide distribution and did not appear to be normally distributed (see Figure 5.30). The DMB difficulty on the ELA task showed that most students found the task to be “kind of easy” or “easy” (see Figure 5.30). Another informative measure, how well each DMB was filled, was a confounding variable to this analysis. For this reason, it was included as a measure of how well the DMB was filled for a correlation matrix that verified that students who found the DMB task easy also filled it correctly.

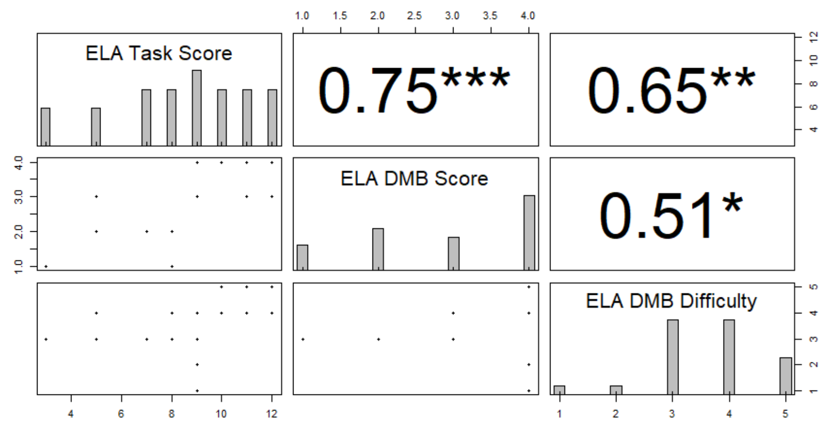


Figure 5.30. ELA task results.

A Spearman’s Rank-Order Correlation was run between the ELA task score and the difficulty the students had using The DMB model, and the results showed a strong positive correlation ($r_S = .65$, $df = 25$, $p < .05$) as shown in Figure 5.30). The correlation coefficient indicated that there was a relationship between the difficulty the students found to complete the DMB and their performance on the task. A moderate correlation between how well students used the DMB and the difficulty the students had with the DMB was also found ($r_S = .51$, $df = 25$, $p < .05$) (see Figure 5.30). Compound findings indicated that students who rated the DMB as easy on the Likert scale also utilized the model correctly, and performed better on the task. Furthermore, these results suggest that there was a relationship between the ease of use on The DMB model and the score on the ELA task. Based on these results, the null hypothesis was rejected in favor of the alternative. As a follow up, a correlation was also run between the ELA task score and DMB score and found a strong, positive correlation ($r_S = .75$, $df = 25$, $p < .05$) as shown in Figure 5.30. The correlation coefficient indicated that students who took part in the DMB exercise also tended to perform better on the ELA task.

Math Task

The math task scores, as well as the DMB difficulty scores, appeared negatively skewed (see Figure 5.31). However, no correlation was not found between the math task score and the difficulty the students had using The DMB Model ($r_S = .36$, $df = 25$, $p > .05$) as shown in Figure 5.31. Such results failed to reject the null hypothesis that there was a relationship between the math task score and the difficulty students found on the DMB task. A Spearman's rank-order correlation was also run between the math task score and the DMB score resulting in a strong positive correlation ($r_S = .64$, $df = 25$, $p <.05$) as shown in Figure 5.31). This agreed with the ELA task in that the students who participated in the DMB task tended to perform higher on the task.

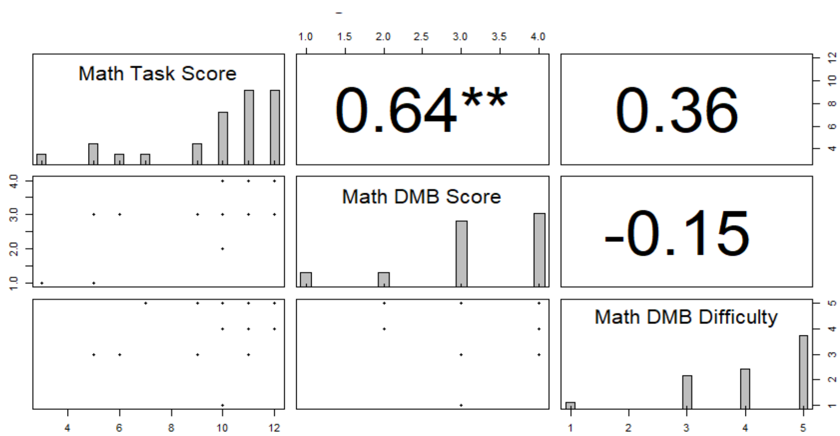


Figure 5.31. Math task results.

Social Studies Task

The social studies task scores had a wide variance, while the difficulty ratings were mostly in the easier range (see Figure 5.32). A strong Spearman Correlation was found between the social science score and the DMB difficulty ($r_S = .60$, $df = 25$, $p < .05$) (see Figure 5.32). In addition, a strong Spearman Correlation was also found between the DMB score and the DMB difficulty ($r_S = .65$, $df = 25$, $p < .05$) (see Figure 5.32). Based on these results, the null hypothesis was rejected in favor of the alternative. Students that found The DMB model to be easy to use tended to perform better in social studies tasks. A Spearman correlation between the social studies task scores and the DMB score revealed once again that that students using the DMB tended to did better on the task ($r_S = .81$, $df = 25$, $p < .05$) (see Figure 5.32)

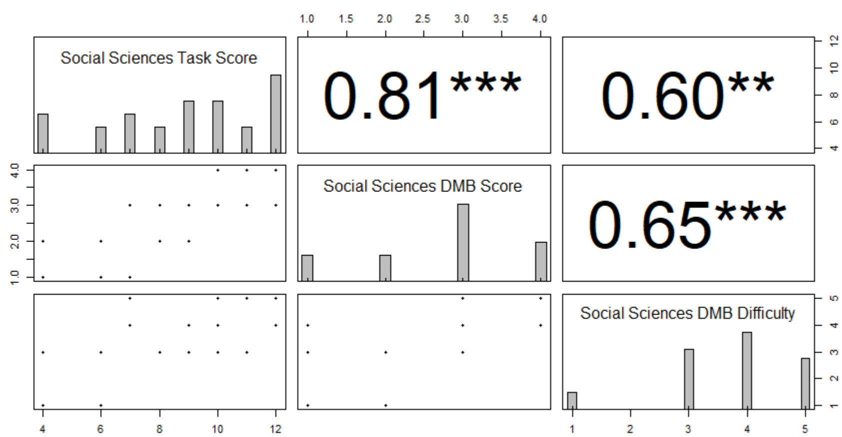


Figure 5.32. Social Science task results.

Science Task

The science task scores were generally high; with a negative skew (see Figure 5.33). The DMB difficulty, by contrast, appeared to span the range of difficulties and had the highest number of "not easy at all" responses than any other task. A Spearman correlation between the science task score and The DMB Model difficulty revealed a moderate positive correlation (r_S = .52, $df = 25$, $p < .05$) as shown in Figure 5.33). However, as illustrated in Figure 5.33, no correlation was found between the DMB difficulty and The DMB Model score ($r_S = .16$, $df = 25$, $p > .05$), meaning that there was no certainty that students finding The DMB Model less difficult were also doing it correctly. Additionally, a significant correlation was found between the science task score and the DMB score ($r_S = .60$, $df = 25$, $p < .05$) which agreed with all previous tasks, and indicated that the students that used the DMB Model tended to perform better (see Figure 5.33). Based on these results the null hypothesis was rejected in favor of the alternative.

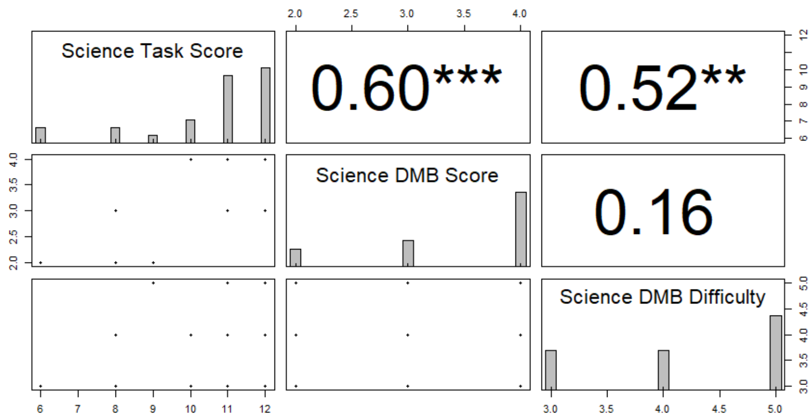


Figure 5.33. Science task results.

Hypothesis Selection

The results of four tasks found significance between the task score and the correct use of The DMB Model, indicating that the model was a useful tool. However, more research is required to confirm and strengthen the results. Varying levels of correlation were calculated between the ease of use of the model and each of the task score (ELA and social studies = strong, math = no correlation, science = moderate), this variability in the results and the small number of samples meant there was insufficient data to reject the null hypothesis.

H_0: Higher scores on Ease of Use scale ≠ higher score on the tasks.

The researcher hypothesized that the task complexity was most likely the factor that affected the correlation between the math task score and the reported ease of use of The DMB

Model. Future research should utilize more tasks to increase the data points, and control for variables such as student motivation and engagement, which were not accounted for in the current study.

Qualitative Findings of Question 4

The qualitative analysis for research question 4 involved examining student and teacher interview questions. The objective was to complement previous results regarding the ease of use of The DMB Model. The researcher first transcribed the data collected from the interview questions and responses. To explore the ease of functional use of The DMB Model, responses provided by teachers and students were analyzed. When directly asked if The DMB Model was easy to use, both teachers and students responded positively. To analyze the responses in further detail, the researcher highlighted the themes that indicated whether The DMB Model was perceived as easy to use. The themes that emerged were: DMB Model comprehensible and DMB Model helpful. The researcher coded the transcribed data by looking for keywords that demonstrated that students could explain how to use The DMB Model, as well as expressions that indicated if and why it was helpful.

