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A Content Analysis of Graphical Literacy Skills Instruction in Fifth Grade Core Reading Programs

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A CONTENT ANALYSIS OF GRAPHICAL LITERACY SKILLS INSTRUCTION IN FIFTH GRADE CORE READING PROGRAMS

by

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ABSTRACT

A Content Analysis of Graphical Literacy Skills Instruction in Fifth Grade Core Reading Programs

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The purpose of this study was two-fold. First, it aimed to conduct a content analysis of the informational texts included in fifth-grade core reading programs' (CRPs) student textbooks to identify the types and functions of graphics contained therein. Second, it aimed to conduct a content analysis of the instructional guidance associated with the informational text selections within fifth-grade CRP teachers' manuals to evaluate and assess the affordances to promote graphical literacy skills as a component of literacy instruction.

This study addressed three research questions: (a) What types of graphics are present in the informational texts included in CRP student textbooks?, (b) What are the functions of the graphics in these informational texts?, and (c) To what extent are graphical literacy skills presented as a component of literacy instruction in the CRP teachers' manuals related to these graphics?

Results of this study indicate that photographs are the dominant graphic category and type used by CRP publishers in informational texts. Most of the graphics within these texts were representation graphics; they concretized the running text. Graphical literacy skills as a component of literacy instruction were also assessed. Across the three CRPs, more than 65% of the graphics had no instructional guidance. Of those graphics that did include instructional guidance, the guidance was reference and/or teach. For those graphics indicated for teach, explicit instruction elements were assessed. Discussion—the teacher is directed to ask a question—was the most common explicit instruction element recommended for teaching.

Findings from this study demonstrate the need for diversity in the types of graphics utilized in informational texts in CRPs so they align more closely with the texts that upper-elementary students read. In addition, graphical literacy skills instruction should accompany more graphics, especially complex graphics and graphics that require more inferencing or background knowledge to interpret. Finally, multiple explicit instruction elements need to be included to scaffold graphical literacy skills instruction.

(286 pages)

PUBLIC ABSTRACT

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The purpose of this content analysis study was to identify the affordances embedded in core reading program (CRP) teacher's manuals that facilitate graphical literacy skills as a component of literacy instruction. In the informational text selections of selected CRPs, graphic category, type, function, and connection to text were assessed to determine the kinds of graphics used to convey information. The instructional guidance associated with these graphics was then evaluated for type of instruction (no instruction, reference, and teach) and explicit instruction elements. The results from this study indicate that representation photographs and general images are the most prevalent type of graphic in informational texts. Complex graphics, such as diagrams, maps, and timelines, are rarely used. The data also indicate that most of the graphics in the informational texts of CRPs are not indicated for graphical literacy skills instruction. For the limited number of graphics that have instructional guidance, explicit instruction was usually discussion. Recommendations for CRP publishers, teacher educators, and teachers is addressed in relation to these findings.

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CHAPTER I

INTRODUCTION

Over the past decade, there has been increased use of informational texts in upper-elementary classrooms (National Center for Education Statistics, 2009; National Governors Association Center for Best Practices and Council of Chief State School Officers [NGA & CCSSO], 2010). These informational texts contain an abundance of graphics, including photographs, images, cross-sections, bird's eye views, etc. (Carney & Levin, 2002; Levie & Lentz, 1982; Mayer, 1993; McTigue & Flowers, 2011; Smith & Robertson, 2019; Walpole, 1998). In fact, the graphics in children's informational texts have evolved, becoming denser and more complex (McTigue & Flowers, 2011; Mayer, 1993; Smith & Robertson, 2019; Walpole, 1998). Several studies have also reported that the complexity of the graphics is tied to their function within the text (Fang, 1996; Fingeret, 2012; Guo et al., 2018; Levin, 1979) and that comprehension of informational texts is affected by the ability of the reader to read the graphics found therein (Brugar & Roberts, 2017; Carney & Levin, 2002; Hannus & Hyona, 1999; Levin & Barry, 1980; Levie & Lentz, 1982; Norman, 2010, 2012; Roberts et al., 2015). Furthermore, graphics often present information that is not found in the written text (Fang, 1996; Fingeret, 2012; Guo et al., 2018). Clearly, it is important for upper-elementary students to effectively access information from graphics presented in informational texts (Duke, 2010; Moss, 2008).

Problem Statement

Graphical literacy is the ability to read and interpret graphics that supplement prose in non-fiction trade books, textbooks, and other print or digital sources (Zhang et al., 2010). It is necessary to foster graphical literacy to support upper-elementary school students' comprehension of informational texts (Brugar & Roberts, 2017; Carney & Levin, 2002; Hannus & Hyona, 1999; Levin & Barry, 1980; Levie & Lentz, 1982; Norman, 2010, 2012; Roberts et al., 2015). Although several prominent literacy researchers have noted the importance of instructional interventions to foster graphical literacy skills, research-based evidence for teaching graphical literacy skills is sparse (Callow, 2008; Duke et al., 2013; McTigue & Flowers, 2011; Roberts et al., 2013).

Historically, research examining graphics and how students read and interpret those graphics was conducted with narrative texts. However, with the call by the National Assessment of Educational Progress (NAEP, 2009) for increased reading of informational texts to prepare students for college and careers, research shifted to include informational texts (Brugar & Roberts, 2017; Fingeret 2012, Guo et al., 2018; Smith & Robertson, 2019). Core Reading Programs (CRPs), the resource most often used by elementary schools, contain informational texts (Dewitz & Jones, 2012). Furthermore, the inclusion of informational texts may prepare students for the demands of secondary education disciplinary area literacy (Ada et al., 2020; Cerna et al., 2020; Coiro et al., 2020).

Grade five CRPs were selected for this analysis because fifth grade is the final grade in which CRPs are typically used. Since the early 2000s, fifth grade, for more than 70% of elementary schools in the United States, has been the final year of a student's

elementary school experience before they transition to middle school (Cook et al., 2006). Finally, fifth grade students are expected to read informational texts in equal proportions to narrative texts in preparation for the complex informational texts that they will encounter in high school, college, and the workforce (National Governors Association Center for Best Practices, Council of Chief State School Officers. 2010), and these complex texts use more intricate graphics (McTigue & Flowers, 2011; Moss, 2008).

Graphics have evolved from basic black and white drawings to multifaceted layouts that resemble internet pages (Carney & Levin, 2002; Levie & Lentz, 1982; Mayer, 1993; McTigue & Flowers, 2011; Smith & Robertson, 2019). Complex graphics, diagrams, timelines, maps, graphs, flow diagrams, and tables, have changed as well. They feature intricate, multi-modal components that represent, extend, and organize the information presented in the written text (Fingeret, 2012; Guo et al., 2018; McTigue & Flowers, 2011). Informational texts are replete with those types of graphics.

Graphics in informational trade books and textbooks have been examined by several researchers (Brugar & Roberts, 2018; Hannus & Hyona, 1999; McTigue & Flowers, 2011; Norman & Roberts, 2015; Walpole, 1998). The results of those studies have emphasized that "children do not naturally respond to illustrations, graphics, and highlighted items. They need instruction in how to make sense of these functions" (Walpole, 1998, p. 364). In studies with upper-elementary school students, researchers noted that "diagram interpretation skills are not intuitive to students" and that graphics instruction should be embedded in comprehension instruction (McTigue & Flowers, 2011, p. 585). Simply stated, upper-elementary students do not effectively read and analyze graphics presented in informational texts unless they receive explicit graphical

literacy skills instruction. Thus, due to the paucity of research about graphical literacy skills instruction, educators must look to reading instruction for guidance. Research has shown that explicit instruction is the most effective method for teaching reading skills, such as graphical literacy (Kamil et al., 2008; National Reading Panel [NRP], 2000), and explicit instruction is a component of the pedagogical guidance associated with CRPs (Child, 2012; Reutzel et al., 2014).

Informational texts contain an abundance of graphics (Fingeret, 2012, Guo et al., 2018, Saynay, 2014), and CRPs are comprised of informational texts (Ada et al., 2020; Cerna et al., 2020; Coiro et al., 2020). Although some research has examined the graphics included in the leveled readers and textbooks for the primary grades (Fingeret, 2012; Saynay, 2014), no research has assessed the instructional guidance associated with the graphics included in the informational texts of upper-elementary CRPs. Thus, more information is needed about the type and function of graphics in those informational texts. In addition, graphical literacy skills instruction in CRPs needs to be assessed for explicit instruction and its elements (Archer & Hughes, 2011; Child, 2012; Reutzel et al., 2014).

Purpose Statement

Core reading programs (CRPs) are the instructional resource most widely used in elementary schools to teach literacy skills (Dewitz & Jones, 2012), and research evidence suggests that CRPs provide explicit instruction guidance for teachers (Child, 2012; Reutzel et al., 2014). Given the importance of graphical literacy skills, it is necessary for teachers to know the types and functions of graphics contained within CRPs. In addition,

it is crucial that teachers provide explicit instruction to assist students in upper-elementary grades to access the abundant information presented through graphics.

The purpose of this study was to conduct a content analysis of the informational text selections in fifth-grade CRP student textbooks and CRP teachers' manuals to: (a) identify the types and functions of graphics and (b) evaluate and assess the affordances to promote graphical literacy skills as a component of literacy instruction.

Research Questions

A better understanding of the nature of CRP graphics and the affordances offered by CRPs was needed to help teachers provide instruction about how to read, analyze, and interpret graphics so that students in the upper-elementary grades can develop essential graphical literacy skills. To address these needs, this study addressed three research questions:

1. What types of graphics are present in the informational texts included in CRP student textbooks?
2. What are the functions of the graphics in these informational texts?
3. To what extent are graphical literacy skills presented as a component of literacy instruction in the CRP teachers' manuals related to these graphics?

Definition of Terms

Core reading program (CRP)— the primary reading program that provides instruction on the essential components of reading for most students. Historically known as basal reading programs as they served as the "basis" for reading instruction (Simmons & Kame'enui, 2006).

Explicit instruction—a structured systematic method of instruction that is unambiguous and that incorporates scaffolds to guide the student through the learning process (Archer & Hughes, 2011).

Graphic—any photograph, image, or illustration including, but not limited to, diagrams, maps, graphs, timelines, and tables (Norman & Roberts, 2015).

Graphical literacy—the ability to read and interpret graphics that supplement prose in non-fiction (i.e., informational texts) trade books, textbooks, and other print or digital sources (Zhang et al., 2010).

Informational text—a text that may (a) convey information about the natural, physical, or social world (i.e., informative/explanatory texts; Duke, 2014); (b) influence the reader's ideas or behaviors (i.e., persuasive or argumentative texts; Duke, 2014); or (c) teach someone how to do something (i.e., procedural texts; Duke, 2014).

Literacy instruction—explicit instruction provided by a teacher to students for the development of receptive (i.e., listening, reading, and viewing) and expressive (i.e., speaking, writing, and visually representing) skills as modes of communication across disciplines and in any context (Malloy et al., 2019).

Significance of the Study

To date, a substantial portion of graphics research examining the types and functions of graphics has been limited to narrative texts and social studies and science textbooks (Carney & Levin, 2002; Fang, 1996; Fingeret, 2012, Guo et al., 2018; Levie & Lentz, 1982; Levin, 1979; Saynay, 2014). Some research has examined informational trade books for type and function, but this research was limited to the primary grades (Fingeret, 2012; Saynay, 2014). Furthermore, no research has been identified that examined the types and functions of graphics utilized in CRPs for upper-elementary grades.

Although several researchers have stated that students need instruction in graphical literacy skills, no research has examined instructional guidance associated with graphics within upper-elementary CRPs in order to aid teachers in the instruction of reading and interpreting graphics (Brugar & Roberts, 2017; Carney & Levin, 2002; Hannus & Hyona, 1999; Levin & Barry, 1980; Levie & Lentz, 1982; Norman, 2010, 2012; Roberts et al., 2015). These findings illuminated the need to examine upper-elementary CRPs for the types and functions of graphics. Furthermore, these findings showed that graphical literacy skills instruction as a component of literacy instruction also needs to be examined.

This study examined the types and functions of graphics used in the informational text selections of CRPs. As a result, this study expanded the scholarship on the types and functions of graphics used in literacy textbooks, contributing to the development of a graphics typology for education.

As graphics are becoming denser and more complex, it is necessary that students receive explicit instruction in how to read and interpret graphics so they can transfer those developing skills to make meaning from trade books and other materials. This study examined the instructional guidance in CRPs. The resulting data should provide researchers and teachers information about how affordances associated with graphical literacy skills development connects with literacy instruction. In so doing, this study supplements the instructional guidance offered by the CRPs, helping educators to develop curriculum that addresses graphical literacy skills instruction. Finally, this study provides researchers and educators with information about the explicit instruction elements associated with graphical literacy skills instruction.

CHAPTER II

REVIEW OF THE LITERATURE

The purpose of this review was to assess and synthesize relevant research that has been conducted about (a) the types and functions of graphics in children's texts, (b) the effects of teaching children how to read and interpret graphics, and (c) the best way to teach children about graphics. This chapter is divided into four main sections. The first section of this review focuses on the theoretical framework for graphical literacy skills as a component of literacy instruction in the context of the theory of affordances (Gibson, 1979). The second section of the review describes why CRPs and informational texts were selected for analysis. The third section of the review examines and synthesizes the research about the types and functions of graphics, as well as the research about learning from graphics. The final section of the review analyzes the limited research associated with graphical literacy skills instruction and concludes with information pertaining to explicit instruction.

Theoretical Framework

This content analysis was informed by the theory of affordances (Gibson, 1979). This theory provides a theoretical perspective to evaluate the instructional guidance associated with the graphics included in the informational text selections in the fifth-grade CRP teacher manuals. Gibson (1979) developed the theory of affordances to assist in his investigations of visual perception of organisms in their environments. Gibson stated, "the affordances of the environment are what it offers the animal, what it provides or furnishes, either for good or ill" (p. 468). Norman (2013) extended Gibson's ideas

about affordances to human-centered designs, suggesting that an affordance is a relationship between an object and the potential uses the object offers an organism. Norman also argued that for affordances to be effective, they need to be easily discernable by the organism. In addition, the more affordances that an object possesses the greater the usability of the object by an organism (Chemero, 2003; Scarantino, 2003). For example, an office chair affords to be sat upon because of the affordance of height; the seat is at the level of the knees. An office chair also affords carrying by one person because of the affordance of a manageable weight. However, an office chair does not afford lying down upon because of the affordance of a rigid back and arm rests.

Recently, several researchers (Blin, 2016; Rietveld & Kiverstein, 2014; Wu & Puntambekar, 2012) have reevaluated the theory of affordances in relation to educational research, expanding the definition of affordance. These researchers suggested that the affordances an environment offers to an organism are dependent upon the skills that the organism possesses. Wu and Puntambekar (2012) conceptualized the theory of affordances and how it related to science education. They extended Chemero's (2003) interpretation of affordances and suggested that the characteristics of an object or environment varies based upon an organism's (hereafter referred to as learner) prior experience and knowledge. Wu and Puntambekar (2012) further hypothesized that the affordances of a single object might evolve when it was combined with other objects suggesting that "multiple objects (or representations) that provide complementary affordances can lead to deeper learning" (p. 760). They did caution, however, that learners may not inherently know how to interpret the new affordances; they "need

suggestions, clues, or supports for how to use and exploit the affordances of representations" (Wu and Puntambekar, 2012, p. 761).

Rietveld and Kiverstein (2014) asserted that the affordances offered by an environment are dependent on the abilities available in a particular ecological niche. For this study, the ecological niche is the classroom in which the teacher uses a CRP as the primary mode of literacy instruction. Additionally, Rietveld and Kiverstein, in accordance with Vygotsky's zone of proximal development, emphasized that a skill is acquired by a novice through the direction of a more knowledgeable other (e.g., the teacher). From the teacher, a novice learns which affordances to pay attention to when encountering an object and which ones to ignore. They also claimed that with experience, the novice learns that not everything within the environment is useful. Rietveld and Kiverstein (2014) stated, "when an individual engages adequately with an affordance this is often an exercise of *skill"* (p. 334, emphasis in original).

In addition, Blin (2016) proposed that affordances and learners' capabilities are dynamic. Both affordances and learners can change across time and space as a result of new needs and maturation. Therefore, as the learner changes or develops new skills, the interaction with an affordance also changes; a re-orientation occurs. Blin also applied the changing abilities of the learner to educational environments. He suggested, "educational affordances can be operationalized through tasks" and a given task will offer different affordances for learning to different learners (Blin, 2016, p. 56). Additionally, Blin stated that affordances are embedded in cultural contexts and emerge as learners interact with one another, objects, and cultural environments. Consequently, affordances depend upon

the skills of the learner, the tasks in which the learner engages, and the cultural environments.

The theory of affordances has been used as a theoretical framework for several studies in literacy. Jones et al. (2016) conducted a content analysis to determine the affordances of children's informational texts to serve as exemplar texts for teaching students about five common informational text structures. From their analysis, Jones et al. concluded that most children's informational texts are organized using multiple text structure, and, therefore, the affordances of single-structure model texts for several of the informational text structures were insufficient. Brown (2018) conducted a content analysis of affordances for social and emotional (SE) competency development in third-grade CRPs concluding that CRPs provide affordances for the development of SE competencies.

This content analysis investigated the affordances offered in the instructional guidance, associated with the informational text selections, of fifth-grade CRP teachers' manuals to promote graphical literacy skills as a component of literacy instruction. As summarized by Norman (2013), well-constructed affordances guide the user in how to read and interpret the graphics. In addition, Kaptelinin and Nardi (2012) stated that perception is a key factor in using the affordances offered by an object within an environment and well-constructed affordances are easily perceived. Therefore, the instructional guidance associated with the informational text selections was analyzed for their relevance and usability.

CRPs and Informational Text

CRPs are the most widely used resource for providing literacy instruction in the elementary school classroom (Brown, 2017; Dewitz, 2009). CRPs are defined as the primary reading program used to provide instruction to most students on the essential components of reading. Historically, they were known as basal reading programs as they served as the "basis" for reading instruction (Simmons & Kame'enui, 2006). From the incorporation of the McDuffy reader to the current use of CRPs, reading programs have figured prominently in the content and method of reading instruction (Dewitz et al., 2009). Although other types of reading textbooks and materials have been used for literacy instruction within elementary school classrooms, previous literature on basal reading programs from the 1980s and 1990s, and their contemporary counterpart, CRPs, were reviewed here as they utilize graphics that pertain to this research.

Basal reading programs from the 1980s were commercially developed comprehensive reading programs that included pedagogical guidance for teacher-directed lessons, small group instruction, and literacy skills instruction (Stein et al., n.d.). The program components consisted of teacher manuals, student readers, student workbooks, and assessment packages. Many of the programs excluded features (e.g., phonics strategies) that current research shows are beneficial to student learning (National Reading Panel, National Institute of Child Health and Human Development, 2000). As competing reading philosophies (e.g., whole language theory) gained traction in the 1990s, basal reading programs shifted to include literature-based instruction (Dewitz et al., 2009; Stein et al., n.d.).

As with the basal reading programs of the 1980s, basal reading programs in the 1990s were usually commercially published. These publications included components for whole class instruction, guided reading and writing, shared reading and writing, and student-directed instructional tasks. However, the instructional focus was not on literacy skills instruction, but on developing a love of reading and writing (Stein et al., n.d.). In addition, basal programs of the 1990s often excluded evidence-based reading instruction (Stein et al., n.d.).

A further shift of basal reading programs occurred with the publication of the National Reading Panel's report (National Reading Panel, National Institute of Child Health and Human Development, 2000), *Teaching Children to Read*, and Reading First legislation (No Child Left Behind Act of 2001, 2002). The publication of this report and government legislation established scientifically based reading research as the preeminent method for literacy instruction (Stein et al., 2001). Basal reading programs were thus rebranded core reading programs and included instructional materials supported by evidence-based research (Dewitz et al., 2009).

Contemporary CRPs are a collection of complex materials that include teachers' manuals, student anthologies, leveled readers, workbooks, and online resources (Dewitz & Jones, 2012). The instructional content within CRPs focuses on the core elements of scientifically based reading instruction (e.g., phonemic awareness instruction, fluency instruction, vocabulary instruction; Stein et al., n.d.). Instruction of these core elements aligns with the findings that explicit instruction is the most effective method for instructing students (Archer & Hughes, 2011; Hughes et al, 2017). In addition to the instructional content, the pedagogical guidance included in the teachers' manuals are a

resource that teachers use to guide and inform their reading instruction (Al Otaiba et al., 2005).

