TYPES OF SELF-REGULATION PROCESSES IN WRITING QUALITY FOR UPPER ELEMENTARY STUDENTS

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ABSTRACT

The aim of this study was to parse types of self-regulation and understand their relations with writing quality. Various skills within self-regulation are indirectly related to written expression. This is because of their influence on self-regulation processes, such as planning, within the writing process. However, studies have not yet clarified how self-regulation and its subskills influence writing quality. Earlier empirical models did not directly measure self-regulation and planning in the mediation model that is currently regarded as the most comprehensive model of writing to-date. This study sought to explore the specific mediational path between types of self-regulation, planning, and writing quality, so that a case for using specific effective intervention strategies within self-regulated strategy development may be supported. A teacher rating scale, the BRIEF-2, was used to conduct factor analytic, correlational, regression, and mediation analyses with planning and writing quality in a sample of Grade 4 and Grade 5 students (n = 161).

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CHAPTER ONE: INTRODUCTION

Most applied research on writing development and the writing process has emphasized the academic and linguistic aspects of writing. Recognition of cognitive processes has been limited. Cognitive processes include executive functions (EF) and planning, the latter of which falls under the gamut of self-regulation. Self-regulation is the ability to integrate top-down control, or EF processes, with verbal, motor, behavioral, or other response as relevant to the environmental context or demand (Montroy et al., 2016). Many of these responses are necessary for students to produce written output. In the writing literature, self-regulation has been extensively studied through an intervention-based approach (Graham et al., 2012). However, less information exists in the literature about self-regulation using an assessment-based approach within writing models. The potential implication of understanding assessment of self-regulation and EF abilities in writing includes gaining insight into where students are along their continuum of development. This study addresses EF and self-regulation in the context of writing.

The interactive relations hypothesis in writing (Kim & Graham, 2022) suggests that the nature of development of writing abilities and component skills, such as self-regulation, is bidirectional and interactive. Self-regulation, which includes self-initiation and self-monitoring, does not necessarily occur through innate learning, however, and must be included as an instructional objective. Writing instruction is one possible way to facilitate students' building of self-regulatory skills because it provides opportunity not only for practice within writing but also for an explicit method by which to self-regulate during a typically frustrating task. In using writing instruction to help students build self-regulatory skills, there might also be the possibility of students transferring foundational EF and advanced self-regulation to other areas of academic achievement (e.g., Dawson, 2021).

In the context of academic achievement, school readiness, and social-emotional development, EF are considered important control processes that affect behavior -- including writing (Ackerman & Friedman-Krauss, 2017; Diamond, 2013). Some researchers even maintain that EF could be embedded within instruction for core school subjects given previous findings that EF support school readiness and success (Baggetta & Alexander, 2016; Blair, 2002; Diamond & Lee, 2011). EF are a core consideration in facilitating the development of self-regulatory skills (Flook et al., 2015), and are important for learning (Baggetta & Alexander, 2016; Blair, 2002). Likewise, self-regulation skills are also contributing factors for ideal learning conditions (Blair, 2002). Therefore, it is supported that EF develop in preparation of, or as a first step to self-regulation skills, which in this context are defined as the ability to execute goal-directed tasks, planning, and self-monitoring.

Foundational EF develop prior to the development of self-regulatory skills as a hierarchical process (Drijbooms et al., 2015). Though less studied, EF and self-regulation have been included as components in current academic reading and writing models. However, there lacks significant consensus about the ranges and boundaries of EF and self-regulatory processes, particularly as they are used and can be used in supporting developing writers. A cognitive self-regulatory process within writing for a fourth grader might be to first mentally create a list of ideas to include in responding to a prompt. Next, to reduce working memory strain while composing, creating a written plan and externalizing cognitions in advance would support swifter composing. Studies have demonstrated strong links between cognitive self-regulation, working memory, and writing achievement. Additionally, there are other EFs and self-regulatory processes that influence writing. Whereas cognitive self-regulation is more proximal, the other EFs and processes may be more distally located from writing achievement. Simultaneously, there

is also research evidence to support that it is difficult to determine these relations because of disagreement regarding the bounds of these constructs, as well as how to best measure them. Finally, this topic is timely because interest in EF and self-regulation and their relation to scholastic achievement is especially high as researchers note the challenges for students returning to schools following the now contained Covid-19 pandemic (e.g., Chairunnisak et al., 2022; Dawson, 2021; Liu & Doan, 2020).

In this study, I will explore a specific path by which EF influences self-regulation in writing to predict student writing performance. This study also incorporates assessment procedures that are commonly used by school psychologists (behavior ratings scales and curriculum-based measurement in writing) as a way to more effectively shape the use of psychoeducational assessments. In delving into the relations between EF and self-regulation with writing outcomes, an overview of the evolution of writing theory and the most current structural model called the Direct and Indirect Effects of Writing (DIEW; Kim & Park, 2019) is provided. Following is a description of each relevant EF and other component skills that inform this study.

Cognitive Theories of Writing

Although Flower & Hayes (1981) are often credited with first drawing attention to cognitive aspects of written expression using protocol analysis, others expanded on the cognitive and language components. Kellogg (1988) first demonstrated that advance planning in the form of a written or mental outline (a strategy used to aide working memory by creating an external representation of the composition plan, based on the memory hypothesis) improved text quality in college students. At present, we know that planning is one of the most important and effective self-regulatory processes within writing. High quality writing processes begin with planning,

which requires students to generate ideas before addressing order and stylistic elements of writing, which can often distract students from quality writing.

After the inclusion of planning as an early cognitive component within the writing process for adults, the Not So Simple View of Writing and the Not So Simple View of Writing-2 established EF as one of three major necessary components for any model of written expression (Berninger & Chanquoy, 2012). The models were facilitated by technological advances in neuropsychology, brain imaging, advanced statistical models, and personal computers (Berninger & Winn, 2006). These models showed bivariate correlational associations between EF and different aspects of writing. Current research has expanded to suggest more complex relations, particularly for developing writers.

Current Writing Model: DIEW

The Direct and Indirect Effects of Writing (DIEW) model is a current ground-breaking model in writing development research. DIEW is more comprehensive than previous models and shows dynamic, hierarchical, and developmental relations between different components of writing (Kim & Park, 2019). Although specific relations between self-regulation and writing outcomes have not yet been studied in the context of assessment and DIEW, the model points to the constructs of EF, higher level cognitions, and self-regulation as critical for written expression.

Within DIEW, component skills may directly or indirectly influence writing outcomes depending on the developmental age of the early writer, per the dynamic relations hypothesis (Kim & Park, 2019; Kim & Graham, 2022). As early as Grade 1, higher level component skills, which involve self-regulation and planning, have been reported to influence written expression outcomes (Kim & Schatschneider, 2017). Separately, domain-general EF or foundational

cognitions have a hierarchical relation to writing quality and writing ability (Kim & Park, 2019; Kim & Graham, 2022). Foundational cognitions or EF effects are indirectly related to writing outcomes via translation of oral language to written discourse. Next, domain-specific EF or higher-level self-regulation skills are directly and indirectly related to writing outcomes via transcription and translation of discourse, as also explained through the hierarchical relations hypothesis (Kim & Park, 2019; Kim & Graham, 2022).

Finally, the relation between self-regulation and writing outcomes and the relation within various writing component skills is interactive and bidirectional. For example, greater self-regulation abilities positively feed into written expression outcomes and vice-versa; with greater written expression, self-regulation abilities continuously improve (Kim & Park, 2019; Kim & Graham, 2022) in consideration of a feedback loop. These empirical models support earlier intervention research showing the impact of self-regulation instruction on writing performance (e.g., Graham & Harris, 2000). The interactive relations hypothesis, however, supports a case for examining self-regulation also from an assessment-based approach. The hierarchical relations hypothesis makes the same case for examining EF.

Executive Functions in Writing Achievement

Foundational or domain general cognitions considered necessary for writing include working memory (WM), inhibitory control (IC), and shifting (SH; Diamond, 2013; Kim & Park, 2019). WM is defined as the space in human cognition within which information from the environment and long-term memory is manipulated during processing (McCutchen, 1996; Spiegel et al., 2021). IC is defined as the process by which a dominant response is suppressed for a less dominant one (e.g., Spiegel et al., 2021). SH is defined as the ability to engage and disengage attention between competing mental sets or tasks (e.g., Spiegel et al., 2021).

According to Drijbooms et al. (2015), EF of inhibition and SH (updating) moderate students' capacity to produce story content, syntactic complexity, and text length in writing.

Studies of children in preschool and early elementary school have shown rapid and exponential development of EF and self-regulation early on, with growth slowing as age increases (Montroy et al., 2016). For example, Riggs et al. (2006) reported a two-fold increase between ages 5 and 10 in visual WM. Spiegel et al. (2021) also posited that in early elementary school, it may be difficult to disentangle the three EF as separate constructs, which changes in upper elementary school. While in upper elementary, the three EF maybe more distinguishable from each other, the discussion for early elementary students may only consist of the EF of WM and IC with SH not necessarily evident yet as a separate detectable process (Spiegel et al., 2021). Nonetheless, the three foundational cognitions have been found to explain variance in current models for reading, components of which share variance with components of writing (Spiegel et al., 2021).

Working Memory

Most relevant to the discussion of writing development and related cognitive processes has been WM. WM has been demonstrated to show both direct and indirect effects on writing quality. For example, Grade 1 WM had significant direct effects on Grade 3 writing quality (Kim & Park, 2019). Grade 1 WM also had significant indirect effects on Grade 3 writing quality via foundational language skills (vocabulary and grammar) and inference, as well as exclusively via Grade 1 inference (Kim & Park, 2019). Finally, Grade 1 WM also had significant indirect effects on Grade 1 writing quality via foundational language skills (vocabulary and grammar), and transcription skills (spelling and handwriting).

Inhibitory Control

IC is another EF that is discussed in writing achievement. IC involves supplanting a subdominant response over a dominant response (Spiegel et al., 2021). The suppression may occur at the behavioral or cognitive level (Altemeier et al., 2008). Studies of EF and writing outcomes have demonstrated some effects of IC on writing (Altemeier et al., 2008). In the behavior and self-regulation literature, IC is often discussed as an EF necessary for delayed gratification (Mischel et al., 1989; Shoda et al., 1990; Spiegel et al., 2021). In one delayed gratification task, a child is presented with a desirable reward (e.g., a marshmallow). The child is then offered a greater reward or more autonomy (e.g., choosing their own reward versus an examiner choosing for them), if they are able to inhibit the instinct to claim the immediate reward being offered (Shoda et al., 1990). Notably, however, IC and other EF may not be quite distinct from each other for the four-year-old children in this type of study (as IC begins to develop at this age), and even throughout early elementary school (Altemeier et al., 2008; Spiegel et al., 2021). Nonetheless, early ability to exhibit IC predicts improved academic outcomes (e.g., performance on the SAT) and management of complex emotions in adolescence (Shoda et al., 1990). Importantly, the ability to wait in this task has shown cross-cultural differences and may be linked to income, suggesting malleability in the IC construct.

Shifting

The final foundational cognition under study for written expression is SH, which describes the basic brain ability to manage alternating one's attention between competing tasks or multiple elements within tasks (Spiegel et al., 2021). Like IC, SH has demonstrated some effects on writing outcomes (Altemeier et al., 2008). Because this is a foundational cognition, or

lower-level EF, the act of switching may vary in degree of deliberateness. This variation in deliberateness might be answered by studying relations with higher-level skills, such as planning.

Theories of Self-Regulation and Writing Development

Self-regulation includes cognitive, behavior, and emotion modulatory responses to implicit and explicit cues in one's environment (Ziv et al., 2017). Children develop more sophisticated self-regulation with increasing age (DeGangi, 2017). This self-regulation develops into goal-directed behavior which is essential for organizing one's ideas into writing (Cirino et al., 2018; Posner et al., 2014).

Notably, EF and self-regulation are not synonymous. However, the development of self-regulation begins early, in the first year of life, with the building of EF (e.g., Ziv et al., 2017). Over time, EF manifest as behavior and other self-regulatory skills (Miyake & Friedman, 2012). Due to its evolving nature, there are limitations for assessing self-regulation in childhood (Howard et al., 2019). Nonetheless, capturing self-regulation across early development has important implications for early education, particularly following prolonged pandemic-induced isolation for multiple years.

Considering development, an appreciation of the cognitive neuroscience literature must also be made as it lends support to the idea that emotion regulation may be related to writing processes. Both behavioral and neural mechanisms have been found to be important for the development of self-regulation (Posner et al., 2014). Specifically, WM, IC, and SH recruit the same brain areas that are implicated in emotion regulation (Kim & Park, 2019; Martin & Ochsner, 2016; Zelazo & Cunningham, 2007). These areas are the dorsolateral prefrontal cortex for WM, ventrolateral prefrontal cortex for IC, and the medial prefrontal cortex for SH to select between competing stimuli (Martin & Ochsner, 2016; Spiegel et al., 2021). Notably, while the

three EF of WM, IC, and SH have been studied for academic outcomes relating to reading, oral language, and mathematics, writing remains to be explored (Spiegel et al., 2021).

Types of Self-Regulation and Their Relations to Academic Achievement Development

Successful writers use self-regulation when they write. Studies underscoring the significance of self-regulation in academic achievement are plentiful. However, the parsing of self-regulation processes in relation to specific EF as well as an emphasis on writing are lacking in the literature. Studies of writing development must regard that writing is a social-cognitive process and must thus consider social, behavioral, motivational, and cognitive processes separately and together (Zimmerman & Risemberg, 1997). In addition to the inclusion of EF in types of self-regulation, Zimmerman and Risemberg (1997) discussed behavioral, covert, and environmental self-regulation as reciprocal determinants of self-regulated functioning within writing (involving the person or self, behavior, and environment).

The connection between types of self-regulation and EF is that domain general EF comprise later self-regulation (Miyake & Friedman, 2012). For example, the EF of WM, in combination with other skills such as planning and organizing, are the elements of cognitive self-regulation (Kim & Schatschneider, 2017; McCutchen, 1996; Spiegel et al., 2021). IC in combination with self-monitoring are the elements of behavior self-regulation (Ziv et al., 2017). Finally, SH (also, cognitive flexibility) and emotion control (also, effortful control), are the elements of emotional self-regulation (Ziv et al., 2017). Appendix C describes the relationship of each EF and self-regulation skills. The following sections explain how three distinct self-regulation processes are supported by various EF.

Behavior Regulation

Behavior regulation describes the ability to modulate behavior. Behavior regulation involves controlling disinhibition, such as by stopping oneself from displaying a confused look on the face upon hearing a confusing comment or simply by stopping another physical or verbal reaction. Behavior regulation may be required for cognitive and self-regulation (Gioia et al., 2015; Munoz & Filippetti, 2021) and is thought to precede the development of other self-regulation skills (Altemeier et al., 2008).

Clinical indicators of behavior regulation have demonstrated negative relations with academic achievement areas, although it is unclear which precedes the other. Measures on the first version of the Behavior Rating Inventory of Executive Function (BRIEF) were found to be statistically significantly correlated with areas of academic achievement including reading and arithmetic (McAuley et al., 2010). Specifically, for children between the ages of six and 15 (M_{age} = 10), the Behavior Regulation Index and the Metacognition Index were significantly correlated with reading and arithmetic (McAuley et al., 2010).

Apart from the BRIEF, the Head-Toes-Knees-Shoulder (HTKS) task is a performance task often used in the literature to measure behavior regulation for early elementary schoolchildren. The task requires students to inhibit literal translation of verbally provided instructions and apply a new rule different than the one learned earlier to carry out a behavioral task (Ponitz et al., 2009). For example, initial instructions might be, “touch your head,” after which students would execute the action of placing their hands on their head. After several trials, the students would be instructed to instead touch their toes upon hearing the same, “touch your head” command (Ponitz et al., 2009). McClelland et al. (2014) found that this task significantly predicted academic growth in vocabulary and math for early elementary students. Extending to

the academic area of writing, Puranik et al. (2019) found significant correlations between the HTKS task and writing outcome measures for early schoolchildren. They reported that for a sentence-writing task, the HTKS task explained 5% of variance in the correct writing sequences accuracy metric often used as a proxy for writing quality for early writers. For an essay writing task, the HTKS task explained 4% of the variance in correct writing sequences (Puranik et al., 2019). Albeit small correlations, studies of the HTKS self-regulation task are scarce with those available reporting only small (and a few moderate) correlations between HTKS and writing component skills for early elementary writers (Puranik & Li, 2022).

In studying relations between behavior regulation and academic achievement, other researchers have also used the HTKS task. Montroy et al. (2014) showed that performance on the HTKS task was mediated by students' teacher-reported problem behaviors and ability to demonstrate social skills to predict growth in literacy. Similarly, Valiente and colleagues (2011) showed that early elementary children's effortful control was fully mediated by their parent-reported social skills and functioning in predicting academic achievement in a six-year longitudinal study. Effortful control in the study was described as the efficiency of using foundational EF contributing to self-regulation, such as behaviorally inhibiting dominant responses and executing a subdominant response, error detection, and planning. Mediators of social functioning included externalizing behaviors and social competence, which are both relevant to behavior regulation. This supports the idea of a potential hierarchical structure in which foundational EF fall at the base, and types of self-regulation may be placed above the base level, to then contribute to overall self-regulation with academic skills (e.g., Morrison et al., 2010).

Emotion Regulation

Emotion regulation encompasses the ability to modulate emotional responses, including in dynamic circumstances. It is pertinent to the discussion of academic achievement. Although not often considered in academic intervention, emotion regulation should be considered as a potential target for intervention and assessment (Gioia et al., 2015). This is because it can influence behavior and cognitive regulation, both of which are related to academic outcomes. In discussing behavior regulation and effortful control in the previous section, effortful control is situated as a cluster of temperamentally-based skills that form the foundation for self-regulation (Valiente et al., 2011). Furthermore, when concerns with emotion regulation are elevated, it is possible that cognitive regulation is being negatively affected (Gioia et al., 2015). Emotion dysregulation has a long history in various mental health disorders (Heatherton, 2011; Sargunaraj et al., 2021), which contribute to poor concentration that inhibit learning and efficient uptake of information – all functions of cognitive regulation (described next). Finally, some of the most effective writing interventions involve an emotion regulation component (Harris et al., 2002; Sargunaraj et al., 2021). Thus, because there is interplay between writing and emotion regulation in the intervention process (Harris et al., 2002; Sargunaraj et al., 2021), emotion regulation must be weighed in writing assessment (for effective intervention).

Even after accounting for children's standardized intelligence quotients, emotion regulation predicts academic outcomes (Graziano et al., 2007). Emotion regulation also positively relates to students' literacy and math achievement (Graziano et al., 2007). These findings are not surprising and may be similar for writing achievement for two reasons. First, it may be because writing is a specific part of literacy achievement, and shares foundational cognition processes with math achievement (e.g., WM, IC, and SH; Spiegel et al., 2021).

Second, it may be because many of the foundational cognitions in writing involve proximal brain regions that are implicated in emotion regulation (Kim & Park, 2019; Martin & Ochsner, 2016; Zelazo & Cunningham, 2007). In fact, there is disagreement about how EF and the brain regions involved in these processes interact within the conscious use of emotional regulation (Zelazo & Cunningham, 2007).

Another relevant construct in the context of emotion regulation and writing involves motivation and motivational processes (e.g., self-efficacy). DIEW and other models of writing included motivation as a component of writing performance (Graham et al., 2017; Graham et al., 2019; Kim et al., 2015). For example, one study found that when writers set goals, (i.e., when planning and revising), their self-efficacy – a motivational process – is increased (Schunk & Ertmer, 2000). Relatedly, students' self-efficacy in writing achievement was found to decrease from Grade 4 to Grade 8 (Pajares et al., 2007). Considering triadic reciprocality and interactions between behavioral, environmental, and personal (cognitions and emotions) factors in Social Cognitive Theory (Schunk & DiBenedetto, 2020), both bidirectionality and unidirectionality between emotion regulation and motivational processes might be considered in writing achievement (Graham et al., 2017; Kim et al., 2015).

Cognitive Regulation

Cognitive regulation is theorized to capture higher-order thinking and is considered essential in facilitating a writer's improvement from within their own writing efforts (Zimmerman & Risemberg, 1997). Hence, cognitive regulation requires awareness on the part of an individual and includes metacognition, WM, organization, and planning. Awareness becomes a factor because to some degree, an individual needs to know the goal or task at hand, and how to meet that goal. Academic interventions in literacy often include targeting metacognitive

awareness (e.g., Ciullo et al., 2016). For example, Self-Regulated Strategy Development and planning interventions are two such interventions that emphasize metacognitive skills to produce improved writing outcomes.