Students were asked to explain how to use The DMB Model (see Table 5.20). Answers indicated an understanding of what the colors represented on The DMB Model. Additionally, they were able to identify the phases each color represented. Though students discussed the three phases of the model in order, none explicitly talked about which phases to complete first, second, or last. Additionally, students' responses did not include information about how to fill out the model or any specific questions the model addressed.

Table 5.20

Interview Responses on Use of the Model

Student	Response
	Question*: How do you use the DMB Model?*
Student 1	Red means to stop. Yellow means to slow down and green means to go. Well, the red one first and to stop and think and the yellow one means to slow down cuz it's getting harder.
Student 2	The red color means to stop, plan, understand. The yellow one means to do your work slowly by monitor at the same time. And green means to check and feel proud of your work. It helps you know what level you in to think more and look at what you're doing.
Student 3	Red is understand and plan. And yellow is to stop and check you work. And green is to reflect and revise.

Students were also asked about the helpfulness of The DMB Model was helpful (see Table 5.21). Responses indicated that they felt The DMB Model was helpful. Two students reported they believed it was helpful because it helped them think more.

Table 5.21

Interview Responses on Helpfulness of the Model

Student	Responses
	Question*: Is the Drive My Brain Model helpful?*
Student 1	Yes. If we do understand it it is helpful because it helps us think more and helps us put in our answers
Student 2	Yes I do because it helps you in…to think more and look at what you're doing.
Student 3	Yeah it is helpful because it helps you know where you are and it also helps you in ask questions and improve what you're struggling with

The teacher was asked how easy The DMB Model was to use (see Table 5.22), the response indicated The DMB Model was perceived as easy and enjoyable to teach. The teacher also indicated that students had similar experiences; however, some phases of the model were harder to use. The teacher then elaborated and explained how her perception was that students using the model's red area, or stop: plan and understand phase, was the easiest for them to successfully complete. She also believed students had a harder time with the second phase, slow: self-monitor during learning because they had to go back and forth between the model and their task. Lastly, the teacher's responses suggested that the "green row," or reflective phase, focused too much on students' reflection on their work, and did not allow students to revise and make changes.

Table 5.22

Interview Responses to Ease of Use of the Model

Teacher	Responses
	Question*: How easy is the Drive My Brain Model to use?*
Teacher 1	It's super easy to teach. I really enjoy teaching it. I find that the kids like it. I think the biggest thing is the yellow and being able to work, go to the model, work, go to the model. They do really well at the red and green. I would say read is the easiest for them. With green, I think there needs to be more about revision of their work.

The participating teacher was also asked to discuss her opinion on how easy it was for the students to use The DMB Model (see Table 5.23). Responses indicate that no perceived difficulty was observed in the students. Additionally, she mentioned the importance of the students practicing using the model.

Table 5.23

Interview Responses to Ease of Use of the Model for Students

Teacher	Response
Question*: How easy do you think it is for your students to use the Drive My Brain Model?*	
Teacher 1	I don't think they have problems with it. Like I say, it is a process. I think as they use it, it will get easier.

The participating teacher was then asked to share her beliefs on whether or not she felt students could use The DMB Model independently. Her responses indicated that the majority of students were able to use the model on their own; however, she also indicated that the accessibility of the task itself was an indicator of how well the students could use the model.

Table 5.24

Interview Responses on Independent use of the Model

Teacher	Responses
Question*: Do you feel your students can use the Drive My Brain Model independently?*	
Teacher 1	Mostly. Most of them. Probably 80% of them. It comes down to if the task is accessible to them because they're low academically. So if it is a harder task, no matter what they do with the process…but when it's an accessible task, they can fill it out no problem.

All data collected through the interview corroborated the findings from the quantitative section. This was a good sign of the ease of use of The DMB Model, and it helps all previous questions converge to the conclusion that The DMB Model had a significant effect on the participants.

Summary of Findings

Research Question 1

After reviewing all elements of the study, it was observed at a level of statistical significance that The DMB Model positively affected English language learners use of MA strategies. Underlying trends also indicated that similar behavior started to manifest for MR strategies, although it did not reach a level of statistical significance. The latter finding was also supported by qualitative data, as participants of the study outperformed the control group when listing MR strategies used during task development. Some discrepancy between quantitative and qualitative results was detected as students were able to name more MR strategies used than MA strategies. It was concluded that such discrepancy was the result of MR strategies being an easier concept for the students as it relates to actions, while the abstract nature of MA strategies was harder to express.

Accepted hypothesis:

H_A: MA answers pre-test ≠ MA answers post-test

H_0: MR answers pre-test = MR answers post-test

Research Question 2

Participants of the study were observed to outperform the control group in regards to the use of cognitive strategies; however, the confidence level was underpowered due to the weak test-retest reliability of the instrument used. For the reading section, the observed ratios differ from the expected ratios in a way that would be expected if the treatment increased the score. However, due to reduced confidence in the instrument, it could not be concluded with certainty the direction of the change, or the difference between the control and the treatment change; since both are significant. For the writing section results were again promising; however, the analysis was unable to evaluate the quantitative improvements from the treatment group as compared to the control group, again failing to reject the null hypothesis.

The qualitative data collected for this research question showed that the treatment group outperformed the control group in regards to how many cognitive strategies were applied to solve each task, and in the variety of strategies used. Such findings aligned with the trends detected by the qualitative data and should be considered in future research, where improved testing procedures would reduce noise and produce more definitive results.

Accepted Hypothesis:

H_0: Cognitive Strategies Use Survey R pre-test results = Cognitive Strategies Use Survey R post-test results

H_0: Cognitive Strategies Use Survey W pre-test results = Cognitive Strategies Use Survey W post-test results

Research Question 3

Quantitative data was collected through researcher observations. The data consistently showed that the treatment group expressed knowledge or usage of metacognitive strategies more consistently than the control group both verbally and in written form. The data collection method utilized for this research question had limited capability to discern between students using buzzwords and actual understanding of the underlying concepts, to address that limitation additional qualitative data were collected by the researcher.

Research Question 4

The data regarding the ease of use of the DMB Model indicated that the model was on average perceived, by a vast majority of students (76%), as “kind of easy” to use or easier. Correlations were also demonstrated between the ease of use of The DMB Model, its correct use, and the score achieved in the task. The correlations were always positive although the strength of the correlations varied from task to task, except the relation between The DMB Model usage and task score. The null hypothesis was rejected in favor of the alternative.

HA: Higher scores on Ease of Use scale = higher score on the tasks.

CHAPTER 6: DISCUSSION

This chapter provides a summary of the entire study, a discussion of the findings, and implications for practice. Lastly, recommendations for future research are discussed.

Summary of the Study

The purpose of this mixed-methods study was to determine the effectiveness of The DMB Model (Gomez, 2016) on English language learners' metacognition. The objective was to promote explicit instruction of metacognitive skills (i.e. planning, monitoring, evaluating) while using The DMB Model across multiple subjects. This study employed a quasi-experimental design, consisting of one control and one treatment group. The study lasted a total of eight weeks, in which the treatment group received 1,155 minutes of intervention using The DMB Model. The qualitative portion of this study focused on a phenomenological design in which the researcher investigated the phenomena of ELLs interacting with The DMB Model.

The Jr. MAI and Cognitive Use Strategy Survey were administered to both groups as pre- and post-tests. Additionally, both groups participated in four content tasks in which the researcher observed each classroom for 20 minutes. Qualitative data collection consisted of student and teacher interviews as well as the collection of student content task (i.e. student task artifacts). The quantitative data was evaluated using Chi-square tests of independence, residual plots, contingency plots, Spearman correlation tests, and count graphs. The qualitative data was evaluated using counts/frequencies, plots, and coding of the data.

Discussion of the Findings

The study sought to answer four main questions, for which the results are presented in Chapter 5. The relevance and implication of the results are discussed in this chapter organized by research question. The research questions this study aimed to answer included:

1. Does The DMB Model increase English language learners' metacognitive awareness and regulation?
2. What is the effect of The DMB Model on the use of cognitive strategies?
3. To what degree does The DMB Model give English language learners language to describe their metacognitive abilities?
4. Is The DMB Model easy for teachers and students to use?

Research Question 1

After evaluating the Jr. MAI for significance and the underlying trends for each answer, it was concluded that The DMB Model did have a significant effect increasing English language learners' MA. These findings supported previous research on the strong impact metacognitive interventions have on the successful learning of ELLs (Dörnyei, 2006; Pintrich, 2002). Additionally, qualitative data reinforced the quantitative findings, indicating that the treatment group outperformed the control group on every task by a significant margin. This difference means that students in the treatment group were able to express what metacognitive strategies they used while completing their tasks. Considering that the control group was a GATE class, in which the majority of students had been reclassified from ELLs to RFEP, the results also point to the conclusion that metacognitive awareness is a weak area in the current education system. Pianta et al. (2007), for example, discovered that fifth-graders received an average of 500% more instruction involving basic skills than metacognitive strategies. Other research has indicated the lack of metacognition in the classroom (Barker & Beall, 2009; Wilson & Conyers, 2016).

The researcher expected the GATE students to outperform the treatment group, as they started at higher levels (i.e. academically, language proficiency) and tended to progress faster. However, the treatment group was not only able to catch up but surpass the control group.

Therefore, the findings of this study further indicate that metacognitive instruction is needed in our classrooms (Pianta et al., 2007; Tanner, 2012; Kai, 2011; Baker & Beall, 2009). Lastly, the results for question 1 confirmed the efficacy of The DMB Model to be high. However, recommendations for future research are provided later in this chapter.

Unlike the MA portion of the Jr. MAI, the evaluation of the MR portion did not produce conclusive results. However, promising trends were discovered in the quantitative data and supported by the qualitative data. It was observed in both sets of data that the treatment group outperformed the control group by a wide margin on every task, and displayed clear, systematic trends of improvement. Promising trends and qualitative evidence, nonetheless, was not enough to reject the null hypothesis with confidence. It was also concluded, based on the researcher's perception and results from the teacher interview, that the short duration of the study was likely a reason for the trends failing to reach levels of significance. Additionally, the sample used for the study included participants with historically lower achievement levels than the country average. According to the US Department, the achievement gap between ELLs and non-ELLs has been reported to be 36 percentage points for fourth graders and 44 percentage points for eighth graders. Therefore, more time may have been required for ELLs to internalize new knowledge, a point perceived by the researcher and mentioned by the participating teacher during the final interview.