In addition, with the adoption of the Common Core State Standards (CCSS) by more than 45 of the 50 United States, CRPs have further shifted to include criteria established by the CCSS as necessary for students "to be ready for college, workforce training, and life in a technological society" (National Governors Association Center for Best Practices, Council of Chief State School Officers, 2010, p. 4). To meet this goal, recommendations were adopted to include more reading and writing of informational content as these are the types of content most often encountered in college and the workforce (National Governors Association Center for Best Practices, Council of Chief State School Officers, 2010). The lack of informational texts in elementary classrooms was highlighted when Duke (2000) published the results of her seminal research showing that only 11% of the books in classroom libraries were informational texts. Since Duke's research, the National Assessment for Educational Progress (National Center for Education Statistics, 2009) and the CCSS (National Governors Association Center for Best Practices, Council of Chief State School Officers, 2010) have stated that by the fourth grade, a 50-50 balance of informational and narrative reading should be implemented in classrooms. Moreover, literacy instruction should not be limited to the English language arts (ELA) classroom. Instruction in disciplinary literacy should be provided when elementary students are receiving instruction in the disciplinary areas (e.g., mathematics, science, social studies). However, federal government educational mandates (Every Student Succeeds Act of 2015 [ESSA]; No Child Left Behind Act of 2002) resulted in a disproportionate allocation of time for literacy and math instruction

within elementary schools as these two disciplines were subject to yearly assessment, especially in the primary grades (Blank, 2013; Heafner & Fitchett, 2012).

Instructional time allocated for science and social studies in elementary schools has continued to decline since the adoption of No Child Left Behind and ESSA (Blank, 2013; Heafner & Fitchett, 2012). The most recent data available for instructional time report that public elementary school students in grades three through five receive, on average, 9.9 hours of ELA instruction per week or about 2 hours per day (Hoyer et al., 2017). Elementary students received significantly less instructional time for social studies and science (2.8 and 2.9 hours, on average, per week, respectively; Hoyer et al., 2017). Due to the decreased time allotted to the disciplines, the responsibility for sharing informational texts, and disciplinary literacy instruction, has remained, primarily, in the literacy classroom (Shanahan & Shanahan, 2014).

CRPs have been identified as the preeminent resource for literacy instruction within most elementary classrooms (Brown, 2017; Dewitz et al., 2009). In addition, based on several recommendations (National Governors Association Center for Best Practices, Council of Chief State School Officers, 2010), CRP publishers have integrated more informational texts into their publications (Braker-Walters, 2014). Furthermore, due to both the decrease in social studies and science instructional time in most elementary schools and the simultaneous increase in time spent in the literacy classroom, reading of most informational texts occurs during literacy instruction (Blank, 2013; Heafner & Fitchett, 2012; Hoyer et al., 2017).

Graphical Literacy

This review of the literature pertaining to graphical literacy included a search of the following bibliographic databases: *Academic Search Ultimate*, *APA PsychInfo*, *Education Full Text*, *Education Resources Information Center (ERIC)*, and *Education Source*. For the searches conducted, the researcher used the following descriptors, in combination, to identify relevant literature: (a) graphical literacy, (b) core reading program, (c) elementary, (d) literacy instruction, (e) types of graphics, and (f) function/purpose of graphics. Due to the scarcity of research that existed regarding graphical literacy and CRPs, the phrase "visual literacy' was added as an alternative search term for graphical literacy. Several researchers have used the term visual literacy instead of graphical literacy to label their research about the graphics (e.g., maps, timelines, pictures, illustrations, etc.) contained within informational texts (Guo et al., 2018; McTigue & Flower, 2011; Norman, 2010, 2012; Roberts et al., 2015).

The terms "informational text" and "basal reading program" were also included in order to expand the search for relevant studies. Historically, core reading programs were referred to as basal reading programs and currently, the terms are used interchangeably (Dewitz et al., 2009; Reutzel et al., 2014; Simmons & Kame'enui, 2003). Finally, due to lack of results when using the search terms "graphical literacy", the search term "graphic*" was added to capture additional articles. The search term "basal read*" was also included to find research articles.

As articles were retrieved, the titles and abstracts of the articles located from the searches were read to determine potential relevance to this study. In addition, reference lists of pertinent articles were examined for potentially relevant sources.

Studies included in this section of the review of literature met the following criteria:

- research published in a peer-reviewed journal or a completed doctoral dissertation
- research conducted between 1980 and 2020. This range was selected as several important studies that focused on the importance of graphics and defined the types of graphics in educational materials were conducted during the 1980s (Levie & Levin, 1982; Levin & Barry, 1980; Levin, 1980)
- research written in English
- participants were elementary-grade students (grades 1-6, ages 6 to 12 years-old) or using elementary-grade texts.

The researcher considered studies if they examined graphical literacy or visual literacy, CRPs or informational texts, the types of graphics used in children's textbooks or trade books, and the function/purpose of graphics in children's textbooks or trade books. The report on the review of these studies is articulated in the following three sections: (a) types of graphics, (b) functions of graphics, and (c) learning from graphics.

Types of Graphics

The first category reported in this review of graphical literacy literature relates to types of graphics. Investigation about graphics has received attention for decades (Carney & Levin, 2002; Coleman & Dantzler, 2016; Levie & Lentz, 1982; McTigue, 2009; Mayer, 1993), with most research focusing on illustrations in children's narrative storybooks or the graphics associated with vocabulary acquisition (Carney & Levin, 2002; Fang, 1996). Some recent research regarding the types of graphics utilized in texts

has expanded to content area textbooks and their publisher-provided assessments (Colemen & Dantzler, 2016; Fingeret, 2012; Guo et al., 2018; Saynay, 2014; Slough et al., 2010), as well as standardized tests (Anagnostopoulou et al., 2012; Lowrie et al., 2011; Yeh & McTigue, 2009). Although several studies have examined the types of graphics in textbooks and trade books, there is not one universally accepted graphics typology (Colemen & Dantzler, 2016; Fingeret, 2012; Guo et al., 2018; Shrum, 2010). However, a few classification systems have provided the basis for subsequent researcher-created typologies (Fingeret, 2012; Moline, 2012; Slough et al., 2010; Vekiri, 2002).

In the early 1980s, Moline (2012) developed a comprehensive list of the types of graphics found in school textbooks and children's trade books. Moline's classification system consists of five categories: simple diagrams, process diagrams, structure diagrams, analytic diagrams, and graphs. Simple diagrams are illustrations with a label or scale (e.g., picture glossary and scale diagram) and maps (i.e., a plan with a labeled diagram and scale that can show orientation). Process diagrams organize a sequence of events (e.g., timelines, storyboards, and flowcharts).

According to Moline (2012), structure diagrams, such as web diagrams, show idea organization and relationships using arrows. Other structure diagrams, tables and Venn diagrams, may be used to show similarities and differences between groups. Analytic diagrams show close-ups or look inside a subject (e.g., enlargement, exploded diagram, cross-sections, cutaway, and block diagram). Moline's final classification explains that graphs measure, rank, and compare using a spectrum (e.g., number line, bar graph, line graph, or pie chart). Moline's classification system, created from anecdotal evidence, has been used and adapted by several researchers as they worked to create a research-based

typology of the types of graphics contained in informational texts (Coleman & Dantzler, 2016; Fingeret, 2012, Guo et al., 2018).

In contrast to Moline's (2012) classification system that was compiled for use by classroom teachers, the focus of Fingeret's (2012) research was to create a working typology of graphics, useable by both practitioners and researchers, to examine the types of graphics used in informational texts. To achieve this goal, Fingeret conducted a content analysis of children's informational texts that included social studies and science textbooks, leveled readers, and trade books recommended for elementary school students in grades two and three. Informational texts were defined as "a text whose primary purpose is to convey information about the natural, social, [or physical world], and that has particular linguistic features to accomplish that purpose" (Fingeret, 2012, pg. 11). Fingeret defined a graphic "as a picture or image of any kind that conveys information" (p. 11).

To initiate the analysis of the types of graphics contained in the sample, Fingeret (2012) utilized a modified form of Moline's (2012) typology, adding some categories and discarding a few as non-representative of contemporary graphics. Using constant comparative analysis, Fingeret identified eight meta-type categories: (a) diagram, (b) flow diagram, (c) graph, (d) image, (e) map, (f) simple photograph, (g) table, and (h) timeline (See Table 1 for a definition of these categories). Fingeret reported that out of a sample of more 12,000 graphics identified in informational texts, more than 80% of all graphics were either photographs (53%) or images (33%).

Table 1

Fingeret's (2012) Typology of Graphics

Graphic Category	Descriptions
Diagrams	Components of a whole, static relationships, usually with labeled parts.
Flow diagrams	Movement or change, complex or hierarchical relationships.
Graphs	Quantities or numbers organized visually.
Images	Information of all kinds, sometimes symbolic, requires interpretation by reader, may require background knowledge.
Maps	Geographical, sociological, or scientific information.
Simple photographs	Photographic images.
Tables	Groups organized in rows or columns.
Timelines	Events in time.

Although Fingeret's (2012) research expanded the field pertaining to types of graphics, replicability is challenging. A detailed description of each meta-category is unavailable, and several of the subtypes (e.g., cutaway and cutaway with inset, realistic illustration and realistic illustration with inset) are excessively narrow. Fingeret also refrained from analyzing the graphics that were not associated with the main body of the text, examining only the graphics within the lesson sections of the chapters and units. Thus, title pages, pages that included review questions, directions for science experiment or project, introductory pages, glossaries, and tables of contents were excluded from the analysis.

The rationale for these exclusions was based on the omission of many of these features from trade books and inability to confirm students' reading of said sections. While Fingeret's research supported Moline's (2012) observational conclusions about the

types of graphics found in informational texts, other researchers (Coleman & Dantzler, 2016; Guo et al., 2018) have suggested classifying graphical displays differently.

For example, Coleman and Dantzler's (2016) content analysis of science trade books for children (as identified by the National Science Teachers Association and Children's Book Council) opted to analyze notational graphics, excluding non-notational graphics. Notational graphics were defined as representations that "seek to reduce reality in some way to produce a one-to-one correspondence between elements and their referents" (Coleman & Dantzler, 2016, p. 26), and they were characterized by their unambiguous and unique meanings. Maps, graphs, diagrams, and charts were classified as notational. Non-notational graphics were representations that mimic reality. Photographs, paintings, and drawings were classified as non-notational because their interpretation is subjective or dependent upon the viewer. Coleman and Dantzler refined their definition of what constitutes a notational graphic through incorporation of Moline's (2012) classification system. Thus, they defined notational graphics as picture glossaries, diagrams (cutaway and cross-section diagrams), graphs (bar and line), maps (bird's eye view, context, and flow), tables, and timelines.

From a sample of 534 children's science trade books published between 1970 and 2007, Coleman and Dantzler (2016) coded the graphics that met their definition of notational; they identified a total of 2,067 graphics. Their findings suggested that picture glossaries, diagrams, and maps were more prevalent than timelines and tables in this census of trade books. However, the exclusion of non-notational graphics limits this research. Many prior studies (Fingeret, 2012; Mayer, 1993; Saynay, 2014; Shrum, 2010) reported the abundance of photographs within social studies and science trade books and

textbooks. In addition, this research did not assess trade books published after 2007, which dates the results of this study.

Research conducted by Fingeret (2012) and Coleman and Dantzler (2016) expanded the field of education's understanding of the types of graphics contained in children's informational texts. Although the researchers used aspects of Moline's (1995) classification system to develop a typology for their studies, the exclusion of non-notational graphics by Coleman and Dantzler make comparison challenging. In addition, both studies are dated. Guo et al. (2018), however, sought to extend the research of Fingeret and Coleman and Dantzler with their content analysis of third- and fifth-grade social studies and science textbooks that were adopted by highly populated states including some that had implemented facets of the Common Core State Standards.

For their research, Guo et al. (2018) defined graphics as "visuals … which are not limited to diagrams, maps, graphs, and tables … [where] the main source of information comes from visual, rather than textual presentation" (p. 250). Although similar to Fingeret's (2012) definition of what constitutes a graphic, Guo et al.'s definition is more precise. Additionally, Guo et al.'s definition broadens Coleman and Dantzler's (2016) narrow definition of notational graphics which excluded photographs, pictures, and drawings. To begin their coding scheme, Guo et al. compared Fingeret's typology with graphics classification systems employed by several other researchers (Coleman & Dantzler, 2016; Moline, 2012; Roberts et al., 2013). Guo et al.'s extensive list of graphics featured nine major graphic categories. Table 2 provides an explanation of these categories. Emulating Fingeret's research, Guo et al. also excluded graphics that did not convey information, such as borders surrounding a page and decorative text boxes.

Table 2

Guo et al.'s (2018) Typology of Graphics

Graphic Category	Description
Comic strips	Traditional comic strips
Diagrams	Graphics that usually use labels to model either the pieces or components of a whole system or parts of a system
Flow diagrams	Graphics that model movement, changes, or hierarchical relationships using arrows to show connections between text and pictures
General images	Information of all types is conveyed without the use of lines, labels, or words, sometimes symbolic
Graphs	Numbers or qualities organized visually
Maps	Sociological, geographical, and scientific information displayed on the representation of an area
Photographs	Photographs that do not fit the description of general images or diagrams
Tables	A set of facts or figures organized in rows and columns
Timelines	Information arranged chronologically by time

In analyzing the content of seven social studies and science textbooks, Guo et al. (2018) coded 3,844 visuals. Of the nine categories (i.e, types of graphics), photographs (62.4%) were the most prevalent graphic in both social studies and science textbooks across both grade levels. General images—defined as a graphic that may contain symbolic information which requires interpretation by the reader and may necessitate the use of background knowledge—were next in prominence (16.3%). Guo et al.'s research aligned with Fingeret's (2012) findings that photographs were the most prevalent type of graphic appearing in textbooks.

The typologies created by Moline (2012) and Fingeret (2012) have been the basis of several studies (Coleman & Dantzler, 2016; Guo et al., 2018; Saynay, 2014). For the purposes of this study, a combination of the typologies utilized by various researchers was implemented (Fingeret, 2012; Guo et al., 2018; Moline, 2012). In addition, for this

research, a graphic was defined as any photograph, image, or illustration including, but not limited to, diagrams, maps, graphs, timelines, and tables (Norman & Roberts, 2015). The following graphics categories were used as a foundation for this content analysis: (a) comic strips, (b) diagrams, (c) flow diagrams, (d) graphs, (e) images, (f) maps, (g) photographs, (h) tables, and (i) timelines (Coleman & Dantzler, 2016; Fingeret, 2012; Guo et al., 2018; Moline, 2012). The nine categories of graphics used for this content analysis, and their types, are described in Table 3.

Table 3

Graphics Categories and Types with Descriptions

Graphic Category	Types	Description
Comic Strip	Produced by CRP publisher or produced elsewhere	Traditional comic strips.
Diagram	Bird's eye view diagram, cutaway diagram, cross-section, scale diagram, picture scale diagram, simple diagram	Graphics that depict the pieces or components of a whole system or static relationship between parts - typically includes labels (Guo et al., 2018).
Flow diagram	Cyclical sequence, forked sequence, linear sequence (concrete start and end point), tree diagram, web diagram	Diagrams that illustrate a set of dynamic relationships within a system or static relationships between parts - usually includes arrows to show connections between parts (Guo et al., 2018).
Graph	Bar graph, line graph, pie chart, pyramid chart, Venn diagram	A visual organization of quantities and numbers - may show comparison (Coleman & Dantzler, 2016; Fingeret, 2012; Guo et al., 2018).
General image	Cartoon illustration, characters (e.g., Chinese), computer enhanced/created image, fine art, image cluster, logo, magnified image, photograph of illustrations, radar image, realistic illustration, scientific model, screen shot, stop motion, x-rays	A graphic which may contain symbolic information and does not have lines with labels or words as is common in diagrams (Guo et al., 2018).
Map	Context map, flow map, grid map, landmark map, region map, street map, topographical map	A display of social, political, physical, or geographical information on a representation of an area.
Photograph	Simple and cluster photograph	A picture of a real-life object produced by photography.
Table	Column table, pictorial table, row table, row and column table	Data organized using rows and columns.
Timeline	Multiple and single timeline	Information organized chronologically on a line.

As graphics are becoming denser and more complex, it was necessary to determine the types of graphics being used in the informational text selections of CRPs (McTigue & Flowers, 2011; Mayer, 1993; Smith & Robertson, 2019; Walpole, 1998). In order to provide explicit instruction in how to read and analyze graphics, teachers need to know what types of graphics appear in CRPs. Furthermore, assessing the types of graphics utilized in CRPs may increase the research base about what kinds of graphics upper-elementary school students encounter in all the disciplinary areas. Finally, evaluating the types of graphics in CRPs may assist educators and education researchers in developing a graphics typology.

Functions of Graphics

The second category of literature reported in this review of graphical literacy relates to functions of graphics. As graphics pervade informational texts in CRPs, it is important to know the types of graphics that appear in CRPs for upper-elementary school children so that they may effectively read and interpret them (McTigue & Flowers, 2011; Mayer, 1993; Walpole, 1998). In addition to knowing the types of graphics, children and teachers need to understand the function of the graphics, the purpose for which graphics are included in the informational text selections of CRPs, to further their understanding of the written text.

The number of graphics in children's informational texts is increasing each year (Walpole, 1998). For example, a content analysis of Orbis Pictus Award winners and honor books found that nonlinear, multimodal texts, that mimic the characteristics of an infographic or internet page were awarded accolades more often than traditional texts in recent years (Smith and Robertson, 2019). With this documented increase in graphics and

graphic complexity, determining the purpose of graphics is necessary to ascertain the benefits of including graphics at the expense of written text (Fingeret, 2012; Guo et al., 2018; Mayer, 1993; Saynay, 2014). Therefore, this study assessed the function of the graphics appearing in CRPs.

The graphics appearing in informational texts serve various functions. Using captions or other components, some graphics convey information that is not included in the main text (e.g., table headings, map legend; Fingeret, 2012; Guo et al., 2018; Levin et al., 1987; Mayer, 1993; Saynay, 2014; Smith & Robertson, 2019; Walpole, 1998). Other graphics concretize the written text reducing verbose descriptions into a diagram or graph (Fingeret, 2012, Guo, Wright, & McTigue, 2018; Levie & Lentz, 1982; Mayer & Gallini, 1990; Peeck, 1995; Saynay, 2014). Still other graphics support the written text by reinforcing concepts through graphical representations (Fingeret, 2012; Guo et al., 2018; Levin et al., 1987; Mayer, 1993; Saynay, 2014).

For example, Levie and Lentz (1982) reviewed 46 experimental comparisons that evaluated how learning from illustrated text was different from and similar to learning from written text alone. From their analysis, they identified four possible functions of text illustrations: attentional, affective, cognitive, and compensatory. Attentional graphics were identified as either attracting the reader's attention to the written text or directing the reader's attention to specific content. Affective graphics were defined as graphics that could enhance the reader's enjoyment of the text or influence the reader's emotions and attitudes. Graphics that were classified with the function of cognitive facilitated learning of the written text by improving comprehension and retention. Levie and Lentz's final

functional category, compensatory graphic, accommodated students that experienced reading difficulties.

Other researchers have suggested alternative definitions for the function of graphics appearing in informational texts. Gillepsie (1993) posited that graphics served a variety of functions in disciplinary area books:

- to provide information not included in the written text
- to reinforce the written text
- to elaborate on the written text by repeating information and adding new information
- to summarize the written text
- to compare and contrast information presented in the written text.

Although the functions that Gillespie and Levie and Lentz identified were similar, there are noticeable differences. Gillespie omitted a function that described a graphic addressing aesthetics, and Levie and Lentz chose not to address graphics that enhanced the written text.

The functions of graphics identified by Levie and Lentz (1982) and Gillepsie (1993) suggest that graphics are included in texts for specific purposes. However, Levin (1979) developed the most comprehensive list addressing the function of graphics. In addition to Levin himself, numerous other researchers (Carney & Levin, 2002; Fingeret, 2012; Guo et al., 2018; Levin et al., 1987; Mayer, 1993; Saynay, 2014; Slough & McTigue, 2013) have used Levin's categories to identify the function of graphics in informational trade books, science and social studies textbooks, and children's reading books.

Levin (1979) asserted that graphics have a purpose when included in a text and proposed that they serve the following functions: decoration, representation, organization, interpretation, and transformation. Graphics identified as serving the functional purpose of decoration are text irrelevant; they are selected for aesthetic reasons and do not support or supplement significant textual information. Representation graphics mimic the written text. They provide the exact same information or substantially overlap the written text, making it more concrete. Graphics that function as organization make explanatory text more coherent. For example, diagrams depicting the steps in a process organize the written directions visually. Interpretation graphics add clarity to abstract passages, making the text more comprehensible. An example of a graphic classified as interpretation would be a diagram of a pump that clarifies how the heart moves blood through the body. Levin's final function is transformation. This function is associated with Levin's research regarding memory and mnemonics. Graphics denotated as transformation recode written text into a more memorable and concrete form, relate separate pieces of information within one graphic, and provide a means for retrieving the information when needed. For example, a science textbook relating the parts of an atom may have a picture of a pen with the word atom bolded to assist the learner in remembering the components of the atom: proton, electron, and neutron. This graphic would be coded as transformation.