Teaching planning to writers is one way that writers can harness cognitive regulation. Planning (Appendix C) is an initial step in the writing process that involves idea generation, organization, and goal development (Graham et al., 2012). When planning is taught and learned students and adults have significantly greater writing quality (Kellogg, 1988; Limpo & Alves, 2018). The relation is maintained for middle and high school students (Limpo & Alves, 2013). Similarly, in mathematics and reading, a higher WM span – as a foundational EF in cognitive regulation – is also associated with greater performance (McClelland & Cameron, 2011).

However, WM may not be the only foundational EF related to cognitive regulation for academic activities (Spiegel et al., 2021). This indicates the possibility of shared variance between types of self-regulation due to common EF. For example, IC and SH are also implicated when engaging in academic tasks that rely heavily on cognitive regulation, such as deciphering the pronunciation of a word or carrying out the steps for a complex math problem (Spiegel et al., 2021). Simultaneously, foundational EF primarily contributing to cognitive regulation, such as WM, might contribute to other types of regulation, such as behavior regulation (Gioia et al., 2015). For example, the HTKS task is primarily considered a behavior regulation task with IC as its primary foundational EF, but it was shown to capture WM and cognitive flexibility, or SH (McClelland et al., 2014). To note, the behavior regulation task also significantly predicted growth in vocabulary for early elementary students (McClelland et al., 2014). WM and cognitive flexibility (or SH) are considered features of cognitive and other self-regulatory processes. Therefore, although the three EF of WM, IC, and SH are considered foundational functions that

are isolated and independent from each other, various combinations may contribute to multiple types of regulatory processes.

Planning

Planning is the initial process in written composition that includes idea generation, memory access, goal-setting, and organizing (Graham et al., 2012; Hayes & Flower, 1986). The planning process begins with a representation of the initial task and proceeds with the development of goals and subgoals with self-monitoring allowing for revision and modification to achieve those goals and subgoals (Flower & Hayes, 1981; Hayes & Flower, 1986). Simplified, planning engages three cognitive subcomponents: gathering information from long-term memory, goal-setting, and organizing the information culled from long-term memory to meet set goals (Zimmerman & Risemberg, 1997). For a fourth grader, this looks like reading the prompt, recalling from memory what they know about a topic, and determining a sequence or order in which to present that information. This sequencing and organizing aspect of planning within the writing process, such as by creating a list or web diagram, is emphasized to produce quality writing.

Studies have repeatedly demonstrated the significance of planning to produce quality writing, in English and a handful of other languages. Experienced writers produce enhanced text quality when planning their work in advance (Kellogg, 1988; Limpo & Alves, 2018). Adolescents who plan their writing also produce more sentences in their text (Williams et al., 2019) as well as better quality writing (Limpo et al., 2014). Other aspects of planning also produce improved quality scores, such as time spent on planning for argumentative text, and the number of planning episodes for narrative text (Beauvais et al., 2011). Ultimately, planning

reduces cognitive load during writing (Kellogg et al., 2013), thereby allowing the writer to focus on other elements of writing.

Per earlier models (e.g., Hayes & Flower, 1986), a distinction may be made between online and offline planning, the former of which is measured via EF tasks. Advance planning is typically measured by evaluating what the writer has transcribed in preparation for the writing task. Superior planning elucidates organized relations between ideas, parts, and propositions (Hayes & Flower, 1986; Olinghouse & Graham, 2009). It remains to be conclusively determined whether for the young writer, the two types of planning may be dichotomized due to the developmental nature of EF and higher-level regulatory skills. Much of the literature on planning indicates that it is a significant predictor of writing quality, particularly for more developed writers. The case for early writers may be different in terms of weaker relations with writing quality, depending on their level of self-regulation skills. It may be that early writers do not yet have the behavior and cognitive self-regulation skills required for planning in writing, such as sitting down, shifting focus from the writing prompt, and creating an outline or structural map of ideas to include to meet writing goals. Notably, for early writers, self-regulation abilities are significantly correlated with the number of correct writing sequences their writing contains (Puranik et al., 2019). Planning is a manifestation of self-regulation skills in writing and is developed through instruction. Therefore, students must be explicitly taught that their ideas can be first captured on paper by using a list or graphic organizer to serve as a working memory aid to which they can return at any point to ensure that all parts of the essay have been included. Considering the important element of repeated practice, teaching self-regulation equates to teaching planning. Teaching planning is an effective intervention for elementary students (Arrimada et al., 2019), adolescents (De La Paz & Graham, 2002; Graham and Perin, 2007,

Torrence et al., 2015), and for children with significant writing difficulties (Saddler & Asaro, 2007). Students who engage in planning, employing their self-regulation skills such as by setting goals prior to composing, produce better quality writing.

Executive Function, Self-Regulation, and Planning in Writing for Elementary Students

The building of EF and self-regulation in elementary students follows a developmental pattern (e.g., Cirino et al., 2018). For example, various EF differently influence writing outcomes depending on grade level or the skill level of the writer (Altemeier et al., 2006; Puranik et al., 2019). For young writers, the EF of inhibition and updating, but not planning, directly contribute to text length (Drijbooms et al., 2015). For upper elementary writers (Grade 4), more developed aspects of EF and planning (e.g., macro-organization; ordering and logically organizing text) showed moderate differences compared to Grade 1 students' macro-organization skills (Wagner et al., 2011). To note, while EF, self-regulation, and planning are different constructs, their distinctiveness may be limited by the writer's developmental level and by the method used to measure each.

Other Factors Influencing Writing Development

Writing follows a developmental arc with variances changing across grades when the same predictors, or component skills, are added to the model. Students vary greatly in their development across factors including fluency, motor, biological, and environmental factors interacting and transacting within the developing writer, at varying degrees of reinforcement at school and at home. This fluency, gender make-up, and environmental input such as language reinforcement, need to be included in writing models due to known differences in and influences on written composition.

Transcription Fluency (control variable)

Transcription is the mode by which people transmit their words through their hands into print (Hayes & Flower, 1980). It can occur through handwriting or typing. Handwriting and typing involve coordinated hand, eye, and other motor movements to capture the orthographical representations of letters and words in written language (Berninger et al., 1994). However, handwriting and typing are dissimilar modes of written language transcription with only the former requiring continuous pencil movements for letter formation and the latter merely requiring tapping of keys (Troia et al., 2020)

Transcription can constrain other elements for elementary students in the writing process, including planning (Limpo et al., 2017). Although many of the effects of transcription on writing have been demonstrated in English-speaking students, students speaking other primary languages have shown similar results (Limpo et al., 2013). In other studies, for middle school students, transcription has had indirect effects on writing quality through planning (Limpo et al., 2017), signaling that mechanics may not play as significant a role. Overall, written production is a cognitively demanding task in which ideas need to consume WM resources rather than the process of transcribing the ideas into text. When transcription is automatized, it frees greater resources for planning and text generation (Olive, 2014). Controlling for transcription is necessary for evaluating other aspects of writing when transcription is still developing.

Gender (control variable)

Significant writing achievement differences between boys and girls are consistently found in most writing research to date. Most notably, the National Assessment of Education Progress reported that girls outperform boys in English writing by 15 to 20 points (National Center for Education Statistics, 2012). Recently, Truckenmiller et al. (2021) found that in a sample of Grade 5 and Grade 6 students, 7% of variance in writing quality was explained by

gender. For Grade 7 and Grade 8 students, gender explained 11% of variance in writing quality. Girls outperformed boys at both grade levels with statistically significant differences in writing quality scores. The root of gender differences is still unknown. Even when various component skills from current writing models are controlled for, such as handwriting automaticity, rapid automatized naming, and attention, language, and spelling, gender effects remain significant (Kim et al., 2015).

Measuring Executive Function and Self-Regulation

There is a variety of tools for measuring EFs and self-regulation. There are direct measures of student performance (e.g., NEPSY-2 and Delis-Kaplan Executive Function System), indirect reports of student behavior based on teacher, parent, or self-report (e.g., Behavior Assessment Scale for Children and the BRIEF), and games such as Head-Toes-Knees-Shoulder tasks. All types – performance-based, naturalistic report measures, and behavior task measures – provide information about self-regulation and implications for academic achievement. The school psychologist will be wary of the different methods, the information they provide, and what it might mean in the context of writing development and writing assessment. Importantly, measures of self-regulation reported via behavior rating scales, such as the BRIEF-2, provide data about a student's functioning in multiple contexts over a longer period of time (six months for the BRIEF-2), compared with cognitive performance tasks, for a more global perspective. In other words, rating scales provide useful observational information from raters familiar with the student's behavior performance and how the three types of regulation manifest across multiple contexts.

Performance-Based Measures

Performance-based measures or direct measures of EF and self-regulation include standardized neuropsychological tasks, such as n-back, digit span, and various sorting tasks. The tasks are often those included in indices used to calculate full scale intelligence quotient scores and cognitive processing. They may also be standalone measures, such as the NIH Cognitive Toolbox List Sorting Working Memory Test. Neuropsychological performance tasks are carried out in a synthetic manner (meant to isolate each EF) and administered by trained examiners. Standardization rules for WM ask the student to complete a task, often a span task measuring the amount of information a person can manipulate at once. For example, a neuropsychological performance task measuring WM would present a student with a short list of numbers and ask the student to state the string of numbers backwards with the length of the list increasing.

Although many of the tasks involve language and mathematical knowledge, the use of such tasks in the context of writing is limited. In the case of the NIH Cognitive Toolbox, the literature base is scant regarding studies linking the NIH List Sorting Working Memory Test to various academic achievement areas. When the NIH working memory test was included as one indicator in an EF factor, the EF latent variable mediated the relation between motor abilities and outcomes in mathematics and language academic achievement only for boys (Fernández-Sánchez et al., 2022). However, because such tasks are isolated and often external to the context of the classroom wherein students conduct much of their writing activities, especially at the elementary school level, the lack of work in this area is understandable.

Studies that have explored writing outcomes for students using neuropsychological measures of EF have reported that low-level EF such as SH can separate upper elementary students in terms of good and poor writers (Hooper et al., 2002). Drijbooms et al. (2015) showed

that the transcription skill of handwriting mediated the relation between IC and SH with writing outcomes. The same EF also directly contributed to length of text.

Behavior Rating Scales

Behavior rating scales are indirect measures of students' EF and self-regulation. They are completed by parents, teachers, and caregivers who have known a child for a specified amount of time (Gioia et al., 2015). Older children can also self-report using behavior rating scales, once some self-awareness has developed. Essentially, rating scales are indirect measurements of an individual's perception about their own, or their child or student's situational behavior tendencies. They report about WM, IC, and SH within cognitive, behavior, and emotion regulation, respectively.

Munoz and Filippetti (2021) argued for the use of rating scales in measures of EF due to the lack of contextualization afforded via neuropsychological measures, and necessary in the context of measuring school achievement and success. Specifically, rating scales provide naturalistic measures of EF by a rater who knows the child participant well and in day-to-day functional contexts in various settings. This improves ecological validity of the interpretation of results (Howard et al., 2019). Neuropsychological measures of EF must be administered in a standardized and controlled manner, limiting information about environmental interaction and applicability to multiple contexts. Naturalistic measures such as parent and teacher reports provide greater confidence about the authenticity of student self-regulatory behaviors (Howard et al., 2019).

Separate from neuropsychological performance tasks, small to moderate correlations have been reported between adult-reported self-regulation and IC with behavior regulation tasks such as the Head-Toes-Knees-Shoulder task (Ponitz et al., 2009). The Head-Toes-Knees-

Shoulder task is a task often used to measure behavior regulation (e.g., McClelland et al., 2014). Robson et al. (2020) found that task-based self-regulation produced comparable effect sizes to teacher-reports of IC, and recommended both teacher- and task-based measures of child self-regulation when possible.

Finally, the use of naturalistic report measures allows for reporting of student self-regulatory behavior from the teacher or caregiver's perspective. Although this is a strength of the measure, the clinician must be aware of response bias and that the items on a measure may not be relevant without cultural bias in the items (Thorell et al., 2013). Thus, selection of a rating scale for administration should be made through careful examination of the items to ensure culturally relevant items are included and irrelevant items are as minimal as possible.

Performance-Based Versus Rating Scales

The contributions of EF and self-regulation to academic achievement have often been studied with neuropsychological tests. Such results produce task-specific versus domain-specific results with limited generalizability and conclusions that can be made with respect to transfer (e.g., Munoz & Filippetti, 2021). Furthermore, such tasks are carried out in controlled rather than naturalistic environments, despite writing and other academic achievement tasks carried out in the latter setting (Munoz & Filippetti, 2021). This may partly explain why measures on the first version of the BRIEF did not align well with neuropsychological measures of EF (McAuley et al., 2010). Some studies have made a similar case for the Behavior Rating Inventory of Executive Function-2nd Edition (BRIEF-2; Gioia et al., 2015).

Munoz and Filippetti (2021) maintain that assessment of EF through behavior versus cognitive approaches measures different features of the EF construct. Cognitive performance approaches to measuring EF would provide information about what those cognitive skills are,

whereas rating scales provide information about how those skills are used by children in the more realistic contexts of home and school. Alternatively, cognitive measures provide information about 'cool' EF, whereas rating scales provide information about 'cool' and 'hot' EF (Munoz & Filippetti, 2021), to accommodate children's emotional and internal states that easily affect cool EF and academic performance in regulated settings, such as school.

In the context of writing, rating scales would account for how a student approaches a writing prompt and what they produce as a result of interactions between 'cool' and 'hot' EF. Thus, information provided through a parent behavior rating scale might be appropriately suited for better understanding students' EF and emotional reactivity (as they relate to writing. With respect to writing achievement, EF component skills develop through interaction with environmental factors (Kim & Graham, 2022). The factors may include a child's literacy environment, school instruction, and home language (Kim & Graham, 2022). The information provided by rating scales thus may be even more relevant, interpretable, and generalizable for understanding students' academic writing achievement in comparison to neuropsychological approaches.

It might be argued that neuropsychological assessment provides data about more cognitive elements of EF whereas behavior rating scales provide data about more behaviorally oriented EF due to the observational nature of rating scales. However, performance tasks tend to be resource-intensive because they typically require administration of multiple items to one student at a time to only provide information about one aspect of their EF and self-regulation abilities. Multiple tasks often must be administered to gain a holistic overview of a student's abilities in the few main EF and self-regulation areas. Instead, rating scales can simultaneously provide information about multiple EF and self-regulation abilities. For example, the BRIEF-2

measures at least three EF (WM, IC, and SH) and self-regulation (behavior, cognitive, and emotion regulation). Questions measuring EF include WM items (total of 8 items), which ask directly about teachers' observations of a student's attention span and concentration, ability to follow multi-step directions, and forgetfulness. The IC items (total of 8 items) ask questions about a student's ability to sustain behaviors that are expected in the classroom, such as keeping quiet and staying seated at certain times, maintaining a control on their behavior, and weighing consequences before taking action. Finally, SH items (total of 8 items) ask teachers to rate a student's ability to adjust to new situations, engage in problem solving, perseverating on the same thoughts or behaviors.

The items included in each of the three EF (WM, IC, and SH) involve aspects of self-regulation and are appropriately captured in three self-regulation indices that the BRIEF-2 measures: cognitive, behavior, and emotion regulation, respectively. The cognitive regulation index also contains (loads on to) other self-regulation skills (subscales) of planning/organization, task monitoring, organization of materials, and task initiation. The behavior regulation index contains the skill (subscale) of self-monitoring, in addition to IC. Finally, the emotion regulation index contains the self-regulation skill (subscale) of emotion control in addition to SH. Rating scales have not been used in previous research on writing and may provide information about the relation of self-regulation with writing. Rating scales provide information about broader EF and self-regulation skills that apply to the writing process as well, such as self-monitoring, task initiation, organization, and emotion management. These skills may be demonstrated in different naturalistic contexts, thus supporting ecological validity of results from the data.

Factor Analytic Studies for EF and Self-Regulation

In light of how various EF discussed in the previous section might map on to three different types of self-regulation, alongside the other EF and self-skills (e.g., planning/organization, emotion control, self-monitoring), studying how these various skills configure into major self-regulation indices (cognitive, behavioral, and emotional) seems logical. It makes sense because the skills may not be all that separable from one another. Specifically, this may be because a single question (item) could be categorized in a different EF scale or index (e.g., thinking of consequences before acting in IC within behavior regulation could be instead a member of cognitive regulation), which can be determined through factor analysis.

Prior factor analytic studies for school-age children have yielded different results regarding the structure of EF and self-regulation. In a study measuring the validity of EF measures from the NIH Cognitive Toolbox for low- and middle-income countries (LMIC), WM, IC, and SH measures loaded onto a unidimensional latent EF factor for samples from the Philippines, Guatemala, and South Africa (Wray et al., 2020). However, it is important to note that EF measures have mostly been validated and used in western, educated, industrialized, rich, and democratic (WEIRD) countries (Wray et al., 2020). Compared to a unitary EF factor alone, a bifactor model was reported to have better fit with a common EF factor and five specific EF factors (WM-Planning, WM-Updating, Fluency, Self-Regulated Learning, and Metacognition; Cirino et al., 2018). In relation to writing component skills, the study supported that WM, planning, updating (which is often synonymous with shifting) and self-regulation are separate factors. Furthermore, the study supported why EF might be held as a multi-factor construct rather than a unitary construct, paralleling that foundational cognitions are held as separate constructs in the BRIEF-2 indices for the three types of self-regulation.

The BRIEF-2 and its earlier version have had high clinical utility, particularly for child populations with autism spectrum disorder, attention deficit hyperactivity disorder, specific learning disorders, and mental disorders (e.g., McAuley et al., 2010). However, a dearth of studies exists regarding its factor structure (Lace et al., 2021). Lace et al. (2021) reported that a two-factor model is parsimonious over a three-factor model such as the one that the publishers of the BRIEF-2 demonstrated to be valid. A two-factor model consisting of the (a) CRI and (b) BRI and ERI combined index, fit the data better. Similar results have been reported for the BRIEF-2 parent rating form (Cumming et al., 2023). Furthermore, in comparing multiple two-factor and three-factor models, Lace et al. (2021) reported that the underlying three-factor theoretical model from Gioia et al.'s (2015) BRIEF-2 publication yielded poor model fit.

Yet, other studies have found that a three-factor model yielded a good fit (Hendrickson & McCrimmon, 2019; Jiménez & Lucas-Molina, 2019). Jiménez and Lucas-Molina (2019) used the BRIEF-2 parent and caregiver form for a sample from a vulnerable population of school-age students with a mean age of 10, at social risk, and from foster home backgrounds. Their three-factor model with the three original theorized indices and the nine original subscales yielded the best fit in comparison to several two-factor models with eight or nine subscales included. The results were robust across the two genders (girls and boys) included in the model, reporting model invariance, despite statistically significant ANOVA mean differences between the two groups on four subscales (Shifting, Initiate, Task Monitor, and Organization of Materials; Jiménez & Lucas-Molina, 2019).

Purpose of Present Study

The aim of this study was to parse the types of regulation and understand their relations with written expression. According to one theoretical approach, foundational cognitions are

indirectly related to writing quality due to their influence on self-regulation processes like planning (Kim & Graham, 2022; Kim & Park, 2019). However, previous empirical models did not directly measure self-regulation and planning in the mediation model. Thus, the goal of this study was to model this specific mediational path in the DIEW theory. Furthermore, this study served a practical purpose by using an assessment of self-regulation that is commonly used in schools for other purposes and has not been directly tied to writing achievement. The results of this study might provide new angles to consider in school psychologists' assessment of writing difficulties. Specifically, the results of this study might provide insight about interpreting behavior, cognitive, and emotion regulation development in relation to academic achievement that can be directly tied to recommendations for self-regulated writing instruction (Gioia et al., 2015; Graham et al., 2012; Harris et al., 2002; Sargunaraj et al., 2021).

The BRIEF-2 measures provide ecologically valid and instructionally useful information about self-regulation skills that may be malleable and targeted through instruction. At the subscale level, the items collectively within each subscale represent various EF. Those EF (subscales) are then combined into factors to represent three types of self-regulation. The primary goal of this study was to see which factors (types of self-regulation) measured by the BRIEF-2 are associated with variance in writing.