Research Question 2

The evaluation of the cognitive strategy use was weakened by the lack of test-retest reliability of the Cognitive Strategies Use Survey, which was tested using the control group before and after results. Because the survey was used and validated by previous studies (Olson, 2011), it was theorized by the researcher that a combination of language complexity and the length of the survey was not adequate for the developmental level of the participants of this study.

Despite the difficulties regarding the tool's reliability, the data was analyzed, and promising trends were discovered at a level that significantly differed from the expected results. The results would usually have been accepted as valid indicators of performance improvements. However, random noise, statistically significant changes in the control group, and the weakening of the instrument previously mentioned were considered by the researcher when failing to reject the null hypothesis for both the reading and writing portions of the survey. Although the null hypothesis was accepted, the trends observed in the quantitative data analysis were reported, as they matched the themes that were discovered in the qualitative data. In combination (i.e. quantitative and qualitative), the two sets of data demonstrated systematic improvement in the treatment group, in contrast to the control group, which presented a completely erratic behavior.

The lack of statistical significance reduced reliability on the conclusions derived from this section of the study; nonetheless, quantitative data showed convergence with the previous section and all trends observed matched the observations of the qualitative portion of this section. This convergence was noted, as it is a trend through the entire study. Recommendations for further research are discussed later in this chapter.

Research Question 3

Research question 3 proposed the hypothesis that English language learners exposed to The DMB model would develop language to express their metacognitive processes at a level significantly higher than students in the control group. However, the tallies could not be analyzed with a statistical tool because the observations produced an insignificant amount of data. Additionally, there were significant variations from task to task (i.e. ELA and social studies).

The researcher, however, noted a difference in both the amount of time spent on tasks and the language used by students. For example, the students in the treatment group spent longer periods of time on their tasks. This amount of time was due to them planning before the task, monitoring during the task, and checking their work before submitting their task. The tally counts indicated that the treatment group displayed higher levels of both verbal and written language to describe metacognitive processes. It was noted that the students in the treatment group, as well as in the control group, had more metacognitive language that expressed regulation than awareness. This finding was contrary to the quantitative results found in question 1 (i.e. MA scores on the Jr. MAI were higher). However, these findings agree with research that has documented that an explicit articulation of metacognitive knowledge is not necessary for obtaining or using it (Baker & Beall, 2009; Lai, 2011; Schraw & Moshman, 1995). For example, Schraw and Moshman (1995) argued: "that a child's implicit beliefs about intelligence constitute a theory because they allow the child to synthesize observations about the nature of intelligence and make predictions based on those observations" (p. 358). Schraw and Moshman (1995) also believed students began developing metacognitive skills with tacit theories. Tacit theories involve students having a certain awareness about what they know even if they are unable to articulate them. Additionally, tacit theories are the first step in becoming proficient in the use of metacognitive regulation skills (Schraw & Moshman, 1995). It was theorized by the researcher that because students displayed high levels of MR, they most likely also had high levels of MA. Regardless, they were unable to articulate them. This inability to articulate further proves a need to extend the study, as students need time to strengthen their deep thinking skills (Weimer, 2012; Wilson & Conyers, 2016).

Qualitative data was collected by evaluating the responses on the student task artifacts, and coding the results based on the responses being word-for-word copies from The DMB Model, paraphrased from the model, or entirely new questions. The paraphrasing and creating new questions required a deeper understanding of the concept, so the researcher utilized these classifications to assess whether the students had internalized the concepts or not. The results indicated that the students asked new questions 19 percent of the time, while they paraphrased 46 percent of the time. It had been theorized that the use of buzzwords could sway the data, but the amount of new and paraphrased questions indicated that only about one-third of the total number of questions could be explained that way. Considering that some students could have internalized the concept while continuing to use the original question, the use of buzzwords was unlikely to be a significant factor to explain the results. Future research focusing on the use of language should focus on the development of instruments to assess the participants before and after language skills, and compare the effect between classes while adjusting for buzzwords and other forms of superficial knowledge. This supports research by Howell and Wilson (2014), who concluded students sometimes learn to identify the names of concepts but fail to use them correctly.

Research Question 4

This research question investigated the relationship between the self-reported ease of use of the DMB Model, and the score obtained during a student content task. Though three of the tasks demonstrated a correlation between the ease of use scale and the tasks score, such correlation was not detected in the math task. This lack of correlation in one of the tasks meant that the null hypothesis could not be rejected with certainty and indicated that the study lacked the means to account for motivation and engagement. It was theorized that the potential reasons for the students' diminished performance to be lack of motivation, engagement, or the complexity of the math task. A particularly interesting finding when comparing the math and science tasks was that a higher number of students rated the model harder to use during science, yet the correlation between the ease of use and the task score was determined to exist. It is theorized that this was due to higher engagement on a more interactive task (i.e. STEM activity).

Although the math task failed to produce any significant correlation between the ease of use of The DMB Model and the task score, the other three tasks (i.e. ELA, social studies, and science) did find significant positive correlation that varied from strong (ELA: $r = .65$, $p < .05$ and social studies: $r = .60$, $p < .05$) to moderate (science: $r = 0.52$, $p < .05$). These results indicate that students who used the model correctly and rated the model easy to use performed better. Furthermore, a strong positive correlation was found between all tasks and the correct use of the model. The DMB Model score on the task rubrics measured how well the model had been completed (i.e. thoughtfully filled in), hence correct use of the model significantly increased students' performance as measured by the student task rubrics.

Finally, the researcher conducted student and teacher interviews using a one-on-one format, and after transcribing the data. The interviews revealed that students and teachers understood how to use The DMB Model. Additionally, both teachers and students reported that the DMB Model was enjoyable and fun to use. In fact, the teacher from the treatment group continued using The DMB Model with her students after the study had concluded. The teacher from the control group indicated interest in using The DMB Model in the future. Further studies are required to test the effectiveness of the model with more diverse populations. Implications for practice and recommendations for future research are further discussed in the following section.

Implications for Practice

The results from this preliminary study indicate that English language learners benefit significantly from the use of The DMB Model, as reported by multiple tools. Furthermore, the findings align with previous research on the importance and benefits of directly teaching metacognitive skills to students (Baker & Beall, 2009; Brown, 1987; Flavell, 1979; Jensen, 2008; Kai, 2011; Olson & Land, 2007; Schraw & Moshman, 1995; Wilson & Conyers, 2016). Elements of instructional support of this study included the creation of The DMB Model, teacher training, material preparation, and ongoing consultation. Additional implications for the practice include the opportunity to incorporate this model in elementary classrooms with diverse populations, providing longer opportunities for practice, ongoing teacher training, and including visual aid around the classroom (i.e. posters). These factors would likely improve the results and application of The DMB Model.

Additional implications, emerging from the phenomenological design of the study, include the potentials for further refining The DMB Model. The overall concept (i.e. visual metaphor and conceptual diagram) seemed to be beneficial; however, small modifications and adjustments could be made to improve student experience while using the model. Another key discovery was the participating teachers' desire to collaborate with colleagues and explore team teaching the model. The DMB Model would benefit from teacher expertise, leading to improved teacher experience for implementation and continued use of the model.

Recommendations for Future Research

Based on the findings of this study, the researcher has suggestions for future research involving metacognition and implementation of The DMB Model.

Studies involving metacognition and young children should make use of metacognitive assessments. Among the most reliable, is the Jr. MAI. It should be noted, however, that the results produced by version 2 of the Jr. MAI is ordinal. Researchers, therefore, should consider using Version 1 when appropriate. Additionally, studies involving metacognitive interventions should increase the duration.

Studies involving the use of cognitive strategies would benefit from the Cognitive Strategies Use Survey. However, a revision of the survey to include a simplified version more appropriate for younger students is recommended. Additionally, the language on the survey should be appropriate for diverse groups of students, such as ELLs who have a more limited vocabulary in English.

Additionally, the researcher provides recommendations for future studies aiming to utilize The DMB Model. The DMB Model is suggested to be implemented within elementary school programs to identify if similar results can be observed. Additionally, teachers should be trained in both the use of the model and instructional implementations. Expanding the use of The DMB Model to the duration of an entire school year would allow for an understanding of student academic growth. Lastly, future research should consider and account for factors such as motivation, student engagement, and academic abilities.

To fully validate The DMB Model for practical use, future studies should incorporate some of the procedures from this study with modifications to address the limitations presented in this research. Among the key changes that should be considered is the selection of more even groups (i.e. both general population classes) and potentially more groups altogether. Equal groups would reduce statistical error and bring more reliability to the findings. Additionally, larger sample sizes would reduce the volatility of sample. The components of this study to be maintained include the mixed-method design and the use of multiple previously validated instruments for data collection.

Conclusion

This preliminary study on the effectiveness of the DMB Model was deeply rooted in previously successful research involving a metacognitive strategies approach to teaching. This study followed a mixed-methods design, which allowed for multiple means of data collection and analysis. The results from the study indicated The DMB Model to be beneficial in improving ELLs' metacognitive awareness. Additionally, The DMB Model was found to be easy and enjoyable to use. A positive correlation between the correct use of the model and students' scores on content tasks was determined. Finally, implications for practice and recommendations for future research were provided by the researcher.