Several studies (Carney & Levin, 2002; Fingeret, 2012; Guo et al., 2018; Levin et al., 1987; Mayer, 1993; Saynay, 2014; Slough & McTigue, 2013) have adapted Levin's (1979) five functions to establish the purpose for the inclusion of graphics in informational texts. Fingeret (2012) implemented Levin's categorization of graphic

functions for a content analysis assessing more than 12,000 graphics that appeared in second- and third-grade science and social studies textbooks and leveled readers (Little books) and a sampling of science and social studies themed information trade books recommended for grades two and/or three.

For inclusion in Fingeret's (2012) study, a graphic was defined as "a picture or image of any kind that conveys information" (p. 11). In addition to Levin's (1979) five functions (decoration, representation, organization, interpretation, and transformation), Fingeret also included the function extension (Fang, 1995) which was defined as a graphic that extends the written text through the inclusion of new information not included in the main body of the text. Therefore, it recognized a situation in which complete comprehension of the text can only occur through integration of the written text and the graphic. For example, a science passage about the states of matter might be accompanied by a graphic that shows water freezing. If the passage does not mention water nor freezing, the reader must be able to connect the passage and the graphic, making this an extension graphic.

The results of Fingeret's (2012) content analysis found that more than half of all the graphics found in textbooks (64.2%), leveled readers (50.5%), and trade books (63.2%) are extension, meaning that they contained pertinent information not referenced in the text. Fingeret also reported that about 25% of graphics appearing in her sample functioned as representation, mimicking the written text. Finally, Fingeret noted that 4.7% of the coded graphics were decoration. However, Fingeret excluded visual decorations such as borders and decorative bullet points and icons denoting a text feature, as well as any graphics that were not associated with the main body of the text (i.e.,

graphics featured on title pages, with experiments or activities, in glossaries or indexes, and in tables of contents) from the coding scheme. Fingeret hypothesized that with the above exclusion criteria, decoration graphics would not be found. Still, approximately 600 graphics were identified as having neither meaningful content nor instructional purpose.

Although Fingeret's (2012) content analysis extended the evidence for Levin's (1979) functions of graphics, the narrow definition for the extension function (a graphic containing any information not included in the written text), omission of various textual components, and exclusion of core reading programs (basal readers), prompted other researchers to conduct additional content analyses of elementary school textbooks. For example, Saynay (2014) conducted a content analysis of second-grade science and social studies textbooks and the informational text selections in a basal reader. Saynay defined a graphic as "pictorial and graphical images, contained within informational text" (p. 19). Saynay coded the graphics in a representative sample of the primary lessons featured in the content area textbooks. Several sections of the science and social studies textbooks and basal readers were excluded from the content analysis and a comprehensive list was presented in the study. Some of the graphics excluded were those in narrative texts, chapter reviews, tables of contents, appendices, glossaries, and indexes. Consequently, 1,505 graphics were coded for Saynay's content analysis.

Saynay (2014) also adopted Levin's (1979) five functions of graphics (decoration, representation, organization, interpretation, and transformation) but added a sixth function, contradictory. Saynay defined a graphic as contradictory when it provided details or information that belied the written text. Saynay reported that graphics that

represent the text are common (71.6%) in all three types of textbooks: science (84.1%), social studies (69.5%), and basal readers (65.2%). Graphics coded with the function of decoration, comprised 15% of the total number of graphics as did graphics coded as organizational. Of note, is that Saynay found no graphics that contradicted the written text.

Comparing Saynay's (2014) and Fingeret's (2012) research is difficult given that Saynay did not include the extension function, opting for contradictory instead. However, evaluating the functions of graphics that were included in both analyses, several discrepancies warrant attention. Fingeret coded 25% of graphics as representation, whereas Saynay classified 70% of graphics in the same way. This vast difference may be explained by the use of different definitions. Saynay defined a representation graphic as one that supports or reinforces the written text (Carney & Levin, 2002; Levin, 1979), whereas Fingeret defined a representation graphic as one that accurately reflects information from the text. The subtle differences between definitions and the exclusion of the extension function by Saynay may account for the discrepancy.

Another startling difference between the findings of Fingeret's (2012) and Saynay's (2014) studies were the percentage of graphics designated as decoration. A decoration graphic was defined as an image that contains no meaningful content. Even though numerous components in all three types of textbooks were excluded from the analysis, Saynay reported that approximately 15% of the total number of graphics coded served no instructional purpose and were included in the textbooks for aesthetic reasons or to motivate readers. By contrast, Fingeret coded 4.7% of graphics as decoration. The difference between findings may be attributed to the inclusion of a basal reader in

Saynay's research. Saynay reported that, excluding science and social studies textbooks, more than 20% of the graphics coded in the basal reader were decoration.

Sayany's (2014) content analysis extended existing research regarding the function of graphics in elementary school textbooks. Although the differences between Fingeret's (2012) and Saynay's content analyses make direct comparison challenging, both studies show that publishers still use graphics that serve no instructional purpose, instead decorating the content area in textbooks. This is concerning as several researchers have noted that students who experience reading difficulties may find graphics distracting and may not know how to read and interpret them without explicit instruction (Guo et al., 2020; Hannus & Hyona, 1999; Levie & Lentz, 1982; Peeck, 1993). Therefore, graphics with a primary function of decoration, may inhibit students' comprehension abilities.

The inconsistencies between Fingeret's (2012) and Saynay's (2014) findings, as well as disagreements about terminology and definitions, prompted Guo et al.'s (2018) content analysis. Guo et al. evaluated the graphics within third- and fifth-grade science and social studies textbooks, ultimately analyzing 3,844 graphics. As with Fingeret and Saynay, Guo et al. also defined the term graphic, but they did so by borrowing from Duke and Billman (2009), who defined a graphic as "any visual whose primary purpose is to convey information about the natural, social, or physical world, and that has particular linguistic features to accomplish the goal" (p. 110).

Guo et al.'s (2018) content analysis also featured Levin's (1979) five functions of graphics: decoration, representation, organization, interpretation, and transformation. The researchers also included Fingeret's (2012) extension function, though they coded extension separately from graphical function. To assess extension, Guo et al. modified

the coding scheme created by Slough and McTigue (2013) to analyze whether a graphic was connected to the written text. The graphics that were coded from the social studies and science textbooks using the modified coding scheme in Guo et al. were denoted as having a connection to the written text, either (a) level 1, additional information included within the graphic aligned closely with the written text, or (b) level 2, the link between the new information presented within the graphic and the written text would require more inferencing.

The results from Guo et al.'s (2018) content analysis were consistent with those of Fingeret's (2012) and Saynay's (2014). Guo et al. concluded that representation graphic—those that concretely depict information relayed in the written text—accounted for a substantial portion of the graphics (60.9%) and that there were few organization or transformation graphics. In addition, Guo et al.'s findings that there are a limited number of graphics contained in social studies and science textbooks that serve no instructional purpose (2.1%) were consistent with Fingeret's results. Guo et al.'s findings, however, contradict Saynay's conclusions regarding decoration graphics, though, again, this may be attributed to the inclusion of basal readers in Saynay's content analysis.

Guo et al.'s (2018) revised coding scheme, coding graphics as having either a level 1 connection or level 2 connection with the written text, elicited an interesting finding. Fingeret (2012) stated that of the more than 12,000 graphics coded for her content analysis, more than half of the graphics presented new information, and, therefore, were classified as extension. In contrast, Guo et al., coding for the connection function, reported that of the 1,615 graphics that contained new information, 73.4% were coded as level 1 and provided information that was clearly linked to the written text and

would be easy for students to interpret. The remaining 26.6% of the graphics coded as connection were level 2 and contained new information that was not concretely linked to the written text. Therefore, although some of the graphics within social studies and science texts contained new information, most of the new information was directly linked to the written text and was easily discernible by the students.

In previous research, Levie and Lentz (1982) and Gillespie (1993) described several functions that identified the purpose of graphics appearing in informational texts. However, throughout several decades of research, Levin's (1979) graphic functions have been consistently utilized by researchers (Fingeret, 2012; Guo et al., 2018; Saynay, 2014). For the purposes of this content analysis, Levin's five graphic functions were adopted. As with Fingeret's (2012) research, graphics that have no instructional purpose (e.g., decorative bullet points) were excluded from this research as no graphical literacy skills instruction are affiliated with these types of graphics. Guo et al.'s (2018) coding scheme, adding connection, was implemented with modifications. Thus, the functions of graphics codes used in this study, the five functions of graphics and the connection to text levels, are defined in Table 4.

It was necessary to determine the function that graphics serve in the informational text selections of CRPs as constructing meaning from contemporary texts requires increased understanding of graphics (Guo et al., 2018). In addition, the function of the graphics contained in texts may either aid or impede upper-elementary school students in their ability to learn from texts (Carney & Levin, 2002; Guo et al., 2020; Hannus & Hyona, 1999; Levie & Lentz, 1982; Peeck, 1999).

Table 4

Functions of Graphics and Connection to Text Levels

Function	Definition	Examples
Decoration	Ornamental; no instructional purpose (Carney & Levin, 2002; Levin, 1979)	Border around perimeter of page, patterned bullet points.
Representation	Illustrates all or part of the written text; concretizes the written text (Carney & Levin, 2002; Levin, 1979)	A photograph of a tractor next to a passage about a tractor.
Organization	Structuralizes the written text with graphics; makes the written text more coherent (Carney & Levin, 2002; Levin, 1979)	How-to-do-it diagrams, illustrated maps, the water cycle.
Interpretation	Clarifies difficult-to-understand text and abstract concepts; makes the written text more comprehensible (Carney & Levin, 2002; Levin, 1979)	A diagram of a pump showing how the heart pumps blood through the body.
Transformation	Utilizes mnemonics to make text more memorable (Carney & Levin, 2002; Levin, 1979)	A picture of a pen with the word atom inscribed on the side to increase recall of the components of an atom: proton, electron, neutron.
Connection	Information represents the text and/or adds new information (Slough & McTique, 2013)	
Level 1	Information included within graphic is easily interpretable and connects easily with written text (Guo et al., 2018)	A photograph caption that uses different terms than the written text but is easily connected.
Level 2	Information included within graphic that is not easily interpretable and requires more inferencing (Guo et al., 2018)	An image of a glass of ice with the caption, "What is the temperature?" and the passage introducing the concept of temperature.

Learning from Graphics

The final category reported from this literature review of graphical literacy relates to learning from graphics. Researchers have been interested in examining the effects of graphics on students' learning for several decades (Brugar and Roberts, 2017; Guo et al., 2020; Hannus and Hyona, 1999; Mayer & Gallini, 1985; Moore & Skinner, 1985; Pike et al., 2009). Results from those studies have shown a generally positive effect on learning

when graphics are included within the text (Brookshire et al., 2002; Guo et al., 2020; Hannus and Hyona, 1999; Pike et al., 2009). In fact, a recent study (Roberts et al., 2015) reported that graphical device comprehension (GDC) and reading comprehension were so highly correlated that GDC actually predicted reading comprehension. Roberts et al. (2015) stated, "significant increases in GDC would likely coincide with significant increases [in] overall comprehension performance" (p. 413). These researchers emphasized that improving students' skills in reading and interpreting graphics could help minimize the number of fourth-grade students reading below the basic reading level (National Assessment for Educational Progress, 2019). In addition to Roberts et al.'s research that showed a correlation between the comprehension of graphics and reading comprehension, two meta-analytic reviews (Guo et al., 2020; Levie & Lentz, 1982) examined the effects of graphics on students' reading comprehension.

Levie and Lentz (1982) conducted a review of graphical literacy research to examine the effects that illustrations (e.g., line drawings, color photographs) have on comprehension. Levie and Lentz collected and summarized evidence to compare the learning from texts featuring illustrations with learning from written text alone. For their review, the researchers included studies that met specific criteria as described in Table 5.

Table 5

Levie and Lentz's (1982) Inclusion Criteria for Review of Research

Criteria	Description	Exclusions
Written text	Prose featured in texts	Oral prose or other verbally presented material
Meaningful, connected discourse	Continuous passages in narrative and informational texts	Word lists, single sentences
Experimenter-provided illustrations	Illustrations were part of the original text or selected by the researcher	Learner-created illustrations
Representational pictures	Line drawings, photographs that reiterated the written text	Maps, diagrams, tables
Comparison of learning from illustrated text vs. learning from text alone	Study must compare readers' learning from an illustrated text vs. a written text	All other comparisons

Levie and Lentz's (1982) review of graphical literacy research examined 46 experimental comparisons (i.e., 23 studies that produced a total of 46 comparisons) that juxtaposed the learning from texts with illustrations with the learning from text without illustrations. The studies included a mix of elementary-grade students (grades 2-6) and high school and college-level students reading narrative and informational texts. Most of the comparisons included in Levie and Lentz's review were conducted with elementary-grade students (i.e., 25 comparisons with elementary- grade students) and 16 of those comparisons juxtaposed learning from narrative text without illustrations and narrative text with illustrations (i.e., the illustration function was representation). It is not surprising that elementary-grade students' learning with illustrated texts was assessed using narrative texts. Subsequent studies (Duke, 2000; Moss, 2008) have shown that most elementary school classrooms primarily used narrative texts for reading instruction and that students rarely encountered informational texts. Additionally, several other studies (Olson, 1985; Spiro & Taylor, 1980; Tun, 1989) have noted that students struggle to

comprehend informational texts as important information may not be easily identifiable (Baumann & Serra, 1984). Thus, the fact that the earliest research studies examining learning from graphics were conducted with elementary-grade students utilizing narrative passages was to be expected.

Levie and Lentz (1982) included the type and function of graphics featured in the studies as part of their inclusion criteria. They defined the graphics that were included in their review as "experimenter-provided illustrations … that can be generally classified as 'representational pictures'" (1982, p. 196). The reviewers further defined illustrations as line drawings and color photographs, explicitly excluding maps, diagrams, and tables. The studies conducted with elementary-grade students utilized simple line drawings, colorful drawings, and cartoon drawings that depicted the main idea of the text or that presented "in visual form the information in the text" (Levie & Lentz, 1982, p. 199).

For their review of research, Levie and Lentz (1982) limited the studies to research that focused on illustrations that featured "text-redundant information" or illustrations that function as representational (p. 226). Levie and Lentz consciously excluded other graphical functions (e.g., organization, transformation) from their analyses. The reviewers stated that the purpose of their review was to determine the effect illustrations had on learning information presented in the written text. Including only illustrations that represent the text accomplishes this purpose as representation graphics mimic the written text, providing the exact same information or substantially overlapping the written text and making it more concrete (Levin, 1979). In addition, research has shown that illustrations or graphics that represent the written text are included most often in publications (Levie et al., 1987; Meyer, 1993). Therefore, limiting

the analyses to representation illustrations aligns with the function of most illustrations included in texts.

From their review, Levie and Lentz (1982) concluded that there was an increase in students' learning when narrative passages included representation illustrations. The research examined showed that, when compared with learning from text without illustrations to learning from text with illustrations, a statistically significant difference in learning occurred in 87% of the studies. In addition, the reviewers stated that the inclusion of illustrations did not detract from elementary-grade students' learning of non-illustrated textual information.

Although most of the research reviewed by Levie and Lentz (1982) examined elementary-grade students' learning with narrative texts, nine comparisons (i.e., four studies comprised of nine comparisons) juxtaposed students' learning with informational texts alone and with illustrations. The passages selected included social studies and science content from textbooks. As previously stated, traditionally, informational texts have been used infrequently for instruction in elementary school classrooms. Thus, students may have received limited instruction in how to read informational texts. Nevertheless, the nine comparisons demonstrated that the illustrated version of each informational passage elicited increased learning of the information by the student.

Levie and Lentz (1982) reported that illustrations had a significant positive effect (average effect size was 0.55) on students' learning of written text when compared with learning from written text alone. In addition, the researchers stated that the type of illustration and how it was used within the text affected learning outcomes. Learning of the written text was facilitated when the illustrations depicted all or part of the written

text (i.e., when it was a representation picture). Furthermore, Levie and Lentz concluded that strong evidence existed to support their claim that illustrations can help readers' comprehension and retention of the written text. Levie and Lentz also reported that the inclusion of illustration positively effects both the immediate and delayed recall of written text. However, the findings from this meta-analytic review should be interpreted with caution as the researchers only included graphics that represented the text. In addition, the types of graphics assessed were severely limited. Only photographs and colorful drawings were included.

Levie and Lentz's (1982) review of graphical literacy research is dated, with the most recent study reviewed from 1981. Graphics have evolved from the uncomplicated illustrations (i.e., simple colored drawings and colored photographs) used in the studies that Levie and Lentz included in their review. Digitally enhanced photographs, bird's-eye views, and combinations of graphics (hybrids) now appear in CRPs, trade books and textbooks. Current textbooks and informational trade books feature denser and more complex graphics emulating internet pages and infographics (McTigue & Flowers, 2011; Smith & Robertson, 2019). How students read and interpret graphics has also changed from a traditional left-to-right, top-to-bottom format to a contemporary non-linear arrangement (e.g., zigzag, circular; Smith & Robertson, 2019; Walpole, 1998). Thus, contemporary graphical literacy research aligns more closely with the types of graphics that students currently engage with as they read and interact with informational texts.

A recent meta-analysis (Guo et al., 2020) evaluating research conducted between 1985 and 2018 quantified the effect of graphics on reading comprehension. Guo et al. (2020) examined to what extent graphics had a positive effect on students' reading

comprehension. They employed rigorous search parameters and inclusion criteria for the article retrieval and identification process (See Table 6 for a delineation of their research criteria). After discarding articles that were irrelevant, duplicates, or did not meet other inclusion criteria, 39 experimental and quasi-experimental studies featuring 2,103 participants remained. The research also included four moderators to determine for whom graphics were beneficial, when graphics were beneficial, and what types of graphics may affect students' learning. The moderators selected were learner's grade level, graphic type, assessment format, and text genre. Table 7 describes the moderators used by Guo et al.

Table 6

Guo et al.'s (2020) Inclusion Criteria

Criteria	Description
Study	Experimental or quasi-experimental design
Graphics comprehension experiment where groups read the same text	Experimental group: text plus graphics or graphics Control group: text-only
Measure reading comprehension	Reading comprehension as a dependent variable
Participants completed tasks independently	Participants did not receive graphical literacy skills instruction
Quantitative information	Studies reported enough information to calculate effect size

Table 7

Guo et al.'s (2020) Moderators

Moderator	Subgroup
Grade level	Elementary (grades 1-6) Secondary (grades 7-12) Adults (college and above)
Graphic type	Picture: realistic illustrations that provided concreteness, engagement, or relevance to a text Pictorial diagram: pictorial representations that included labels Flow diagram: organizational charts that explained processes or structures Mixed: more than one type of graphic
Assessment format	True/false Multiple choice Short answer Mixed: more than one type of assessment Other: assessment not identified above
Text genre	Narrative: a text written to entertain, that follows a story grammar, and is, typically, fiction Informational: a text that conveys information about an event, situation, phenomenon, or procedure Mixed: components of narrative and informational

The results from Guo et al.'s (2020) meta-analysis showed that when compared with written text alone, written text including graphics has a moderate, positive effect (Hedge's g = 0.39) on students' reading comprehension. Further analyses identified which moderators affected students' learning from graphics. The results showed grade level had no significant effects; students across grade levels benefited from the inclusion of graphics. Graphic type, however, was a significant predictor of reading comprehension. Students' reading comprehension improved when pictures (i.e., realistic illustrations that provided concreteness, engagement, or relevance to a text), as opposed to mixed types of graphics (e.g., picture and pictorial diagram) were included in the text (See Table 7 for descriptions of the graphic types that Guo et al. used in their study). Additionally, when individual graphic types were compared, after controlling for other

moderator effects, pictures, pictorial diagrams, and flow diagrams showed similar positive effects on students' learning.

Guo et al. (2020) also found that when assessing students' reading comprehension, graphics produced larger effects when students were tested using short-answer or mixed formats (e.g., multiple choice and short answer questions) in contrast to true/false formats. Guo et al. hypothesized that this might be due to the nature of true/false formats as they prioritize recall rather than contextual understanding. The fourth moderator, text genre, was removed from the analysis due to interdependence with graphical type. For example, informational texts typically feature pictorial diagrams or flow diagrams whereas narrative texts usually do not. In conclusion, Guo et al. found that the presence of graphics is beneficial to students' reading comprehension and learning of written text.

In summary, research shows that graphics facilitate students' learning of written text (Guo et al., 2020; Levie & Lentz, 1982). In addition, it shows that graphics have a statistically significant positive effect on students' reading comprehension (Guo et al., 2020), and that significant increases in graphical device comprehension offers promise of improved skills in reading and comprehension of text (Roberts et al., 2015). Despite these conclusions, research investigating how teachers of upper-elementary school students provide instruction in graphical literacy skills is scarce.