For the age group in this study (8-11 years), cognitive processes have recently undergone a rapid increase in development and complexity (Cicchetti & Toth, 1998), necessitating an examination of the underlying factor structure for these students' BRIEF-2 rating scales as reported by teachers. Factor structure determination was achieved by conducting an exploratory factor analysis (EFA) of the 60 items on the three BRIEF-2 indices comprising behavior (BRI), cognitive (CRI), and emotion (ERI) regulation. Each of the three indices contains two, five, and

two subscales, respectively, for a total of nine subscales distributed among the three regulation indices. An examination of the items within subscales suggests that assignment to another subscale or index is plausible, as explained above. Furthermore, mixed findings have been reported regarding the number of factors representing the EF (subscales) along with theoretical conceptualizations of cognitive regulation as having a mediating role for emotion and behavior regulation (Gioia et al., 2015; Lace et al., 2021). Finally, their relations to academic subjects of language, English, mathematics, history, and natural science have also produced mixed results (Munoz & Filippetti, 2021).

This study builds on an established knowledge base for the contributions of EF and self-regulation to writing quality by examining their influence on the planning process element in writing. When students apply time prior to composing to determine content and its order within an underlying structure, they produce higher writing quality scores. The planning process element, along with reviewing and revision, requires the most self-regulation in the process of writing. This study sought to determine how much a permanent product measure of students' planning captures individual student variability in their foundational EF and self-regulation specific to a writing situation. However, the three foundational cognitions have not been explicitly evaluated against the most current writing models – namely, DIEW (Kim & Park, 2019). Nor have they been extensively evaluated using behavior rating scales, such as the BRIEF-2, instead of performance assessment, which provides different information in relation to EF compared with cognitive assessment (Munoz & Filippetti, 2021).

On the BRIEF-2, each of the three main foundational EF (in parentheses) is included in one of three separate types of self-regulatory processes: cognitive regulation (WM), behavior regulation (IC), and emotion regulation (SH). This study sought to determine how the three types

of internal regulatory processes contribute to planning and writing quality, as measured through a rating scale approach (Munoz & Filippetti, 2021). The goal was to understand the direct and indirect effects of the three internal regulatory indices on writing quality via planning as a higher-level self-regulatory skill in Grade 4 and Grade 5 students. Upper elementary school is a time point at which writing development takes a steeper direction both in terms of curriculum expectations and cognitive development (e.g., Drijbooms et al., 2015).

Research Questions and Hypotheses

As demonstrated, EF are foundational for self-regulation skills and writing in elementary students. These include both overall and specific EF in three different self-regulatory areas of cognitive, behavior, and emotion regulation. Although not necessarily following a linear developmental pattern, and possibly not exclusive to a single regulation index, the foundational EF of WM may be most prominently foundational to cognitive regulation, IC is considered most closely related to later behavior regulation, and SH may be most foundational to emotion regulation. The foundational and self-regulation skills were conceptualized in this way for the purposes of this study. A teacher-report behavior rating scale, the BRIEF-2, was used and provides normed clinical index scores in which higher T-scores indicate greater dysregulation than same-age peers. Typing fluency and gender were controlled for.

Preceding model testing, a review of the literature supported that there is mixed information regarding the factor structure of the BRIEF-2 and whether the subscales and corresponding items fit a two- or three-factor model. A three-factor model regards the three separate regulatory indices as presented in the BRIEF-2 manual (BRI, CRI, and ERI; Gioia et al., 2015). A two-factor model combines the BRI and ERI regulatory indices into one factor, with CRI remaining as a separate factor. Thus, research question one seeks to add to the literature on

the facture structure of the BRIEF-2 subscales and indices, beyond the data available based on the normed sample in the publisher's manual.

Research Question 1: EFA

RQ1a. What is the underlying factor structure of the items on the BRIEF-2 teacher form?

H1a. Factor analysis will produce a two- or three-factor solution based on the items captured within each index. Factor loadings on each of the 60 items will be largest for their respective indices. I hypothesized a two- or three-factor solution will result.

RQ1b. What is the correlation of the resulting factor solution with Writing Quality?

H1b. Writing quality and factor solution correlations will produce small to moderate correlations based on earlier demonstrations of correlation and effect size for related EF processes (e.g., WM; Kim, 2020).

Research Question 2: BRIEF-2 and Planning

How much variance do the BRIEF-2 factors uniquely explain in students' Planning scores while controlling for Typing Fluency and Gender?

Research Question 3: BRIEF-2 and Writing Quality

How much variance do the BRIEF-2 factors uniquely explain in students' Writing Quality while controlling for Typing Fluency and Gender?

Research Question 4: BRI, CRI, ERI mediated effects via Planning on Writing Quality

Does Planning fully or partially mediate the relation between each of the BRIEF-2 factors and Writing Quality, using the factor solution determined in the EFA study? With Planning as a combination of simultaneous operations including behavior, cognitive, and emotion regulation, I hypothesized that Planning will partially mediate the relation between the types of regulatory indices and Writing Quality because various features of the factors in the first research question

will differently contribute to Writing Quality and to Planning, in which the writer configures a written outline or blueprint for writing.

CHAPTER TWO: METHOD

Participants

Participants in this convenience sample included Grade 4 and Grade 5 students from nine classrooms across four midwestern schools participating in a larger study about student writing. Affirmative parental consent was obtained for all student participants (Appendix O). Teacher participants of consenting parents and their children received a $10 gift card per student for a major online retailer in appreciation of their willingness to participate. The incentive amount was communicated before teachers opted to participate. Demographic data for student participants is provided in Table 1. Special education status data are unavailable. No exclusionary criteria were imposed for consenting students with disabilities by the researcher, teacher, or writing study.

Table 1

Demographics.

		N (%)
Gender	Female	82 (50.9%)
	Male	79 (49.1%)
Age (years)	8	2 (1.2%)
	9	55 (34.2%)
	10	83 (51.6%)
	11	19 (11.8%)
Grade	4	73 (45.3%)
	5	88 (54.7%)
English language status	No	157 (97.5%)
	Yes	4 (2.5%)
Socioeconomic status	School 1	77.5%
	School 2	52.8%
	School 3	> 95.0%
	School 4	68.3%

Note. *Percentage of economically disadvantaged students represents data from students qualifying for free or reduced lunch programs, residing in homes receiving food or cash assistance, in foster care, Medicaid-eligible, holding migrant status, or who are homeless.

Procedures

Grade 4 and 5 classrooms were invited as part of a larger study to participate in this project. Students completed a writing task in a group setting using a web-based computer application, Writing Architect (WA). In this application, students listened through headphones to an informational passage and a question about that passage to prompt them to compose an informational response (see Appendix F for a sample prompt). Students also held a paper copy of the passage and question about the passage to refer to at any time. Next, they were given three minutes and a piece of paper to plan their response. They could choose to plan or not and after three minutes, were prompted to begin the composition component of the task. Students were given 15 minutes to compose a response, typed into a text box within the WA application. They could choose to submit their response earlier than the 15-minute time frame. Following completion of the writing task, students were given a 90-second typing fluency task using a paragraph copy task. The total administration time for all tasks was approximately 40 minutes, with additional time for transitions, set-up, and directions.

Separately, teachers of participating Grade 4 and 5 students in general education classrooms were invited to complete the teacher survey portion of the study. Teachers were provided a letter explaining the scope of the project, the extent of their involvement, their time commitment, and request for consent. Participating teachers were sent a survey link via electronic mail to complete the BRIEF-2 teacher form. The form was independently completed online by each teacher respondent for each of their students. Each form took approximately 10 minutes to complete. Data collection commenced in Fall of 2023 (September), at the time of pre-test data collection for the larger study, at which point planning, writing quality, and typing

fluency data were also collected by trained graduate research assistants. Recruitment and consent for the larger study were also completed in Fall of 2023.

Inclusionary and Exclusionary Criteria

Inclusionary criteria consisted of all students in participating general education classrooms whose parents and guardians provide consent. Additional inclusionary criteria include participants for whom BRIEF-2 teacher forms are returned within the timeframe of data collection. Exclusionary criteria included incomplete BRIEF-2 teacher forms with more than 12 items missing, per the BRIEF-2 manual. BRIEF-2 scores also comprise three additional scales: Inconsistency (16 items), Negativity (8 items), and Infrequency (3 items) scales to make a determination about the validity of the data. The Inconsistency scale of validity provides information about the extent to which a teacher responded to similar items in a contrasting way when it might be expected that the item responses would not be very different in degree. The Negativity scale of validity detects whether the teacher might hold an inflated negative perception of the child when the items are compared to clinical populations. Elevated scores on this scale may also indicate severe executive dysfunction. The Infrequency scale of validity measures how basic items that might be expected to receive a specific score are endorsed in an atypical manner. The scale score might indicate whether a respondent answered haphazardly. In the case of elevated scores in any of the three BRIEF-2 validity scales, the researcher may choose to eliminate a response protocol from the data collection due to possible invalid data that could thereby skew the results or provide inaccurate information for further analyses. This decision would be made considering that other clinical data about student participants will not be available to determine whether specific item responses are accurate or valid (Gioia et al., 2015).

However, considering that clinical decision-making was not the purpose of this BRIEF-2 administration, validity scales were not calculated.

Interrater Reliability

Two research assistants completed scoring for Planning and Writing Quality. Interrater reliability was measured via percent exact agreement for Planning and two-way random absolute agreement intraclass correlation (ICC) for Writing Quality for 20% of the sample. Acceptable reliability correlations were set at .70 or above (Troia et al., 2020). Resulting percent agreement and ICC for Planning and Writing Quality, respectively, are reported in the Results section.

Data Management Plan

Data were collected and managed in the Research Electronic Data Capture (REDCap) software hosted at Michigan State University (Harris et al., 2009; Harris et al., 2019). The REDCap tool administers surveys to users on the front end and stores multiple relational databases on the back end. Only study investigators could access the data, which was password protected. Each submitted form included the child participant's name, birthdate, gender, grade level, special education status, and the date, entered by the teacher along with their own name and how long they have known the child as the first series of questions. Teacher email addresses were also entered for electronic delivery of participation incentives. This information was collected to match each participant's survey data to their writing data. Following data collection, the anonymization procedure deidentified all child participants' names along with their associated teacher names, prior to data analysis.

Measures

Several measures were included to capture students' EF abilities, writing quality, and control variables (i.e., typing fluency and gender).

BRIEF-2

The teacher form of the Behavior Rating Inventory of Executive Function-2nd Edition (BRIEF-2; Gioia et al., 2015) captures a Global Executive Composite (GEC), as well as three clinical indices. Higher scores indicate greater dysregulation. The Behavior Regulation Index (BRI) includes Inhibit and Self-monitor scores. The Emotion Regulation Index (ERI) is comprised of Shift and Emotional Control scores. Lastly, the Cognitive Regulation Index (CRI) includes Working Memory, Task Monitor, Initiate, Plan/Organize, and Organization of Materials. For the goal of understanding EF and eventual development of self-regulation, all three of the indices were used as intended in the standardized BRIEF-2 administration, without modification.

Each clinical index directly captures one of the three EF theoretically linked to writing, in a teacher report format. The teacher responds to 60 items used in the calculation of index scores and three additional items (items 18, 36, and 54) not used in the calculation of clinical index scores (and used only for calculation of the Infrequency validity index score), for a total of 63 items. Teachers are directed to reflect on the frequency of their student's behaviors in the provided statements over a span of the preceding six months. Item response options range from Never (N; 1 point), Sometimes (S; 2 points), or Often (O; 3 points). A raw subscale score may not be calculated if more than one item is missing for a subscale (Gioia et al., 2015).

Behavior Regulation Index

The Behavior Regulation Index (BRI), "represents a child's ability to regulate and monitor behavior effectively," (Gioia et al., 2015, p. 37). Behavior regulation is likely required for cognitive regulation and self-regulation (Gioia et al., 2015). The index is comprised of two clinical subscales: Inhibit (8 items) and Self-Monitor (5 items). Teacher response is collected for

items reflecting their student's difficulty with managing action impulses with respect to speech and physical behavior, as well as social and self-awareness, respectively. The BRI clinical index indicates difficulties with controlling, moderating, and monitoring one's own behavior. The BRI reliability coefficient for Cronbach's (1951) alpha was high (.95) and validity coefficients with the BASC-2 Teacher Rating Scale Behavioral Symptoms Index (.73) and Externalizing Problems Composite (.79) were adequate. The Self-Monitor subscale reliability coefficient was .89. Evidence of validity for Self-Monitor with the BASC-2 Teacher Rating Scale Behavioral Symptoms Index and Hyperactivity scale was adequate (.71 and .66, respectively), showing some evidence of convergent validity. There was also evidence of divergent validity, such as with the Learning Problems scale (.20), given the differences between the constructs they are purported to measure. The Inhibit subscale reliability coefficient was .92 and convergent validity with the BASC-2 Teacher Rating Scale Behavioral Symptoms Index (.68) and with the Hyperactivity scale (.81) was adequate. By gender and age group, the BRIEF-2 teacher form internal consistency coefficients for BRI were high as follows: .95 (Boys 8-10), .95 (Boys 11-13), .93 (Girls 8-10), and .92 (Girls 11-13). The BRI variable is represented as a T-score (M = 50, SD = 10).

Cognitive Regulation Index

The Cognitive Regulation Index (CRI), "represents a child's ability to control and manage cognitive processes and problem solve effectively," (Gioia et al., 2015, p. 37). Cognitive regulation may be necessary for higher-order problem solving, learning, information recall, and knowledge application (Gioia et al., 2015). The index is comprised of five clinical subscales: Working Memory (8 items), Plan and Organize (8 items), Task-Monitor (6 items), Organization of Materials (5 items), and Initiate (4 items). Teacher response is collected for items reflecting

their student's difficulty with holding and executing multi-step directions over a short period of time, organizing an execution plan to achieve goals, neatly and accurately executing written work, general forgetfulness, and self-initiating activities. The CRI clinical index indicates challenges with management of various cognitive organization and control properties.

The CRI reliability coefficient for Cronbach's (1951) alpha was high (.98) and validity with the BASC-2 Teacher Rating Scale showed some evidence of convergent validity, such as with the Attention scale (.73) and some evidence of divergent validity (e.g., Externalizing Problems Composite correlation of .47), given the differences between the constructs they are purported to measure. The Working Memory subscale reliability coefficient was .93 and showed adequate evidence of convergent validity with the BASC-2 Teacher Rating Scale Attention scale (.76). The Plan and Organize subscale reliability coefficient was .91 and showed evidence of some convergent validity, such as with the Attention scale (.63) and some evidence of divergent validity, such as on the Withdrawal scale (.27) on the BASC-2 Teacher Rating Scale. The Task-Monitor subscale reliability coefficient was .92 and showed some evidence of convergent validity (.57) with the Attention scale, along with some evidence of divergent validity such as with the Withdrawal scale (.33) on the BASC-2 Teacher Rating Scale. The Organization of Materials subscale reliability coefficient was .89 and showed some evidence of convergent validity, such as with the Attention scale (.54) and some evidence of divergent validity, such as with the Leadership scale (-.28) on the BASC-2 Teacher Rating Scale. The Initiate subscale reliability coefficient was .91 and showed some evidence of convergent validity with the Attention scale (.67) and some evidence of divergent validity (.42) for Atypicality on the BASC-2 Teacher Rating Scale. By gender and age group, the BRIEF-2 teacher form internal consistency coefficients for CRI were high as follows: .98 (Boys 8-10), .98 (Boys 11-13), .97

(Girls 8-10), and .98 (Girls 11-13). The CRI variable will be represented as a T-score (M = 50, SD = 10).

Emotion Regulation Index

The Emotion Regulation Index (ERI), "represents a child's ability to regulate emotional responses, including in response to changing situations," (Gioia et al., 2015, p. 37). Emotion regulation is held to be required for effective cognitive regulation (Gioia et al., 2015). The index is comprised of two clinical subscales: Shift (8 items) and Emotional Control (8 items). Parent response is collected for items reflecting their child's difficulty with adapting to change in environments, individuals, or routines, and managing reactions to situations, respectively. The ERI clinical index indicates problems with modulating one's own emotional responses. The ERI reliability coefficient for Cronbach's (1951) alpha was high (.94) and showed adequate evidence of convergent validity with the BASC-2 Teacher Rating Scale Externalizing and Internalizing Problems Composite (.58 for both). The Shift subscale reliability coefficient was .88 and showed some evidence of convergent validity (-.58) with the BASC-2 Teacher Rating Scale Adaptability scale. The Emotional Control subscale reliability coefficient was high (.94) and showed some evidence of convergent validity (-.61) with the BASC-2 Teacher Rating Scale Adaptability scale. By gender and age group, the BRIEF-2 teacher form internal consistency coefficients for ERI were high as follows: .94 (Boys 8-10), .94 (Boys 11-13), .97 (Girls 8-10), and .98 (Girls 11-13). The ERI variable will be represented as a T-score (M = 50, SD = 10).

Planning

Planning quality was assessed by trained research assistants using students' permanent product. Students were given unlined blank sheets of paper and instructed to plan how they will respond to the writing prompt. Planning was scored as an ordinal variable, with a 5-point scale

rubric ranging from 0 to 4, using a similar scale as Truckenmiller et al. (2022) and Agha et al. (2022), but included a fifth integer to capture use of 'TIDE' labels or elements in planning. Higher scores indicate greater sophistication of planning. A high planning score, such as a 2, 3, or 4 in this study, reflects a general or specific organizational structure, respectively, of the elements to be included in the written composition. A low planning score of 0 or 1 is assigned when fewer than five words are written (0) or no structure in the plan for writing is apparent (1). See Appendix D for the planning rubric to be used in this study. This scoring scheme reflects typical scoring and measurement of planning with rubrics in previous studies ranging from an integer score of 0 to 3, 4, 5, or 6 (Limpo & Alves, 2013; Limpo et al., 2017; Olinghouse & Graham, 2009; Whitaker et al., 1994). Interrater reliability between scorers for similar planning rubrics ranged between .87 and .96 (Limpo & Alves, 2013; Limpo et al., 2017; Olinghouse & Graham, 2009). Correlations between planning and metrics for writing quality (e.g., correct writing sequences) in other studies using similar planning rubrics have ranged between .27 and .59 (Agha et al., 2022; Limpo & Alves, 2018; Olinghouse & Graham, 2009; Truckenmiller et al., 2022). Approximately 20% of the scores were randomly selected and scored by a second rater to ensure interrater reliability.

Writing Quality

Writing quality, using a genre discourse elements rubric, was hand-scored by trained research assistants using the TIDE writing rubric, which features four important elements in writing pertaining to content development and structure: topic, idea, detail, and ending (Collins et al., 2021; Harris et al., 2023). This writing quality rubric is unique because it does not place a score limit on a student's writing. Students receive between 0 and 2 points for each different idea and supporting details they include in their writing. Additionally, the inclusion of a topic and

ending earns between 0 and 2 points. Scorers were also instructed to highlight any sentences that were copied word-for-word from the text and these sentences were not eligible for scoring (see Appendix E for the full writing quality rubric). The number of copy elements were highlighted and excluded from a student's cumulative total for a final writing quality score (i.e., the copied text was not scored for TIDE, nor included in the student's TIDE score). An intraclass correlation coefficient (ICC) for reliability between two raters reported for this type of rubric is 0.81 (Collins et al., 2021).

Typing Fluency

Student participants were instructed to type a paragraph appearing at the top of their screens following the writing task. They were asked to type as quickly and as accurately as possible into a textbox that would automatically end at 90 seconds. This task is an extended version of the Monroe and Sherman (1966) paragraph copy handwritten task. The computer automatically captured the number of characters typed in 90 seconds. This task and scoring method have demonstrated evidence of predictive validity for Grade 4 and Grade 5 writing quality in other studies (r = .53 and r = .56; Troia et al., 2020 and Truckenmiller et al., 2022, respectively). IRR for typing fluency was not calculated because the computer automatically counted the number of characters typed.

Gender (control variable)

Gender was included in the analyses as an independent control variable. For each participant, gender was reported as a dichotomous variable and a value of '0' indicated male gender, whereas a value of '1' indicated female gender. Although gender is not a binary measure, student gender identities as recorded by the school were used for this study.

Study Design and Planned Analyses

The major goal of this study was to understand the role of various regulatory processes, which include foundational cognitions and form the basis of overall self-regulatory abilities, for writing quality. Mediation analyses utilized the macro, Hayes' PROCESS Procedure for SPSS Version 4.2 (Hayes, 2022) to determine how much variance in writing quality is explained by the BRIEF-2 regulation indices as reported by teachers. SPSS was also the program used by the BRIEF-2 publishers. The first research question conducted exploratory factor analysis (EFA) to determine the factor structure of the BRIEF-2. Research questions two and three contained direct paths, while research question four measured the indirect path. The hypothesized model contained up to three factors: BRI, CRI, and ERI, with direct and indirect relations to Writing Quality via Planning. Control variables to be included were Typing Fluency using the paragraph copy task described above and Gender.