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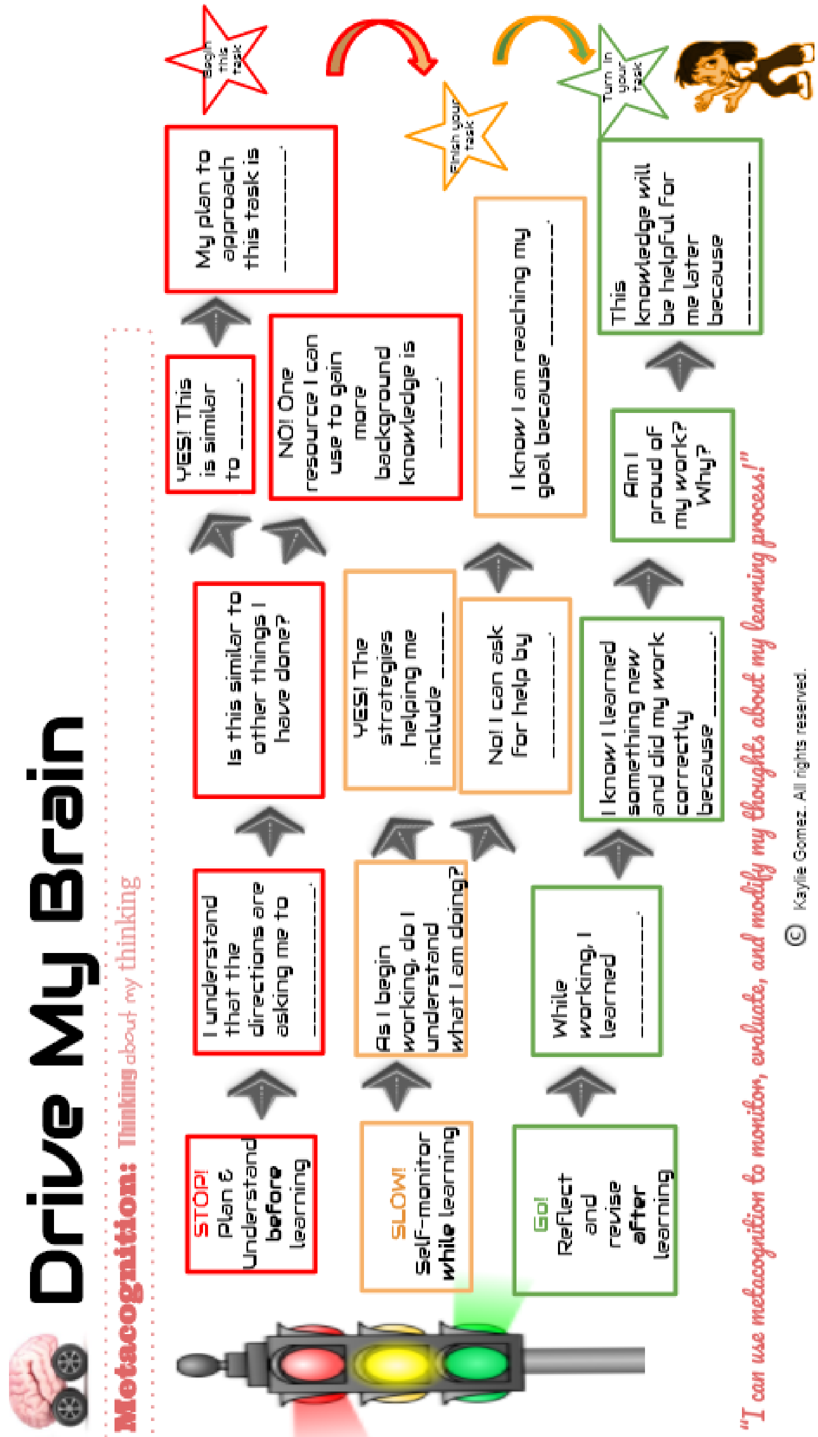
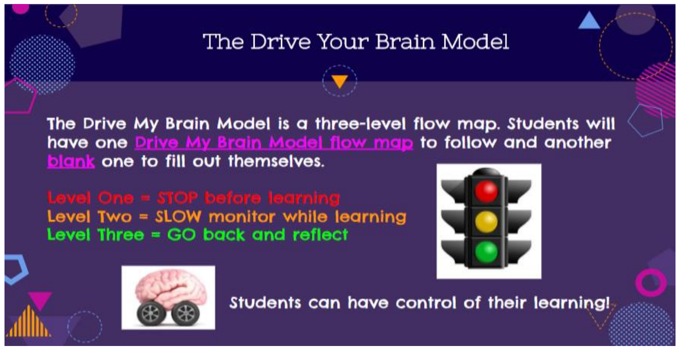
APPENDIX A

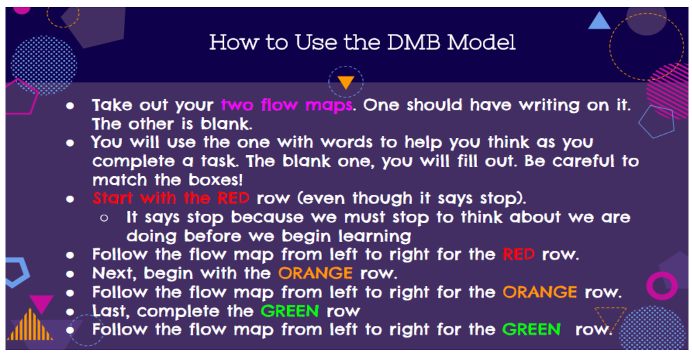
Drive my Brain Model

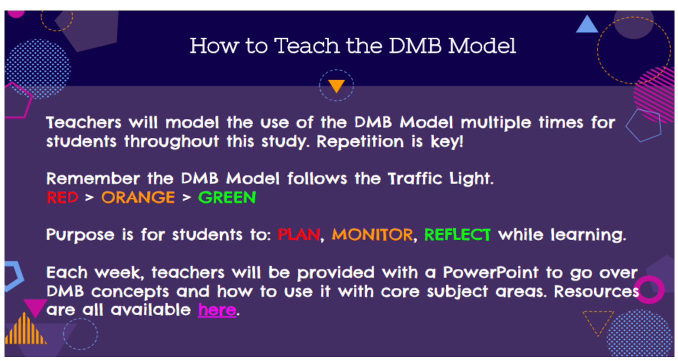


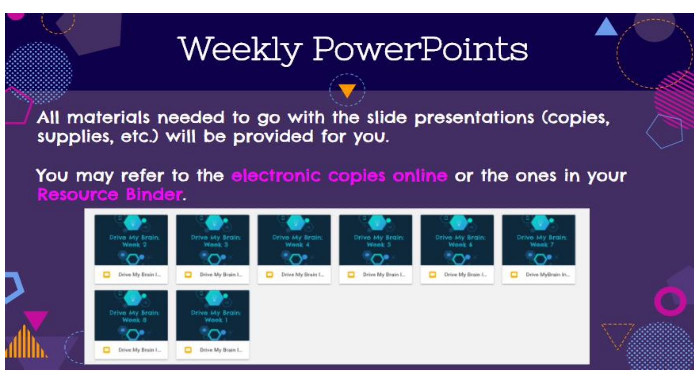
APPENDIX B

Sample of Teacher Training









APPENDIX C

Pre and Post-Tests

The Jr. Metacognitive Awareness Inventory

We are interested in what learners do when they study. Please read the following sentences and circle the answer that relates to you and the way you are when you are doing school work or home work. Please answer as honestly as possible.

1 = Never 2 = Seldom 3 = Sometimes 4 = Often 5 = Always

1. I know when I understand something.	1	2	3	4	5
2. I can make myself learn when I need to.	1	2	3	4	5
3. I try to use ways of studying that have worked for me before.	1	2	3	4	5
4. I know what the teacher expects me to learn.	1	2	3	4	5
5. I learn best when I already know something about the topic.	1	2	3	4	5
6. I draw pictures or diagrams to help me understand while learning.	1	2	3	4	5
7. When I am done with my schoolwork, I ask myself if I learned what I wanted to learn.	1	2	3	4	5
8. I think of several ways to solve a problem and then choose the best one.	1	2	3	4	5
9. I think about what I need to learn before I start working.	1	2	3	4	5
10. I ask myself how well I am doing while I am learning something new.	1	2	3	4	5
11. I really pay attention to important information.	1	2	3	4	5
12. I learn more when I am interested in the topic.	1	2	3	4	5
13. I use my learning strengths to make up for my weaknesses.	1	2	3	4	5
14. I use different learning strategies depending on the task.	1	2	3	4	5
15. I occasionally check to make sure I'll get my work done on time.	1	2	3	4	5
16. I sometimes use learning strategies without thinking.	1	2	3	4	5
17. I ask myself if there was an easier way to do things after I finish a task.	1	2	3	4	5
18. I decide what I need to get done before I start a task.	1	2	3	4	5

The Cognitive Strategies Use Survey

WHAT I DO WHEN I READ

Thank you for your help today. I'm going to give you a list of statements that represent what people might do when they read. I'd like you to think about what you do and rate on a scale of one to four how much you engage in each of these reading behaviors. There are no right or wrong answers. There may be some people who engage in many of these behaviors and other people who don't do any of them. You may find that you might do some but not all of these things. Just be honest. I would like to know what you think you do when you read.

1 means "I **never or almost never** do this"
2 means "I do this **only occasionally or once in a while**"
3 means "I **usually** do this"
4 means "I **always or almost** always do this

When I *read* a text…

1. I have a purpose in mind when I read.	1	2	3	4
2. I take notes while reading to help me understand what I read.	1	2	3	4
3. I think about what I know to help me understand what I read.	1	2	3	4
4. I preview the text to see what it's about before reading it.	1	2	3	4
5. I summarize what I read to reflect on important information in the text.	1	2	3	4
6. I think about whether the content of the text fits my reading purpose.	1	2	3	4
7. I underline or circle information in the text to help me remember it.	1	2	3	4
8. I use reference materials such as dictionaries to help me understand what I read.	1	2	3	4
9. I paraphrase (restate ideas in my own words) to better understand what I read.	1	2	3	4
10. I try to picture or visualize information to help remember what I read.	1	2	3	4
11. I use typographical aids like boldface and italics to identify key information.	1	2	3	4
12. I critically analyze and evaluate the information presented in the text.	1	2	3	4
13. I go back and forth in the text to find relationships among ideas in it.	1	2	3	4
14. I check my understanding when I come across conflicting information.	1	2	3	4
15. When text becomes difficult, I reread to increase my understanding.	1	2	3	4
16. I ask myself questions I like to have answered in the text.	1	2	3	4
17. I check to see if my guesses about the text are right or wrong.	1	2	3	4
18. I try to guess the meaning of unknown words or phrases.	1	2	3	4
19. Based on what I've read so far, I make predictions of what's to come.	1	2	3	4
20. I connect things that I read to my own life.	1	2	3	4
21. I identify with the characters or subjects I am reading about.	1	2	3	4
22. I form interpretations about the big ideas in a text.	1	2	3	4
23. I revise my interpretations when something in the text surprises me.	1	2	3	4
24. I pay attention to how the author uses language to get the point across.	1	2	3	4
25. After I read, I step back and reflect about the deeper meaning and relate what I've read to other texts or situations.	1	2	3	4