Graphical Literacy Skills Instruction

Decades of research has examined students' learning from graphics (Levie & Lentz, 2002; Watkins, Miller, & Brubaker, 2004; Guo et al., 2018). However, minimal research has investigated how upper-elementary teachers provide graphical literacy skills

instruction. A search of the bibliographic databases *Academic Search Ultimate, APA Psychinfo, Education Source,* and *ERIC* was conducted to determine the types of graphical literacy skills instruction upper-elementary students are receiving. The search terms used were "graphical literacy," "visual literacy," "elementary," and "instruction." From this search, two studies (Coleman et al., 2011; Brugar & Roberts, 2017) were found, one that addressed graphical literacy skills instruction in science (Coleman et al., 2011) and one that addressed graphical literacy skills instruction in social studies (Brugar & Roberts, 2017). An additional search of the database *Digital Dissertations* yielded a study that investigated the instructional suggestions associated with graphics in science, social studies, and basal textbooks for second grade (Saynay, 2014). No other studies were identified that addressed graphical literacy skills instruction in ELA or literacy classrooms. Following are sections that describe these research studies and an additional section on the literature on explicit instruction to help further clarify ways of teaching described in Brugar and Roberts (2017).

Graphical Literacy Instruction in Elementary Settings

Coleman et al. (2011) sought to determine how much and in what manner (i.e., students asked to interpret and construct graphics) elementary school teachers were using graphics in their science lessons. The researchers created an electronic survey that was forwarded to a national sample of K-5 teachers. The survey results showed that graphics are used across the content areas (e.g., mathematics, science, social studies, and reading). When asked to report how students were instructed to interpret graphics, the respondents reported that the most frequently used practice was the teacher pointing to the graphic in the text (More than 70% of upper-elementary respondents did this.) Teachers also

reported asking students to interpret information presented in a graphic and then write about that information. However, this was not standard practice and occurred only "sometimes" or "rarely" in elementary classrooms. Teachers also reported "rarely" or "never" asking students to discuss or write captions for graphics. Regarding the production of graphics, students were frequently asked to organize information and to create tree diagrams to classify information. However, respondents reported rarely or never having children "draw and label details of a graphical representation" (Coleman et al., 2011, p. 627).

Although the results from the Coleman et al. (2011) survey showed that some teachers occasionally show students how to interpret graphics, most of the teacher respondents (73%) reported "never" or "rarely" having their students create graphics. Based upon the results of the survey, the researchers determined that the use of graphics by elementary school teachers is limited both in terms of frequency and depth of instruction. In addition, other than pointing to the graphics, the use of supplementary specific instructional strategies (e.g., modeling, direct explanation, guided practice) were not reported by teachers. The findings from Coleman et al.'s research suggest that teachers primarily rely upon pointing to graphics as their mode of instruction. Several other researchers have suggested that students require additional support when learning to read and interpret graphics (Brugar & Roberts, 2018; Hannus & Hyona, 1999; Levin et al., 1982; McTigue & Flowers, 2011; Meyers, 1993). In addition, these same researchers have stated that explicit instruction in the reading and interpretation of graphics is needed because graphics can be complex.

Brugar and Roberts (2017) sought to examine the effects that teachers' graphical literacy skills professional development has on students' learning. The researchers hypothesized that teachers needed instruction in how to teach graphical literacy skills and to be comfortable with the instructional strategies before they could implement the practices in their classrooms. Brugar and Roberts' research was conducted with upper-elementary teachers and focused on social studies curriculum. The participating teachers received direct instruction in graphical literacy, observed lessons modeled by the researchers, and were observed teaching a lesson. Additionally, teachers spent time discussing with the researchers what they had learned.

To assess the teacher's implementation of graphical literacy skills instruction, Brugar and Roberts (2017) named and defined five levels of teaching:

- no evidence—there is no evidence that the teacher uses graphics within the lesson
- decoration—graphics are present within the lesson, but they are not part of the instruction
- reference—graphics are referenced, but the teacher does not provide instruction about the graphic or use the graphic to create or convey information (e.g., points to the graphic)
- teach—the teacher provides explicit instruction about graphics
- construct or convey meaning—the teacher creates opportunities for students to use graphics within the/a lesson in a way that helps the students create and convey information.

The levels were defined as hierarchical where higher levels presupposed adoption of prior levels. The researchers found that students learned more about the topic of the social studies lesson when teachers incorporated "teach" and "construct or convey meaning" levels into their graphical literacy skills instruction. The students who received these types of instruction were also more knowledgeable about the components of graphics (e.g., more able to identify the parts of a map). In addition, when students encountered graphics in their social studies texts, they were able to read and interpret those graphics, which increased their comprehension of the texts.

Saynay's (2014) content analysis (introduced in the section titled Graphic Functions) conducted with a representative sample of second grade textbooks, sought to determine the instructional suggestions associated with the graphics that were provided in the teachers' manuals. The sample consisted of three textbooks, one science, one social studies, and one basal reader. For the analysis, only the pages of the textbooks that contained content were examined. Thus, website links, chapter reviews, tables of content, appendices, reference pages, lesson extensions, reading skills pages, and glossaries, were omitted from the analysis. The analysis of the basal reader also excluded fiction passages.

Saynay (2014) identified four categories to ascertain the types of instructional strategies included in the teachers' manuals to assist teachers in teaching students to read and interpret graphics. The following levels were identified: (a) no support, (b) some support—draw students' attention to the graphic, (c) good support—explain what information was to be gleaned from the graphic, and (d) excellent support—explain the graphic and provide additional background information to increase understanding. Saynay (2014) reported that for the science (37%) and the social studies (20%) textbooks,

excellent support was found more often than some support or good support. However, this was not the case for the basal reader. Of the 267 graphics identified in the basal reader, excellent support occurred for only 12% of those graphics. In addition, Saynay found that for more than half of all graphics, no support was indicated in the teachers' manuals and the basal reader (60%) had less support than either the science or social studies textbooks.

For the purposes of this content analysis, graphical literacy skills as a component of literacy instruction utilized several aspects of Brugar and Roberts' (2017) levels of teaching, as described in Table 8. The category "no evidence" was discarded because all the assessed informational texts contained graphics. The category "decoration" was referred to as "no instructional guidance" because decoration has been previously characterized as a graphics function. The category "reference" remained the same. The level of teaching identified as "teaching" was delineated further using elements of explicit instruction, and is described in the next section. Brugar and Roberts' final level of teaching, "construct and convey meaning," was not used for this content analysis.

Table 8

Levels of Teaching

Level	Description	Example
No instructional guidance	Graphics are present in the text, but no graphical literacy skills instruction is provided to the teacher.	A timeline runs across the bottom of the page identifying when Articles of the Bill of Rights were added.
Reference	The manual directs the teacher to verbally reference the graphic, but no other instruction about the graphic is provided (Brugar & Roberts, 2017).	Look at the timeline on page 57.
Teach	The teacher is directed to provide explicit instruction about the graphic (Brugar & Roberts, 2017).	When I read a timeline, first I look at the title to determine what the timeline is about. Then, I scan the timeline and ask myself questions about what I am seeing.

Explicit Instruction

Minimal research has been published that examines graphical literacy skills instruction in upper-elementary school classrooms. Of the research that does exist, Brugar and Roberts' (2017) study identified teaching as one level of instruction in which the teacher was directed to provide explicit instruction about the graphic. The following section provides information about explicit instruction and its use in CRPs.

With the publication of the National Reading Panel (NRP) report (National Reading Panel, National Institute of Child Health and Human Development, 2000), the components of evidence-based reading instruction came to the forefront of literacy instruction. Shanahan (2003) stated, "the major conclusion [of the National Reading Panel] is that teaching matters," and the greatest success is evidently accomplished when teachers offer *explicit instruction* and guidance (p. 648; emphasis added). As with the findings from the NRP, explicit instruction has frequently been identified as a core factor for student learning. Several publications, including the Institute of Education Science (IES) practice guides for reading and writing instruction (Graham et al., 2012; Graham et al., 2016; Kamil et al., 2008), as well as response to intervention practices (RTI; Fien et al., 2015), have also recognized the benefits of explicit instruction.

Explicit instruction is a relatively new term used within the educational environment to describe a structured, systematic method of teaching. Explicit instruction shares similar instructional components with Direct Instruction (Engelmann et al., 1988). Whereas Direct Instruction includes curriculum and instruction, explicit instruction focuses on how to teach. As with Direct Instruction, explicit instruction incorporated direct explanations and teacher modeling. In addition, the teacher scaffolded instruction

and guided students' practice, gradually releasing responsibility to the student as they engaged in independent practice (Reutzel et al., 2014). Another similar instructional approach, known as "direct instruction" (with lower-case letters) precedes explicit instruction. As with explicit instruction, direct instruction focuses on the how of teaching, regardless of the program. The instructional components of direct instruction were identified through correlation research and, subsequently, verified through experimental research conducted in the 1970s and 1980s (Hughes et al., 2017).

Many researchers (Hughes et al., 2017; Luke 2014) have argued that direct instruction and explicit instruction are synonymous and, as with other innovations within education, an opportunity to appear "cutting edge is presented by using a new term that eschews a teacher-centered approach" (Hughes et al., 2017, pg. 144). Hughes et al. (2017) suggested that the shift in terminology from direct instruction to explicit instruction may be a result of the knowledge base which has grown in the past 20+ years. Thus, they state the following:

> . . . explicit instruction was viewed as a more encompassing and/or a more descriptive term incorporating new findings in areas such as procedures for providing students with opportunities to respond (e.g., peer interactions), refining how and when corrective and affirmative feedback are provided, or being more deliberate in designing effective practice activities to promote retention of newly acquired skills (Hughes et al., 2017, p. 144).

Several researchers (Archer & Hughes, 2011; Hughes et al., 2017; Reutzel et al., 2014) have examined what distinguishes explicit instruction from other forms of

instruction. Archer and Hughes (2011) defined explicit instruction as "a structured, systematic, and effective methodology for teaching academic skills" (pg. 1) and stated that it is one of the most effective methods available to teachers in the advancement of student learning. To guide teachers in the implementation of this instructional method, these researchers also provided a thorough list of the elements of explicit instruction that they identified. Archer and Hughes' list consisted of 16 instructional elements that were identified by research as either instructional behaviors or components of explicit instruction.

Subsequent researchers (Reutzel et al. 2014; Hughes et al., 2017) have examined studies that investigated and then described the most effective elements of explicit instruction consistently used by educators. Hughes et al. (2017) and Reutzel et al. (2014) broke the components of explicit instruction into five and seven components respectively, as described in the subsequent sections.

Hughes et al. (2017) conducted a detailed search of research published between 2000 and 2016 that included either a definition of or teaching components of explicit instruction in an attempt to answer the question "What is explicit instruction?" (p. 140). The researchers reviewed 68 publications that met their criteria. Frequency counts were employed to detect the most common components used to indicate explicit instruction. Hughes et al. identified five components of explicit instruction (described in Table 9) that were included in at least 75 percent of the 68 reviewed publications.

In addition to identifying the essential components of explicit instruction, Hughes et al. modified Archer and Hughes' (2011) definition of explicit instruction. The expanded definition includes references to "research support[ing] instructional behaviors"

that increase acquisition of information stored in a person's long-term memory and "promot[ing] active student engagement" (Hughes et al., 2017, pg. 143).

Table 9

Hughes et al.'s (2017) Components of Explicit Instruction

Essential component	Description
Segment complex skills	Break down complex tasks and strategies into more manageable units of instruction.
Teacher modeling/think-alouds	Provide students with "clear, concise, and consistent descriptions and demonstrations of how the skill or strategy is performed" (Hughes et al., 2017, p. 141).
Systematically faded supports/prompts	Provide scaffolded practice opportunities that align with the needs of the learner utilizing prompts (visual, verbal, and/or physical) concluding with monitoring of unprompted tasks to verify students' readiness for independent practice.
Opportunities to respond and receive feedback	During a lesson, students are asked to respond frequently so the teacher can check for understanding and provide timely feedback.
Purposeful practice opportunities	Students are given opportunities to practice newly learned skills independently.

As with Hughes et al. (2017), Reutzel et al. (2014) conducted a systematic search of research published between 2000 and 2010 to identify publications that included elements of explicit instruction or described specific characteristics of explicit instruction. The final review featured 40 articles and books that met the specific inclusion criteria. A frequency count was conducted to determine the most salient explicit instruction elements. Reutzel et al. identified seven elements of explicit instruction that were mentioned in at least 25% or more of the identified publications (See Table 10 for descriptions of these seven elements). Reutzel et al.'s definition of explicit instruction was similar to that of Archer and Hughes' (2011), which focused on teacher-guided instruction that is "delivered in an effective and efficient manner" (p. 13).

Table 10

Elements of Explicit Instruction as Identified by Reutzel et al. (2014)

Explicit Instruction Element	Definition
Direct explanation	The teacher clearly and concisely informs the students of the lesson objective(s) including definitions of unfamiliar terms and the how, what, when, and why of the new information to be taught.
Modeling	The teacher demonstrates, usually through think aloud, how to use a strategy, skill, or concept.
Discussion	The teacher engages students in dialogue through questioning, encourages students to elaborate upon responses, and provides opportunities for students to communicate with peers.
Guided Practice	The teacher provides opportunities for students to practice newly learned strategies, skills, or concepts using a gradual release of responsibility model.
Feedback	During guided practice, the teacher praises students for correct responses or addresses misunderstandings as students learn new strategies, skills, and concepts. Feedback may also come from peers.
Monitoring	The teacher provides ongoing supervision of student activity.
Independent Practice	Students are asked to apply newly learned strategies, skills, or knowledge, without teacher guidance, in novel contexts or situations.

The primary reason for Reutzel et al.'s (2014) identification of the elements of explicit instruction was to aid the researchers' content analysis of CRP teachers' manuals. Reutzel et al. analyzed the pedagogical guidance associated with the five essential components (phonemic awareness, phonics, vocabulary, comprehension, fluency) of reading instruction and their alignment with explicit instruction. The researchers found that all seven elements of explicit instruction, to varying degrees, were present. This information suggests that the publishers of CRPs are cognizant of the benefits of explicit instruction as a component of evidence-based reading instruction.

For the purposes of this content analysis, *explicit instruction* refers to a structured, systematic method of teaching that is unambiguous and incorporates scaffolds to guide the student through the learning process (Archer & Hughes, 2011). In addition, for the analysis of CRP teachers' manuals—to analyze graphical literacy skills as a component of literacy instruction—elements of explicit instruction, as identified by Reutzel et al., were used to expand upon Brugar and Roberts' (2017) levels of teaching. Brugar and Roberts defined teaching as instruction in which the teacher is directed to provide explicit instruction. This content analysis sought to determine what elements of explicit instruction were being used to teach students graphical literacy skills.

Summary

This review of literature provided an overview of the research on the frequency of graphics in trade books, textbooks, and educational materials. CRPs and their prevalence for literacy instruction was specifically addressed. In addition, an overview of graphics complexity was delivered, outlining the numerous types of graphics and functions of graphics with which upper-elementary students should be familiar. Research also showed

that students' reading comprehension is positively affected when graphics are included with written text. Graphical literacy skills instruction was also reviewed. Although minimal research exists regarding instruction, what does exist demonstrates that when teachers provide instruction, students comprehend more and develop a better understanding of the graphics and their features. As there was minimal research about graphical literacy skills instruction, elements of explicit instruction were also reviewed. Based on the findings of several reviews of research, instructional guidance in CRP teacher manuals should include elements of explicit instruction as learning is positively affected.

The use of content analysis as a method for examining graphics and instructional guidance featured in the informational texts of fifth-grade CRPs is supported by other studies. The studies reviewed substantiate the basis for this study. These studies show that (a) students are being asked to read and interpret increasingly more complex graphics within informational texts, (b) students' reading comprehension is affected by graphics, and (c) the inclusion of graphics in texts positively effects students' learning in the content areas. Several of these studies guided the development of the research questions and subsequent analyses in this study.

CHAPTER III

METHODS

Graphical literacy skills as a component of reading instruction is needed because of the recommendation that teachers in upper-elementary classrooms have students read more informational texts (National Center for Education Statistics, 2009; NGA & National Reading Panel, National Institute of Child Health and Human Development, 2000) and because of the abundance of graphics contained within these publications (Carney & Levin, 2002; Levie & Levin, 1982; Mayer, 1993; McTigue & Flowers, 2011; Smith & Robertson, 2019; Walpole, 1998). In addition, several prominent reading and writing researchers have recommended that graphical literacy skills instruction be integrated with traditional reading and writing instruction in upper-elementary classrooms (Brugar & Roberts, 2017, 2018; Duke et al., 2013; McTigue & Flowers, 2013; Roberts et al., 2013). Furthermore, these researchers have recommended explicit instruction as the most effective method for increasing students' learning from graphics (Brugar & Roberts, 2017; Cromley et al., 2013; Peeck, 1993).

The purpose of this study was two-fold: (a) to conduct a content analysis of the informational texts included in fifth-grade CRP students' textbooks to identify the types and functions of graphics contained therein and (b) to conduct a content analysis of the instructional guidance associated with the informational text selections within fifth-grade CRP teachers' manuals to evaluate and assess the affordances to promote graphical literacy skills as a component of literacy instruction. This study addressed three research questions.

1. What types of graphics are present in the informational texts included in CRP student textbooks?
2. What are the functions of the graphics in these informational texts?
3. To what extent are graphical literacy skills presented as a component of literacy instruction in the CRP teachers' manuals related to these graphics?

Research Design

A content analysis is a systematic and objective research technique. This type of quantitative analysis interprets the messages within texts to identify characteristics and to describe inferences using the scientific method (Krippendorf, 1989; Neuendorf, 2017). Neuendorf (2017) describes nine processes for typical content analysis research:

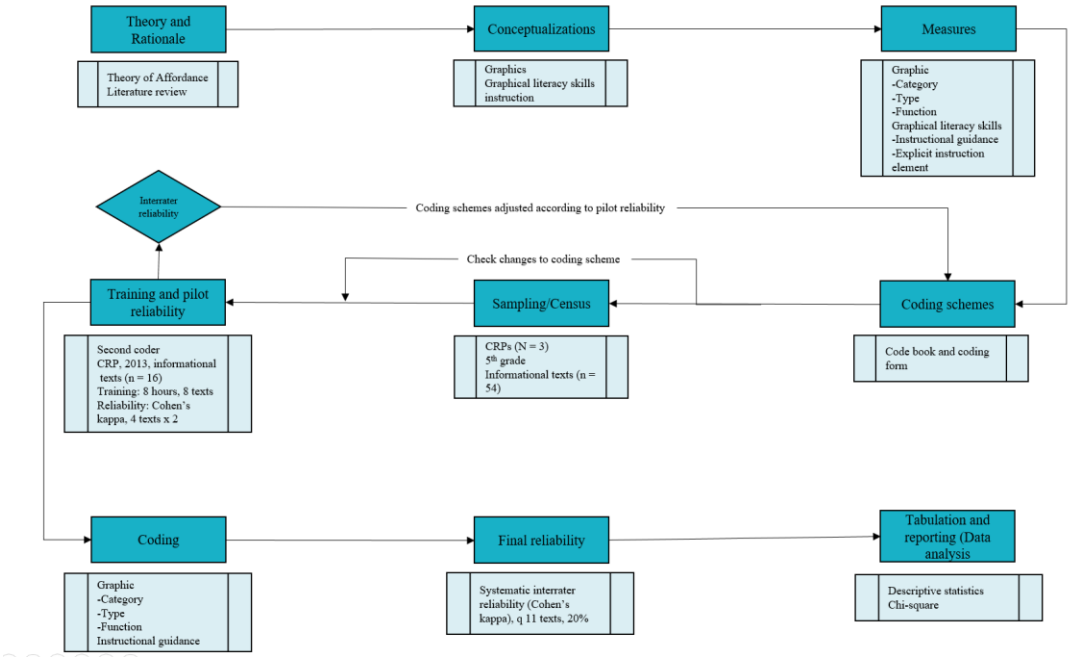
1. theory and rationale—determine the content to be examined and why it will be examined
2. conceptualizations—determine the variables that will be used and define them
3. measures (operationalizations)—establish the unit of data collection that further characterizes the conceptualizations
4. coding schemes—create a codebook defining the variable measures and produce a coding form
5. sampling—create a census of the content or subset of the population
6. training and pilot reliability—establish intercoder reliability for each variable and revise codebook and coding form as needed
7. coding—test coding to establish at least a 10% overlap for reliability parameters
8. final reliability—calculate a reliability figure for the second, "final" intercoder reliability check

9. tabulation and reporting—present the relationships between variables to establish criterion and construct reliability.

These processes, and how they related to this content analysis, are briefly summarized in Figure 1. A comprehensive description of the processes is provided in the subsequent sections.