EFA

EFA was conducted using SPSS (IBM Corp., 2022) to determine dimensionality of the BRIEF-2. In this unrestricted measurement model, indicators are permitted to depend on all factors (Kline, 2015). A three-factor model (Figure 1, Appendix A) would consist of the behavior, cognitive, and emotion regulation indices (Jiménez & Lucas-Molina, 2019; Miyake et al., 2000; Munoz & Filippetti, 2021). A two-factor model (Figure 2, Appendix B) would likely consist of the cognitive regulation index and a combined behavior and emotion regulation index (Lace et al., 2021).

Assumptions about the data for conducting an EFA were checked first. Data were examined for normal distribution properties including skewness, kurtosis, and outliers. Normality is assumed for the variables in the model in order to conduct EFA (Raykov & Marcoulides, 2008). The linearity of associations assumption also applies. Additional

assumptions about EFA include that errors are normally and independently distributed. Finally, the mean of each factor is 0, and factors and errors are not correlated. The Bartlett's Test of Sphericity (which assumes normality), if significant, will indicate that the observed data are interrelated with a correlation matrix that is diagonal (and not an identity matrix with correlations between variables equal to 0). Pending a significant Bartlett's Test of Sphericity, the EFA may be reviewed to examine factor loadings.

In conducting the EFA, factor extraction usually stops when the proportion of variance captured by the factors exceeds 75%-80%, or when an eigenvalue for a factor that results is smaller than the average eigenvalue of the variance-covariance or correlation matrix, which is equal to 1 (Raykov & Marcoulides, 2008). These data are observed on a scree plot, which indicates factor eigenvalues in decreasing order and is used to determine the number of factors resulting. EFA would proceed by using either Principal Axis Factoring or Maximum Likelihood Factor Analysis. Principal axis factoring is more robust to small sample sizes and does not make assumptions about sample distributions (Watkins, 2018). Principal axis factoring is also considered to provide more precise communalities estimates (Watkins, 2018). An additional step in EFA is to rotate the solution. This is considered to improve interpretability of the factors retained (Kline, 2015). However, the primary goal of the EFA is to identify the number of factors resulting from the data and not to study relations between the factors and items (Jacobson et al., 2020).

Mediation Analysis

Checks for model assumptions are conducted first with data examined for normal distribution properties including skewness, kurtosis, and outliers. Second, the dependent variable would be assumed to be a linear function of the independent variables or predictors in the study

(Kline, 2015). Third, each participant and their observations would be assumed to be independent of one another. Fourth, errors would be assumed to be normally distributed and homoscedastic (constant for all values of the predictors), and uncorrelated with the exogenous or independent variables. Fifth, validity and reliability in measurement of the predictors would be assumed. Finally, it would be assumed that there are no problems with multicollinearity, in which independent or exogenous variables might be correlated with each other.

Proceeding, correlation tables were generated to address the second and third research questions. For the fourth research question, a mediation model was run using the EFA resulting in the first research question (Figure 3, Appendix K). Statistics were interpreted to determine whether there was partial or full mediation for the BRIEF-2 factors on writing quality via planning. fit, adjusted based on the number of factors resulting from the first research question.

Plan for Missing Data

This project was designed to be a survey study with a convenience sample. Data were automatically captured in REDCap for all variables of interest. All item responses provided were included for the purposes of conducting the EFA. This includes all item-level data on the BRIEF-2 comprising each of the three indices. Data were matched to the writing data collected in the larger study and then deidentified prior to analysis.

Typically for calculating subscale and index scores, teacher reports that violate one or more of the three validity scales are excluded. In addition, "if the total number of unanswered items that contribute to the calculation of raw scale scores is greater than 12…then the BRIEF-2 protocol cannot be appropriately scored," (Gioia et al., 2015, p. 13). If only one item is missing in the calculation of a raw subscale score, the item is automatically assigned a value of '1' or N

(Gioia et al., 2015). If more than one item is missing for a given subscale, a T-score cannot be calculated (Gioia et al., 2015).

In the event data were missing for any variable (BRI, CRI, ERI, Planning, Typing Fluency, Writing Quality, and Gender), the data would be checked to see if they are missing completely at random, missing at random, or missing not at random. Next, the pattern of missingness would be determined to check for systematic missingness before a method for handling missing data is selected (Kline, 2015). A possible method would be pairwise deletion of missing data. This means that a case with a missing value for a particular variable will not be used in the calculation of any correlations for that particular variable, but other case value data will still be used to calculate other correlations. However, the limitation of this method is that sample sizes for covariances between variables will be different, which can give rise to out-of-bound correlations or covariances (Kline, 2015). An alternative method would be maximum likelihood estimation or full information maximum likelihood that utilizes the available data to estimate parameters and errors (Kline, 2015).

Power Analysis

An a priori power analysis was conducted using G*Power version 3.1.9.7 software (Faul et al., 2009) to determine the number of participants needed to detect a significant effect size, using an alpha of .05, and power at .80. To calculate effect size, parameter estimates were taken from a Grade 4 sample for effects of WM on writing quality used in Kim (2020). An effect size (f^2 = .07) was calculated from a standardized regression weight (r = .25) and produced a required sample size of 168 participants. However, because this study is part of a larger study, obtaining that large a sample may not be feasible. It is anticipated that the actual number of participants will be approximately 150 students. A power analysis with this sample size was conducted with

an alpha of .05, power at .80, and five predictors (BRI, CRI, ERI, typing fluency, and gender). The analysis indicated adequate power (.80) to detect $f^2 = .07$. This is the same as $R^2 = .07$.

CHAPTER THREE: RESULTS

Descriptive Statistics

All data analyses were conducted using the Statistical Package for Social Sciences Version 29.0 (SPSS Version 29.0; IBM, 2022). The final number (n = 161) of students whose teachers completed the BRIEF-2 rating scale included 82 females and 79 males (51% and 49%, respectively). Teachers and students were recruited from nine classrooms across four schools.

Table 2

Descriptive Statistics.

	Mean	SD	Range	Min	Max	Skewness	Kurtosis
Typing Fluency	91.62	51.69	280	9	289	1.03	1.36
Planning	0.87	0.92	3	0	3	0.71	-0.49
Writing Quality	3.75	2.99	11	0	11	0.59	-0.58
Age	9.75	0.68	3	8	11	0.10	-0.43

Note. Planning was scored on an ordinal scale.

Missing Data

A total of three values were missing for writing quality (n = 158) and for the mediator variable, planning (n = 158). Two students were missing data on both variables. The researcher had knowledge that one of the two students was not required to take the administration due to specific school and home circumstances. A third student was missing data only on writing quality, and another student was missing data only on planning, due to there being a missing record in the WA system or a planning sheet that could not be located, thus missing completely at random. No data were missing for any of the 63 BRIEF-2 items (n = 161). Little's MCAR test was nonsignificant (χ^2 = 198.807, DF = 184, Sig. = .216). Pattern of missingness was determined to be missing completely at random (total missing = 1.9%; Woods et al., 2023). Considering that less than 2% of values were missing, pairwise deletion was used in subsequent analyses.

Interrater Reliability

Interrater reliability was calculated between scorer 1 and scorer 2 for approximately 20% of the samples. For the writing quality variable using the TIDE writing rubric, a Two-Way Random ICC of consistency type using Cronbach's Alpha yielded 89.8% agreement between the two raters. For planning, exact agreement between two scorers was 82%.

Research Question 1: EFA

RQ1a: What is the underlying factor structure of the items on the BRIEF-2 teacher form?

Exploratory factor analysis was used to identify the underlying dimensions (factors) within the BRIEF-2 rating scale items and to examine the structural validity of item scores. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's Test of Sphericity were examined to determine the suitability of data for factor analysis. Factor extraction was subsequently carried out using the Principal Axis Factoring analysis method, which assumes normal data distribution and allows for smaller sample sizes, followed by Promax oblique rotation to allow for analysis of correlated factors and to improve interpretability of the factor structure results (Costello & Osborne, 2005; Kline, 2013). Oblique rotation also parallels the type of rotation used by the BRIEF-2 publishers. To calculate factor scores, the Bartlett method (weighted least squares) was used for BRIEF-2 categorical data (Cumming et al., 2023).

The KMO measure of sampling adequacy was acceptable (i.e., .930), indicating that there were intercorrelations among the variables (items) in this study (r between 0.5 and 1) and that the data were suitable for factor analysis. The Bartlett's Test of Sphericity was significant (χ^2 = 11784.99, df = 1770, $p < .001$), indicating that there were statistically significant group correlations among variables (items) to support factor extraction. Results of the initial EFA revealed six factors with eigenvalues exceeding 1 after seven iterations. The scree plot, which

indicates the point at which factor extraction should be stopped, showed definite plateauing after six factors. The six factors explained approximately 75% of the variance in the model. The steepest drop occurred after the first factor, followed by factors 2 and 3. The flattening of the slope in the scree plot indicated that additional factors with small eigenvalues captured only a small increase in variance explained in the model. All communalities after extraction were > .50 (see Table 7, Appendix G; Costello & Osborne, 2005). However, there was little additional variance (less than 7%) explained by a six-factor solution compared to a three-factor solution. Thus, based on examination of the scree plot and parallel analysis, a final 3-factor solution was selected. The process of selecting the final 3-factor solution follows.

Parallel analysis was conducted as best practice over the scree test in determining the number of factors to retain (Hayton et al., 2004; Kline, 2013; Matsunaga, 2010; Watkins, 2018). A freely available macro that conducts parallel analysis using Monte Carlo simulation was downloaded and used to carry out parallel analysis for determining the number of factors to retain (Watkins, 2018). The number of variables was set at 60 and replications at 1,000 (n = 161). The parallel analysis indicated that three of the actual eigenvalues were larger than their random eigenvalue counterparts, supporting that only those three factors should be retained from the initial EFA (Watkins, 2018). Eigenvalues for factors below their random counterparts generated from parallel data indicate that a factor is not substantial and is merely random (Matsunaga, 2010).

Factor loadings greater than .40 were considered significant, with two correlations lower than .40; for Item 15, "gets caught up in details and misses the big picture" (r = .39) and for Item 41, "forgets what he/she was doing" (r = .35). See Table 8, Appendix H for all factor loadings from the pattern matrix in the initial EFA. Upon examination of all 60 items, the initial six

extracted factors, the scree plot, and results of parallel analysis, three factors were eliminated. These indicators showed that additional variance explained by the three eliminated factors was small and possibly random (see Discussion for further explanation and theoretical discussion on why the three particular factors were retained).

Following the initial EFA, an EFA was rerun fixing the number of factors to three and keeping only the items with loadings greater than .4. The remaining 60 items and 3 factors resulted in a total of 68% of the variance was explained. The KMO measure of sample adequacy was acceptable (i.e., .930). The Bartlett's Test of Sphericity remained significant ($\chi^2 = 11784.99$, $df = 1770$, $p < .001$). However, five communalities after extraction (Items 15, 17, 37, 40, and 45) were less than .5 (ranging between .397 and .495). In addition, two items (Items 11 and 46) had loadings from two factors with only a small difference between the values (loadings), indicating cross loading (see Table 9, Appendix I). Finally, two items (Items 40 and 45) did not show loading from any of the three factors. Therefore, after qualitative review of the items, another EFA was run with the following items removed: 15, 17, 37, 40, 45, 11, and 46.

When the final EFA was rerun fixing the number of factors to three and considering only items with loadings greater than .4, a total of 70% of the variance was explained after seven iterations (total of 53 items). The KMO measure of sample adequacy was acceptable (i.e., .936). The Bartlett's Test of Sphericity remained significant ($\chi^2 = 10388.17$, $df = 1378$, $p < .001$). All communalities were greater than .5 and no cross loadings were observed (see Table 10, Appendix J). For all subsequent analyses, this 3-factor solution was retained and used.

The first retained factor was named the cognitive regulation index (CRI). The CRI mostly contained items relating to WM, as well as monitoring and organizing, which are skills related to self-regulation that do not necessarily carry an emotion or behavior component. The CRI in this

study included 27 items from the BRIEF-2's original CRI factor containing 31 items in total. The second factor retained was named the behavior regulation index (BRI), which contained 12 out of 13 items of the BRIEF-2's original BRI factor. The BRI was named such because it contained items relating to self-monitoring of one's own behavior, as well as inhibiting outward actions (e.g., staying in one's seat). The third factor retained was named the emotion regulation index (ERI). The ERI was named so because it contained items relating to managing one's feelings, reacting strongly to one's environment, and effects on mood when there is environmental change. The ERI in this study included 10 items from the BRIEF-2's original ERI containing 16 items.

RQ1b: What is the correlation of the resulting factor solution with Writing Quality?

Correlations between writing quality (TIDE rubric score) and each of the final retained factor scores are displayed in Table 3. Writing quality was most highly correlated with CRI (r = -.374). As scores increased on the CRI index (indicating worsening cognitive regulation and increasing cognitive dysregulation), writing quality statistically significantly decreased. Considering the clinical nature of the BRIEF-2 factors where a higher score on a BRIEF index indicates clinical significance, a negative correlation between the BRIEF indices and writing quality was expected. BRI and ERI were not significantly correlated with writing quality. As clinical index scores increased for BRI and ERI, writing quality showed a decreasing trend but no statistically meaningful relation was found for the two indices and writing quality.

Table 3

Bivariate Pearson and Spearman's Rho Correlations Between Factor Scores in Final Solution and Writing Quality.

	Writing quality	CRI	BRI	ERI	Planning	Typing fluency	Gender
Writing quality	1						
CRI	-.374**	1					
BRI	-.105	.588**	1				
ERI	-0.066	.507**	.611**	1			
Planning	.290**	-.395**	-.198*	-.201*	1		
Typing fluency	.546**	-.386**	-.127	0.068	.267**	1	
Gender	0.023	-.219**	-.367**	-.117	.244**	.124	1

**Correlation is significant at the 0.01 level (2-tailed). *Correlation is significant at the 0.05 level (2-tailed). Sample sizes: Writing quality N = 158, planning = 158, factor 1, factor 2, and factor 3 N = 161, typing fluency N = 159, gender N = 161. Planning and gender correlations report Spearman's Rho.

Research Question 2: BRIEF-2 and Planning

How much variance do the BRIEF-2 factors uniquely explain in students' Planning scores while controlling for Typing Fluency and Gender?

Spearman's rho correlations between planning and the three resulting factors are included in Table 3. Planning was moderately correlated with CRI (r = -.395). BRI displayed a small correlation with planning (r = -.198), as did ERI with planning (r = -.201). When controlling for typing fluency and gender, the three factors along with the two control variables explained 18.4% of the variance in planning scores (F = 6.845, p < .001; see Table 4). Only CRI had a unique significant contribution toward planning above BRI, ERI, gender, and typing fluency (b = -.281; p = .003).

Table 4

Regression: BRIEF-2 Indices and Planning.

	B	Std. Error	Beta	t	*p-value*	Lower Bound	Upper Bound
(Constant)	.179	.252		.708	.480	-.320	.677

Table 4 (cont'd)

Typing Fluency	.002	.002	.129	1.516	.132	-.001	.005
Gender	.322	.146	.176	2.206	.029	.034	.610
CRI	-.281	.095	-.310	-2.969	.003	-.468	-.094
BRI	.024	.095	.026	.249	.804	-.165	.212
ERI	.030	.090	.033	.334	.739	-.148	.208

CRI = cognitive regulation index; BRI = behavior regulation index; ERI = emotion regulation index.

Research Question 3: BRIEF-2 and Writing Quality

How much variance do the BRIEF-2 factors uniquely explain in students' Writing Quality while controlling for Typing Fluency and Gender?

Pearson correlations between writing quality and the three resulting factors are included in Table 3. When controlling for typing fluency and gender, the three factors along with the two control variables explained 33.9% of the variance in writing quality ($F = 15.624$, $p < .001$; see Table 5). Only CRI had a unique significant contribution toward writing quality above BRI, ERI, gender, and typing fluency (b = -.237; $p = .013$).

Table 5

Regression: BRIEF-2 Indices and Writing Quality.

	B	Std. Error	Beta	t	*p-value*	Lower Bound	Upper Bound
(Constant)	1.583	.741		2.137	.034	.120	3.046
Typing Fluency	.028	.004	.480	6.270	<.001	.019	.036
Gender	-.248	.428	-.042	-.579	.563	-1.094	.598
CRI	-.700	.278	-.237	-2.519	.013	-1.249	-.151
BRI	.336	.280	.114	1.200	.232	-.217	.889
ERI	-.169	.264	-.057	-.638	.524	-.691	.353

CRI = cognitive regulation index; BRI = behavior regulation index; ERI = emotion regulation index.

Research Question 4: BRI, CRI, ERI mediated effects via Planning on Writing Quality

Does Planning fully or partially mediate the relation between each of the BRIEF-2 factors and Writing Quality, using the factor solution determined in the EFA study?

Following the EFA, Hayes' PROCESS macro was used to run a mediation analysis. Simple mediation corresponding to model 4 in the PROCESS Procedure for SPSS Version 4.2 (Hayes, 2022) was selected with each of the BRIEF-2 indices as the independent variable, planning as the mediator, and writing quality as the outcome variable. The remaining two regulation indices, gender, and typing fluency were entered as covariates (control variables) in the mediation model. Unstandardized values are reported here per recommendations by Hayes (2022). The results of the mediation analysis indicated partial mediation by planning between CRI and writing quality. An indirect effect between CRI and writing quality was significant. A bootstrap confidence interval for the indirect effect (*ab* = -.140) based on 5,000 bootstrap samples was entirely above zero (-0.342 to -0.004). A significant direct effect was also observed from CRI to writing quality (*c'* = -.642, $p < .028$). The number of bootstrap samples was set to 5,000 per the default setting in Hayes' PROCESS macro (Hayes, 2022). Indirect effects from BRI (*ab* = 0.017., CI = -0.073 and .129 and ERI (*ab* = 0.011, CI = -0.078 and .114 to writing quality were nonsignificant. Only total effects for CRI remained significant (b = -.781, $p < .007$).

Table 6

Coefficients (Standard Errors) of Direct, Indirect, and Total Effects of BRIEF-2 Factors on Writing Quality.

	Writing Quality		
	Direct	Indirect	Total
Planning	0.484 (.235)*	--	--
Gender	-0.291 (.433)	--	-.130 (.430)
Typing fluency	0.027 (.004)**	--	0.028 (.004)**
CRI	-0.642 (.289)*	-.140 (.087)$^{+}$	-0.781 (.284)**
BRI	0.426 (.285)	0.017 (.050)	0.443 (.288)
ERI	-0.226 (.004)	0.011 (.046)	-0.216 (.263)

Table 6 (cont'd)

*p < .05; **p < .01. CRI = cognitive regulation index; BRI = behavior regulation index; ERI = emotion regulation index. [+]Bootstrap confidence interval for the indirect effect was entirely above zero (-0.342 to -0.004).

CHAPTER FOUR: DISCUSSION

This study aimed to understand whether certain types of self-regulation slightly more upstream than foundational EF and slightly more downstream than overall self-regulation or planning, may be more relevant to the writing process for elementary students. I expected that all three self-regulation indices would significantly relate to writing quality. However, this was not the case as BRI and ERI did not show a correlation with writing quality. Furthermore, while BRI and ERI were significantly correlated with planning, the two factors were not mediated by planning on writing quality for this sample – likely because no direct relation was found with writing quality in the first place. Several other findings presented intriguing interpretations in considering the meaningfulness of self-regulation and planning within writing instruction.

Cognitive Regulation and Writing Quality

I expected that cognitive regulation would be most significantly related to variance in writing, which was confirmed by the results. I expected this for two reasons. First, it is the self-regulation index with the largest variety of EF subscales and items that pertain to writing. Second, those EF subscales and items, including questions pertaining to WM and planning/organization, have are consistently related to writing component skills and writing outcomes in studies of writing assessment (e.g., Kim & Park, 2019) and writing intervention (e.g., Graham & Harris, 2000).

Writing demands that multiple processes and memory are activated to produce written text (Ehri, 2000). Some processes are more or less related to writing quality depending on the writer's age or stage of writing development. For example, self-regulatory behavior like planning more heavily influences writing quality for middle and high school students, as well as for adults, than for younger writers. For elementary age writers, more foundational variables, WM,

oral language, and phonological awareness exert greater influence on writing quality (Peng et al., 2022).