The Cognitive Strategies Use Survey Continued

WRITING ABOUT WHAT I'VE READ

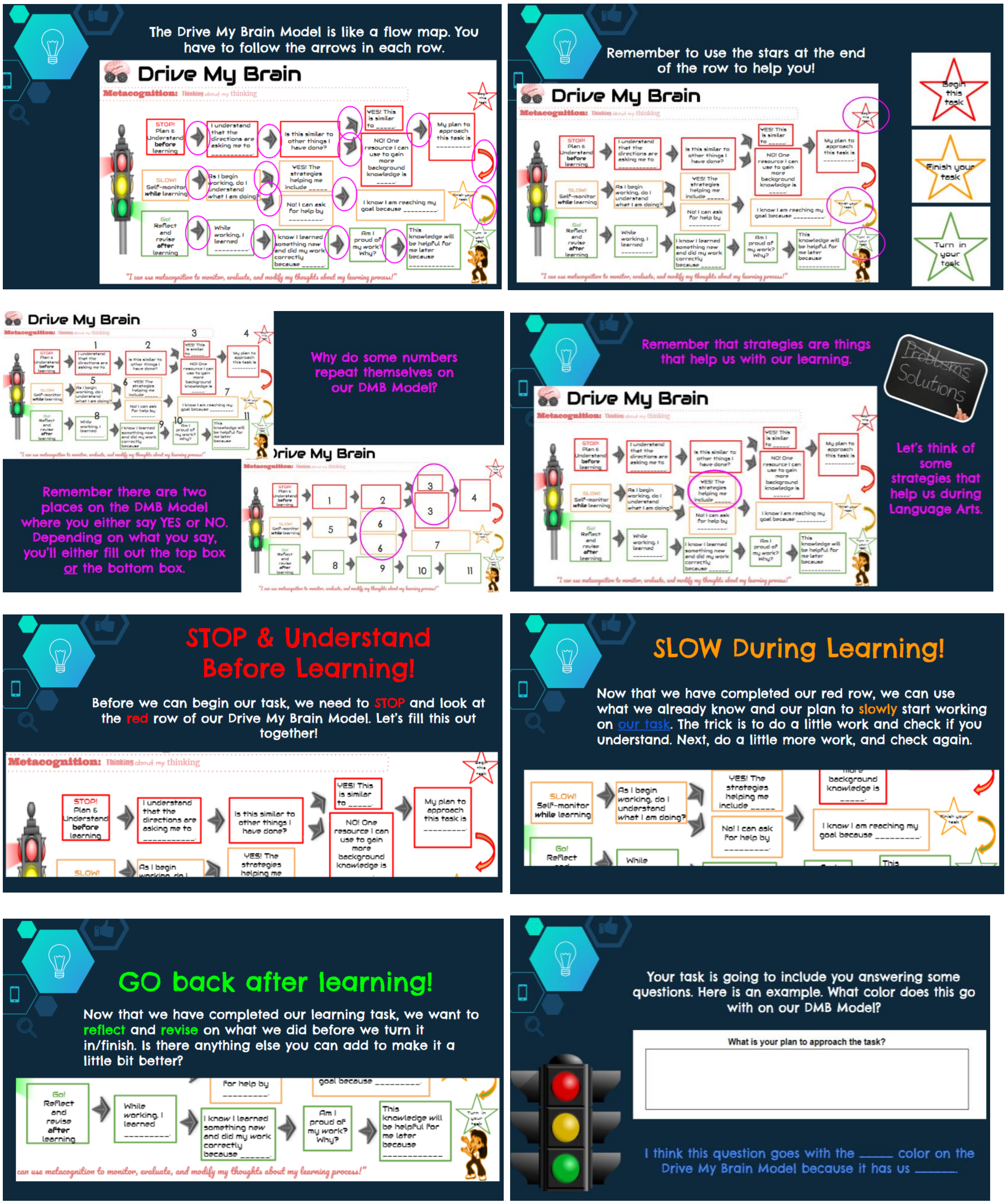
Thank you for your help today. In school, you are often asked to write about something that you have read. I'm going to give you a list of statements that represent what people might do when they write about an article, book, or story. I'd like you to think about what you do and rate on a scale of one to four how much you engage in each of these behaviors related to this kind of writing. There are no right or wrong answers. There may be some people who engage in many of these behaviors and other people who don't do any of them. You may find that you might do some but not all of these things. Just be honest. I would like to know what you think you do when you write about something you've read.

1 means "I **never or almost never** do this"
2 means "I do this **only occasionally or once in a while**"
3 means "I **usually** do this"
4 means "I **always or almost** always do this

When I WRITE about what I've read…				
1. I have a purpose in mind when I write.	1	2	3	4
2. I think or brainstorm about everything I know about the topic in general in order to help me figure out what to write.	1	2	3	4
3. I think or brainstorm about what I've just read in order to help me figure out what to write.	1	2	3	4
4. I make notes about what I've just read in order to help me figure out what to write.	1	2	3	4
5. I pay attention to the directions in the essay's prompt in order to help me figure out what to write.	1	2	3	4
6. I summarize what I've just read, either on paper or in my head, in order to reflect on important information from the reading.	1	2	3	4
7. I skim what I've just read to find the parts that fit with my writing purpose.	1	2	3	4
8. I underline or circle information in what I've just read in order to help me figure out what to write.	1	2	3	4
9. I paraphrase or restate ideas in my own words as I write about what I've read.	1	2	3	4
10. I try to picture or visualize what I've just read about in order to help me figure out what to write.	1	2	3	4
11. I critically analyze and evaluate the information presented in what I've just read in order to help me figure out what to write.	1	2	3	4
12. I reread parts of the text that were difficult, either before or as I write, in order to increase my ability to write about what I've just read.	1	2	3	4
13. I ask myself questions about what I've just read, either before or as I write, in order to increase my ability to write about what I've read.	1	2	3	4
14. While writing, I imagine the reaction that readers of my writing might have.	1	2	3	4
15. I try to stick to the rules and formats I've learned about writing paragraphs and essays and apply them to my writing.	1	2	3	4
16. I try to keep in mind the grammar and punctuation.	1	2	3	4
17. I try to incorporate new vocabulary words, either from class or what I've just read, into my writing.	1	2	3	4
18. I usually write several drafts when I'm writing a paragraph or an essay.	1	2	3	4
19. I divide up ideas from the text I've just read into camps or sides, either before or as I write, in order to figure out what information will support the points I am trying to make.	1	2	3	4
20. I reread my paper to see where the reader might get lost and revise my meaning when necessary.	1	2	3	4
21. I analyze my own craft as a writer so that my words will have an impact on my readers.	1	2	3	4

APPENDIX D

Sample Google Slide Presentation



APPENDIX E

Student Tasks

English Language Arts Task

Task: Read the story below. What is the theme of the text? Explain using key details from the text to support your answer.

The Shiny Red Helmet By Kiki E.

A few months ago Fred got a skateboard for his 9th birthday. It was shiny red with white stripes. It came with a matching helmet. Fred was excited to ride his new board because lots of his brothers' friends like to ride, and Fred liked to spend time with the big kids. So, Fred tried on his new helmet, and he felt ridiculous! It seemed like the helmet was too big, but his mom insisted, "No helmet, no wheels." So, Fred snapped the helmet into place and headed out the door. He didn't feel "cool", but he had a plan. As soon as Fred was out of sight, he yanked off the helmet and left it on the curb to pick up later before he rolled back into his mom's view. Fred was breaking a rule, and he knew it.

The wind whipped through Fred's curly hair, and he felt free. After all, what could really happen? A skateboard is only a few inches off the ground. Well, Fred had no idea what could really happen, so off he flew down the road. A disaster was just waiting for him, and he didn't know it. It seemed to happen all at once. Fred could tell he was losing control, but he didn't know how to stop the board from rolling so quickly. He tried putting a foot on the ground, but all that did was burn a little of the rubber off the edge of Fred's shoe. So, Fred did what most out-of-control riders would do, and he jumped off. Things were in slow motion for Fred at this point. When the motion stopped, he thought something hurt, so he put his hand on top of his head. It didn't feel like it usually did in the morning when he combed his hair. There was an extra bump on top like an egg in a nest. Oh boy. Fred knew he had a problem. As he walked home, Fred tried to make up a story that would make sense to his mother, but nothing made any sense through his dizziness. Fred knew he had to tell his mother what had happened. Fred knew he was in trouble. "You are grounded," was all he could hear. And, more importantly, Fred knew that there was a trip to Doc Alley in his immediate future. The doctor confirmed what Fred already knew. He had a seriously big goose egg on the top of his head because he broke the most important rule of the road. No helmet, no wheels…

After a week-long wait, Fred was allowed back on his skateboard. That had given Fred plenty of waking hours, 112 long ones to be exact, to think about how he had gotten himself into this situation in the first place. Fred was happy to see that as the week went on, the goose egg disappeared because that didn't look "cool" at all. As the goose egg faded, something became clear to Fred. Number one, moms generally know what they are talking about. All those years of living give them what some call "life experience", and Fred's mom deserves an apology. Number two, looking "cool" is overrated when it comes to safety- that's for sure! So, as Fred readied himself for the open road, he clicked on his helmet and made a promise to his mother. No helmet, no wheels…no matter what!

English Language Arts Task Continued

What is your plan to approach the task?

What is the theme of the text? Explain using key details from the text to support your answer.

What strategies did you use while completing this task?

What questions did you ask yourself while completing this task?

Math Task

Raven received 138 emails in 6 weeks. She received the same amount of emails each week. How many emails did she receive each week?

What is your plan to approach the task?

How many emails did Raven receive each week?

What strategies did you use while completing this task?

What questions did you ask yourself while completing this task?