Figure 1

Content Analysis Research Design



Theory and Rationale

Neuendorf (2017) states that the first step in a content analysis is to determine the content to be examined and why it should be examined. The researcher studied the graphics to determine type and function. In addition, the instructional guidance associated with the graphics was examined. As graphics are evolving in complexity and content, teachers need to know what graphics are featured in CRPs because they are the primary mode of literacy instruction in most upper-elementary classrooms (DeWitz & Jones, 2012). Teachers also need to know if CRPs are providing pedagogical guidance to facilitate graphical literacy skills instruction.

The theoretical framework that informed this study is the theory of affordances (Gibson, 1979). This theory was used to examine the instructional guidance associated with the graphics that are featured in the informational text selections within fifth-grade CRPs. Affordances are defined as a relationship between an object, the potential uses an object offers a learner, and an ecological niche (Norman, 2013; Rietveld & Kiverstein, 2014). By identifying the affordances in CRPs, teachers will become familiar with the resources available to instruct students in graphical literacy skills.

The review of literature summarized and synthesized relevant scholarship pertaining to the types and functions of graphics, learning from graphics, and graphical literacy skills instruction. Additionally, the review discussed the theory of affordances and how this theory was used to analyze the instructional guidance associated with the informational texts in CRPs.

Conceptualizations

The second step of a content analysis is identifying and defining the variables that are associated with the research questions (Neuendorf, 2017). The variables that were used for this content analysis were graphics and graphical literacy skills instruction. Graphics were defined as any photograph, image, or illustration including, but not limited to, diagrams, maps, graphs, timelines, and tables (Norman & Roberts, 2015).

The second variable identified for this content analysis was graphical literacy skills instruction. Graphical literacy was defined as the ability to read and interpret graphics that supplement prose in non-fiction trade books, textbooks, and other print or digital sources (Zhang et al., 2010). Literacy instruction was defined as systematic instruction provided by a teacher to students for the development of receptive (i.e., listening, reading) and expressive (i.e., speaking, writing) skills as modes of communication across disciplines and in any context (Malloy et al., 2019). Thus, graphical literacy skills instruction was defined as systematic instruction to help students develop the ability to read, interpret, and create graphics as modes of communication.

Measures (Operationalization)

The third step in conducting a content analysis requires defining the measures to align with the conceptualizations (Neuendorf, 2017). The graphics, in the informational texts within the students' textbooks, were examined for (a) graphic category, (b) graphic type, and (c) graphic function. More information about coding schemes is found in the section titled "Coding Schemes."

The measures used for the teachers' manuals were (a) instructional guidance (e.g., teach) and (b) element of explicit instruction (e.g., direct explanation). Additional information about coding schemes is found in the section titled "Coding Schemes."

Coding Schemes

According to Neuendorf (2017), the development of coding schemes is the fourth step of content analysis research. The purpose of coding schemes is to create a clearly defined process that outlines a priori categories potentially eliminating differences among individual coders and avoiding researcher bias. A codebook and coding form, as recommended by Neuendorf, was created to address the objectives of this content analysis. The codebook explained the measures used for data collection and the electronic coding form provided a place to record the information outlined in the codebook.

The codebook created for this study was "Specific Instructional Guidance Codebook" and it outlined the procedures for analyzing the graphics found in the informational text selections of CRP students' textbooks and the graphical literacy skills instruction associated with those graphics in the CRP teachers' manuals. The creation of this codebook is described below and then the coding form is described.

Specific Instructional Guidance Codebook

The purpose of this codebook was to describe the steps involved in coding the graphics utilized in the informational text selections in the CRP students' textbooks, as well as the specific graphical literacy skills instruction in the teachers' manuals associated with the graphics that addressed this study's research questions. The following metadata were collected: (a) publisher and student textbook number (See Table 11 for

more information), (b) title, (c) text length (the starting page number and ending page number), (d) disciplinary area (i.e., a field of academic study). Four a priori codes were implemented for disciplinary area (Table 12 provides definition of disciplinary areas). Prior research examining the types and functions of graphics have primarily focused on social studies and science textbooks and trade books (Fingeret, 2012; Guo et al., 2018; Slough & McTigue, 2013; Walpole 1998). Thus, those two disciplinary areas were included as a priori codes. The disciplinary areas math and art were adopted as a priori codes because they are also considered disciplinary areas in which students should engage in literacy practices (International Literacy Association, 2017). The above information was entered into the electronic coding form titled "Specific Instructional Guidance Codes" in the columns with corresponding names (hereafter called electronic coding form).

Table 11

Coding Scheme for CRP Textbooks by Publisher

Code	Publisher/Publication	Code	Resource
A	Houghton Mifflin Harcourt (HMH)/ *Into Reading*	1	myBook 1
		2	myBook 2
B	McGraw Hill Education/*Wonders*	1	Literature anthology
		2	Reading/Writing Companion Units 1-2
		3	Reading/Writing Companion Units 3-4
		4	Reading/Writing Companion Units 5-6
C	Pearson Education /*myView Literacy*	1	Student Interactive 5.1
		2	Student Interactive 5.2

Table 12

Disciplinary Area Coding Scheme

Code (disciplinary area)	Definition
Arts	The text conveys information about the arts (e.g., dance, painting).
Mathematics	The text conveys information about a mathematical concept or topic.
Science	The text conveys information about scientific phenomena and/or conveys information about scientific activities.
Social studies	The text conveys information about history, culture, government, religion, and/or economics (Ogle et al., 2007).
Other	The text does not align with listed content areas.

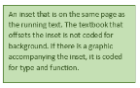
The graphics in the informational texts were then coded for (a) page number and graphic number, (b) category, (c) type, (d) function, and (e) connection to text. After coding the graphics in the students' textbooks, the same informational texts were analyzed in the teachers' manuals for associated graphical literacy skills instruction. When instructional guidance was indicated for a specific graphic, the following information was entered into the coding form: (a) instructional guidance number (the number assigned to individual graphics), (b) teacher manual number, (c) starting and ending page numbers from the teacher's manual, (d) page number of instructional guidance, (e) graphical literacy skills instruction (instructional guidance), and (f) element of explicit instruction. This information was entered into the electronic coding form beneath the columns with corresponding names. Detailed information about the coding of the graphics and associated graphical literacy skills instruction is outlined in the subsequent sections titled "Graphics" and "Instructional Guidance."

Graphics

In accordance with Fingeret (2012) and Guo et al. (2018), only the graphics both associated with the main body of the informational text and aligned with the definition of an informational text were coded. In addition, graphics that were only used for decorative purposes (e.g., backgrounds, bullet points, text boxes) were excluded from this analysis as they had no instructional purpose and no associated instructional guidance (See Table 13 for a more detailed explanation of what was excluded; Fingeret, 2012). To clarify the coding process, operational definitions are described in three sub-sections: (a) Graphic Page Number and Position, (b) Graphic Category and Type, and (c) Graphic Function and Connection to Text.

Table 13

Graphics Excluded from Content Analysis

Graphic	Description	Example
Background	The background on which the running text and other graphics are superimposed. The background may be colored (other than the traditional white or ecru) or textured (may simulate different types of writing matter, e.g., papyrus, rock, leather, etc.).	
Bullet points	A graphic that is used as a bullet point.	
Insets	A colored box on which an inset is superimposed.	
Text box	A graphic that is used to decorate a textbox.	
Title bullet point	A graphic that appears with the title and is used to offset the title.	
Title graphic	A graphic that is used to represent a letter or letters in a title or subtitle.	

Graphic Page Number and Position. To code each graphic, the coder recorded the number of the page on which the graphic appeared in the student textbook. To code graphics that extended across adjacent pages, two numbers were recorded, the number of the page on which the graphic first appeared and then the concluding page number. For example, a photograph that is across adjacent pages was coded as page number 255-256. The information was then entered into the electronic coding form in the column with the corresponding title.

To code for graphic position, the location of the graphic was indicated by a number. When there was only one graphic on the page, the graphic number was entered as one. For pages that featured multiple graphics, the graphics were coded from left to right and then top to bottom. For example, in Figure 2 the graphics would first be coded by page number (e.g., 12). Then, beginning on the left side of the page and moving to the right side of the page, the graphics would be coded by position on the page. Graphic numbers would then be recorded in the coding form below the column heading “Graphic Number.” Figure 3 shows what this looks like.

Figure 2

Numbering Multiple Graphics Example

Note. Method for numbering multiple graphics on one page. Number from left to right, top to bottom. From Galaxy-Elements of this image furnished by NASA", by M. Aurelius, 2021, April 17, Shutterstock, https://www.shutterstock.com/image-photo/galaxy-elements-this-image-furnished-by-1716207277; "Man with a telescope looking at stars," by Allexxandar (Photographer), 2021, April 17, Shutterstock, https://www.shutterstock.com/image-photo/man-astronomy-telescope-looking-stars-starry-580851391; "Beautiful galaxy somewhere in deep space," by Outer Space, 2021, April 17, Shutterstock, https://www.shutterstock.com/image-photo/beautiful-galaxy-somewhere-deep-space-cosmic-1933690022; "Space telescope, above the planet Earth," by Artsiom P, 2021, April 17, Shutterstock, https://www.shutterstock.com/image-photo/space-telescope-above-planet-earth-elements-1487940788

Figure 3

Sample Coding Form for Coding Graphics

Starting page	Ending page	Total pages	Disciplinary area	Graphic page number	Graph	Graphic categ	Graphic type	Graphic functio	Connection to main text
16	17	2	arts	16-17	1	general image	Computer enhanced photograph	Representation	level 2
18	30	13	arts	18-19	1	Photograph	Simple photograph	Representation	Level 1
18	30	13	arts	21	1	Map	Context map	Representation	level 2
18	30	13	arts	21	2	general image	realistic illustration	Representation	level 1
18	30	13	arts	21	3	Photograph	Simple photograph	Representation	level 1
18	30	13	arts	22	1	Photograph	Simple photograph	Representation	level 1
18	30	13	arts	22	2	Photograph	Simple photograph	Representation	level 1
18	30	13	arts	22	3	Photograph	Simple photograph	Representation	level 1
18	30	13	arts	23	1	Photograph	Simple photograph	Representation	level 2

Note. A screenshot of the coding form.

Graphic Category and Type. The graphics featured in an informational text in the students' textbooks were coded for graphic category and type. Graphic categories and types are briefly defined and described in Table 14 which was first introduced in the literature review section (detailed table of the operational definitions and examples may be found in Appendix A).

Table 14

Basic Coding Scheme for Graphic Categories and Types

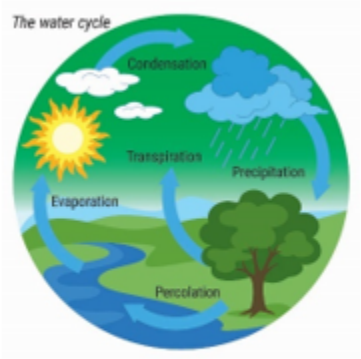
Code (Category)	Code (Type)	Description
Comic Strip	Content, entertainment/example	Traditional comic strip (Guo et al., 2018).
Diagram	Bird's eye view diagram, cutaway diagram, cross-section, picture scale diagram, scale diagram, simple diagram	Graphics that depict the pieces or components of a whole system or static relationship between parts; typically includes labels (Guo et al., 2018).
Flow diagram	Cyclical sequence, forked sequence, linear sequence, tree diagram, web diagram	Diagrams that illustrate a set of dynamic relationships within a system or static relationships between parts; usually includes arrows to show connections between parts (Guo et al., 2018).
General image	Cartoon illustrations, characters, computer enhanced/created photography/image, fine art, image cluster, logo, magnified image, photographs of illustrations, radar image, realistic illustration, scientific model, screen shot, stop motion, x-rays	A graphic which may contain symbolic information that requires interpretation by the reader and may necessitate the use of background knowledge; does not have lines with labels or words as in common in diagrams (Guo et al., 2018).
Graph	Bar graph, line graph, pie chart, pyramid chart, Venn diagram	A visual organization of quantities and numbers which may show comparison (Coleman & Dantzler, 2016; Fingeret, 2012; Guo et al., 2018).
Map	Context map, flow map, grid map, landmark map, region map, street map, topographical map	A display of social, political, physical, or geographical information on a representation of an area.
Photograph	Cluster and simple photograph	A picture of a real-life object produced by photography.
Table	Column table, pictorial table, row table, row and column table	Data organized using rows and columns.
Timeline	Multiple and single timeline	Information organized chronologically on a line.
Other		Graphic that does not align with listed category

Note. This table is similar to Table 3 which was introduced in the Literature Review.

Using these definitions, the coders coded the graphics for category and type and then recorded the information in the electronic coding form. For example, the graphic in Figure 4 was coded as follows: (a) the category is flow diagram as the graphic depicts the pieces or components of a whole system (Guo et al., 2018), and (b) the type is cyclical sequence as the graphic shows the water cycle.

Figure 4

Example for Coding Category and Type



From "Vector schematic representation of the water cycle in nature [digital image]," by 3xy, 2021, April 17, Shutterstock. https://www.shutterstock.com/image-vector/vector-schematic-representation-water-cycle-nature-694784353

Graphic Function and Connection to Text. The graphics appearing in an informational text were coded for function and connection to the running text. The functions of graphics are identified and defined in Table 16, which is a compilation of the functions of graphics as categorized by several researchers and discussed in the literature review (Table 4 provides more details about functions of graphics; Carney & Levin, 2002; Guo et al., 2018; Levin, 1979; Slough & McTique, 2013). The coders first coded the graphics for one of five functions; (a) decoration, (b) representation, (c) organization, (d) interpretation, or (e) transformation. The coders recorded the information in the electronic coding form below the column heading, "Function." The graphics were then coded for connection to the running text-level 1 or level 2 using the descriptions in Table 15.

Table 15

Coding Scheme for Graphic Functions

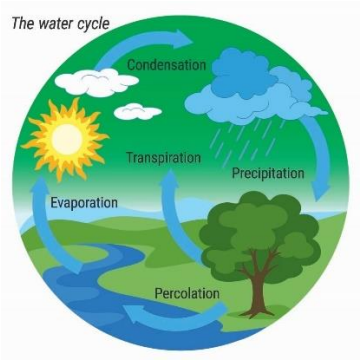
Code (function)	Definition	Examples
Decoration	Ornamental; no instructional purpose (Carney & Levin, 2002; Levin, 1979).	Graphic as part of the title, decorative bullet point
Representation	Illustrates all or part of the written text; concretizes the written text (Carney & Levin, 2002; Levin, 1979).	A photograph of a tractor next to a passage about a tractor.
Organization	Structuralizes the written text with graphics; makes the written text more coherent (Carney & Levin, 2002; Levin, 1979). A process or a sequence or where the relative position of things is important in relation to one another.	How-to-do-it diagrams, illustrated maps, the water cycle.
Interpretation	Clarifies difficult to understand text and abstract concepts; makes the written text more comprehensible (Carney & Levin, 2002; Levin, 1979).	A diagram of a pump showing how the heart pumps blood through the body.
Transformation	Utilizes mnemonics to make text more memorable (Carney & Levin, 2002; Levin, 1979).	A picture of a pen with the word atom inscribed on the side to increase recall of the components of an atom, proton, electron, neutron.
Connection	Information represents the running text and/or adds new information (Slough & McTique, 2013).	
Level 1	Information included within graphic is easily interpretable and connects easily with written text (Guo et al., 2018).	A photograph caption that uses different terms than the written text but is easily connected.
Level 2	Information included within graphic that is not easily interpretable and requires more inferencing (Guo et al., 2018). May contain language and/or concepts that are not found in the running text. The graphic requires background knowledge and scrutiny.	A bar graph titled “Gas Consumption of Sedans” but the running text does not reference sedans. The bar graph also includes information about gas powered cars, but the running text is about electric cars.

Note. This table was first introduced in the Literature Review as Table 4.

For example, Figure 5 shows a graphic with the accompanying running text. The function for this graphic is organization because the graphic "structuralizes the written text" (Carney & Levin, 2002, pg. 7). After being coded for function, the graphic was then coded for connection to the running (written) text. This graphic was coded as Connection, level 2 as the graphic labels feature different terminology than that of the running text and may "not [be] easily interpretable and require more inferencing" (Guo et al., 2018).

Figure 5

Example for Coding Graphic Function.



Water is essential to life on Earth. The water cycle shows the continuous movement of water within the earth and atmosphere. Water evaporates into water vapor which condenses to form clouds. Water then falls as precipitation from clouds. When precipitation falls, water moves through the atmosphere in different phases and is also absorbed by the ground.

Note. Text was written by the dissertation author. From "Vector schematic representation of the water cycle in nature [digital image]," by 3xy, 2021, April 17, Shutterstock. https://www.shutterstock.com/image-vector/vector-schematic-representation-water-cycle-nature-694784353

Instructional Guidance

The purpose of this section is to outline the steps involved in coding the instructional guidance that was found within CRP teachers' manuals and that was associated with a particular graphic in the corresponding informational text within the students' textbooks. As with the informational text selections, only instructional guidance that was indicated for whole class instruction was included. The instructional guidance components that were excluded were:

- As needed instruction—The teacher could choose to implement the instruction.
- Differentiated instruction—Pedagogical guidance was indicated for small group instruction and not every student may receive the same guidance.
- English language learner— Pedagogical guidance was indicated for small group instruction and not every student may receive the same guidance.
- Small group/reading group instruction— Pedagogical guidance was indicated for small group instruction and not every student may receive the same guidance.

The graphics in the informational text selections in the CRP students' textbooks were coded and the information entered in the electronic coding form titled Specific Instructional Guidance. After coding the graphics, the coders then coded these same graphics for associated graphical literacy skills instruction in the CRP teachers' manuals. To clarify the coding process for specific instructional guidance, the following sub-sections outline the coding process: (a) "Inclusion of Instructional Guidance," (b) "Instructional Guidance Numbers," (c) "Teacher's Manual and Page Numbers," and (d) "Graphical Literacy Skills Instruction."

Inclusion of Instructional Guidance. The informational texts that corresponded with the texts identified in the CRP students' textbooks were also in the teachers' manuals. The instructional guidance pertaining to those informational texts was examined for graphical literacy skills instruction. A code of "y" indicated instructional guidance specific to a graphic. A code of "n" showed that there was no instructional guidance associated with an individual graphic. For example, Figure 6 was coded "y" for inclusion of instructional guidance as the close read instructions direct the teacher to teach the students about the water cycle diagram.

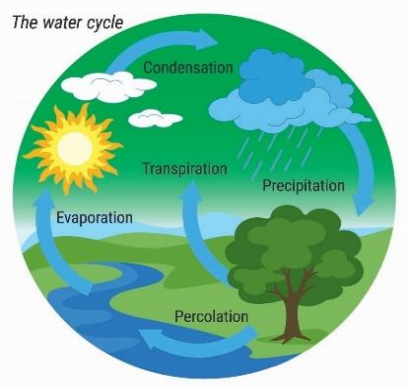
Codes were entered into the electronic coding form, in-line with the previously entered graphic information, beneath the corresponding heading. Graphics that received a "n" code were coded no further. Graphics that received a "y" code were then coded for instructional guidance number, teacher's manual and page number, location of instructional guidance, and graphical literacy skills instruction (instructional guidance and element of explicit instruction).

Instructional Guidance Number. Graphical literacy skills instruction, in the teacher's manual was coded for by occurrence. The first occurrence was coded with a "1," indicating the first time that graphical literacy skills instruction was designated for that specific graphic. For graphics for which there was more than one instance of graphical literacy skills instruction, the instructional guidance (IG) number was increased by plus one increments. For example, in the teacher's manual, the teacher was directed to refer to the water cycle diagram (See Figure 6 for an example), during a pre-reading text walk and again during the "Close read." The IG number for the pre-reading guidance is

one, and the IG number for the Close read is two (Figure 7 demonstrates what the coding form looked like once Figure 6 had been coded).

Figure 6

Example for Coding Inclusion of Instructional Guidance



Close read: Direct students' attention to the diagram of the water cycle. Tell students that the diagram visually represents the water cycle. Ask students to compare the written text and the diagram. Ask students to discuss similarities and differences.

Water is essential to life on Earth. The water cycle shows the continuous movement of water within the Earth and atmosphere. Water evaporates into water vapor which condenses to form clouds. Water then falls as precipitation from clouds. When precipitation falls, water moves through the atmosphere in different phases and is also absorbed by the ground.

T25

Note. Text was written by the dissertation author. From "Vector schematic representation of the water cycle in nature [digital image]," by 3xy, 2021, April 17, Shutterstock. https://www.shutterstock.com/image-vector/vector-schematic-representation-water-cycle-nature-694784353

Figure 7

Example Coding for Instructional Guidance Number

Graphic codes from student's textbook are copied and pasted.

IG number is increased in plus one increments.