At the same time, students who have learned to regulate their behavior during a writing task have higher writing performance (Graham & Harris, 2000). The self-sustained and self-planned nature of writing is theorized to rely heavily on self-regulatory skills. Therefore, skilled writers are considered to maintain high levels of self-regulation (Graham & Harris, 2000).

This study found similar results. The relationship between writing quality and CRI was moderately strong (r = -.37). This relationship remained significant above and beyond the other variables in the model (b = -.700, p = .013). Considering that WM is a major component of the CRI clinical index (hence a negative correlation), a significant relationship was anticipated.

Studies demonstrating a correlational relationship between writing quality and WM are plentiful. Correlations in earlier studies have typically ranged between .14 and .37 (Kim & Graham, 2022; Kim & Park, 2019; Kim & Schatschneider, 2017). Studies exploring relations between WM on the BRIEF-2 clinical scale and broader English and language communication subjects have reported moderate to strong correlations (r = -.48 and r = -.58, respectively; Munoz & Filippetti, 2021). Correlations between CRI with English and language and communication subjects have also been reported in the moderate to strong range (r = -.46 and r = -.57, respectively; Munoz & Filippetti, 2021). This study reported slightly lower correlations. However, this study controlled for two variables (gender and typing fluency) that have previously captured a significant amount of variance in writing quality, thus adding new information to better understand how indices of self-regulation explain writing quality. The results suggested that building cognitive regulation might be an appropriate target in writing instruction, which was one of the main goals of this study.

Behavior Regulation, Emotion Regulation and Writing Quality

The relationship between writing quality and BRI, which captures items related to IC and self-monitoring, was not significant. This disagrees with an earlier study exploring relations between the BRI and IC with writing subjects (Munoz & Filippetti, 2021). Relations between IC and writing quality have been established in the literature, especially for the age group in this study (Altemeier et al., 2006; Drijbooms et al., 2015). However, only a portion of the earlier studies specifically addressed writing quality. In the current study, the measurement using domain-general items in the BRIEF and the teacher report may account for the differences found in the current study. Furthermore, it is likely that behavior regulation was not a focus of writing instruction in this study like it usually is for younger age groups (Puranik et al., 2019).

The relationship between writing quality and ERI was also not significant, suggesting that the BRIEF ERI, which includes items related to SH and emotion control, does not detect the emotion regulation needed for Grade 4 and 5 students' writing. This contradicts some earlier findings. Positive relations between SH (updating) and writing quality have been established in the literature for the age group in this study (Drijbooms et al., 2015). Furthermore, socio-emotions (about writing) positively influence writing quality and are involved throughout the writing process, including goal-setting, planning, idea generation, translation, transcription, evaluation, and revising process steps (Kim & Graham, 2022). The current study advances the body of literature by exploring relationships specifically between emotion regulation based on teacher ratings about general classroom challenges and writing quality. Results show that socio-emotions were not captured by the BRIEF-2 ERI teacher rating (nor measured about writing specifically). Thus, while a broader emotions element may be implicated in writing, emotion regulation skills as measured in this study, may not have utility in being included within writing

instruction. Future study of emotion regulation within writing might consider an instrument other than the BRIEF-2 ERI teacher rating to capture socio-emotions more closely related to writing, such as the Writing Motivation Questionnaire (Graham et al., 2022) and other surveys about writing motivation, attitude, and interest.

Self-Regulation and Planning

One of the goals of this study was to better understand the relationship between self-regulation and planning and how self-regulation may be meaningful for inclusion as a target in teaching planning during writing instruction. This is because many underlying skills for planning require self-regulation components. These self-regulation components include WM, IC, and SH. The components are thought to be integrated into self-regulation in writing as a fourth-grade writer pulls relevant information from long-term memory to translate and transcribe ideas into organized visuals or sentences on paper (i.e., planning). This study found a significant relationship between planning and the BRIEF-2 self-regulation factors. The three BRIEF-2 factors explained 18.4% of the variance in planning while controlling for typing fluency and gender, indicating some utility of including self-regulation skills within writing instruction for the purposes of developing students' abilities to plan their writing.

Cognitive Regulation and Planning

Planning was most strongly related to cognitive regulation, or CRI (r = -.40). CRI includes WM, task initiation, and executing goals. Capacity theories of writing support that WM is involved in the planning process and that planning may be constrained by WM capacities (Berninger & Winn, 2006; McCutchen, 1996). The results of this study support the capacity theories of WM in writing and earlier models theorizing a relationship between WM (within CRI) and planning. CRI additionally includes items about other cognitive regulation skills such

as initiating, planning, and organizing. The relationship between WM and planning, however, has had mixed results in empirical literature. For example, Drjibooms and colleagues did not find significant relations between WM and planning (2015). The differences in findings on whether WM has a significant relationship with planning may be due to instrumentation, as they used an online planning task (e.g., Tower of London) instead of a rating scale.

Despite a vast theoretical base in the literature, there is a dearth of studies explicitly exploring the relationship between WM and planning processes (Kim & Graham, 2022). This study builds on Kim's model by further describing planning as task monitoring, initiation, and organizing, in addition to WM (all of which comprise the CRI) as potential targets for building self-regulation and developing students' planning skills in writing instruction. The findings in this study also raise questions for future research by suggesting that these specific target skills of WM, initiating, and organizing are included in writing intervention studies to further strengthen planning skills.

Behavior Regulation and Planning

This study further clarified the role of behavior regulation in upper elementary students' planning, after controlling for gender and typing fluency. Initially, planning demonstrated a small inverse relationship with IC and BRI (r = -.20). This finding is supported by earlier studies on behavior regulation. Both IC and behavior regulation are theorized to influence academic outcomes (Ackerman and Friedman-Krauss, 2017; Shoda et al., 1990; Spiegel et al., 2021), paralleling the significant correlation between planning and BRI in this study. However, after controlling for gender and typing fluency, BRI did not explain unique variance above the other variables in the study. This was a surprising result because for elementary students, planning may be considered partly behavioral in nature. A student must engage in planning as an explicit

step in the writing process and build a habit of pulling a blank piece of paper after reviewing a writing prompt, generate ideas to include in an essay, recall background knowledge about the topic, and create some kind of logical order for their ideas. One explanation for the findings in this study is that most of the variance for BRI is shared with CRI. This makes a case for self-regulation potentially being a unidimensional construct.

BRI includes the foundational EF of IC (along with self-monitoring) and studies exploring relations with planning in writing specifically are few. Some earlier empirical studies, nonetheless, have also found nonsignificant correlations between planning and BRI or IC (Drijbooms et al., 2015). The findings in this study, however, suggest that a relationship between BRI and planning is present given the small significant correlation between the two components. Future studies might examine the extent to which behavior regulation within self-regulation for writing is salient for upper elementary students.

Emotion Regulation and Planning

This study adds new information about potential relations between emotion regulation and planning in the writing process. Similar to BRI, the correlation between planning and ERI was also very small but significant (r = -.20). However, after controlling for gender and typing fluency, ERI did not significantly explain any unique variance above other variables in the model. The significant correlation is consistent with studies exploring SH (captured in ERI) and planning (Drijbooms et al., 2015) and because SH has been significantly related to other more complex component skills of writing, such as oral language (Spiegel et al., 2021), the significant correlation with planning was expected. Emotion regulation (and SH) in planning supports abandoning an idea that may not be relevant to the prompt or pivoting from an idea to jot another when it comes to mind, then returning to complete the first idea – all the while managing

frustration about the writing task along the way. The findings from the regression, however, may be attributed to possible floor effects in planning for this transitional age group. It is probable, however, that most of the variance is shared with CRI, again suggesting that self-regulation may be a unidimensional construct as others argue.

Factor Structure of the BRIEF-2

The underlying factor structure of the BRIEF-2 was explored to determine how these self-regulation indices relate to academic achievement in writing in addition to the BRIEF's typical use for examining behavior disorders or brain injury. An initial six factor solution resulted from the analysis. The initial and final solutions presented a few interesting patterns in thinking ultimately about their possible relations to writing.

Several considerations were made prior to final factor selection. First, the initial six factor solution was not expected, as three factors contained only zero to three items that most strongly loaded on to the latter three factors. Second, it was interesting that handwriting-related items (e.g., handwriting and neatness of written work) appeared to cluster and comprise a separate factor (Factor 6). However, handwriting was most strongly captured by the CRI factor (Factor 1). It is not surprising that the BRIEF-2 does not have a separate handwriting factor because the tool was designed to capture EF related to EF disorders. Nevertheless, teachers who are responsible for writing instruction might attend more to handwriting differences rather than general EF. Third, Factor 4 presented an interesting division of CRI (Factor 1) into two separate factors, yet Factor 4 was comprised only of one subscale (organization of materials) from the original CRI factor in the BRIEF-2. Factor 4 included three of the five items in the BRIEF-2's organization of materials subscale as part of its original CRI factor, with the two remaining items indicating

issues with potential cross loading (r = .44 and r = .34), though most strongly correlating with Factor 1.

The final solution eliminated Factors 4, 5, and 6. Factor 4 was excluded based on the discussion above. Factors 5 and 6 were not included in the final model because they contained only one or two items (Watkins, 2018), respectively, with the only two high-loading items in Factor 6 having the strongest correlations with Factor 1. Furthermore, they seemed to be items that could not be reliably estimated by teachers (e.g., thinks too much about the same topic). A total of eight items were excluded from the final solution, including four items from the BRIEF-2's original CRI factor (from the WM, planning/organization, and organization of materials subscales) and three items from its original ERI factor (all from the SH subscale). All items relating to the BRIEF-2's original BRI factor were retained in the study due to acceptable loadings, with just one item (item 13) correlating most strongly with the CRI factor in this study (compared to the BRI factor).

The final three factors retained also displayed intriguing results. While the BRI and ERI factors in this study contained only items from the BRIEF-2's original BRI and ERI factors, the CRI factor in this study contained an additional few items from the other factors. The CRI factor in this study contained three items from the BRIEF-2's original ERI factor (within the original SH subscale) and one item from its original BRI factor (within the original self-monitoring subscale). The three items in CRI from the BRIEF-2's original ERI factor all pertained to problem-solving, which may be reconsidered a mental or cognitive process rather than an emotion regulation process. Similarly, the BRIEF-2's original BRI item (item 13) included in this study's CRI factor discussed understanding one's own strengths and limitations, which,

again may be reconsidered a cognitive process involving self-awareness and metacognition, rather than involving behavior modulation within behavior regulation.

Considering that there lacks consensus about the bounds of EF and self-regulatory processes, particularly as they can be used to support developing writers, additional findings were expected. One, because relations between behavior and emotion regulation along with their respective EF (subscales) with writing have not been as reliably established, ambiguity in item membership between factors was slightly anticipated for this sample. However, the items included in the final EFA for behavior and emotion regulation mostly matched those in the BRIEF-2's original BRI and ERI factors. It was also considered that behavior and emotion regulation may not yet be distinguishable for this sample of children (Cummings et al., 2023). However, three distinct factors were evident in the EFA (Munoz & Filippetti, 2021). This finding about distinct BRI and ERI factors might be supported by the distribution of scores on the writing assessment for this sample, some of whom may have been slightly more mature writers.

Direct and Indirect Relations Between Self-Regulation Indices and Writing Quality

Research question four asked whether planning partially or fully mediates the relation of CRI, BRI, and ERI with writing quality. The relationship between CRI and writing quality remained significant with and without the mediator, planning (see Table 5). When planning was added as a mediator, the direct path remained significant (see Table 6). This supports that planning captures some of the variance from CRI in writing quality but does not fully mediate the relation between CRI and writing quality. The indirect path from CRI to writing quality remained significant though with a small beta value, concluding that planning partially mediates the relationship between CRI and writing quality. In extension, and as predicted, planning requires the skills captured by the CRI of the BRIEF-2. Skills such as WM, organizing,

initiating, and task monitoring are required in the planning phase of the writing process. These skills, however, also are needed directly for producing quality writing.

The self-regulation index of CRI includes the foundational cognition of WM. In agreement with what other researchers have found, there are significant direct relations between WM and writing quality (Kim & Graham, 2022; Kim & Park, 2019). Kim and Graham (2022) reported significant direct relations between WM and writing quality with a beta weight of .17, for a sample of Grade 2 students. Kim and Park (2019) reported significant direct relations between Grade 1 WM and Grade 3 writing quality, with a beta value of .19.

In addition, significant indirect relations between WM and writing quality have also been reported, though without planning included as a mediator (Kim, 2020; Kim & Park, 2019; Kim & Schatschneider, 2017). Kim (2020) reported a beta value of .25 for WM mediated by vocabulary, grammar, spelling, oral language, and theory of mind on writing quality for Grade 4. Kim and Park (2019) reported a beta weight of .12 for Grade 1. They also reported indirect relations between Grade 1 WM and Grade 3 writing quality through vocabulary, grammar, spelling, and inference, with a beta value of .11. Similarly, Kim and Schatschneider (2017) reported a beta value of .43 for indirect relations between Grade 1 WM and writing quality, mediated by vocabulary, grammar, spelling, oral language, theory of mind, inference, and sentence copying. Although planning was not a mediator in the aforementioned studies, there is some assumption that planning would consider several of the variables through which the relation between WM and writing quality was mediated, such as theory of mind, inference, vocabulary, and oral language. For example, the fourth grader would need to consider the audience for whom they were writing, the level of details and explanations to provide in their

writing for this audience (theory of mind), and how to articulate those details and explanations (vocabulary and oral language).

That planning did not mediate the relationship between BRI and ERI was less expected in light of theory. When BRI and ERI were dropped from the mediation model, the changes in R^2 was small. The R^2 value for total effects dropped from 34.47% to 33.43%, a difference of approximately 1%. The R^2 value for direct effects reduced from 36.26% to 35.29%, a difference of less than 1%. Consequently, it was noted that the variance explained by BRI and ERI was small (approximately 1%).

Regarding ERI (emotion regulation) and its nonsignificant relation with writing quality in this study, there is less clarity. One consideration for these results is that this Grade 4 and 5 sample's teacher rating scale did not produce enough variation in ERI to explain writing quality. There also remains the consideration that ERI may not be distinguishable from BRI for certain age groups. Other researchers have found that the BRIEF-2 may carry a two-factor model which does not include ERI as a separate factor for younger students (Cumming et al., 2023). Finally, writing interventions have been used to build emotion regulation (Sargunaraj, 2021), which suggests that emotion regulation could have a bidirectional relationship with writing. The current study was not designed to evaluate the potential of that relationship, as it did not embed an emotion regulation intervention.

Limitations

There were several limitations of this study. First, although the power analysis indicated that meaningful differences could be detected with the current sample size, the literature on sample size for mediation analysis is limited (Hayes, 2022). This study's sample size remained below a suggested size of 200. With a larger sample size, there may also be a better chance of

detecting potential significant relations, such as between BRI or ERI with writing quality, which were not significant in this study. Particularly for item-level analysis, a larger sample might produce more variability in scores and therefore different factor loadings. Additional studies with larger sample sizes might consider first and second order factors to go from item to subscale, then to scale or factor (Cumming et al., 2023). However, there is no fixed recommendation for sample size and a power analysis is limited by the effect sizes and results found in other studies entered in the power analysis (Hayes, 2022).

On the note of sample size in mediation analysis, there is an argument that a smaller sample size may be better suited for detecting results in which complete mediation is hypothesized in reality (which was not the case in this study), because there is low power to detect direct effects (Hayes, 2022). In the case where partial mediation is hypothesized , as in this study, a larger sample size is suggested because there is greater power to detect a direct effect, which might be otherwise missed with a smaller sample size (Hayes, 2022). In this study, notwithstanding sample size limitations, a partial mediation effect was detected nevertheless, and a direct effect was also significant. The discussion, however, is complex because there are component skills in writing per DIEW (Kim & Graham, 2022; Kim & Schatschneider, 2017) that were not measured in this study due to resource limitations.

Second, a subsequent study might also account for the fact that approximately one-third of the sample in this study came from one teacher respondent. Therefore, looking for possible effects at the teacher level may be warranted and this may be a necessary control in subsequent studies. Relatedly, the BRIEF-2 provides additional indices that detect certain response patterns. These indices determine the extent to which respondents answer items negatively, inconsistently, or atypically above and beyond set thresholds. These indices were not considered in the

statistical analysis for this study. However, utilizing those special response pattern indices might have revealed certain response patterns that address whether a student's BRIEF-2 scores should be used in subsequent analysis. Multiple responses with scores in the unacceptable, inconsistent, or questionable ranges on these indices for a particular teacher might further elucidate how teacher effects need to be considered.

Third, limitations of instrumentation may have been present. While the BRIEF-2 provides an overview of a student's self-regulation indices in the naturalistic school environment, the item responses are limited due to indirect behavior report and the three-point Likert scale limits variability. Also regarding instrumentation, the BRIEF-2 psychometrics, although adequate, are not without criticism. Evidence for convergent validity, for example, is limited for certain scales and indices. Follow up studies might consider alternative behavior rating scales, parent and multiple respondents, and scales with updated norms.

Additionally, while normal distribution was determined via examination of several indicators, there was possible bimodal distribution of the writing quality data (with floor effects for a portion of the sample), limited variability and floor effects in planning, and floor effects for the BRIEF-2 item responses. There may have been too few dysregulated students in the sample (and high average performance in regulation). To note, positive skewness is common for behavior rating scales to reflect that most subjects would fall at the normal or lower end of a clinical scale (Gioia et al., 2015). However, a quantile regression, as opposed to a mean-based regression, may show different relations at different points in the distribution of student writing performance. Other methods, such as probit regression could be considered to determine if there is a meaningful difference between the majority of students and a subset of students who fall at the higher end of the distribution.

A more comprehensive model with additional mediating variables may be warranted due to the developmental trajectory of writing. For example, for early writers, vocabulary and grammar have been found to indirectly predict writing quality via oral language, spelling, and handwriting (Kim & Schatschneider, 2017; Kim & Park, 2019). There are also relations between reading comprehension and writing quality (Kim & Graham, 2022). Therefore, a more comprehensive model taking into account various other components of writing might be better suited to draw conclusions about predictors of writing quality for upper elementary students. This model might then use structural equation modeling (SEM) or a more elaborate model within the PROCESS macro to account for latent variables comprised of observed writing variables, multiple mediators, and consider maximum likelihood-based SEM programs, such as Amos (Hayes, 2022). However, results from either SEM or PROCESS, utilizing ordinary least squares regression) might be expected to be similar (Hayes, 2022).

Future research should further explore relations between foundational cognitions, other than WM, and writing quality. WM, captured in CRI in this study as well as in the original BRIEF-2, has repeatedly demonstrated direct and indirect relations with writing quality (Kim, 2020; Kim & Graham, 2022; Kim & Park, 2019; Kim & Schatschneider, 2017). For example, Grade 1 WM has been found to directly predict Grade 3 writing quality (Kim & Park, 2019). Additionally, the nonsignificant findings between some of the self-regulation indices (BRI and ERI) in this study are likely because the BRIEF-2 is an indirect measurement of students' self-regulation, and particularly the BRI and ERI are far removed from the more direct performance measures included in the DIEW studies (e.g., Kim & Graham, 2022). Finally, future studies should also consider the role of the various types of self-regulation in more comprehensive models of writing than the one considered in this study, potentially using a more sophisticated

planning rubric that differentially considers various aspects of planning, such as the number of ideas and organizational notes (Harris et al., 2023).

CHAPTER FIVE: IMPLICATIONS FOR PRACTICE

Introduction to Writing and Self-Regulation

Research findings from writing assessment and intervention studies should be used to inform decisions in education and school psychology about intervention targets for students experiencing writing difficulties. Writing ability carries significance for one's engagement and interaction with the world. Engagement includes writing narrative or opinion style text for advocacy or producing content for job applications. Despite these crucial and meaningful purposes for writing, writing receives less attention in schools than other foundational subjects like reading and math (Brindle et al., 2016). Policy may explain some of the discrepancies between the popularity and preference for instruction in other subjects besides writing. Nevertheless, an emphasis on writing can have positive effects on other classroom skills, including self-regulation as a major goal of elementary schooling in particular, thus making it a worthy cause to introduce writing early on (Arrimada et al., 2019; Klein et al., 2022). Self-Regulated Strategy Development (SRSD) is an evidence-based intervention that has repeatedly demonstrated effectiveness in building students' self-regulation skills and their academic skills in writing (Klein et al., 2022; Graham & Harris, 2000). The effectiveness of SRSD has been captured through historically large effect sizes.