Social Studies Task

Creating Your Own Bill of Rights

The Bill of Rights make up the first 10 amendments of the US Constitution. The US Constitution is like a rulebook for our government. The Bill of Rights are a list of things citizens are allowed to do.

Task: Create a Bill of Rights for students at your school! Use the Constitution's Bill of Rights to help you develop 10 things students should be able to do no matter what. Remember to be fair and think creatively.

What is your plan to approach the task?

What rules should your school follow?

What strategies did you use while completing this task?

What questions did you ask yourself while completing this task?

Science Task

Building a Parachute

Task: Build a **parachute** with the items provided that will bring a clothespin man to the ground the **slowest** and **safest** possible way. Remember you can use the Engineering Design Process and The Science and Engineering Practices to help you.

Key Terms:

Velocity	Gravity	Air Resistance (Drag)
The speed of something in a given direction.	A force on Earth that causes things to fall down towards Earth.	Slows things down as they fall

Materials:

2 pipe cleaners
2 feet of string
2 feet of yarn
1 square of tissue paper
1 piece of white copy paper
2 coffee filters
1 ziplock bag
4 inches of tape
1 clothespin man
Scissors

Science Task Continued

What is your plan to approach the task?

Describe the parachute you built.

What strategies did you use while completing this task?

What questions did you ask yourself while completing this task?

APPENDIX F

Student Task Rubrics

English Language Arts Task Rubric

English Language Arts Task

Criterion	Above Average (4)	Average (3)	Below Average (2)	Poor (1)
Task	The student identified a theme for the story using two or more details from the text.	The student identified a theme for the story using one detail from the text.	The student identified a theme for the story, but did not use details from the text to support their answer.	The theme identified did not make sense and was not supported by details from the text.
Metacognitive Awareness and Regulation	The student listed at least 5 questions they asked themselves while learning.	The student listed at least 3 questions they asked themselves while learning.	The student listed at least 1 question they asked themselves while learning.	The student did not list any questions they asked themselves while learning.
Cognitive Strategies	The student listed at least 3 cognitive strategies that helped them complete the task.	The student listed at least 2 cognitive strategy that helped them complete the task.	The student listed at least 1 cognitive strategy that helped them complete the task.	The student had a response that did not discuss cognitive strategies.
			Total Score	/12

Criterion	Above Average (4)	Average (3)	Below Average (2)	Poor (1)
Completion of DMB Model	All necessary boxes of the DMB Model are filled out using thoughtful responses.	Most necessary boxes of the DMB Model are filled out using thoughtful responses.	There is missing information from the boxes and not all responses are thoughtful.	Responses in the boxes is missing or did not contain thoughtful responses.
			Total Score	/4

Math Task Rubric

Math Task

Criterion	Above Average (4)	Average (3)	Below Average (2)	Poor (1)
Task	The student came to the correct answer and had work to support that answer.	The student showed some work that could be correct, but did not reach the correct answer.	The student's work was limited and they did not reach the correct answer.	The student did not show work or reach the correct answer.
Metacognitive Awareness and Regulation	The student listed at least 5 questions they asked themselves while learning.	The student listed at least 3 questions they asked themselves while learning.	The student listed at least 1 question they asked themselves while learning.	The student did not list any questions they asked themselves while learning.
Cognitive Strategies	The student listed at least 3 cognitive strategies that helped them complete the task.	The student listed at least 2 cognitive strategy that helped them complete the task.	The student listed at least 1 cognitive strategy that helped them complete the task.	The student had a response that did not discuss cognitive strategies.
			Total Score	/12

Criterion	Above Average (4)	Average (3)	Below Average (2)	Poor (1)
Completion of DMB Model	All necessary boxes of the DMB Model are filled out using thoughtful responses.	Most necessary boxes of the DMB Model are filled out using thoughtful responses.	There is missing information from the boxes and not all responses are thoughtful.	Responses in the boxes is missing or did not contain thoughtful responses.
			Total Score	/4

Social Studies Task Rubric

Social Studies Task

Criterion	Excellent (4)	Average (3)	Below Average (2)	Poor (1)
Task	The student thoughtfully created 10 rights for students at their school to have.	The student created rights 10 rights for students at their school, but may not have been thoughtful on all of them.	The student created rights for students at their school, but may not have been thoughtful or included all 10.	The student is incomplete and listed responses are not thoughtful.
Metacognitive Awareness and Regulation	The student listed at least 5 questions they asked themselves while learning.	The student listed at least 3 questions they asked themselves while learning.	The student listed at least 1 question they asked themselves while learning.	The student did not list any questions they asked themselves while learning.
Cognitive Strategies	The student listed at least 3 cognitive strategies that helped them complete the task.	The student listed at least 2 cognitive strategy that helped them complete the task.	The student listed at least 1 cognitive strategy that helped them complete the task.	The student had a response that did not discuss cognitive strategies.
			Total Score	/12

Criterion	Above Average (4)	Average (3)	Below Average (2)	Poor (1)
Completion of DMB Model	All necessary boxes of the DMB Model are filled out using thoughtful responses.	Most necessary boxes of the DMB Model are filled out using thoughtful responses.	There is missing information from the boxes and not all responses are thoughtful.	Responses in the boxes is missing or did not contain thoughtful responses.
			Total Score	/4

Science Task Rubric

Science Task

Criterion	Excellent (4)	Average (3)	Below Average (2)	Poor (1)
Task	The student thoughtfully completed the STEM activity using the engineering and design process.	The student completed most of the STEM activity, and used some steps in the engineering and design process.	The student had missing parts to their STEM activity and did not use the engineering and design process.	The student's STEM activity was incomplete.
Metacognitive Awareness and Regulation	The student listed at least 5 questions they asked themselves while learning.	The student listed at least 3 questions they asked themselves while learning.	The student listed at least 1 question they asked themselves while learning.	The student did not list any questions they asked themselves while learning.
Cognitive Strategies	The student listed at least 3 cognitive strategies that helped them complete the task.	The student listed at least 2 cognitive strategy that helped them complete the task.	The student listed at least 1 cognitive strategy that helped them complete the task.	The student had a response that did not discuss cognitive strategies.
				Total Score	/12

Criterion	Above Average (4)	Average (3)	Below Average (2)	Poor (1)
Completion of DMB Model	All necessary boxes of the DMB Model are filled out using thoughtful responses.	Most necessary boxes of the DMB Model are filled out using thoughtful responses.	There is missing information from the boxes and not all responses are thoughtful.	Responses in the boxes is missing or did not contain thoughtful responses.
			Total Score	/4

APPENDIX G

Observation Checklist

Classroom Observation Checklist

Date: ____________________ Group: ___________ Subject: ____________

Language	Variable	Tally
Verbal	Metacognitive Awareness	
Verbal	Metacognitive Regulation	
Written	Metacognitive Awareness	
Written	Metacognitive Regulation	

MA: What students know about what they know, what students know about the task, and what students know about how to use strategies.

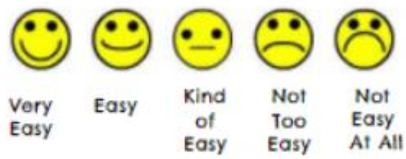
MR: Students monitoring how they are using the strategies, and making changes if needed to control or improve what they know.

Notes:

APPENDIX H

Student Likert Survey Questionnaire

How easy was it to use the DMB Model when you completed this task?



APPENDIX I

Student Interviews

Drive My Brain Intervention Model
Treatment and Control Student Interview #1

Date:
Time:
Location:
Student ID:

1. What can you tell me about your brain?

2. What do you do if something becomes hard in school?

3. How do you think you learn best?

4. Can you tell me what you know about metacognition?

Drive My Brain Intervention Model
Treatment Group Student Interview #2

Date:
Time:
Location:
Student ID:

1. What can you tell me about your brain?

2. What do you do if something becomes hard in school?

3. How do you think you learn best?

4. What kinds of things do you think about while you are learning?

5. What kinds of things do you think about after you are done learning?

6. How would you define metacognition to someone who does not know what it means?

7. What does it mean to Drive My Brain?

8. What do the colors represent on the Drive My Brain Model?

9. Do you think the Drive My Brain Model is helpful? Why or Why not?

Drive My Brain Intervention Model
Control Group Student Interview #2

Date:
Time:
Location:
Student ID

1. What can you tell me about your brain?

2. What do you do if something becomes hard in school?

3. How do you think you learn best?

4. What kinds of things do you think about while you are learning?

5. What kinds of things do you think about after you are done learning?

6. Can you tell me what you know about metacognition?

Drive My Brain Intervention Model
Treatment Group Student Interview #3

Date:
Time:
Location:
Student ID:

1. What can you tell me about your brain?
2. What do you do if something becomes hard in school?
3. How do you think you learn best?
4. What kinds of questions do you ask yourself while you learn?
5. How do you know if you have learned something?
6. Can you tell me what you know about metacognition?
7. What is the Drive My Brain Model?
8. How do you use the Drive My Brain Model?
9. Do you think the Drive My Brain Model is helpful? Why or why not?
10. If you could change anything about the Drive My Brain Model, would you? If so, what?

Drive My Brain Intervention Model
Control Group Student Interview #3

Date:
Time:
Location:
Student ID:

1. What can you tell me about your brain?
2. What do you do if something becomes hard in school?
3. How do you think you learn best?
4. What strategies help you most in school?
5. What kinds of questions do you ask yourself while you learn?
6. How do you know if you have learned something?
7. What do you want more help with in school?
8. Can you tell me what you know about metacognition?

APPENDIX J

Teacher Interviews

Drive My Brain Intervention Model
Treatment and Control Teacher Interview #1

Date:
Time:
Location:

1. How long have you been teaching?

2. What grades have you taught?

3. What are some of the biggest challenges about teaching?

4. What can you tell me about metacognition?

5. Have you ever taught students anything about metacognition or how to use it? If so, when?

Drive My Brain Intervention Model
Treatment Group Teacher Interview #2

Date:
Time:
Location:

1. How have your students responded to the Drive My Brain Model?

2. Have you noticed any changes in your classroom?

3. Have you noticed anything different about the language students use in the classroom?

4. Have you seen students referring to the model or any posters up in the room having to do with DMB throughout the school day?