431	451	21	science	448	1	flow diagr	Cyclical se	Organizati	level 1	y	1	first read
431	451	21	science	448	1	flow diagr	Cyclical se	Organizati	level 1	y	2	close read

Note. A copy of the coding form.

Teacher's Manual and Page Numbers. In addition to coding the graphics for inclusion of specific instructional guidance and instructional guidance number, the coders also gathered information about the teachers' manuals. The codes for publisher/publication were not entered at this time because they had already been recorded when the graphic was coded for type and function (See section "Graphics."). The coders entered the resource code, as shown in Table 16, into the electronic coding form in the column titled "TE book number." The starting page number and ending page number of the informational text and accompanying lessons were entered into the electronic coding form in the columns titled "Starting Page Number" and "Ending Page Number." For example, an informational text in Houghton Mifflin Harcourt's "*Into Reading*" that was also in book one of the teachers' manuals would be coded for resource, 1, and page numbers, T25 (starting page) and T40 (ending page).

Table 16

Coding Scheme for CRP Teachers' Manuals by Publisher

Code	Publisher/Publication	Code	Resource
A	Houghton Mifflin Harcourt (HMH)/*Into Reading*	1-7	Teacher's Manual Books 1-5; code number corresponds with book number Teaching Pal 1-2; code as 6 and 7 respectively
B	McGraw Hill Education/*Wonders*	1-6	Teacher's Manual Books 1-6; code number corresponds with book number
C	Pearson Education/ *myView Literacy*	1-6	Teacher's Manual Books 1-6; code number corresponds with book number

Graphical Literacy Skills Instruction. The codes for instructional guidance and explicit instruction element are interrelated. A coding scheme that shows the two codes together is included in Appendix B. However, for ease of coding, separate coding schemes were created (described in Table 17 and Table 18). To begin coding for graphical literacy skills instruction, the coders coded for instructional guidance. Four codes were used for instructional guidance: (a) no instructional guidance, (b) reference, (c) teach, and (d) other. A detailed description for each code is provided in Table 18. The Coding Scheme for Instructional Guidance features components of the levels of teaching as categorized by Brugar and Roberts (2017) which were discussed in the literature review. The coders entered the appropriate codes into the electronic coding form.

Table 17

Coding Scheme for Instructional Guidance for Graphical Literacy Skills Instruction

Instructional Guidance	Description	Example
No instructional guidance	Graphics are present in the text, but no graphical literacy skills instruction is provided to the teacher.	A timeline runs across the bottom of the page identifying when Articles of the Bill of Rights were added, but the teacher is not directed to reference or teach about the timeline.
Reference	The manual directs the teacher to verbally reference the graphic, but no other instruction about the graphic is provided (Brugar & Roberts, 2017).	Look at the timeline on page 57.
Teach	The teacher is directed to provide explicit instruction about the graphic (Brugar & Roberts, 2017).	When I read a timeline, first I look at the title to determine what the timeline is about. Then, I scan the timeline and ask myself questions about what I am seeing.
Other	Instructional guidance does not align with other codes.	Graphical literacy skills instruction that does not meet a priori codes.

Note. Examples were written by the study author.

After this, the graphical literacy skills instruction identified as “teach” was then coded for element of explicit instruction. There were eight possible codes for elements of explicit instruction: (a) direct explanation, (b) modeling, (c) guided practice, (d) feedback, (f) discussion, (g) monitoring, (h) independent practice, and (i) other. Operational definitions are detailed in Table 18. The Coding Scheme for Elements of Explicit Instruction table is like Table 10, Elements of Explicit Instruction as Identified by Child (2012), which is located in the literature review.

Occasionally, a level of instructional guidance had more than one element of explicit instruction. In this instance, the coders coded for the additional elements of explicit instruction, as defined in Table 18, and recorded the data in the electronic coding form in subsequent columns with the same heading.

Table 18

Coding Scheme for Elements of Explicit Instruction

Explicit Instruction Element	Description	Example
Direct explanation	New material is taught in a concrete way using clear and concise language (Child, 2012).	This is a timeline. This timeline organizes information chronologically. That means the order in which these events occurred.
Modeling	When a teacher demonstrates (e.g., think aloud) and describes the use of a particular skill, strategy, process, or concept (Hughes et al., 2018; Hughes et al., 2017).	When I read a timeline, first I look at the title to determine what the timeline is about. Then, I scan the timeline and ask myself questions about what I am seeing.
Discussion	Teacher asks questions which elicits students' responses, conversation either with the teacher or with peers (Child, 2012).	What kind of information is being shared on this timeline? Discuss with your neighbor how knowing the information on the timeline helps you comprehend the main text.
Guided practice	Makes use of scaffolding, teacher and peer support, and a gradual release of responsibility (Child, 2012).	Look at the timeline on page 57. With your partner, read the timeline, making note of the features of the timeline.
Feedback	Teacher provides corrective verbal feedback as students are learning to apply skills, strategies, processes, and concepts (Child, 2012).	As the students are reading the timeline, walk around the room and provide feedback or assistance.
Monitoring	Teacher carefully attends to students' responses through observation (Child, 2012).	As the students read the informational text the teacher will watch and make sure that students are attending to the graphics.
Independent practice	Teacher instructs student to independently read a graphic and discuss with a partner or the teacher directs student to create a graphic.	Compare the information in the text with the information in the timeline. Using information from the text, create a timeline that highlights the history of national parks.

Note. This table is similar to Table 10, "Elements of Explicit Instruction as Identified by Reutzel et al. (2014) located in the chapter titled "Review of the Literature." Examples were written by the study author.

Coding Form

The purpose of a coding form is to document the code variables as described in the "Specific Instructional Guidance Codebook" (Neuendorf, 2017). For this study, a coding form was created using Microsoft Excel. The form was titled "Specific Instructional Guidance Codes" and was previously referred to as the electronic coding form. The standard Excel function "Data Validation" was used for coder convenience, to reduce coder transcribing errors, and to increase validity.

The codes created and defined in the Specific Instructional Guidance codebook were used to identify the data that was recorded in the electronic coding form. The electronic coding form used nominal measures because the order of the categories was arbitrary. Table 19 summarizes the column headings from the Excel worksheet that was used as the electronic coding form to record the codes for graphic type and function, graphical literacy skills instruction aligned with a specific graphic, and other relevant data.

Table 19

Specific Instructional Guidance Codes Summary

Column Heading	Description
Unique ID	Excel code written to identify individual graphics (publisher, ST number, graphic page number, graphic number, inclusion of instructional guidance).
Publisher	Code to identify the publisher (e.g, A, HMH-*Into Reading*; Table 11).
Student textbook (ST) number	Code to identify the ST number (e.g., 2, HMH-*Into Reading*, *MyBook 2*; Table 11).
Informational text (IT) title	The title of the informational text.
Starting page	The first page of the informational text.
Ending page	The final page of the informational text.
Total pages	The total number of pages that comprised the informational text.
Disciplinary area	Code to identify the field of academic study (e.g., science; Table 12).
Graphic page number	The page number on which the graphic appears in the student's textbook.
Graphic number	The number of the graphic as it appears on the page. When there is only one graphic, the number is "1." For pages with multiple graphics, the graphics were numbered left to right, top to bottom.
Graphic category	Code to label the category to which the graphic belongs (e.g., photograph; Table 14).
Graphic type	Code to label the type of graphic—more precise than category (e.g., simple photograph; Table 14).
Graphic function	Code to label the function of the graphic in relation to the running text (e.g., decoration; Table 15).
Connection to text	Code to label the connection level of the graphic in relation to the running text (e.g., level 2; Table 15).

Column Heading	Description
Inclusion of instructional guidance	Code to identify graphical literacy skills instruction that is affiliated with a specific graphic in the teacher's manual. If "yes," enter codes or information for the remaining columns. If "no," then coding ends for that graphic.
Instructional guidance (IG) number	Graphical literacy skills instruction is found in the teacher's manual specific to this graphic. A number one is recorded for the first instance. Subsequent instances are coded in plus one increments.
Teacher manual (TM) book number	Code for the teacher's manual (e.g., 5 for HMH's teacher's manual, book 5; Table 15).
Starting page	The first page of the informational text instruction in the teacher's manual.
Ending page	The final page of the informational text instruction in the teacher's manual.
Page number of IG	The page number in the teacher's manual where the IG occurs.
Graphical literacy skills instruction	Code for the level of instructional guidance (e.g., teach; Table 17).
Element of explicit instruction	Code for the element of explicit instruction when the graphical literacy skills instruction is "teach" (e.g., direct explanation; Table 18). Additional columns as needed.

Sampling

Neuendorf (2017) states that the fifth step in the process of content analysis research is to select a census or define the sample. For this research, all the informational texts, in the chosen CRPs, that aligned with the definition were analyzed. Riffe et al. (2014) states that when time and resources allow for a census, the researcher should utilize the population as the results will be less biased.

CRPs were selected because they are the most widely used instructional resource for teaching literacy skills in elementary schools (Dewitz & Jones, 2012). Additionally,

scant research has examined the types and functions of graphics in CRPs or the instructional guidance associated with graphics in CRP teachers' manuals (Roberts et al., 2013; Saynay, 2014). The CRPs selected for this content analysis were Houghton Mifflin Harcourt's (HMH) *Into Reading*, Savas's (formerly Pearson) *myView Literacy*, and McGraw-Hill MacMillan's (MHM) *Wonders.* These three CRPs were selected because they were published in 2020 by the dominant educational resources publishing companies (Brown, 2017).

This study analyzed the graphics appearing in the informational texts within fifth-grade students' CRP textbooks and graphical literacy skills instruction offered within the corresponding CRP teachers' manuals. An informational text was defined as a "text that may (a) convey information about the natural, physical, or social world (i.e., is informative/explanatory; Duke, 2014); (b) influence the reader's ideas or behaviors (i.e., is persuasive or argument; Duke, 2014); or (c) teach someone how to do something (i.e., is procedural; Duke, 2014).

To identify the informational texts included in each CRP, two coders—the primary researcher and a second coder—independently identified texts within the students' textbooks that both met the definition of informational text for this content analysis and were indicated for whole class instruction. A second coder was recruited for this study to establish reliability (Neuendorf, 2017). Information about the second coder and the process for verifying interrater reliability is found in the section below titled "Training and Pilot Reliability."

After each coder compiled a list of texts, the coders compared the lists, discussed differences, and agreed on the final census of 54 informational texts. The number of

informational texts per publication was: (a) Houghton Mifflin Harcourt's *Into Reading*, n = 21, (b) McGraw Hill Education's *Wonders*, n = 21 and (c) Savas's *myView Literacy*, n = 12.

The analysis was conducted across several resources associated with each CRP. Table 20 identifies the publications, the resources, and material analyzed. Information about CRPs and informational texts was previously seen in the literature review. To address research questions one and two, the coders analyzed the graphics included within the informational texts of the stated student materials. To address research question three, the coders analyzed graphical literacy skills instruction associated with the graphics included in the informational text selections within the teachers' manuals.

Table 20

CRP Materials Included by Publisher/Publication

Publisher/Publication	Resource	Material
Houghton Mifflin Harcourt (HMH)/ *Into Reading*	myBook 1 myBook 2	Graphics featured within informational texts
	Teacher Manuals 1-6 My Teaching Pal 1-2	Instructional guidance associated with graphic in informational texts
McGraw Hill Education/ *Wonders*	Student Literature Textbook	Graphics featured within informational texts
	Student Reading/Writing Companion, Units 1-6	
	Teacher Manuals 1-6	Instructional guidance associated with graphic in informational texts
Savas (formerly Pearson Education)/ *myView Literacy*	Student Interactive 5.1 and 5.2	Graphics featured within informational texts
	Teacher Manuals 1-5	Instructional guidance associated with graphic in informational texts

Training and Pilot Reliability

The sixth step identified by Neuendorf (2017) in content analysis research is training and pilot reliability. Neuendorf states that the purpose of training is to ensure that more than one individual can use the codebook and coding form. The researcher trained a second coder in using the codebook and coding form. The second coder was an elementary educator with a master's degree in literacy instruction. Because this research examined the informational text selections from the stated CRPs, the researcher and second coder used the 2013 edition of Houghton Mifflin Harcourt's (HMH) CRP *Journeys* for training and pilot reliability. HMH's publication *Journeys* was not one of the texts utilized for this study because no 2020 edition of this publication existed.

The researcher and second coder met several times for training and pilot reliability. In the first session, they met for four hours to read and discuss the codebook as well as examine the coding form. The two coders worked to clarify the codes and definitions. The coders also examined the CRP to be used for training and named the informational texts. The coders identified 16 texts that aligned with the definition of an informational text as defined for this study. In addition, the coders refined the list of sections within the teachers' manuals that to be analyzed for graphical literacy skills instruction. Several sections were excluded because instruction was not designated for the whole class. The sections excluded were (a) English language learners, (b) small group instruction, (c) differentiated instruction, and (d) as needed instruction. The coders clarified that graphical literacy skills instruction must be in the teacher's manual and led by the teacher. These changes were made to the codebook.

The coders then worked together to code four randomly selected informational texts from the training CRP census. Four texts were selected because the coders, upon initial inspection, noted the variability in the types of graphics among the informational texts. The coders determined that a sample greater than 10% was needed for exposure to more types of graphics. Thus, the coders coded 40% of the informational texts for this first training. The coders coded the graphics in the selected informational texts and the corresponding graphical literacy skills instruction in the teacher's manual. Data were recorded in the proposed digital coding form.

Based on the coding and resulting discussions during the training session, the coders refined the list of graphics that were excluded from the analysis because they had no instructional purpose (e.g., bullet points; See Table 13 for descriptions of what was excluded). At the conclusion of the training session, four informational texts were randomly selected from the remaining census for independent coding using the revised codebook and digital coding form.

For the second session, the coders met and compared their digital coding forms. Coding concerns were recorded and inconsistencies resolved (Mackay & Gass, 2005). The definitions for the graphic types "fine art" and "realistic illustration" were refined and changes were made to the codebook. At the conclusion of the meeting, the coders agreed to independently code four more randomly selected informational texts, from the remaining texts in the census, to test the changes to the codebook and to calculate reliability.

After both coders completed coding these four selections, the primary researcher calculated interrater reliability in Excel using Cohen's kappa (Neuendorf, 2017).

Neuendorf (2017) states that Cohen's kappa is the most widely used reliability coefficient for interrater reliability agreement calculation when there are two raters. Neuendorf reports that acceptable levels for agreement reliability coefficients that account for chance (Cohen's kappa) vary among researchers. However, Neuendorf suggests that a Cohen's kappa of ".80 or greater would be acceptable to all, .60 or greater would be acceptable in most situations, and below that, there exists disagreement" (p. 168).

To calculate Cohen's kappa, the primary researcher copied and pasted the second coders data into an Excel spreadsheet along with the researcher's data (first coder). The researcher created a cross tabulation to compare agreement for: (a) graphic category, (b) graphic type, (c) graphic function, (d) connection to running text, (e) instructional guidance, and (f) element of explicit instruction. Interrater reliability was computed using Cohen's kappa and is reported in Table 21.

Table 21

Cohen's Reliability Kappa 1

Cross tabulation	Agreement
Graphic category	$\kappa = .85$
Graphic type	$\kappa = .78$
Graphic function	$\kappa = .94$
Connection to text	$\kappa = .75$
Instructional guidance	$\kappa = .65$
Element of explicit instruction	$\kappa = .75$

The coders identified and discussed the differences in coding. From their discussion, colored (i.e., color other than the traditional ecru or white) and textured (i.e., simulating another type of writing matter; e.g., papyrus, rock) backgrounds were added to the list of graphics that were excluded from the analysis as they had no instructional purpose (Table 14 explains what types of graphics were excluded). The definition for connection to text-level 1 and level 2 was improved for clarity, and changes were made to the codebook.

In addition, the definition of instructional guidance was clarified to align with research question three; the coders determined that graphical literacy skills instruction must be associated with a specific graphic. They also agreed that no inferences about graphical literacy skills instruction could be made. The coders could not assume that a statement to discuss a particular graphic was preceded with direct explanation. For example, when the teacher's manual stated, "What information do you learn from the graph's introductory paragraph,", (August et al., 2020c, p. T230) the coders would code the guidance as discussion, but could not infer that the teacher would also provide direct explanation of how to read and interpret the graphic. The primary researcher noted that this clarification concretized the definition of graphical literacy skills instruction. Finally, the Specific Instructional Guidance codebook was revised to reflect those changes.

Based on the results of the interrater reliability, the final four informational texts from the training CRP were coded to ascertain the reliability of the revised codebook and to provide practice with the newly created second codebook. The coders separately coded the informational texts, "Four Seasons of Food," "Vaqueros," "Westward to Freedom," and "Lewis and Clark" from the CRP training text.

After the two coders completed their coding, the primary researcher copied and pasted the second coders data into an Excel spreadsheet along with the researcher's data. The researcher created a cross tabulation to compare agreement for (a) graphic category, (b) graphic type, (c) graphic function, (d) connection to text, (e) specific instructional guidance, and (f) explicit instruction element. Cohen's kappa was then calculated, and the results are reported in Table 22.

Table 22

Cohen's Reliability Kappa 2

Cross tabulation	Agreement
Graphic category	$\kappa = .96$
Graphic type	$\kappa = .86$
Graphic function	$\kappa = .95$
Connection to running text	$\kappa = .81$
Instructional guidance, specific	$\kappa = 1.0$
Explicit instruction element	$\kappa = .95$

The coders then met and discussed the differences. They also discussed the difficulty in determining the level of connectedness (level 1 or level 2) between the graphic and the running text. The coders revised "Connection, level 2" making it more precise (see Table 16 for an explanation of the scheme used for coding graphics). The coders also revised and strengthened the definitions of several diagrams and modified the graphic type computer enhanced graphic/image to computer enhanced/created photography/image (e.g., a photograph that has been photo-shopped).

As acceptable levels for interrater reliability were established, it was concluded that independent coding of the content analysis census could proceed. The coders agreed that the extended training and the pilot coding were beneficial. From the training CRP, the coders coded all 16 informational texts which resulted in approximately 15 hours for training and practice coding. Furthermore, the revision of several definitions for graphic type also resulted in more consistent coding between the coders. The coders agreed that the changes to the codebook and the coding form increased reliability and reduced coding discrepancies.

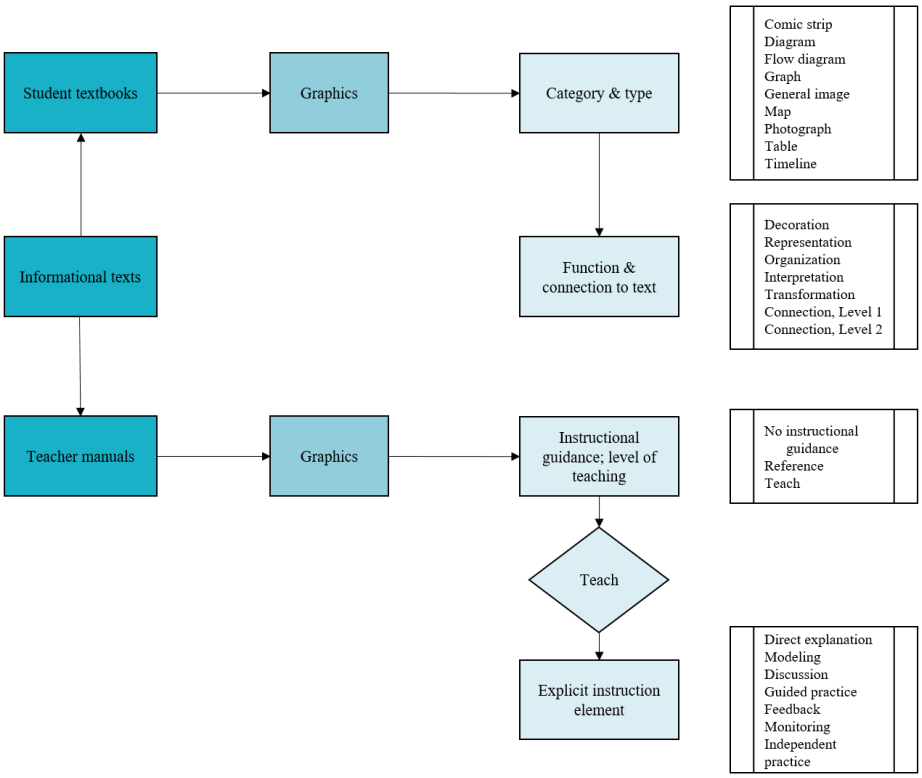
Coding

Upon completion of training and pilot reliability, Neuendorf (2017) recommends coding as the seventh step of content analysis research. The purpose of coding is to analyze the materials of the study using the procedures listed in the codebook. Figure 8 outlines the coding process for this content analysis. The researcher and second coder independently coded all the graphics in the informational text selections (N=54) in the students' textbooks for category, type, function, and connection to running text. In the corresponding teachers' manuals, the informational texts were coded for graphical

literacy skills instruction. Specific instructional guidance corresponded with a particular graphic appearing in the informational text.