School psychologists, owing to their knowledge about evidence-based practices and the interrelation between academic skill development and self-regulation, should recommend SRSD. Consistently emphasizing skills that build students' self-regulation can support improvement in students' written expression. Specifically, school psychologists and other educators can integrate and interpret their assessment of behavior rating scales (e.g., BRIEF-2) and students' self-regulation in conjunction with their academic skills assessment using curriculum-based

measurement (CBM) and achievement batteries to best inform recommendations for students' writing.

This chapter provides suggestions for practice in improving students' self-regulation within the writing process. Self-regulation strategies integrate writing skill development with the self-regulation skills necessary for improving outcomes (Graham & Harris, 2000). Of the core academic subject areas, writing is typically prioritized after reading and mathematics. However, writing is equally important as reading and mathematics, and even required for successful participation in academic, social, and work spheres. Furthermore, access to high quality writing instruction is an equity issue, with students in historically marginalized groups (e.g., emerging bilinguals, students of color, and students with disabilities) given less access to high quality writing instruction (National Assessment of Educational Progress; NAEP, U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, 2011). Following, a case example is presented along with sample assessment case data. Then, goals for targeting skill improvement are identified. Finally, recommendations matching specific evidence-based interventions to the student's assessment profile are shared.

Hypothetical Case: Sarah

Sarah, a nine-year-old student, was referred to the school psychologist for evaluation for a learning disability after her teacher reported that she struggled with producing adequate written composition text after a 6-week intervention period. In addition to work incompletion, such as copying words and sentences from the board, Sarah frequently spends writing time looking for a pencil. This happened at the start of at least three of the five weekly writing instruction sessions during the intervention period. The teacher also noticed that Sarah interrupted the teacher's instructions, despite previous prompts to raise her hand before asking a question. When Sarah

did talk out of turn, however, she presented brilliant ideas. Despite her verbal fluency, writing down those ideas was a frequent challenge. Sarah's mother observed that when talking to friends, Sarah found it difficult to stop talking at times. Although she spoke fluently and with prolific production, it was often difficult to understand her main point. Based on this descriptive information from the teacher and parent, the school psychologist decided to assess Sarah's self-regulation and writing skills. The school psychologist administered the BRIEF-2 and CBM in written expression (WE) probes. Although other measures were also included within the learning disability evaluation, information from the BRIEF-2 and CBM-WE are specifically used to show how these data align with evidence-based writing instructional practices. Sarah's scores on the BRIEF-2 are in Table 11 in Appendix L and her CBM-WE scores are shown in Table 12, Appendix M.

Interested in learning about Sarah's written production and her self-regulation capabilities, school psychologist examined Sarah's total words written (TWW), words spelled correctly (WSC), and correct writing sequences (CWS). The school psychologist also interpreted Sarah's scores in the three BRIEF-2 indices, as well as subscales within each index to determine whether they could provide more information about Sarah's difficulties with writing, particularly interested in her working memory score (in conjunction with other data).

Within written production, the school psychologist was interested in knowing whether Sarah's challenges related to writing fluency or writing accuracy. With regard to Sarah's overall performance on the CBM-WE, her TWW (total production) was average. This data supported the parent and teacher observations of high verbal fluency. However, with regard to the content of her writing it was often challenging for her teachers and peer reviewers to determine the point she aimed to make while reading extraneous details prior to the thesis statement or premise of

her narrative writing. For example, she introduced a topic over numerous sentences and did not move on to other elements of the narrative story before instructional time ended. Sometimes, her writing included an ending, but it was before a climax or conflict was introduced. The disorganization made it difficult for the teacher to qualitatively evaluate Sarah's work.

In addition, the school psychologist evaluated the accuracy of Sarah's writing. An error analysis of her work showed that while Sarah had few spelling errors and used grade-level vocabulary, she made frequent mistakes such as forgetting to add punctuation and derivational morphemes to indicate plurality or action verbs. Her writing frequently included words and sentences crossed out and corrected for spelling, grammar, syntax, and semantics. Although she did not consistently apply the spelling, grammar, and text structure rules, Sarah could verbally state most writing rules if the teacher asked or redirected her attention while she was writing.

The school psychologist also considered teacher and parent observations, which suggested that Sarah's self-regulation challenges would benefit from SRSD. Further assessment data from self-regulation measures (the BRIEF-2) provided evidence for the same, helping to better understand whether Sarah's challenges related to overall self-regulation or difficulty with regulating behaviors only for writing and otherwise. Because of her challenges with behavior regulation (inhibition) and cognitive regulation (working memory, plan/organize, and organization of materials), the school psychologist recommended SRSD as a way to improve Sarah's outcomes in writing as well as her self-regulation skills in writing. Further, given the discrepancies between Sarah's knowledge of writing rules and skills in oral language, in comparison to her performance on CBM-WE, the school psychologist determined that Sarah would benefit from explicit instruction with the revision strategies in SRSD.

Self-Regulated Strategy Development to Improve Writing Outcomes and Self-Regulation

This section serves as an interlude to explain the development of self-regulation before specific recommendations from SRSD are introduced. Self-regulation begins to build in the first year of life. While the first five years are profound for the development of self-regulation, different development stages occur until young adulthood (Rosanbalm & Murray, 2017). Self-regulation is comprised of foundational cognitions such as WM and IC, with significant involvement in behavior and other types of self-regulatory processes (Hofmann et al., 2012). Notably, however, types of self-regulation develop at different times, at different paces, and as different constructs (Montroy et al., 2016). For example, emotion regulation is thought to develop before behavior regulation (Montroy et al., 2016). Both, 'hot' and 'cool' processes, those involving emotion and those not involving emotion, respectively, are represented through types of regulation (e.g., emotion and cognitive regulation) under the broader umbrella of self-regulation (Ackerman & Friedman-Krauss, 2017; Hofmann et al., 2012).

Self-regulation pervades an academic task like writing and is essential to weigh in addition to behavioral considerations. More specifically, however, behavior regulation should also be considered in academic tasks. For example, behavior difficulties such as low task-engagement in Grade 1 are related to Grade 3 reading difficulties after controlling for a multitude of other factors (Morgan et al., 2008). Conversely, reading problems in Grade 1 have been found to be related to behavior difficulties in Grade 3 (Morgan et al., 2008). This paper will focus on writing due to the high rates of behavioral difficulties occurring with writing task demands and the degree of self-regulation required to persist in a writing activity at school.

For early elementary students, behavior regulation is almost indistinguishable from writing outcomes (Puranik et al., 2019). Meta-analytic reviews for wider age ranges (ages 3 to

13) also show that self-regulation development and writing, reading, math, and vocabulary development influence each other (Robson et al., 2020). This relation is bidirectional. The bidirectionality hypothesis states that stronger EF (particularly WM, IC, and attention) and self-regulation lead to stronger academic outcomes and vice versa. Thus, while the Grade 4 and 5 sample data in this study did not produce significant results with BRI and ERI, SRSD provides targets for instruction in many of the areas that are captured in CRI, both for hypothetical case student Sarah, and the many students included in this study whose CRI scores were elevated.

Recommendations

Explicit Instruction

SRSD is considered by many to be the gold standard for writing intervention because it explicitly teaches strategies for both the structural and organizational components of writing as well as strategies for persisting with the writing activity amid emotional and behavioral regulation challenges inherent in the writing process (Graham et al., 2016). SRSD is a highly effective writing intervention that explicitly teaches self-regulation within the writing process. Specifically, SRSD teaches students to set goals, self-monitor, and provide self-instructions, self-reinforcement, and self-assessment (Harris et al., 2012). Including self-regulation in writing strategy instruction has been meaningful for writing improvement (ES = 0.50; Graham et al., 2012). SRSD does this through six instructional stages: background development (pulling information from long-term memory about what is already known about a topic), discussion of the information, teacher modeling, memorizing, supporting, and independently performing. Importantly, the stages must be recursive and interactive (Harris et al., 2012).

Alleviating Working Memory Limitations

Figure 4 in Appendix N illustrates how long-term memory and WM can be activated for a writing task. Using a graphic organizer helps to alleviate working memory constraints as well as guide the structure expectations within writing. In this case it is the writing structure necessary for writing in the informational genre (Harris et al., 2012). Furthermore, the graphic organizer can be used for goal-setting and planning. When taught to use the graphic organizer, Sarah can list her ideas and *organize* or pre-assign an order to the informational elements she wants to include in her writing, without the cognitive load of complete sentences, and language components, such as grammar, and spelling. Given Sarah's strength in expressing good ideas, writing a few words in the graphic organizer was enough to remind her what ideas she wanted to write.

The writing prompt asks students to write about the general behavior of dogs. In the graphic organizer in Figure 5 in Appendix N, Sarah identified two ideas and specific details that can lead to more elaboration, specifically related to what dogs *do*, and not what they think. Although Sarah initially resisted writing it, the organizer is a pre-writing step – as part of a self-regulation strategy in writing – that allows the writer to order and organize their thoughts in a logical manner to be more coherent to the reader (Graham et al., 2012). Drafting as a pre-writing strategy has shown moderate to large impacts on writing (ES = .54; Graham et al., 2012).

Building Cognitive Regulation in Writing

There are several strategies within SRSD to support cognitive regulation. One strategy is POW, which stands for *pick* my idea, *organize* my notes, and *write* and say more. POW can be used to support cognitive regulation in the process of a writing task (Harris et al., 2012).

Organizing the writing demand into three simplified tasks may be particularly helpful for students for whom writing is an anxiety-inducing activity.

The *TREE* and *WWW, What = 2, How = 2* strategies within SRSD can be taught as ways to remember the elements in two genres of writing (Harris et al., 2012). The *TREE* mnemonic stands for *topic* sentence, *reasons*, *explanation,* and *ending*, which are the critical elements of the opinion-writing genre. For *topic* sentence, the writer tells what they believe, and then provides three or more *reasons* for why they believe it and why their readers should believe it. For *explanation,* the writer is provided with an opportunity to elaborate on the reasons given to support their topic sentence. Finally, for *ending*, the writer is invited to summarize the earlier three sections into a succinct statement that concludes the writing. The TREE strategy (with some variations for early writers) positively affects the quality of students' opinion writing (ES = 1.84; Harris et al., 2012).

The *WWW, What = 2, How = 2* strategy provides students with the elements to include in a narrative genre, or story writing. A story should start with *who*, *when*, and *where*. Next, the writer provides two pieces of information regarding *what* the main characters want to do and *what* happens around that situation. Lastly, the writer provides two pieces of information addressing *how* the story ends and *how* the characters feel (Harris et al., 2012). WWW positively affects the quality of students' narrative writing (ES = .27; Harris et al., 2012).

In addition to these process and structure strategies, SRSD teaches students to use cognitive regulation strategies that help with persistence through a writing task, which include goal-setting, self-monitoring, and self-assessment. They are regarded as cognitive regulation because the individual must review their writing and continuously reflect on whether the translated and transcribed ideas achieve the goal of the writing task and how well. Assessment

that goals are not being met requires the writer to revise or return to an earlier planning phase (such as within POW or TREE) to update ideas. Cognitive regulation in writing should be scaffolded using pre-existing tools, such as the graphic organizer used for the case example. WWW, POW, and TREE are a few strategies within SRSD that can be utilized during the planning process. Through repeated practice, students memorize the organizer and strategy and it is a goal to fade the teacher-provided organizer.

Building Behavior Regulation in Writing

The strategies within SRSD can also be considered behavior regulation, particularly for younger developing writers. Behavior regulation includes the rehearsal of strategies in stage 4 of SRSD. Students, in other words, must learn to apply the steps in conducting writing activities. In addition, teaching students to self-reinforce is an important self-management skill that is behavioral in nature. When presented with a writing task, the student needs to recognize how much time they have to complete the task, align their focus with the writing activity, and ignore other tempting or procrastination activities. Regardless of level of proficiency with applying SRSD, the student must begin engaging with the steps as best as possible.

Explicitly teaching self-regulatory skills can improve behavior regulation (Hofmann et al., 2012). Possible ways to build behavior regulation are to start with requiring only basic or initial steps to begin engaging in writing tasks. For example, the student might read the prompt or choose a topic. Once initiating and engaging with a writing task is achieved by the student, they might be given a second slightly more demanding step in the writing process. For example, to activate memory and background knowledge, the teacher might ask about their past experience with the topic (such as the first day of summer or being in a car or bus).

Building the use of self-regulatory strategies as a habit may require external rewards as an intensification of the SRSD intervention. Rewards might include an extra minute at recess, a leadership opportunity (e.g., line leader), or getting to check out an extra book at the school library. Rewards can be increased in value depending on the student's motivation. For example, the longer a student engages with a writing task, the greater or more valued the reward by the student. This might look like five minutes of engaging with a writing task earning two extra minutes at recess. Teachers able to engage in some pre-planning and design can support students' motivation towards engaging with the writing process.

In selecting rewards for writing tasks, some sensitivity should be exercised. For children from low-resource backgrounds, rewards that merely meet basic needs such as snacks may not support appropriate and equitable design. Instead, rewards such as those supporting academic engagement and motivation are more favorable (with the school potentially taking on the responsibility of meeting the children's basic needs).

Activities to build more domain-general behavior regulation include games like Simon Says and Red Light-Green Light. In these games students practice shifting between different sets of rules. Students must also inhibit initial responses based on the rules initially taught and swiftly apply the other set of rules (McClelland et al., 2014). One well-studied task, Head-Toes-Knees-Shoulders employs motor inhibitory control movements, cognitive flexibility or switching, and WM. Performance on this task positively influences mathematics, vocabulary, and growth in other academic areas (McClelland et al., 2014). However, it should be noted that interventions in these areas have not resulted in direct effects on academic achievement.

Building Emotion Regulation in Writing

SRSD can support students' emotion regulation skills. It can do this through strategies such as modeling, self-talk, and peer support. These strategies involve the teacher, the student themself, or classmates and peers. Ideally, the following strategies would be employed in unison to add variety to instruction and present lessons through multiple individuals.

One efficient way to build emotion regulation is through modeling. By design, students look to teachers to learn how to respond to situations beyond concrete academic instruction. Much like a parent or caregiver, the teacher is in a position to impart skills of persistence and perseverance, beyond academic skills. This requires conscious awareness on the teacher's part in the presence of their students. Modeling emotion regulation and verbalizing thoughts particularly through task engagement with writing sends important messages that engaging with writing tasks does not need to be an unpleasant process.

A second major component of SRSD that can support emotion regulation is the self-talk strategy. Self-talk must be explicitly taught first. A teacher or instructor prompts the writer to think of positive self-talk statements to refer to when the writer feels stuck (Laud & Patel, 2008). Teachers might write these statements on chart paper for reference or prompt students to write them at the top of their paper. When feeling stuck, the writer vocalizes or rehearses their motivating self-talk statements. One broad goal in supporting use of self-talk statements is to have students overlearn, internalize, and automatize other writing steps using SRSD so that there can be a dedicated focus on self-talk for young writers (Laud & Patel, 2008). Alternatively, collaborative peer editing and revision can be employed within SRSD to support emotion regulation. In this, the writer engages in discussion of information about their writing with peers or other individuals who can provide feedback.

Peer feedback may be additionally meaningful for writing and revising, allowing the writer to hear their work. Hearing and reading one's sentences involves the phonological loop within WM, which is implicated in reading comprehension (Kellogg et al., 2013). Peer reading during revision may be even more effective than reading aloud one's own work, as the writer's own WM involvement is likely reduced after planning and subsequent translating to catch mistakes in writing (Kellogg et al., 2013). The phonological loop also plays a role in written production by aiding orthographic encoding processes. Given the benefits of peer review, including a checklist for evaluating goals met for writing, the potential of the strategy should not be underestimated. Reading or hearing one's written text can help to improve the way ideas are translated into text, both situationally and syntactically. Ultimately, peer feedback supports further automatizing writing strategies so as to focus more on self-talk and become an independent writer (Laud & Patel, 2008).

Another way to build emotion regulation is to intentionally implement a developmentally appropriate social-emotional learning program, which can also involve peers. Social competencies and social skills are moderately associated with self-regulation for elementary-age students (Robson et al., 2020). Considering this association, focusing on teaching prosocial skills and social competence is a valuable use of instructional time.

There are several specific target skills and goals for intervention in building emotion regulation. Specific target skills for intervention include peer relations that arise in the school setting. This has the additional benefit of a timely and responsive remedy to issues that arise with the aim to prevent future fallouts as well as corrective strategies for students involved (without specifically targeting or naming them). More specifically, goals for intervention in a social-emotional learning course for improvement in writing might be chosen. These include improving

communication and assertiveness, such as building skills to share opinions, refuse requests, express displeasure, and request behavior change. Goals might also include improving self-control, such as managing strong emotions and expressing them. Lastly, goals can include improving academic social skills, such as requesting help, working in a group, and staying focused (Siqueira De Souza et al., 2022).

Providing students with explicit instruction to process issues relating to social development facilitates academic improvement. For example, following ten hours of instruction in social-emotional learning, students in an intervention group demonstrated gains in writing assessment (Siquera De Souza et al., 2022).

In imparting explicit writing instruction in the context of self-regulation, there are a few significant recommendations. First, intentional time must be set aside for writing instruction, specifically (Adolf & Hogan, 2019; Graham et al., 2016). Second, the intentional time must provide instruction on specific component skills of writing, SRSD, behavior regulation, cognitive regulation, and emotion regulation. Third, providing teachers with professional development training in writing instruction, and specifically, how to use SRSD, will likely prove useful for effecting students' writing development (Harris et al., 2012). Finally, many students need additional instruction in language skills (e.g., spelling, vocabulary, and writing complete sentences). Explicit instruction in these areas may be necessary if the breakdown in writing quality occurs in the language dimension versus the higher-order planning, cognitive, or behavior dimensions (Adlof & Hogan, 2019; Graham et al., 2016).

Conclusion

Integrating behavior and emotion with academics sets students up for the best outcomes. In combining academic instruction with instruction in strategies for behavior, cognitive, and

emotion regulation, educators provide advantages for students like Sarah beyond what either academic instruction or social skill instruction could solely provide. They are also able to affect the greatest number of students with preventative strategies embedded within Tier 1 instruction. Therefore, it is beneficial to implement self-regulation practices consistently and intentionally in education. Writing instruction offers an ideal space to introduce self-regulation strategies that can be translated to other academic subject areas. Written expression includes both an input and comprehension component for understanding and provides a path for converting thoughts and information into meaningful communication and sharing of knowledge.