5. How easy is the Drive My Brain Model to use?

6. How easy do you think it is for your students to use the DMB Model?

7. How does using the DMB Model compare to them not using it during tasks?

8. If you could change something about the Drive My Brain Model or the overall intervention (PowerPoints) would you? If so, what would you do differently?

Drive My Brain Intervention Model
Teacher Interview #2

Date:
Time:
Location:

1. Do you think it is important to model things for your students? Why?

2. What kinds of cognitive strategies do your students use on a daily basis?

3. Last time you mentioned teaching metacognition implicitly through strategies...can you give me some examples of these?

4. What do you teach your students about their thought process?

Drive My Brain Intervention Model
Treatment Group Teacher Interview #3

Date:
Time:
Location:

1. How have your students responded to the Drive My Brain Model?

2. Have you noticed any changes?

3. Have you seen students referring to the model or any posters up in the room having to do with DMB throughout the school day?

4. Do you feel students are able to use the DMB Model independently?

5. What do you feel your students know about metacognition?

6. Would you conduct this intervention again in the future?

7. If you could change something about the Drive My Brain Model or the overall intervention (PowerPoints) would you? If so, what would you do differently?

Drive My Brain Intervention Model
Control Group Teacher Interview #3

Date:
Time:
Location:

1. Over the last 8 weeks, we have done a few tasks (ela, math, social studies, science). How do you feel your students did on the task?

2. What do you think are the most important skills your students should take away from your class?

3. Do you feel your students have high levels of metacognitive awareness or regulation? Can you provide some examples?

4. How do you think explicitly teaching metacognition to students could improve their learning?

5. I developed a tool that helps students gain metacognitive awareness and regulation skills. Would you be interested in learning about this tool and having your students use it?

APPENDIX K

Parent-Informed Consent

A PRELIMINARY STUDY ON THE DRIVE MY BRAIN MODEL ON ENGLISH LANGUAGE LEARNERS' METACOGNITION

The study in which you are being asked to participate is designed to investigate the effectiveness of the Drive My Brain Model intervention on students' metacognition. This study is being conducted by Miss Kaylie Michele Gomez under the supervision of Dr. Belinda Karge, Professor of Doctoral Programs, Concordia University Irvine. This study has been approved by the Institutional Review Board, Concordia University Irvine, in Irvine, California.

PURPOSE: The Drive My Brain Model was developed by the researcher as a tool to help students: (1) plan before they learn, (2) monitor as they learn, and (3) reflect after they learn. Over 50 years of research has shown the benefits of metacognitive abilities and its high correlation to student achievement. The goal of this study is to determine if the Drive My Brain Model will increase student metacognition.

DESCRIPTION: The Drive My Brain Model intervention is an eight-week intervention in which students will learn about metacognition and their brain. The goal is to teach students how to think and about how they learn. Students will participate in roughly 30 minutes a day for 38 days of school.

PARTICIPATION: Participation in this study is voluntary. Students who do not participate will not lose any benefits of which they are entitled to. Furthermore, you may decide to discontinue your participation at any time throughout the duration of the study.

CONFIDENTIALITY OR ANONYMITY: Throughout the study, student work samples and student interviews will be conducted. Students names will not be included on any documents; students will use an identification number for any paperwork involved for this study. Furthermore, all documents will be kept in a locked portable file cabinet that only the researcher has access to. The researcher will not report the name of the school or students in the results of the study.

DURATION: The study will begin October 2, 2017 and end November 22, 2017. This eight-week period consists of 38 school days.

RISKS: There are no major risks involved in this study. Students will be participating in learning similar to what they do on a daily basis. The intervention involves a lot of time. The students will be participating in roughly 30 minutes of intervention a day for 38 days. Although the researcher is not administering the intervention, the researcher works at the school site. Participating teachers and students may alter answers due to thinking the researcher will know who wrote responses.

BENEFITS: Student participation could lead to your child: (1) enhancing metacognitive abilities, (2) learning how to monitor and evaluate their metacognitive abilities, and (3) having a tool that can help them continue to enhance their metacognitive abilities. The goal is to help students realize how they learn best so they can always reach their full potential.

VIDEO/AUDIO/PHOTOGRAPH: Student interviews will be recorded. Not all students will be interviewed. You will be notified if your student will be interviewed.

I understand this research will include audio recordings Initials _______ and/or I understand this research will include photographs of student work Initials ______. You can also choose Yes □ or No □ by checking a box.

CONTACT: For answers to pertinent questions about the research and participants' rights, you may contact Dr. Belinda Karge, Professor of Doctoral Programs, (949)-214-333, Belinda.karge@cui.edu or Kaylie Michele Gomez, Doctoral student, kaylie.gomez@eagles.cui.edu.

RESULTS: Results of the study can be obtained from Concordia University Irvine, located at 1530 Concordia Irvine, CA 92612.

CONFIRMATION STATEMENT:

I have read the information above and agree to allow my child to participate in your study.

SIGNATURE:

Signature: ___________________________________

Date: _______________________________________

Printed Name: _______________________________

The extra copy of this consent form is for your record.

Parent Informed Consent Continued

A PRELIMINARY STUDY ON THE DRIVE MY BRAIN MODEL ON ENGLISH LANGUAGE LEARNERS' METACOGNITION

El estudio en el que se le solicita participar está diseñado para investigar la eficacia del modelo de intervención "Drive My Brain" ("Manejando Su Cerebro") sobre las habilidades metacognitivas de los alumnos(as). El estudio será conducido por Miss Kaylie Michele Gomez bajo la supervisión de la Doctora Belinda Karge, Profesora de Programas de Doctorado, Universidad Concordia de Irvine. El estudio ha sido aprobado por la Junta de Revisión Institucional ("Institutional Review Board") de la Universidad Concordia de Irvine, en Irvine, California.

PROPÓSITO: El modelo Drive My Brain fue desarrollado por la investigadora como una herramienta para ayudar a los alumnos(as) a: (1) planificar antes de empezar una tarea, (2) monitorear su progreso, y (3) reflexionar sobre lo aprendido. Más de 50 años de investigación han demostrado que las habilidades metacognitivas benefician al alumno(a) y existe una alta correlación entre dichas habilidades y los logros alcanzados por los alumnos(as). El propósito de este estudio es determinar si el modelo Drive My Brain ayuda a desarrollar habilidades metacognitivas en los alumnos(as).

DESCRIPCIÓN: La intervención del modelo Drive My Brain toma ocho (8) semanas, durante las cuales los alumnos(as) aprenderán acerca de lo que significa metacognición y el funcionamiento del cerebro. El objetivo es enseñarle al alumno(a) como pensar y cómo reconocer la forma en que aprenden. Los estudiantes participarán en sesiones de 30 minutos por día, durante 38 días de clases.

PARTICIPACIÓN: La participación en el estudio es voluntaria. Los estudiantes que no deseen participar no perderán beneficios a los que tienen derecho. Adicionalmente, los alumno(a) tiene derecho a terminar su participación dentro del estudio en cualquier momento durante la duración del mismo.

CONFIDENCIALIDAD O ANONIMATO: Durante el estudio, muestras del trabajo de los alumnos(as) y entrevistas con los alumnos(as) serán llevadas a cabo. Los nombres de los estudiantes no estarán contenidos en los documentos utilizados, en su lugar los alumnos(as) utilizarán un número de identificación en todos los documentos de este estudio. Adicionalmente, todos los documentos están guardados bajo llave por medio del uso de un gabinete portable al cual únicamente la investigadora tiene acceso. La investigadora no reportará el nombre de la escuela o los estudiantes en los resultados de este estudio.

DURACIÓN: El estudio iniciará el 2 de Octubre de 2017 y concluirá el 22 de Noviembre de 2017. El periodo de ocho semanas contenido dentro de estas fechas representa 38 días de clases.

RIESGO: No existen mayores riesgos relacionados con participar en este estudio. Los estudiantes estarán participando en actividades de aprendizaje similares a las que realizan en el día a día dentro de la escuela. La intervención tomará un tiempo significativo. Los estudiantes participaran en aproximadamente 30 minutos de intervención por día, durante los 38 días del estudio. Aunque la investigadora no conducirá la intervención directamente, la investigadora es parte del personal de la escuela. Existe el riesgo de que los participantes del estudio cambien sus respuestas por creyendo que serán identificados en el estudio.

BENEFICIOS: Los estudiantes que participen en el estudio pueden: (1) mejorar sus habilidades metacognitivas, (2) aprender cómo monitorear y evaluar sus habilidades metacognitivas (3) obtener una herramienta que puede ayudarles a seguir desarrollando sus habilidades metacognitivas. El objetivo es ayudar al alumno(a) a descubrir cómo aprende mejor, para que pueda estudiar mejor y alcanzar su máximo potencial.

VIDEO/AUDIO/FOTOGRAFÍAS: Las entrevistas con los estudiantes serán grabadas. No todos los estudiantes serán entrevistados. Los padres o guardianes legales del alumno(a) serán notificados si el alumno(a) será entrevistado.

Entiendo que este estudio incluye grabaciones de audio *Iniciales* ______ y/o entiendo que este estudio incluye fotografías del trabajo de los alumnos(as) *Iniciales* _______. Favor elegir Si □ o No □ para aceptar o declinar las grabaciones.

CONTACTO: Para preguntas pertinentes al estudio y los derechos de quienes participen en el mismo, puede contactar a la Dr. Belinda Karge, Profesora de Programas de Doctorado, (949)-214-3333, Belinda.karge@cui.edu o Kaylie Michele Gomez, Estudiante de Doctorado, kaylie.gomez@eagles.cui.edu.

RESULTADOS: Los resultados del estudio pueden ser obtenidos en Concordia University Irvine, localizada en 1530 Concordia Irvine, CA 92612

DECLARACIÓN LEGAL:

He leído la información en este documento y estoy de acuerdo con la participación de mi hijo(a) en el estudio.

FIRMA:

Firma: Fecha: ____________________________

Nombre:

La copia adicional de esta forma es para sus récords.