Figure 8

Coding Process Outline



The coders used original copies of the publications. Neuendorf (2017) recommends that coders should "attempt to code in the *same modality* in which the messages are created and received" (p. 160, emphasis in original). Because the graphics used in the informational text selections of CRPs were analyzed, it was imperative that the coder see the colors and other subtleties of each graphic to ensure that the graphic was assessed correctly. All data, as defined in the "Specific Instructional Guidance Codebook," were entered into the electronic coding form. An overview of the electronic coding form is found in the section titled "Coding Schemes." (see Appendix C for a screenshot of the Excel coding form).

At this stage, Neuendorf (2017) recommends establishing initial interrater reliability. Reliability is sought through intercoder reliability or replicability (Krippendorf, 2019; Neuendorf, 2017). Krippendorf (2019) stated, "replicability is a measure of the degree to which a process can be reproduced by different analysts, working under varying conditions, at different locations, or using different but functionally equivalent measuring instruments" (p. 281). Replicability was assessed through accuracy, and accuracy was measured with systematic interrater reliability checks. Similarities and differences were calculated using Cohen's kappa. Neuendorf states that 10% overlap is sufficient to establish intercoder reliability. They also suggest that "agreement reliability coefficients that account for chance of ".80 or greater would be acceptable to all" (Neuendorf, 2017, p. 168). Reliability checks were conducted throughout the coding process to reduce potential coding drift, as described below.

To conduct systematic interrater reliability checks, every informational text, within each CRP, was assigned a number. The numbering was used for random selection

of informational texts. After completing the first round of coding, the primary researcher randomly selected two texts (20%) from the sample of eleven texts using the random number generator in Excel. The primary researcher determined that because the types of graphics in the informational texts in the 2020 CRP editions varied from those in the training CRP, it was prudent to test a larger sample. Cohen's kappa was calculated.

Following the first interrater reliability check, subsequent interrater reliability checks were conducted after every eleven informational texts were coded. Each time, two texts (20%) were randomly selected for comparison. A sample of 20% for all reliability checks was deemed appropriate based on the variability in the number of graphics per informational text within the first group of texts coded (i.e., range = 2 to 10).

For the final interrater reliability check, two informational texts were selected from the remaining ten texts. Systematic interrater reliability checks were conducted for: (a) graphic category, (b) graphic type, (c) graphic function, (d) connection to running text, (e) instructional guidance (e.g., teach), and (f) element of explicit instruction (e.g., modeling). The primary researcher created cross-tabulations and calculated Cohen's kappa. To mitigate coder drift, after each interrater reliability check, the coders discussed any discrepancies in coding that resulted in a Cohen's kappa of less than .80 (Neuendorf, 2017). The results of the interrater reliability checks are reported in the "Results" section.

Final Reliability

According to Neuendorf (2017), the eighth step in the process of content analysis research is the final reliability check. Subsample interrater reliability checks were calculated throughout the coding process as described in the section titled "Coding." Overall interrater reliability levels fell within acceptable standards.

Tabulation and Reporting

The final step of content analysis, as described by Neuendorf (2017), is tabulation and reporting or data analysis. The graphics in the informational text selections, in the students' textbooks, for the designated CRPs were coded for (a) graphic category and type, (b) graphic function, and (c) graphic connection to the running text. After coding the graphics, the data were entered into the electronic coding form for calculations and analyses. Descriptive statistics were computed for (a) graphic category, (b) graphic type, (c) graphic function, and (d) graphic connection to the running text.

After coding the students' textbooks, the same informational texts in the teachers' manuals were coded for graphical literacy skills instruction associated with a specific graphic. This pedagogical guidance was coded for instructional guidance and element of explicit instruction. After coding, the data were entered into the coding form for calculations and analyses. Descriptive statistics were computed for graphical literacy skills instruction.

In addition to calculating descriptive statistics for the graphics and graphical literacy skills instruction, the researcher used Chi-square analysis to test for the existence of a relationship between categories of comparisons. Comparisons were made across publishers and disciplinary areas for type and function of graphics and graphical literacy skills instruction. Reporting of the statistical analyses is documented in the "Results" section.

Summary

The purpose of quantitative content analysis is to assess written, verbal, and visual communication employing the standards of the scientific method. This chapter presented

the methodology used to examine the extent to which graphical literacy skills instruction, associated with a specific graphic, was presented as a component of literacy instruction in fifth-grade CRP teachers' manuals. To aid this analysis, the graphics used by CRP publishers in the accompanying fifth-grade CRP students' textbooks were examined for category, type, function, and connection to the main text.

This content analysis provided information about the frequency of graphics included in informational texts within CRPs, the complexity of said graphics, and what pedagogical guidance was provided to teachers to instruct students in how to read and interpret graphics. The next chapter, "Results," reports the findings from this study.

CHAPTER IV

RESULTS

The purpose of this content analysis was to identify the types and functions of graphics in the informational text selections of fifth-grade CRP student textbooks and to evaluate the affordances to promote graphical literacy skills as a component of literacy instruction in the corresponding CRP teachers' manuals. This study used the census (N = 54) of informational texts from the three most widely used CRPs in the United States. This chapter will present the results from the content analysis in relation to the following research questions:

1. What types of graphics are present in the informational texts included in CRP student textbooks?
2. What are the functions of the graphics in these informational texts?
3. To what extent are graphical literacy skills presented as a component of literacy instruction in the CRP teachers' manuals related to these graphics?

This chapter is organized into five sections: (a) "Informational Texts," (b) "Graphic Category and Type," (c) "Graphic Function," (d) "Graphical Literacy Skills Instruction," and (e) "Interrater Reliability." Each section will address the relevant components.

Informational Texts

This section relates the general findings about informational texts and disciplinary areas. Informational texts within each CRP were independently identified by each coder using the concept of informational text as defined for this study. The primary researcher

and second coder agreed on the final census, which consisted of 54 informational texts comprising a total of 417 pages. The mean number of pages per text was 7.72.

Programs A and B included 21 texts, and program C included 12 texts. The number of informational texts, total number of pages comprising the informational texts, the range of number of pages, and the mean number of pages are reported by program in Table 23.

Table 23

Census Count of Texts and Pages

				Number of pages per text	
CRP	Number of texts	Number of pages	Range of number of pages	Mean	*SD*
A	21	166	2 to 19	7.90	6.00
B	21	100	2 to 16	4.76	3.82
C	12	151	3 to 21	12.58	5.84
Total	54	417	2 to 21	7.72	5.92

The informational texts in each CRP were coded for disciplinary area. Although four possible a priori codes, as stated in the Methods section, were identified in relation to the definition of an informational text, only three disciplinary areas were represented in the census. No informational texts were coded as math. Across the census, texts about the arts constituted 5.56% of the total, science themed texts represented 53.70%, and social studies themed texts accounted for 40.74%. Table 24 reports findings in relation to the disciplinary area; number of texts; percentage of informational texts by CRP; and mean number of pages.

Table 24

Core Reading Program Data by Disciplinary Area

CRP and Disciplinary area	per CRP			per Disciplinary area	
	Number of texts	Percent of informational texts	Number of pages	Range of number of pages	Mean number of pages
A					
Arts	3	14.29	17	2 to 13	5.67
Science	8	38.10	70	2 to 17	8.75
Social Studies	10	47.62	79	2 to 19	7.90
B					
Arts	0	0.0	0	--	--
Science	12	57.14	54	2 to 16	4.5
Social Studies	9	42.86	46	2 to 16	5.11
C					
Arts	0	0.0	0	--	--
Science	9	75.00	129	7 to 21	14.33
Social Studies	3	25.00	22	3 to 15	7.33
Total					
Arts	3	5.56	17	2 to 13	5.67
Science	29	53.70	253	2 to 17	8.72
Social Studies	22	40.74	43	2 to 19	1.95

Note. "--" denotes that there is no range or mean to report.

Graphic Category and Type

Graphics were defined as any photograph, image, or illustration including, but not limited to, diagrams, maps, graphs, timelines, and tables (Norman & Roberts, 2015). Graphics in the informational text census that met this definition were analyzed for graphic category and type using the Specific Instructional Guidance codebook as described in the Methods section. The findings from these analyses are presented holistically and then by CRP.

This study resulted in the evaluation of 494 graphics from 54 informational texts. Within the census, the mean number of graphics per text was 9.15 and the mean number of graphics per page was 1.18. Table 25 describes the number of graphics per CRP and the mean number of graphics per page for each informational text by CRP. On average, Program B utilized the least number of graphics. Program C used the greatest number of graphics (n=161) but had fewer pages of text.

Table 25

CRP Count of Graphics and Mean

				Number of graphics per page	
CRP	Number of graphics	Mean number of graphics per text	Range of graphics	Mean	SD
A	220	10.48	1 to 32	1.33	0.85
B	113	5.38	2 to 14	1.13	0.60
C	161	13.42	2 to 31	1.07	0.37
Total	494	9.15	1 to 32	1.18	0.72

Census

The graphics within each informational text were first coded for graphic category. Following that analysis, the graphics were coded for graphic type. Information about graphic category and type were presented in the Literature Review. The following sections report the results of the analysis, first by graphic category and then by graphic type for the census.

Graphic Category

Graphic category is a broad descriptor used to delineate graphics that was examined in the Literature Review. The graphics included in the census featured several categories. As detailed in Table 26, photographs (59.51%) were most often used in the texts. General images (27.33%), a graphic which may contain symbolic information that requires interpretation by the reader and may necessitate the use of background knowledge; does not have lines with labels or words as is common in diagrams (Guo et al., 2018), was the graphic category used second most often by publishers; photographs were twice as prevalent as general images. Tables and timelines each accounted for less than one percent of the graphics and comic strips were not used by any of the publishers.

Table 26

Census Graphic Categories

Graphic category	Total count of graphics	Percent of graphics
Photograph	294	59.51
General image	135	27.33
Diagram	27	5.47
Map	16	3.24
Flow diagram	8	1.62
Graph	7	1.42
Table	4	0.81
Timeline	3	0.61
Comic strip	--	--
Total	494	100

Note. "--" denotes that there is no data to report.

The different graphic categories were not equally represented across informational texts. Table 27 reports the number of informational texts that featured a graphic from a specific category. The range of specific category varied across the informational texts. In a text that featured a specific category, that category may have appeared only once or 29 times.

Table 27

Graphic Categories per 54 Informational Texts

Graphic category	Count of informational texts	Percent of informational texts	Range	Median
Photograph	45	83.33	1 to 27	5
General image	31	57.41	1 to 29	2
Map	14	25.93	1 to 2	1
Diagram	10	18.52	1 to 6	2
Flow diagram	5	9.26	1 to 3	1
Graph	3	5.56	2 to 3	2
Table	4	7.41	--	1
Timeline	3	5.56	--	1
Comic strip	--	--	--	--

Note. "--" denotes that there is no data to report.

Graphic category also varied by disciplinary area. Table 28 outlines the identified graphic categories by disciplinary area and reports both the total number of graphics per category and the percent of graphics per category. Informational texts about the arts featured the least number of graphics but included a larger percentage of photographs (77.79%) than did texts for science or social studies (53.82% and 65.24%, respectively).

Table 28

Census Disciplinary Area and Graphic Category

	Art		Science		Social Studies		Grand total	
Graphic category	Total number of graphics	Percent of graphics	Total number of graphics	Percent of graphics	Total number of graphics	Percent of graphics	Total number of graphics	Percent of graphics
Photograph	14	77.78	170	57.82	110	60.44	294	59.51
General image	3	16.67	74	25.17	58	31.87	135	27.33
Diagram	--	--	25	8.50	2	1.10	27	5.47
Map	1	5.56	9	3.06	6	3.30	16	3.24
Flow diagram	--	--	8	2.72	--	--	8	1.62
Graph	--	--	5	1.70	2	1.10	7	1.42
Table	--	--	3	1.02	1	0.55	4	0.81
Timeline	--	--	--	--	3	1.65	3	0.61
Comic strip	--	--	--	--	--	--	--	--
Grand total	18	100	294	100	182	100	494	100

Note. "--" denotes that there is no data to report.

Graphic Type

Graphic type was the term used to break the nine graphic categories into numerous sub-categories. For this analysis, 48 graphic types were defined based on previous research (Fingeret, 2012; Guo et al., 2018). A detailed list of the graphic types and their definitions are found in Appendix A. The type "other" was added to capture any graphics that did not align with a priori types. As coding commenced for this analysis, a forty-eighth type, collage, was identified. The graphic type collage was defined as an image that was created using pieces of paper, fabric, or other materials and glued onto a supporting surface (Tate, 2022), and it was embedded in the graphic category general image because a collage "does not have lines with labels or diagrams" and reading one "may require interpretation by the reader" (Guo et al. 2018).

Several different types of graphics were found across the census of informational texts. Of the 48 types included in the coding book for this study, 27 (56.25%) were used by the CRP publishers. The 27 graphic types, their frequencies, and percentages are shown in Table 29. As indicated previously in "Graphic Category," publishers used photographs most often. However, of the two types of photographs, simple and complex, simple photographs accounted for 97.62% of the photographs CRP publishers used. Cluster photographs were rarely used (2.38%). The next most common type of graphic used by CRP publishers was realistic illustration, which accounted for about 11% of the total number of graphics.

Of the 27 types, 26% appeared only once in an informational text. The following six types of graphics (22.22%) were used by all three publishers: (a) simple photograph,

(b) realistic illustration, (c) computer enhanced/created photography/image, (d) simple diagram, (e) context map, and (f) cutaway diagram.

Table 29

Census Graphic Types within Graphic Categories

Graphic Type	Total number of graphics	Percent of total graphics	Percent withing graphic category
Photograph			
Simple photograph	287	58.10	97.62
Cluster photograph	7	1.42	2.38
General image			
Cartoon illustration	14	2.83	10.37
Collage	18	3.64	13.33
Computer enhanced/created photography/image	22	4.45	15.56
Fine art	14	2.83	10.37
Magnified image	3	.61	2.22
Photographs of illustrations	7	1.42	5.19
Realistic illustration	57	11.54	42.96
Diagram			
Bird's eye view diagram	5	1.01	18.52
Cross-section	1	.20	3.70
Cutaway diagram	6	1.21	22.22
Picture scale diagram	1	.20	3.70
Scale diagram	1	.20	3.70
Simple diagram	13	2.63	48.15
Map			
Context map	13	2.63	81.25
Flow map	1	.20	6.25
Grid map	1	.20	6.25
Region map	1	.20	6.25
Flow diagram			
Cyclical sequence	6	1.21	75
Linear sequence	2	.40	25
Graph			
Bar graph	3	.61	42.86
Line graph	2	.40	28.57
Pie chart	2	.40	28.57
Table			
Column table	1	.20	25
Row and column table	3	.61	75
Timeline			
Single timeline	3	.61	100
Total	494	100	100

The use of graphic type varied among informational texts. Table 30 reports the types of graphics found and the number of texts that featured those specific graphic types. Of the 54 informational texts, 83.33% used a simple photograph. Realistic illustration was the second most often used graphic type appearing in 29.63% of the informational texts.

Table 30

Total Graphic Types Across Informational Texts

Graphic type	Count of informational texts	Percent of informational texts	Range	Median
Simple photograph	45	83.33	1 to 27	5
Realistic illustration	16	29.63	1 to 29	1
Context map	12	22.22	1 to 2	1
Computer enhanced/created photography/image	11	20.37	1 to 6	1
Simple diagram	8	14.81	1 to 3	1
Cutaway diagram	4	7.41	1 to 3	1
Fine art	4	7.41	1 to 9	2
Cluster photograph	3	5.56	1 to 5	1
Cyclical sequences	3	5.56	1 to 3	2
Photographs of illustrations	3	5.56	1 to 5	1
Row and column table	3	5.56	--	1
Single timeline	3	5.56	--	1
Bar graph	2	3.70	1 to 2	1.5
Bird’s eye view diagram	2	3.70	1 to 4	2.5
Cartoon illustration	2	3.70	2 to 12	7
Linear sequence	2	3.70	--	1
Magnified image	2	3.70	1 to 2	1.5
Pie chart	2	3.70	--	1
Grid map	1	1.85	--	--
Collage	1	1.85	--	--
Column table	1	1.85	--	--
Cross-section	1	1.85	--	--
Flow map	1	1.85	--	--
Line graph	1	1.85	--	--
Picture scale diagram	1	1.85	--	--
Region map	1	1.85	--	--
Scale diagram	1	1.85	--	--

Note. “--” denotes that there is no range or median to report.

There was variability between disciplinary area and graphic type (See Table 31 for a report of the types of graphics used in texts about disciplinary area topics). Several types of graphics were utilized to convey information in texts about the arts, science, and social studies. Simple photographs were the predominant graphic type, but realistic illustrations, computer enhanced/created photography/images, and context maps were also found across the three types of disciplinary areas. The graphic type, collage, was identified in a social studies themed text. Realistic illustrations were used more in texts about science than those about the arts or social studies.

Table 31

Graphic Type and Disciplinary Area

Graphic type	Count of type by disciplinary area			Total
	Arts	Science	Social Studies	
Simple photograph	14	163	110	287
Realistic illustration	1	49	7	57
Computer enhanced/created photography/image	2	20	--	22
Collage	--	--	18	18
Cartoon illustration	--	2	12	14
Fine art	--	--	14	14
Context map	1	8	4	13
Simple diagram	--	11	2	13
Cluster photograph	--	7	--	7
Photographs of illustrations	--	--	7	7
Cutaway diagram	--	6	--	6
Cyclical sequences	--	6	--	6
Bird's eye view diagram	--	5	--	5
Bar graph	--	2	1	3
Magnified image	--	3	--	3
Row and column table	--	3	--	3
Single timeline	--	--	3	3
Line graph	--	2	--	2
Linear sequence	--	2	--	2
Pie chart	--	1	1	2
Column table	--	--	1	1
Cross-section	--	1	--	1
Flow map	--	1	--	1
Grid map	--	--	1	1
Picture scale diagram	--	1	--	1
Region map	--	--	1	1
Scale diagram	--	1	--	1

Note. "--" denotes that there is no data to report.

Program A

There were 21 informational texts in Program A, comprising 166 pages and containing 220 graphics that were analyzed for this study. The mean number of pages per text was 7.90 and the mean number of graphics per text was 10.48. The mean number of graphics per page was 1.33. Program A featured informational texts representing three of the disciplinary areas: (a) art (n=3), (b) science (n=8), and (c) social studies (n=10).

Graphic Category and Type

The graphics utilized in Program A represented several categories. As detailed in Table 32, photographs (63.18%) and general images (27.73%) were the dominant graphic categories. The ratio of photographs to general images was 2 to 1. Neither comic strips nor graphs were present in any of the texts.

Of the identified 27 graphic types, Program A featured 15. Table 33 lists graphic category and type in relation to disciplinary area. Graphic categories comic strip and graph were omitted from the table because no graphics were coded as such. Simple photographs accounted for more than 60% of the total number of graphics. Collage, the graphic type added during coding, was the second most common type (8.18%). Of the 15 types represented, six appeared once across the 21 informational texts. Program A also used four graphic types that were not used by the other programs: (a) collage, (b) flow map, (c) region map, and (d) grid map.

Table 32

Program A Graphic Category and Type by Disciplinary Area

	Art		Science		Social studies		Total	
Graphic category	Count	Percent (n = 18)	Count	Percent (n = 88)	Count	Percent (n = 115)	Count	Percent (n = 220)
Diagram	--	--	8	9.20	--	--	8	3.64
Cutaway diagram	--	--	3	3.45	--	--	3	1.36
Simple diagram	--	--	5	5.75	--	--	5	2.27
Flow diagram	--	--	1	1.15	--	--	1	.45
Linear sequence	--	--	1	1.15	--	--	1	.45
General image	3	16.67	19	21.84	39	33.91	61	27.73
Cartoon illustration	--	--	2	2.30	12	10.43	14	6.36
Collage	--	--	--	--	18	15.65	18	8.18
Computer enhanced/created photography/image	2	11.11	13	14.94	--	--	15	6.82
Photographs of illustrations	--	--	--	--	5	4.35	5	2.27
Realistic illustration	1	5.56	4	4.60	4	3.48	9	4.09
Map	1	5.56	4	4.60	4	3.48	9	4.09
Context map	1	5.56	4	4.60	4	3.48	6	2.73
Flow map	--	--	--	--	--	--	1	.45
Grid map	--	--	--	--	--	--	1	.45
Region map	--	--	--	--	--	--	1	.45
Photograph	14	77.78	54	62.07	71	61.74	139	63.18
Simple photograph	14	77.78	54	62.07	71	61.74	139	63.18
Table	--	--	1	1.14	--	--	1	.45
Row and column table	--	--	1	1.14	--	--	1	.45
Timeline	--	--	--	--	1	0.87	1	.45
Single timeline	--	--	--	--	1	0.87	1	.45

Note. "--" denotes that there is no data to report.