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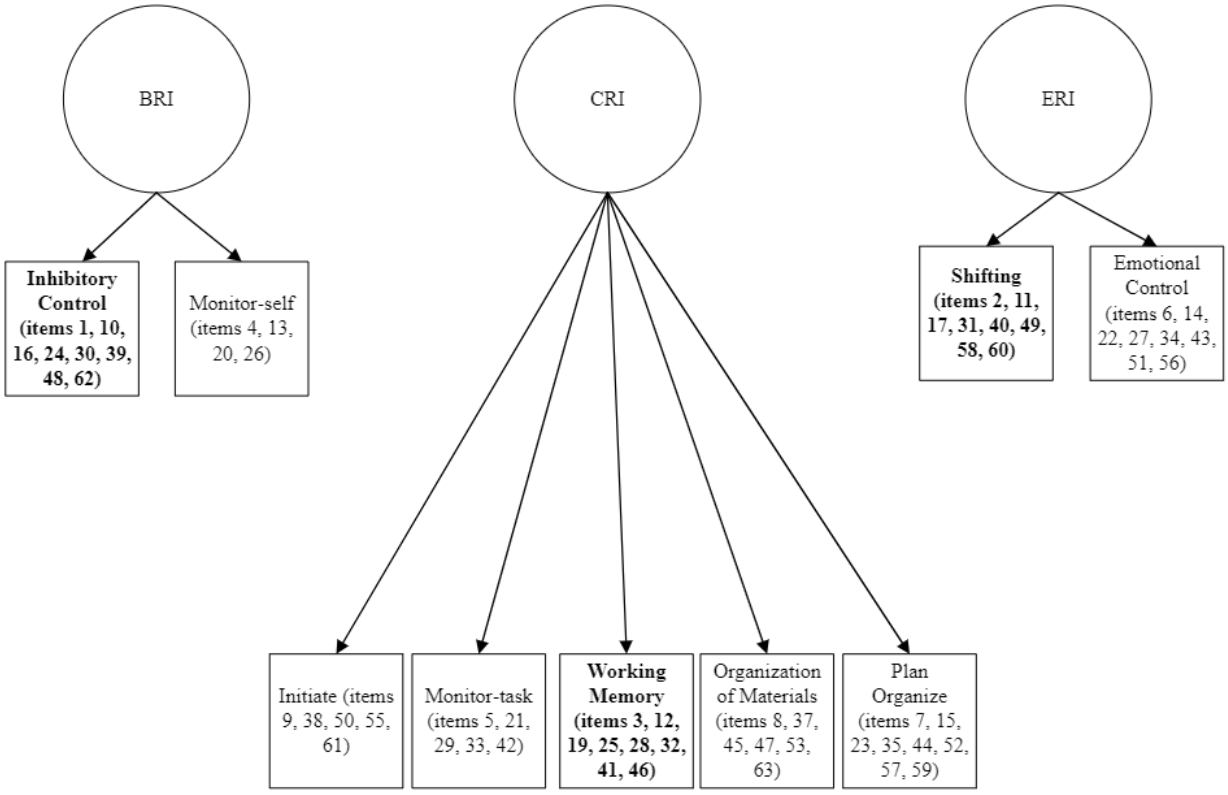
APPENDIX A

FIGURE 1

Figure 1

Three-factor model

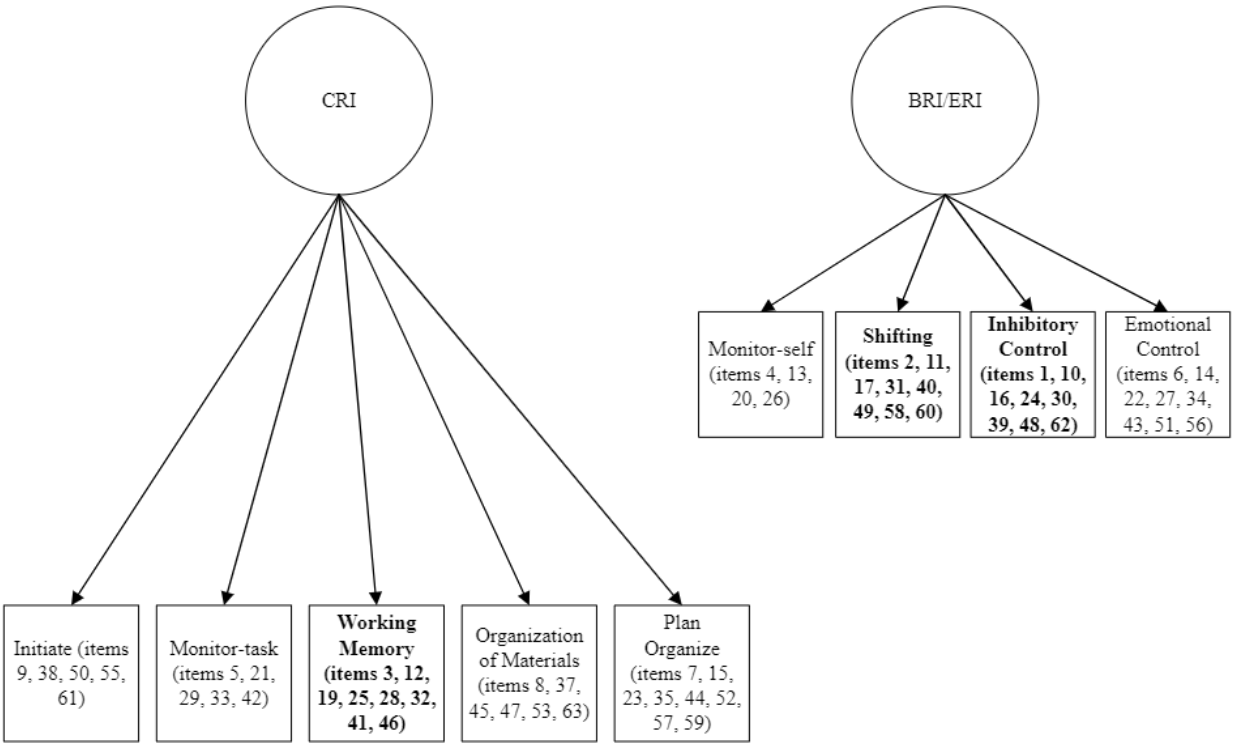


APPENDIX B

FIGURE 2

Figure 2

Two-factor model



APPENDIX C

GLOSSARY OF COMPONENT SKILLS

Component Skill	Description	Source(s)
Academic domain-specific measurement of working memory	Key examples: information search and retrieval tasks.	Peng & Swanson (2022)
Background Knowledge	Similar to long-term memory for content knowledge, and includes discourse and conventional knowledge about how to respond to specific genre (e.g, appropriate text structure).	Kim & Graham (2022)
Behavior Regulation	Ability to modulate behavior. Likely required for cognitive and self-regulation. Per BRIEF-2, behavior regulation clinical index indicates difficulties with controlling/moderating/monitoring one's own behavior.	Gioia et al. (2015); Munoz & Filippetti (2021)
Cognitive Regulation	Ability to manage cognitive processes and problem solve. May be necessary for higher-order problem solving, learning, information recall, and knowledge application. Per BRIEF-2, cognitive regulation clinical index indicates problems with management of various cognitive organization and control properties.	Gioia et al. (2015); Munoz & Filippetti (2021)
Direct and Indirect Effects of Writing	Model of writing that proposes that higher order skills are supported by lower-level skills, that hierarchical structural relations exist among component skills, and that these various component skills make direct and indirect contributions to final written composition.	Kim & Park (2019)
Discourse Oral Language	Parallel to 'ideation' (Simple View of Writing, Juel et al., 1986) and 'text generation' (Not So Simple View of Writing, Berninger & Winn, 2006); defined as the skill to create ideas and present in oral discourse mode.	Kim & Graham (2022)
Domain-general measurement of working memory	Key examples: span/ordering tasks (using numbers, words, or categories) and recall tasks of select items from a list. E.g., N-Back, Visual Matrix Tasks, Finger Windows.	Spiegel et al. (2021)

Dynamic Relations Hypothesis	Relations between component skills and writing are modified across development.	Kim & Park (2019); Kim & Graham (2022)
Emotion Regulation	Ability to modulate emotional responses, including in dynamic circumstances. Required for effective cognitive regulation. Per BRIEF-2, emotion regulation clinical index indicates problems with modulating/controlling one's own emotional responses.	Gioia et al. (2015); Munoz & Filippetti (2021)
Executive Functions	Group of basic (lower-level) top-down control processes. Synonymous with foundational (domain-general) cognitive skills in writing, consisting of working memory, inhibitory control, shifting, (and attentional control), based on the unity and diversity model.	Diamond (2013); Kim & Graham (2022); Spiegel et al. (2021); Ziv et al. (2017)
Foundational (Domain-General) Cognitions	Basic level cognitive functions, cognitions, or 'skills' "necessary for all processes," consisting of working memory, inhibitory control, shifting, and attentional control. Synonymous with executive functions (in writing).	Kim & Park (2019); Kim & Graham (2022)
Foundational Oral Language	Basic level language skills necessary for writing, consisting of vocabulary and grammar (morphosyntactic and syntactic knowledge). Necessary for syntactic maturity.	Kim & Graham (2022)
Hierarchical Relations Hypothesis	A major basis for DIEW that contains a foundational role of executive function with indirect relations to written expression through transcription and oral language.	Kim & Park (2019); Kim & Graham (2022)
Higher Order Cognition (& Regulation)	High level cognitions necessary to "establish local and global coherence," modulate one's strategy use throughout the writing process, consisting of inference, theory of mind/perspective taking (audience awareness), monitoring (of comprehension, self, performance), goal-setting, and reasoning. May also include self-assessment and self-reinforcement.	Kim & Graham (2022)
Inference	Higher order cognitive skill. "Ability to infer information based on background knowledge."	Kim (2020)
Inhibitory Control	Lower-level executive function process by which a dominant response is inhibited "in favor of a subdominant response".	Spiegel et al. (2021)

Interactive Relations Hypothesis	Bidirectional relation between the components of writing.	Kim & Park (2019); Kim & Graham (2022)
Monitoring	Metacognitive higher order cognitive skill for self-checking comprehension.	Kim & Park (2019)
Perspective-taking	Higher order cognitive skill. Ability to obtain insight and make inferences about another individual's mental/emotional states.	Kim & Park (2019)
Planning	Initial process in written composition that includes idea generation, memory access, goal-setting, and organizing.	Graham et al. (2012); Hayes & Flower (1986)
Self-regulation	Conscious, deliberate, and effortful self-initiated modulatory behaviors in response to behavioral, cognitive, and emotional arousal (to keep within adaptive ranges).	Ziv et al. (2017)
Shifting	Lower-level executive function process. Capacity to switch attention "between mental sets or tasks, or ability to engage and disengage with specific aspects within tasks".	Spiegel et al. (2021)
Social-emotional features of writing	Feature "attitude, interest, motivation, efficacy, self-concept, and anxiety," all of which develop alongside writing development. "Needed to support writing processes and tasks."	Kim & Graham (2022)
Theory of Mind	Higher order cognitive skill. Having knowledge that another individual's thoughts, emotions, and perspectives exist (separately to one's own mental status and perspectives). Often a measure in neuropsychological testing to measure perspective-taking higher order cognitive skill (via false-belief tasks).	Kim & Park (2019)
Working Memory	Lower-level executive function process. The space in human cognition within which information from long-term memory and the environment is held, manipulated, and updated during processing, reflecting a "dynamic relationship between storage and processing," (McCutchen, 1996).	McCutchen (1996); Spiegel et al. (2021), Kim & Schatschneider (2017)
Writing Architect	Web-based application that automatically records timed student writing progress and facilitates assessment of various indicators of writing quality.	Truckenmiller et al. (2020)

APPENDIX D

PLANNING QUALITY RUBRIC

Score	Description
0 = Minimal planning	• Less than or equal to 5 words
1 = Drafting	• More than 5 words • Written plan includes drafted text or a portion thereof
2 = Basic outline	• Written plan includes idea words/phrases or illustration(s) as reminders for text to be written • List of 2 or more thoughts, may or may not use bullet points
3 = Organizer	• Written plan includes structural reminders like introduction, conclusion, main idea, points, warrants, claims • Draws a graphic organizer (e.g., venn diagram, web, columns)
4 = TIDE	• Includes the letters TIDE or terms topic, ideas, details, ending/conclusion

APPENDIX E

WRITING QUALITY RUBRIC

	0 **(Absence)**	**1** **(Presence)**	**2** **(Sophistication)**
Topic	Topic introduction is **not present**. • No semblance of a topic/thesis is introduced.	Topic introduction is **present**. • Topic of essay is introduced. • Don't penalize by reading something as "Important Evidence" before the Topic if it is context. Good writers situate the topic as they introduce it.	**Relevant or engaging context** to the essay topic is introduced and flows with the topic sentence. • This may include setting up the topic in context, a hook sentence, or an element, such as a quote, critical question, vignette, a statement that directly addresses the reader, or another engaging element. • Introduction may end up being two (or more) sentences but doesn't need to be.
Important Evidence	Important Evidence is **not present**. • Idea is unrelated to the	Important Evidence is **present**. • Important evidence is viewed as facts, definitions,	Important Evidence is **clearly linked to the topic** statement. • It is well-chosen and

	passage or topic.	concrete details, or quotes. • Important evidence consists of summarizations. • If no Topic statement is present, each piece of important evidence can earn a maximum of one point for presence (despite not having a clearly stated topic to support/help develop).	relevant to the topic. Important evidence is **more than** just a **repetition** of a **textual** idea. • Consists of inferences and insights beyond what was stated in the text.
Detailed Examination	Detail that supports corresponding Important Evidence is **not present**.	(1) Detail that supports Important Evidence is **present**. • A Detailed Examination explains how information develops the topic. • A 1-point score uses a sentence stem/generic sentence such as ("This shows…"), repeats a quote word-for-word, or includes unclear explanation or connection to Important Evidence. • 1-point details explain more	Supporting detail(s) includes **one or more** of the following: • **Multiple supporting details** clearly related to the Important Evidence are given. • Provides more facts with explanation, synthesis, connections, or insights that go beyond stating the obvious and develop the topic.

		about the Important Evidence, but do not elaborate like a 2-point detail.	• 2-point details include those that explain more about 1-point details (elaboration).
Ending/Conclusion	Conclusion is **not present**, is **unrelated** to essay topic, or is **generic**. • There is no reference to the topic of the essay or no concluding statement present.	Conclusion is **present**. • Provides a concluding statement or section **related** to the topic of the essay.	Conclusion includes a **call to action / generalized message or summary** related to the information presented. • This includes "That's why" statements that include a summary, generalization, or outcome (see examples).

Note: These scoring rules are adapted, with permission, from Collins, Ciullo, Graham, Sigafoos, Guerra, David, & Judd, 2021, *Reading and Writing;* and Harris, Kim, Yim, Camping, & Graham, 2023, *Contemporary Educational Psychology*. Adaptations included additional rules for clarity, solely to improve interrater reliability. The full scoring manual may be accessed at https://osf.io/5xukt.

APPENDIX F

INFORMATIONAL WRITING PROMPT

"Write an informative essay that will help others learn about building houses out of plastic bottles. Be sure to use information from the article you just read to give reasons why using plastic bottles to build homes would be helpful. Remember, a well written informative paper (1) has a clear main idea and stays on topic, (2) includes a good introduction and conclusion, (3) uses information from the article stated in your own words plus your own ideas, and (4) follows the rules of writing" (Truckenmiller et al., 2022).

APPENDIX G

TABLE 7

Table 7

Initial EFA Communalities.

	Initial	Extraction
item1	0.778	0.608
item2	0.867	0.637
item3	0.834	0.609
item4	0.911	0.803
item5	0.865	0.758
item6	0.858	0.683
item7	0.895	0.685
item8	0.781	0.673
item9	0.923	0.696
item10	0.913	0.809
item11	0.815	0.638
item12	0.841	0.701
item13	0.844	0.698
item14	0.919	0.817
item15	0.798	0.534
item16	0.940	0.846
item17	0.731	0.535
item19	0.840	0.709
item20	0.898	0.781
item21	0.887	0.809
item22	0.860	0.701
item23	0.855	0.648
item24	0.854	0.738
item25	0.854	0.763
item26	0.928	0.841
item27	0.894	0.790
item28	0.789	0.526
item29	0.869	0.747
item30	0.829	0.717
item31	0.902	0.790

	Initial	Extraction
item32	0.856	0.706
item33	0.878	0.791
item34	0.902	0.775
item35	0.890	0.677
item37	0.817	0.732
item38	0.877	0.761
item39	0.920	0.794
item40	0.738	0.617
item41	0.766	0.604
item42	0.802	0.667
item43	0.914	0.790
item44	0.895	0.746
item45	0.841	0.739
item46	0.896	0.730
item47	0.839	0.737
item48	0.953	0.862
item49	0.790	0.619
item50	0.869	0.746
item51	0.890	0.741
item52	0.853	0.681
item53	0.859	0.725
item55	0.832	0.626
item56	0.936	0.834
item57	0.878	0.777
item58	0.948	0.842
item59	0.955	0.879
item60	0.852	0.674
item61	0.837	0.639
item62	0.839	0.749
item63	0.880	0.717

APPENDIX H

TABLE 8

Table 8

Initial EFA Loadings.

	Factor					
	1	2	3	4	5	6
item1	0.253	0.714	-0.122	-0.083	0.050	0.131
item2	0.534	0.247	0.071	-0.037	0.103	-0.089
item3	0.829	0.052	-0.036	-0.211	0.137	0.212
item4	0.143	0.848	-0.081	-0.109	0.168	-0.064
item5	0.568	0.255	-0.070	0.111	0.042	0.429
item6	-0.042	0.243	0.788	-0.142	-0.117	0.024
item7	0.641	0.070	0.133	0.097	0.000	0.093
item8	0.329	0.032	0.014	0.492	0.092	0.233
item9	0.803	-0.065	0.041	-0.006	0.106	-0.028
item10	0.045	0.851	-0.083	0.038	0.113	-0.081
item11	0.428	-0.146	0.324	0.128	0.216	-0.114
item12	0.613	0.436	-0.192	-0.043	0.056	-0.028
item13	0.674	0.027	0.044	-0.124	0.326	-0.036
item14	-0.002	-0.009	0.895	-0.023	0.042	-0.039
item15	0.389	0.103	0.112	0.062	0.275	0.001
item16	-0.103	0.710	0.485	-0.106	-0.153	0.048
item17	0.408	0.179	0.026	-0.032	0.333	-0.012
item19	1.010	-0.202	-0.056	-0.161	0.131	0.103
item20	-0.058	0.833	0.064	-0.007	0.134	-0.046
item21	0.895	0.054	-0.017	-0.073	-0.021	0.384
item22	0.090	0.027	0.716	0.079	0.003	-0.028
item23	0.782	0.027	-0.031	0.027	0.014	0.185
item24	-0.257	0.877	0.012	0.193	-0.030	0.139
item25	0.899	-0.064	0.080	0.038	-0.151	0.048
item26	-0.060	0.802	0.047	0.141	0.107	-0.006
item27	0.067	0.256	0.711	-0.071	-0.051	-0.056
item28	0.595	-0.023	0.119	0.076	0.071	0.089
item29	0.925	0.044	-0.055	-0.017	-0.153	0.152
item30	-0.086	0.822	0.040	0.063	0.069	0.133
item31	0.140	-0.094	0.789	0.107	0.044	0.000
item32	0.677	0.365	-0.124	-0.027	-0.100	-0.074
item33	0.620	0.028	-0.038	0.108	0.081	0.613

Table 8 (cont'd)

item34	-0.020	0.147	0.835	-0.085	-0.039	-0.051
item35	0.989	-0.066	0.055	-0.245	-0.025	0.229
item37	-0.160	0.255	-0.113	0.777	0.268	0.071
item38	0.662	0.212	-0.150	0.177	-0.068	-0.159
item39	-0.117	0.732	0.414	-0.081	-0.112	0.116
item40	0.025	0.184	0.076	0.194	0.580	0.075
item41	0.347	0.140	0.012	0.186	0.345	0.158
item42	0.799	0.023	-0.060	0.098	-0.109	0.117
item43	-0.155	0.006	0.877	0.035	0.185	0.094
item44	0.816	-0.238	0.260	-0.066	0.138	-0.020
item45	-0.100	-0.046	0.105	0.884	0.075	0.019
item46	0.585	0.439	-0.069	-0.007	-0.153	-0.110
item47	0.488	0.051	0.035	0.441	-0.235	0.047
item48	-0.130	0.797	0.345	-0.072	-0.013	-0.014
item49	0.078	-0.164	0.506	0.369	0.138	-0.096
item50	0.714	0.085	0.046	0.001	0.002	-0.241
item51	0.145	0.219	0.639	-0.080	0.016	-0.060
item52	0.568	0.147	0.088	0.096	0.089	0.051
item53	0.579	0.022	0.011	0.344	-0.047	0.072
item55	0.796	0.034	-0.017	-0.037	-0.057	-0.134
item56	0.096	-0.104	0.896	0.086	-0.029	0.030
item57	0.481	0.058	0.186	0.286	0.009	-0.069
item58	0.057	0.831	0.068	0.001	0.001	-0.036
item59	0.122	0.844	-0.063	0.017	0.078	-0.107
item60	0.837	-0.101	0.075	-0.087	0.130	0.025
item61	0.993	-0.172	-0.012	-0.093	-0.125	-0.033
item62	0.738	-0.047	-0.022	0.274	-0.143	-0.024
item63	0.861	-0.139	0.085	-0.083	0.161	0.045

APPENDIX I

TABLE 9

Table 9

Three-Factor EFA Loadings.

	Factor		
	1	2	3
item1		0.677	
item2	0.535		
item3	0.790		
item4		0.727	
item5	0.680		
item6			0.717
item7	0.682		
item8	0.614		
item9	0.822		
item10		0.799	
item11	0.523		0.496
item12	0.621		
item13	0.710		
item14			0.939
item15	0.504		
item16		0.736	
item17	0.503		
item19	0.980		
item20		0.774	
item21	0.880		
item22			0.742
item23	0.815		
item24		0.968	
item25	0.851		
item26		0.810	
item27			0.719
item28	0.652		
item29	0.872		
item30		0.841	
item31			0.823
item32	0.626		
item33	0.745		
item34			0.844
item35	0.868		
item37		0.423	
item38	0.709		
item39		0.764	
item40			
item41	0.570		
item42	0.816		
item43			0.911
item44	0.802		
item45			
item46	0.519	0.438	
item47	0.609		
item48		0.781	
item49			0.629
item50	0.674		
item51			0.682
item52	0.641		
item53	0.727		
item55	0.734		
item56			0.876
item57	0.596		
item58		0.816	
item59		0.788	
item60	0.829		
item61	0.886		
item62	0.806		
item63	0.866		

APPENDIX J

TABLE 10

Table 10

Final Three-Factor EFA Loadings.