APPENDIX L

Student Assent

A PRELIMINARY STUDY ON THE DRIVE MY BRAIN MODEL ON ENGLISH LANGUAGE LEARNERS' METACOGNITION

I am doing a study to see if the Drive My Brain Model helps students gain more metacognitive skills. I created the Drive My Brain Model to help students think of a plan before learning, monitor their thinking as they learn, and reflect on their thinking after they have learned something. I am asking if you will help me because the Drive My Brain Model has never been studied before.

If you agree to be in my study, you will participate in an eight-week program. Your teacher will spend about 30 minutes a day teaching you about the Drive My Brain Model and how to use it. You will learn about metacognition and how your brain learns information. Some students will be asked to answer interview questions. Additionally, some students will be asked if their work samples can be used as examples. If you work is used as an example, a picture of your work will be taken. Your name will not be on your work.

You can ask questions about this study at any time. If you decide you do not want to be part of the study, you can ask to be removed at any time.

If you sign this paper, it means that you have read this and that you want to be in the study. If you don't want to be in the study, don't sign this paper. Being in the study is up to you, and no one will be upset if you don't sign this paper or if you change your mind later.

Signature of person obtaining assent: ______________________________ Date: _____________

Printed Name of person obtaining assent: ____________________________________

Your Signature: ____ Date: __________________

Your Printed Name: ______________________________________

Student Assent Continued

A PRELIMINARY STUDY ON THE DRIVE MY BRAIN MODEL ON ENGLISH LANGUAGE LEARNERS' METACOGNITION

Estoy estudiando la eficacia del modelo Drive My Brain en ayudar a estudiantes a obtener y desarrollar habilidades metacognitivas. He desarrollado el modelo Drive My Brain con la intención de ayudar a los estudiantes a pensar en un plan antes de aprender, monitorear su aprendizaje durante sus estudios, y refleccionar sobre lo aprendido luego de terminar la actividad. Me gustaria realizar este estudio con tu ayuda, ya que el modelo Drive My Brain nunca ha sido utilizado por estudiantes.

Si aceptas participar en mi estudio, participaras en un programa de ocho semanas. Tu maestro(a) dedicará 30 minutos cada día enseñándote cómo funciona y cómo utilizar el modelo. Durante el tiempo del estudio aprenderás sobre metacognición y cómo tu cerebro aprender información nueva. Pediré además que algunos estudiantes participen en entrevistas y respondan algunas preguntas sobre lo aprendido. Adicionalmente, pediré también a algunos estudiantes si sus trabajos pueden ser utilizados como ejemplos en mi estudio. Si tu trabajo es utilizado como ejemplo, tomaré fotografías de el. Tu nombre no estará en tu trabajo.

Puedes hacer preguntas respecto a este estudio en cualquier momento. Si decides que ya no quieres participar en el estudio, puedes indicarlo y ya no tomarás parte en el.

Si firmas este documento, significa que has leído la información y que deseas participar en mi estudio. Si no deseas participar en el estudio, no debes firmar este documento. Participar en el estudio es tu desición y es completamente voluntario, nadie se molestara contigo si prefieres no ser parte del estudio o si deseas dejar de ser parte de él en el futuro.

Firma de la persona recibiendo la declaración: ________________________ Fecha:__________

Nombre de quien recibe la declaración: ___________________________________

Firma del Alumno(a):___________________________________ Fecha:__________________

Nombre del Alumno(a): _____________________________________

APPENDIX M

Teacher Consent

A PRELIMINARY STUDY ON THE DRIVE MY BRAIN MODEL ON ENGLISH LANGUAGE LEARNERS' METACOGNITION

The study in which you are being asked to participate is designed to investigate the effectiveness of the Drive My Brain Model intervention on students' metacognition. This study is being conducted by Miss Kaylie Michele Gomez under the supervision of Dr. Belinda Karge, Professor of Doctoral Programs, Concordia University Irvine. This study has been approved by the Institutional Review Board, Concordia University Irvine, in Irvine, California.

PURPOSE: The Drive My Brain Model was developed by the researcher as a tool to help students: (1) plan before they learn, (2) monitor as they learn, and (3) reflect after they learn. Over 50 years of research has shown the benefits of metacognitive abilities and its high correlation to student achievement. The goal of this study is to determine if the Drive My Brain Model will increase student metacognition.

DESCRIPTION: The Drive My Brain Model intervention is an eight-week intervention in which students will learn about metacognition and their brain. The goal is to teach students how to think and about how they learn. Students will participate in roughly 30 minutes a day for 38 days of school. Participating teachers will receive training prior to using the intervention with students. Teachers will be asked to participate in three interviews throughout the duration of the study. The goal is to get feedback on the Drive My Brain Model intervention.

PARTICIPATION: Participation in this study is voluntary. You may decide to discontinue your participation at any time throughout the duration of the study.

CONFIDENTIALITY OR ANONYMITY: Participant names (students and teachers) will not be included on any documents. All documents will be kept in a locked portable file cabinet that only the researcher has access to. The researcher will not report the name of the school or students in the results of the study.

DURATION: The study will begin October 2, 2017 and end November 22, 2017. This eight-week period consists of 38 school days.

RISKS: There are no major risks involved in this study. The intervention could add frustration to time management in the classroom, as it will take at least 30 minutes of the school day for the duration of the 8 weeks. Although the researcher is not administering the intervention, the researcher works at the school site. Participating teachers and students may alter answers due to thinking the researcher will know who wrote responses.

BENEFITS: Participation could lead to your students: (1) enhancing metacognitive abilities, (2) learning how to monitor and evaluate their metacognitive abilities, and (3) having a tool that can help them continue to enhance their metacognitive abilities. The goal is to help students realize how they learn best so they can always reach their full potential. You may, as the teacher, find a tool you can use throughout the year with your students and/or with future classes.

VIDEO/AUDIO/PHOTOGRAPH: Student and teacher interviews will be recorded. Not all students will be interviewed, but all teachers will be. I understand this research will include audio recordings Initials _______ . You can also choose Yes □ or No □ by checking a box.

CONTACT: For answers to pertinent questions about the research and participants' rights, you may contact Dr. Belinda Karge, Professor of Doctoral Programs, (949)-214-333, Belinda.karge@cui.edu or Kaylie Michele Gomez, Doctoral student, kaylie.gomez@eagles.cui.edu.

RESULTS: Results of the study can be obtained from Concordia University Irvine, located at 1530 Concordia Irvine, CA 92612.

CONFIRMATION STATEMENT:

I have read the information above and agree to allow my child to participate in your study.

SIGNATURE:

Signature: ___________________________________ Date: _____________________________

Printed Name: ______________________________

The extra copy of this consent form is for your record.

APPENDIX N

Photography/Video/Audio Use

PHOTOGRAPHY/VIDEO/AUDIO USE

As part of this research project, I will audiotape record students during their participation in the experiment. An iPhone and Olympus WS-852 will be used for digital voice recording. Additionally, photographs of student work samples will be collected. iPhones will be used to take pictures of student work samples and convert them to PDF files. Student work will not contain student names, but a random number given to them by their teacher, not the researcher. Please indicate what uses of audiotape/photograph you are willing to consent to by initialing below. You are free to initial any number of spaces from zero to all of the spaces. Your recording will in no way affect your student's participation. I will only use photographs/audiotapes in way(s) you agree to. In any use of these audiotapes/photographs, student names will not be identified.

Please indicate the type of informed consent.

The photograph/audiotape can be studied by the research team for use in the research project.	Please initial _________
The photograph/audiotape can be shown/played to subjects in other experiments.	Please initial _________
The photograph/audiotape can be used for scientific publications.	Please initial _________
The photograph/audiotape can be shown/played at meeting of scientists.	Please initial _________
The photograph/audiotape can be shown/played in classrooms to committee members from the university.	Please initial _________

I have read the above description and give my consent for the use of the photograph/videotape/audiotape as indicated above.

Signature: ___________________________________ Date: _____________________________

Printed Name: _______________________________

The extra copy of this consent form is for your record.

Photo/Audio/Video Use Continued

USO DE AUDIO/VIDEO/FOTOGRAFÍA

Como parte del estudio, se tomarán audio grabaciones de los alumnos(as) durante su participación en el estudio. Un iPhone y Olympus WS-852 serán utilizados para grabaciones de voz. Adicionalmente, fotografías del trabajo de los alumnos(as) serán recolectadas. iPhones serán utilizados para tomar las fotografías del trabajo de los alumnos, las cuales serán convertidas a formato PDF. El trabajo realizado por los estudiantes no contendrá su nombre, sino un número aleatorio asignado por el(la) profesor(a), no la investigadora. Por favor indique en la sección a continuación, si está de acuerdo con la cada uno de los puntos mencionados colocando sus iniciales. Recuerde que tiene el derecho de seleccionar todos o ninguno de los renglones. Su decisión sobre las grabaciones no afectará la participación del alumno(a) en el estudio. El uso de las fotografías y grabaciones dependerá de sus preferencias y no serán utilizadas de ninguna otra manera a las indicadas en este documento. En todos los usos de las grabaciones y fotografías, el nombre del estudiante (a) no será revelado.

Por favor indique con qué uso de las grabaciones y/o fotografías está de acuerdo.

Las fotografías/grabaciones pueden ser utilizadas por la investigadora y su equipo para el estudio.	Iniciales _________
Las fotografías/grabaciones pueden ser reproducidas para participantes en estudios futuros.	Iniciales _________
Las fotografías/grabaciones pueden ser usados en publicaciones científicas.	Iniciales _________
Las fotografías/grabaciones pueden ser reproducidos en reuniones científicas.	Iniciales _________
Las fotografías/grabaciones pueden ser utilizadas/reproducidas en clases para los miembros del comité de la universidad.	Iniciales _________

He leído la información en este documento, y autorizo el uso de las fotografías/grabaciones en la forma indicada en la sección anterior.

Firma:__________________________________Fecha: _____

Nombre Completo: _________________________

La copia adicional de este documento es para sus récords.

APPENDIX O

National Institutes of Health (NIH) Certificate

Certificate of Completion

The National Institutes of Health (NIH) Office of Extramural Research certifies that **Kaylie Gomez** successfully completed the NIH Web-based training course "Protecting Human Research Participants".

Date of completion: 06/23/2017.

Certification Number: 2423212.