	Factor		
	1	2	3
item1		0.692	
item2	0.534		
item3	0.780		
item4		0.747	
item5	0.673		
item6			0.729
item7	0.682		
item8	0.616		
item9	0.819		
item10		0.820	
item12	0.611		
item13	0.694		
item14			0.932
item16		0.722	
item19	0.969		
item20		0.783	
item21	0.875		
item22			0.751
item23	0.813		
item24		0.948	
item25	0.848		
item26		0.806	
item27			0.721
item28	0.652		
item29	0.868		

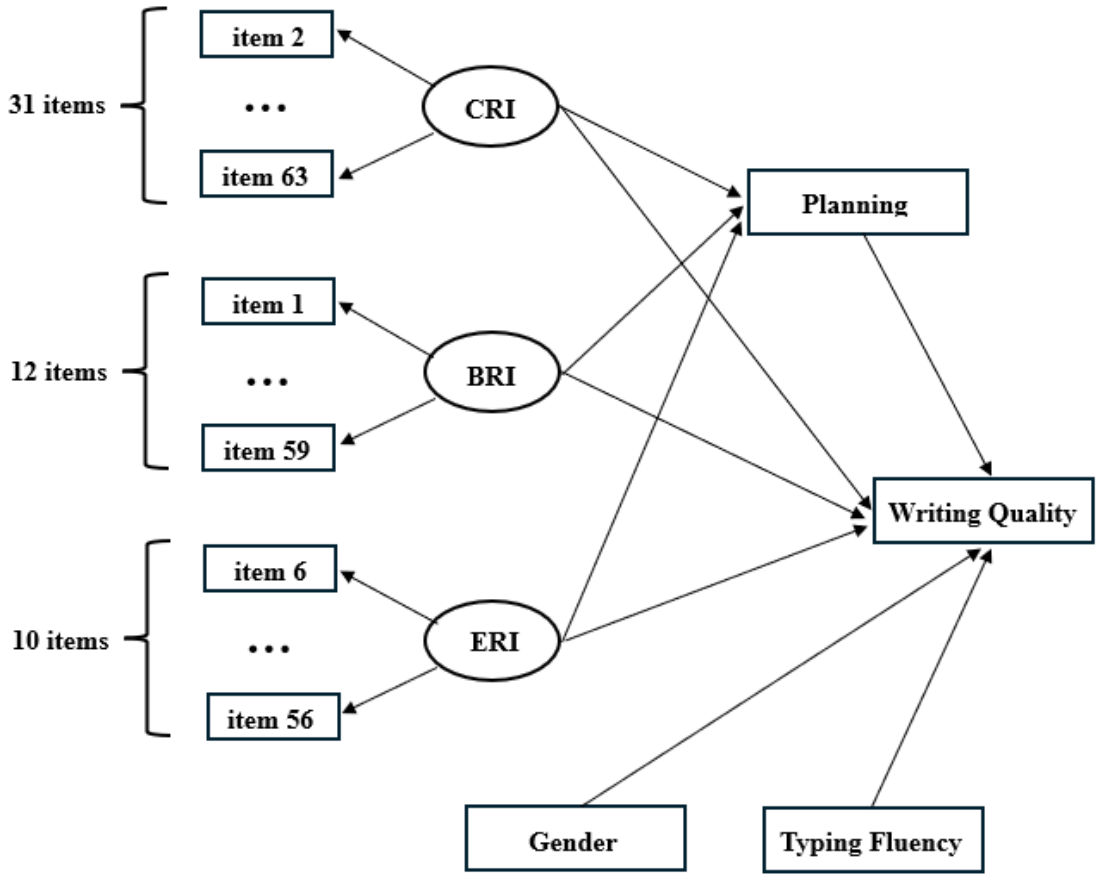
	Factor		
	1	2	3
item30		0.849	
item31			0.821
item32	0.619		
item33	0.740		
item34			0.855
item35	0.865		
item38	0.703		
item39		0.746	
item41	0.565		
item42	0.811		
item43			0.904
item44	0.797		
item47	0.615		
item48		0.776	
item49			0.626
item50	0.670		
item51			0.684
item52	0.637		
item53	0.728		
item55	0.730		
item56			0.894
item57	0.598		
item58		0.820	
item59		0.795	
item60	0.823		
item61	0.879		
item62	0.803		
item63	0.861		

APPENDIX K

FIGURE 3

Figure 3

Mediation Model.



Notes:

- CRI includes items 2, 3, 5, 7, 8, 9, 12, 13, 19, 21, 23, 25, 28, 29, 32, 33, 35, 38, 41, 42, 44, 47, 50, 52, 53, 55, 57, 60, 61, 62, and 63.
- BRI includes items 1, 4, 10, 16, 20, 24, 26, 30, 39, 48, 58, and 59.
- ERI includes items 6, 14, 22, 27, 31, 34, 43, 49, 51, and 56.

APPENDIX L

TABLE 11

Table 11

Sarah's BRIEF-2 Scores.

Subscale/Index/Composite	T Score	Percentile Rank	Level of Concern
BRI	**71**	**95**	*Clinical*
Inhibit	72	95	*Clinical*
Self-Monitor	64	91	*Mild*
ERI	**54**	**73**	*None*
Shift	61	84	*Mild*
Emotional Control	48	58	*None*
CRI	**72**	**97**	*Clinical*
Initiate	66	95	*Potential*
Working Memory	72	98	*Clinical*
Plan/Organize	71	99	*Clinical*
Task-Monitor	65	93	*Potential*
Organization of Materials	71	98	*Clinical*
GEC	**68**	**92**	*Potential*

APPENDIX M

TABLE 12

Table 12

Sarah's CBM Data (Based on Fall Grade 4 Norms).

Measure	**Sarah's Average Scores**	**Average**	**Range for 16th-84th Percentile**
Total Words Written	41	41	30-52
Correctly Spelled Words	36	38	26-50
Correct Writing Sequences	25	38	25-51

APPENDIX N

FIGURE 4

Figure 4

Graphic Organizer Example for Planning in Writing Process.

Prompt: Describe the behavior of dogs.

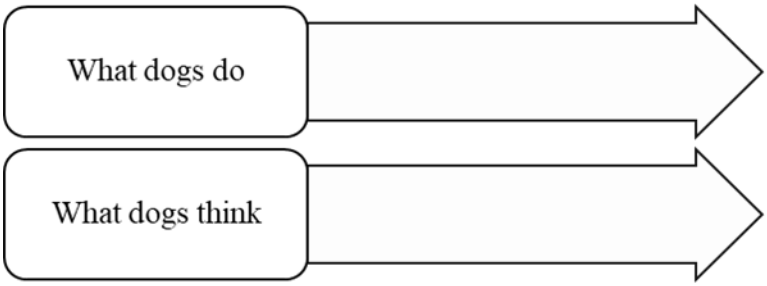
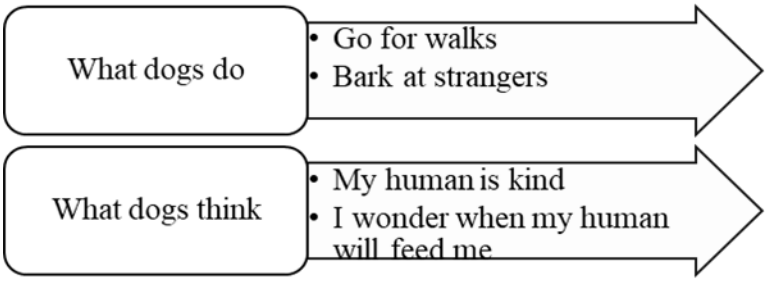


FIGURE 5

Figure 5

Completed Graphic Organizer Example for Planning in Writing Process.



APPENDIX O

RECRUITMENT AND CONSENT FORMS

Teacher Recruitment Letter

October 25, 2023

Hello Teachers,

Happy Fall! I am recruiting teacher participants for my dissertation study as part of the Writing Architect Project at Michigan State University and seek your help. I am looking for teachers to fill out this survey about their students' classroom behaviors. Each form takes about **10 minutes per student** to complete. Compensation for completion is **$10 per completed form**. We only seek form completion for students whose parents consented. (For example, if you have 20 consenting students and complete a form for each, you would be compensated $200.)

We will make a lump sum payment once you email me to confirm that you've completed forms for all of your consenting students. Please let us know if you would be willing to take on this brief 2 to 3-hour project!

The survey will ask you complete frequency ratings (often, sometimes, never) for the behaviors listed. You would have to have known the student for at least 1 month. We would appreciate it if you could **please respond over the next few weeks (by end of November)**.

If you have any questions about the survey at any point, please contact me at aghaamna@msu.edu or 734-335-0531.

If you have any questions or concerns about the larger Writing Architect study, please contact my supervisor and the Principal Investigator, Dr. Adrea Truckenmiller atruck@msu.edu or 517-798-0085. If you have questions or concerns about your role and rights as a research participant, would like to obtain information or offer input, or would like to register a complaint about this study, you may contact, anonymously if you wish, the Michigan State University's Human Research Protection Program at 517-355-2180, Fax 517-432-4503, or e-mail irb@msu.edu or regular mail at 4000 Collins Road, Ste. 136, Lansing, MI 48910.

Thank you for your time,

Amna A. Agha, MA
Doctoral Candidate, School Psychology
Department of Counseling, Educational Psychology & Special Education
Michigan State University
aghaamna@msu.edu
(734) 335-0531

PLEASE RETURN THIS FORM BY: _____

PARENT CONSENT FORM

For participation in a research study

Study title: Writing Architect: a web-based tool for tailoring writing instruction to meet students' needs

Researcher: Dr. Adrea Truckenmiller, Associate Professor

Department of Counseling, Educational Psychology and Special Education,

Michigan State University

Address: Erickson Hall

620 Farm Lane, room 340

East Lansing, MI 48824

Phone: (517) 353-7211

Email: atruck@msu.edu

Sponsor: Institute for Education Sciences

Dear Parent or Guardian,

My name is Adrea Truckenmiller and I am a faculty member at Michigan State University. I am working on a research study in your child's school in an attempt to better understand and improve instruction in writing. I am asking for your permission for your child to participate in this research study at school. Participation is voluntary. This consent form will describe the project, explain the risks and benefits of your child's participation, and empower you to make an informed decision. Please feel free to call me (517-353-7211) or email me (atruck@msu.edu) if you have any questions.

Purpose of research

You have been selected as a potential participant in this study because the language arts teachers at your child's school volunteered to participate and are interested in understanding the important components of writing. The purpose of this study is to develop a tool (the Writing Architect) that will assist teachers in connecting evidence-based writing instruction with students' needs as

demonstrated in a classroom written composition assessment. The goal is to improve elementary students' written composition and best practices in writing instruction.

What you and your child will do

First, if you agree to allow your child to participate, we ask that you sign this form. If you choose not to have your child participate in the study, please indicate that on this form. My research team will be administering brief writing assessments (no more than four assessments over the course of the year). During the assessments, your child will be asked to participate in grade-appropriate writing activities with pencil/paper and on the computer. All activities will be very similar to the writing practices your child's teacher uses. Your child's responses will be transmitted via an internet application to secure servers at Michigan State University. I will also provide a printed copy of your child's written responses, features of your child's response, and instructional recommendations to your child's language arts teacher. At the beginning and end of the study, your child will be administered a part of the Oral and Written Language Scales, Second Edition, in their classroom. This is a standardized norm-referenced assessment that some teachers use to plan individualized writing instruction for their students. If you would like a copy of your child's responses from any of the assessment activities, please contact me and I will provide them to you. Finally, I will request that the school provide me with your child's score on the Michigan Student Test of Educational Progress at the end of the school year, their reading screening scores, and demographic information about your child, including gender, age, race/ethnicity, special education status, qualification for free and reduced price lunch, and English Learner status.

What will we ask you to do

As part of this research study, we are interested in the role of students' self-regulation to their writing development. To answer this question, we will ask you to complete a rating form about your child. The form items will describe various behaviors and ask parents to respond about the frequency of those behaviors within the last 6 months. This form will be sent via electronic survey similar to this one. Survey completion will take approximately 10 to 15 minutes. You may choose to have your child participate in the study during school and opt out of taking the parent survey.

Potential benefits of participation

The potential benefit to your child participating in this study is extra practice with writing. Your child's teacher may use your child's responses to identify strengths and weaknesses and adjust instruction for your child accordingly.

Potential risks of participation

The risks of participating in this study are minimal. We will be transmitting your child's name with their written compositions and their scores on the written composition via the web. We are

employing industry-standard data security protocols to ensure that only your child's teacher and the researchers see your child's scores. However, we wanted to make you aware that there is always a small risk of a data breach. No other sensitive data will be transmitted other than your child's name. We have also confirmed with your child's school that the scores from the written compositions will not affect your child's grade or any high stakes decision (e.g., retention). If you do not want your child's name transmitted in the online written composition, please contact me.

Privacy and confidentiality

Information collected during this study will be kept confidential to the maximum extent allowable by law. That is, the work that your child produces will not be shared with anyone outside the research team, your child's teacher, and personnel from the Human Research Protections (HRPP) program. HRPP personnel may have access to all research records. After the study is concluded, all of your child's work will be assigned a random identifier so that your child's work cannot be linked to your child. The link between your child's name and the identifier used in this study will be kept in a separate password-protected file on my computer and will not be shared with anyone else. IP addresses will not be collected. The rest of the de-identified information that I collect, including your child's education records will be kept in a file that can only be accessed by me, my research assistants, and the Human Research Protections Program personnel. Your child's participation in the study will NOT affect your child's grades or your relationship with your child's teacher.

At the completion of this study we will be writing a report about the results. This report will not include any identifiable information about your child or your child's school.

We also plan to make the final dataset available to other researchers who may be able to enhance what is known about student writing development. Any information that can link you/your child to this study will be removed prior to any data being made publicly available or shared with other researchers who request the data. There will be no information that can link your participation to the study, and as such no one outside of those directly involved with the research will know that you took part in this study. We cannot guarantee that reidentification is impossible, but will take all of the steps we can to ensure that your data is as safe and private as is currently possible.

Your rights to participate, say no, or withdraw

Your child's participation in this study is voluntary. You are free to choose not to have your child's work included in this study. You may also withdraw your child from the study at any time, for whatever reason, without risk to your child's school grades or relationship with the

school. In the event that you do not give consent or withdraw consent, your child's work will be kept in a confidential manner.

Costs and compensation

Participation in this study does not involve any cost to you or your child. Your child's teacher will receive a gift card to purchase classroom supplies. The gift cards will be distributed during the final session. We will not administer the study or the gift cards to classrooms with fewer than 10 students providing affirmative consent.

Contact Information

If you have concerns or questions about this study, such as scientific issues, how to do any part of it, or to report a complaint, please contact me (Adrea Truckenmiller by email at atruck@msu.edu, by phone at 517-353-7211, or by mail at 620 Farm Lane, room 340, East Lansing, MI 48824).

If you have questions or concerns about your role and rights as a research participant, would like to obtain information or offer input, or would like to register a complaint about this study, you may contact, anonymously if you wish, the Michigan State University's Human Research Protection Program at 517-355-2180, Fax 517-432-4503, or e-mail irb@msu.edu or regular mail at 4000 Collins Road, Ste. 136, Lansing, MI 48910.

Please sign yes or no and return this to the school. After signing this form, please keep a photograph copy of it for your records.

Yes, I give my consent for _____ to participate in the study,

(name of child)

"Writing Architect: a web-based tool for tailoring writing instruction to meet students' needs".

_____ _____

(Parent/ caregiver signature) (Date)

We also ask for the child's assent to participate in the study. Please ask your child to sign their name here to indicate that they assent to participate in the study.

_____

(Child signature)

_____

No, I do not give my consent for _____ to participate in the study,

(child's name)

"Writing Architect: a web-based tool for tailoring writing instruction to meet students' needs".

_____ _____

(Parent/ caregiver signature) (Date)

Demographic Information

We are asking for demographic information about your child so that we can describe the population for which the Writing Architect has been used. You may choose not to answer.

Child's birthdate (mm/dd/yyyy): _____

Does your child have a disability? If yes, please list the disability: _____

Is English your child's native language?

- ❑ Yes
- ❑ No

Gender identity of your child: _____

Select all categories that apply to your child's identity:

- ❑ American Indian or Alaskan Native
- ❑ Asian
- ❑ Black or African American
- ❑ Hispanic
- ❑ Indigenous group other than Native American
- ❑ Latino/a/x
- ❑ Middle Eastern origin
- ❑ Native Hawaiian or Other Pacific Islander
- ❑ White
- ❑ Choose not to answer

Photo Images and Video/Audio Recordings Release Form

This release form is separate from the consent to have your child participate in research. This is to allow your child's image to be used in materials showcasing your child's teacher's instruction. You may respond differently to this form than the consent form.

We are interested in capturing the high quality instruction occurring in your child's classroom in video and photographs. These photographs may be included in the publications of our research and to be used to educate our undergraduate and graduate students and to prepare professional development materials for educators in the community. These videos and photographs are used as illustrations of high quality classroom practice. We are interested in taking several videos and photographs in your child's classroom. We would appreciate your permitting us to video and photograph your child, individually or as part of a group so we may capture various examples of high quality classroom practice and examples of children's work. Because our goal is to highlight high quality, rest assured your child will be always presented in a positive way. Please, sign this video/photo release form attached to confirm that your child may be included in the video and pictures we take. These videos and pictures may be used in academic/educational publications, webpages, educational presentations, etc. Thank you for supporting our ability to showcase the work of your child's amazing teacher.

I hereby permit my child to be photographed by Michigan State University, Dr. Adrea Truckenmiller, as part of typical classroom instruction.

I hereby assign full copyright of these photo images/video/audio recordings to the above-mentioned organizations/persons together with the right of reproduction either wholly or in part.

I agree that Adrea Truckenmiller can use the above-mentioned images either separately or together, either wholly or in part, in any way and in any context, particularly including release on Michigan State University and Web sites hosted by Dr. Truckenmiller.

Adrea Truckenmiller may have unrestricted use of these images for whatever purpose, including promotion of research, presentations, educational purposes, Websites or Michigan State University functions, with any reasonable retouching or alteration.

I will not initiate legal claims or demands against either the Photographer/Videographer, Adrea Truckenmiller, or Michigan State University regarding any of the above mentioned images. I release the above mentioned organizations/persons and those acting pursuant to its authority from liability for any violation of any personal or proprietary right I may have in connection with the use of the Media. I understand that the photographs, videos and audio recordings shall remain the property of Adrea Truckenmiller. I have read this model release form carefully and fully understand its meanings and implications.

Child Name: _____
Parent/ Guardian Signature: _____
Date: _____

APPENDIX P

AUTHOR CONTRIBUTIONS

Paper 1 (Mediation)

Agha, A. A., Truckenmiller, A. J., Cho, E., Dixson, D. D., Fine, J. G., & Skibbe, L. E.

Conceptualization, A.A.A., A.J.T., and J.G.F.; Methodology, A.A.A., A.J.T., D.D.D., and E.C.; Validation, A.A.A. and A.J.T.; Formal Analysis, A.A.A.; Investigation, A.A.A.; Resources, A.J.T.; Data Curation, A.A.A.; Writing – Original Draft, A.A.A.; Writing – Review and Editing, A.A.A., A.J.T., and L.E.S.; Visualization, A.A.A.; Supervision, A.J.T.; Project Administration, A.A.A. and A.J.T.; Funding Acquisition, A.A.A. and A.J.T.

Paper 2 (Practice)

Agha, A. A. & Truckenmiller, A. J.

Conceptualization, A.A.A. and A.J.T.; Methodology, A.A.A. and A.J.T.; Investigation, A.A.A.; Resources, A.J.T.; Data Curation, A.A.A.; Writing – Original Draft, A.A.A.; Writing – Review and Editing, A.A.A. and A.J.T.; Visualization, A.A.A.; Supervision, A.J.T.; Project Administration, A.A.A. and A.J.T.; Funding Acquisition, A.A.A., A.J.T.

A.A.A. - Amna A. Agha

A.J.T. - Adrea J. Truckenmiller

E.C. - Eunsoo Cho

D.D.D. - Dante D. Dixson

J.G.F. - Jodene G. Fine

L.E.S. - Lori E. Skibbe

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