Program B

There were 21 informational texts analyzed in Program B that comprised 100 pages and included 113 graphics. The mean number of pages per text was 4.76 and the mean number of graphics per text was 5.38. The mean number of graphics per page was 1.13. For program B, two of the three coded disciplinary areas were identified, science (n=12) and social studies (n=9). Program B featured no informational texts about the arts.

Graphic Category and Type

Graphics utilized by Program B represented seven of the nine a priori categories described in the Methods section. Table 33 lists the number of graphics coded for category and type by disciplinary area. Photographs (61.06%) were the primary category used by the publisher. Program B did not contain any graphics categorized as flow map or comic strip.

Program B featured 14 of the 27 identified types (See Table 34 for an account of types). Simple photographs (61.06%) overshadowed the other graphic types and was the only type of photograph included. Fine art, however, was utilized by the publisher as the second most common type of graphic. Program B incorporated several graphic types more than once across the 21 informational texts. Two graphic types, bird's eye view diagram and scale diagram, appeared only once. Program B used three graphic types that were not found in Program A or Program C: (a) bar graph, (b) pie chart, and (c) scale diagram. Program B also utilized different categories of graphics depending on whether the text conveyed information about a science or social studies topic. Science texts featured more photographs than social studies texts, but social studies texts utilized more general images.

Table 33

Program B Graphic Category and Type by Disciplinary Area

	Science		Social studies		Total	
Graphic category	Count	Percent (n = 62)	Count	Percent (n = 51)	Count	Percent (n = 113)
Diagram	5	8.06	2	3.92	7	6.19
Bird's eye view diagram	1	1.61	--	--	1	.88
Cutaway diagram	2	3.23	--	--	2	1.77
Scale diagram	1	1.61	--	--	1	.88
Simple diagram	1	1.61	2	3.92	3	2.65
General image	11	17.74	15	29.41	26	23.01
Computer enhanced/created photography/image	4	6.45	--	--	4	3.54
Fine art	--	--	12	23.53	12	10.62
Photographs of illustrations	--	--	2	3.92	2	1.77
Realistic illustration	7	11.29	1	1.96	8	7.08
Graph	3	4.84	2	3.92	5	4.42
Bar graph	2	3.23	1	1.96	3	2.65
Pie chart	1	1.61	1	1.96	2	1.77
Map	1	1.61	1	1.96	2	1.77
Context map	1	1.61	1	1.96	2	1.77
Photograph	40	64.52	29	56.86	69	61.06
Simple photograph	40	64.52	29	56.86	69	61.06
Table	2	3.23	--	--	2	1.77
Row and column table	2	3.23	--	--	2	1.77
Timeline	--	--	2	3.92	2	1.77
Single timeline	--	--	2	3.92	2	1.77

Note. "--" denotes that there is no data to report.

Program C

Twelve texts were coded as informational in Program C. These 12 texts consisted of 151 pages and 161 graphics. The mean number of pages per text was 12.58, and the mean number of graphics per text was 13.42. The mean number of graphics per page was 1.07. The informational texts in Program C addressed two of the three identified disciplinary areas, science (n = 9) and social studies (n = 3).

Graphic Category and Type

Program C used seven of the nine graphic categories; the categories comic strip and timeline were not coded for in the program and are not included in the results. Table 34 reports the count of graphics by category and type across disciplinary area. Program C included 16 of the 27 graphic types. Simple photographs (49.07%) accounted for most of the graphics. Five graphic types appeared only once across the 12 informational texts. Program C featured six graphic types that were not used by Programs A or B: (a) cluster photograph, (b) cyclical sequence, (c) line graph, (d) column table, (e) cross-section, and (f) picture scale diagram.

Program C included informational texts that were coded for either science or social studies. Only three categories—photograph, general image, and map—were used in texts for both disciplinary areas. Tables were not found in any of the nine science themed texts, but one was used in a social studies text.

Table 34

Program C Graphic Category and Type by Disciplinary Area

	Science		Social studies		Total	
Graphic category	Count	Percent (n = 145)	Count	Percent (n = 16)	Count	Percent (n = 161)
Diagram	12	8.28	--	--	12	7.45
Bird's eye view diagram	4	2.76	--	--	4	2.48
Cross-section	1	.69	--	--	1	.62
Cutaway diagram	1	.69	--	--	1	.62
Picture scale diagram	1	.69	--	--	1	.62
Simple diagram	5	3.45	--	--	5	3.11
Flow diagram	7	4.83	--	--	7	4.35
Cyclical sequence	6	4.14	--	--	6	3.73
Linear sequence	1	.69	--	--	1	.62
General image	44	30.34	4	25	48	29.81
Computer enhanced/created photography/image	3	2.07	--	--	3	1.86
Fine art	--	--	2	12.50	2	1.24
Magnified image	3	2.07	--	--	3	1.86
Realistic illustration	38	26.21	--	--	40	24.84
Graph	2	1.38	--	--	2	1.24
Line graph	2	1.38	--	--	2	1.24
Map	4	2.76	1	6.25	5	3.11
Context map	4	2.76	1	6.25	5	3.11
Photograph	76	52.41	10	62.50	86	53.42
Cluster photograph	7	4.83	--	--	7	4.35
Simple photograph	69	47.59	10	62.50	79	49.07
Table	--	--	1	6.25	1	.62
Column table	--	--	1	6.25	1	.62

Note. "--" denotes that there is no data to report.

Comparisons

A Chi-square test was computed to determine whether graphic category and program publisher were independent. The parameters for conducting a Chi-square test state that "a chi-square test should not be performed when the expected frequency of any cell is less than five" (Gravetter & Wallnau, 2014, p. 534). To address this restriction, six of the eight reported graphic categories were combined into one category. The categories combined were: (a) diagram, (b) flow diagram, (c) graph, (d) map, (e) table, and (f) timeline. As the sample size for each of these categories was limited, the expected values were minimal. The resulting three categories used to calculate the Chi-square test were: (a) combined, (b) general image, and (c) photograph. Table 35 lists graphic categories and frequencies by program. The results from the Chi-square test showed that there is no evidence that graphic category and publisher are dependent. $\chi^2(4, N = 494) = 7.72$, $\rho > .05$.

Table 35

Graphic Categories and Frequencies by Publisher for Chi-square

	Publisher			
Category	Program A	Program B	Program C	Total
Combined	20 (9.09%)	18 (15.93%)	27 (16.77%)	65 (13.16%)
General image	61 (27.73%)	26 (23.01%)	48 (29.81%)	135 (27.33%)
Photograph	139 (63.18%)	69 (61.06%)	86 (53.42%)	294 (59.51%)
Total	220 (100%)	113 (100%)	161 (100%)	494 (100%)

A second Chi-square test was computed to determine if there was a relationship between graphic category and the disciplinary areas. As the assumptions for conducting a Chi-square test could not be met for disciplinary area art, it was combined with social studies (Gravetter & Wallnau, 2014, p. 534). Those two disciplinary areas were combined because a major theme in social studies standards is culture, and societies around the world express their culture through the arts (Burstein & Knotts, 2010).

Additionally, to conduct a Chi-square test, six of the eight graphic categories were combined because their expected frequency counts were less than five. The six graphic categories combined were: (a) diagram, (b) flow diagram, (c) graph, (d) map, (f) table, and (g) timeline. Table 36 reports the frequencies and percentages by category for disciplinary area. The results from the Chi-square test showed that there is evidence that graphic category and disciplinary area are dependent. $\chi^2(2, N = 494) = 9.76$, $\rho < .05$ with a small effect size (Cramer's V = .14; Cohen, 1988).

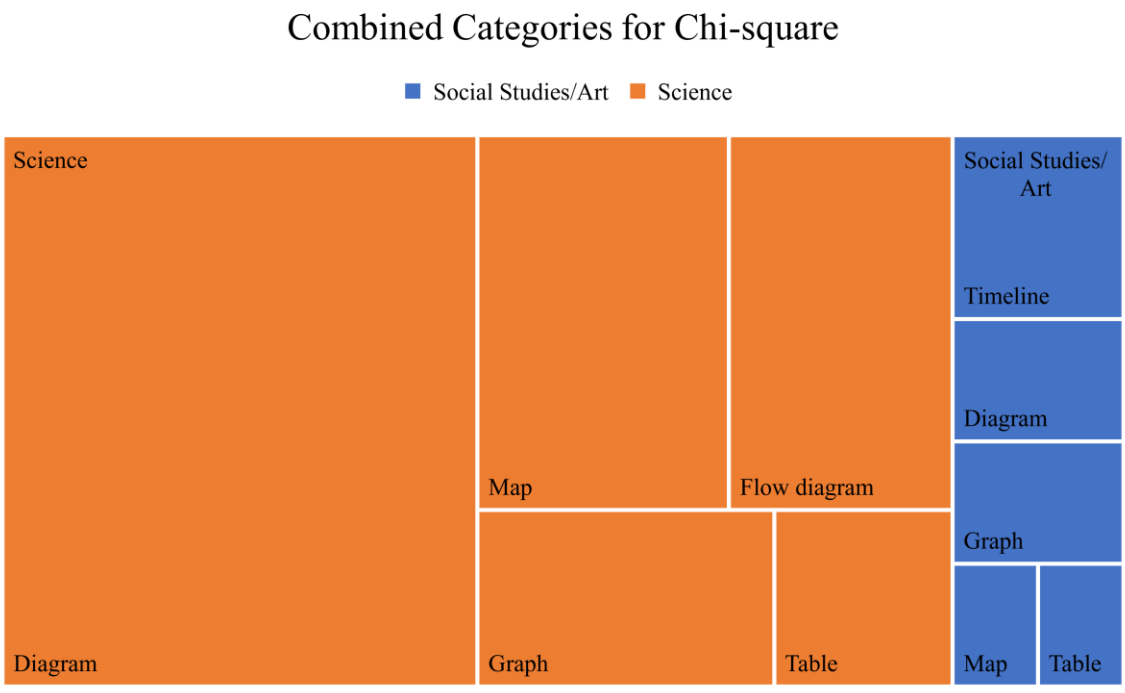
A review of Table 37 shows significance in the differences in categories combined, general image, and photography between science and social studies/art. Science texts contained 17.01% combined categories (i.e., the categories were combined as the expected counts were less than five and violated the assumptions for a Chi-square analysis) versus social studies/art texts which contained only 7.50% combined categories. Figure 9, the hierarchy chart, illustrates the differences.

Table 36

Graphic Categories and Frequencies by Disciplinary Area for Chi-square

Category	Disciplinary area		Total
	Science	Social Studies & Art	
Combined	50 (17.01%)	15 (7.50%)	65 (13.17%)
General image	74 (25.17%)	61 (30.50%)	135 (27.33%)
Photograph	170 (57.82%)	124 (62%)	294 (59.51%)
Total	294 (100%)	200 (100%)	494 (100%)

Figure 9



Graphic Function

The second research question investigated the functions of graphics in the informational texts from the fifth-grade CRPs. The graphics in the informational text selections were analyzed for the following:

- function—the purpose for which graphics are included in the informational texts
- connection to text—the relationship between the written (running text) and the graphics.

An overview of the functions and connection to text were discussed in the literature review.

The five functions coded for were (a) decoration, (b) representation, (c) organization, (d) interpretation, and (e) transformation. Connection to text was coded as level 1 or level 2, depending upon the relationship between the graphic and the written text. Results are reported by census and then program, concluding with comparisons between publishers and disciplinary areas.

Census

This content analysis examined 494 graphics across 54 informational texts. The coders determined the function of each graphic and its connection to the written text based on the criteria set forth in the Specific Instructional Guidance codebook. An overall picture of graphic function and connection to text is reported in subsequent sections.

Graphic Function

Five graphic functions were recognized and used to code graphics. However, throughout the coding process, only three functions were identified across the census: (a) decoration, (b) representation, and (c) organization. Two functions, interpretation (i.e., graphics that clarify difficult to understand text and abstract concepts) and transformation (i.e., graphics that utilize mnemonics to make the text more memorable) were not found in the census.

Table 37 lists the functions and the number of graphics that were coded for each function. The function representation, a graphic that illustrates all or part of the written text, described most of the graphics (89.47%). In addition, although several graphics were excluded from the analysis (See Methods section for detailed information about exclusions and Literature Review for rational for those exclusions) because they served no instructional purpose, more than five percent of the graphics across the census were coded as decoration.

Graphic function was also assessed by informational text. Every informational text within the census featured at least one graphic identified as representation. Eleven texts (20.37%) had graphics characterized as decoration.

Table 37

Census Graphic Function

Function	Count of graphics (percent of graphics)	Count of informational texts with each function (percent of texts)
Decoration	27 (5.47)	11 (20.37)
Organization	25 (5.06)	15 (27.78)
Representation	442 (89.47)	54 (100)
Total	494 (100)	54 (100)

Disciplinary Area. The function of graphics by disciplinary area is reported in Table 38. Across the three disciplinary areas, graphics were predominantly coded as representation. Within science and social studies texts, there were a meaningful number of graphics coded as decoration even though there were several exclusions. Additionally, science texts utilized more graphics coded as organization than social studies texts.

Table 38

Census Graphic Function by Disciplinary Area

	Arts		Science		Social Studies		Total	
Graphic function	Total number of graphics	Percent of graphics	Total number of graphics	Percent of graphics	Total number of graphics	Percent of graphics	Number of graphics	Percent of graphics
Decoration	--	--	17	5.78	10	5.49	27	5.47
Organization	--	--	20	6.80	5	2.75	25	5.06
Representation	18	100	257	87.41	167	91.76	442	89.47
Total	18	100	294	100	182	100	494	100

Note. "--" denotes that there is no data to report.

Graphic Category and Type. Graphic function was also assessed by graphic category and type. Table 39 reports these findings (Comic strip is excluded from the table as no CRP used a comic strip.) The graphics identified as photograph and general image were the only categories with graphics coded as decoration. Graphics that organized the text were most often classified as diagram or flow diagram. Flow diagrams represented 32% of the graphics coded as organization. Graphics coded as representation were usually photographs (n = 277). They accounted for more than 60% of the graphics of this category.

Graphic category was divided into more precise classifications, graphic types. Twenty-seven graphic types were coded for in this content analysis. Table 39 also lists the count of graphics by type. Graphics categorized as representation were predominantly simple photographs (n = 270); simple photographs accounted for more than 60% of the graphics coded as representation.

Table 39

Census Graphic Function, Category, and Type

	Decoration		Organization		Representation		Total	
Graphic type within graphic category	Count of graphics	Percent of graphics	Count of graphics	Percent of graphics	Count of graphics	Percent of graphics	Count of graphics	Percent of grand total (n = 494)
Photograph	14	51.85	3	12	277	62.67	294	59.51
Cluster photograph	--	--	--	--	7	1.58	7	1.42
Simple photograph	14	51.85	3	12	270	61.09	287	58.10
General image	13	48.15	--	--	122	27.60	135	27.33
Cartoon illustration	3	11.11	--	--	11	2.49	148	2.83
Collage	--	--	--	--	18	4.07	18	3.64
Computer enhanced/created photography/image	10	37.04	--	--	12	2.71	22	4.45
Fine art	--	--	--	--	14	3.17	14	2.83
Magnified image	--	--	--	--	3	.68	3	.61
Photographs of illustrations	--	--	--	--	7	1.58	7	1.42
Realistic illustration	--	--	--	--	57	12.90	57	11.54
Diagram	--	--	7	28	20	4.5	27	5.46
Bird's eye view diagram	--	--	1	4	4	.90	5	1.01
Cross-section	--	--	--	--	1	.23	1	.20
Cutaway diagram	--	--	2	8	4	.90	6	1.21
Picture scale diagram	--	--	--	--	1	.23	1	.20
Scale diagram	--	--	1	8	--	--	1	.20
Simple diagram	--	--	3	12	10	2.26	13	2.63
Map	--	--	4	16	12	2.71	16	3.24
Context map	--	--	4	16	9	2.04	13	2.63
Flow map	--	--	--	--	1	.23	1	.20
Grid map	--	--	--	--	1	.23	1	.20
Region map	--	--	--	--	1	.23	1	.20
Flow diagram	--	--	8	32	--	--	8	1.62
Cyclical sequence	--	--	6	24	--	--	6	1.21
Linear sequence	--	--	2	8	--	--	2	.40
Graph	--	--	--	--	7	1.58	7	1.42
Bar graph	--	--	--	--	3	.68	3	.61
Line graph	--	--	--	--	2	.45	2	.40
Pie chart	--	--	--	--	2	.45	2	.40
Table	--	--	--	--	4	.90	4	.81
Column table	--	--	--	--	1	.23	1	.20
Row and column table	--	--	--	--	3	.68	3	.61
Timeline	--	--	3	12	--	--	3	.60
Single timeline	--	--	3	12	--	--	3	.61
Total	27	100	25	100	442	100	494	100

Note. "--" denotes that there is no data to report.

Connection to Text

In addition to coding the graphics as one of five functions, the coders coded every graphic for connection level, its association to the running text (Connection to text was described in the Literature Review.) Graphics coded as connection level 1 were easily interpretable and/or may have included a caption that related to the running text. Connection level 2 graphics required more inferencing or prior knowledge to interpret because they were not easily associated with the running text.

Table 40 reports connection to text by graphic and across informational texts. Most graphics were coded as connection to text-level 1 (61.74%). Numerous texts (92.59%) comprising the census included a graphic with a level 1 connection. Texts that contained level 2 graphics was slightly less common (83.33%). Table 41 shows connection to text by CRP. Publisher B had a greater percentage of graphics coded as connection to text-level 1 (72.57%) had fewer graphics as connection to text-level 2 (27.42%).

Table 40

Census Connection to Text

Level	Count of graphics (percent)	Count of informational texts with connection (percent of texts)
Level 1	306 (61.94)	50 (92.59)
Level 2	188 (38.06)	45 (83.33)
Total	494 (100)	54 (100)

Table 41

CRP Connection to Text

Level	CRP A count (percent)	CRP B count (percent)	CRP C count (percent)	Total count (percent)
Level 1	124 (56.36)	82 (72.57)	100 (62.11)	306 (61.94)
Level 2	96 (43.64)	31 (27.43)	61 (37.89)	188 (38.06)
Total	220 (100)	113 (100)	161 (100)	494 (100)

Disciplinary Area. Data was collected for disciplinary area and connection to text and the results are shown in Table 42. Science texts featured more graphics that were coded as level 1 and level 2 when compared with social studies texts. There were only three texts about the arts. Within these three texts there were a total of 18 graphics. These graphics were coded as level 1 (n = 9) and level 2 (n = 9). All three art texts included graphics coded as level 2 and only one text had graphics coded as level 1.

Table 42

Census Connection to Text and Disciplinary Area

	Level 1		Level 2		Total	
Disciplinary area	Count of graphics	Percent of total	Count of graphics	Percent of total	Count of graphics	Percent of grand total (n = 494)
Arts	9	2.94	9	4.79	18	3.64
Science	172	56.21	122	64.89	294	59.51
Social studies	125	40.85	57	30.32	182	36.84
Grand total	306	100	188	100	494	100

Graphic Category and Type. Connection to text varied by graphic category. Table 43 reports findings by category and type. Most of the graphics across the census were coded as photographs. Therefore, photographs were the primary category coded for level 1 (n = 183) and level 2 (n = 97).

Table 43

Census Connection to Text and Graphic Category

	Level 1		Level 2		Total	
Graphic type within graphic category	Count of graphics	Percent of graphics	Count of graphics	Percent of graphics	Count of graphics	Percent of grand total (n = 494)
Photograph	183	59.8	111	29.04	294	59.51
Cluster photograph	5	1.63	2	1.06	7	1.42
Simple photograph	178	58.17	109	57.98	287	58.10
General image	92	30.07	43	22.87	135	27.33
Cartoon illustration	8	2.61	6	3.19	14	2.83
Collage	17	5.56	1	.53	18	3.64
Computer enhanced/created photography/image	6	1.96	15	7.98	22	4.45
Fine art	9	2.94	5	2.66	14	2.83
Magnified image	1	.33	2	1.06	3	.61
Photographs of illustrations	7	2.29	--	--	7	1.42
Realistic illustration	44	14.38	14	7.45	57	11.54
Diagram	15	4.90	12	6.38	27	5.47
Bird's eye view diagram	4	1.31	1	.53	5	1.01
Cross-section	1	.33	--	--	1	.20
Cutaway diagram	2	.66	4	2.13	6	1.21
Picture scale diagram	--	--	1	.53	1	.20
Scale diagram	--	--	1	.53	1	.20
Simple diagram	8	2.61	5	2.66	13	2.63
Map	4	1.31	12	6.38	16	3.24
Context map	4	1.31	9	4.79	13	2.63
Flow map	--	--	1	.53	1	.20
Grid map	--	--	1	.53	1	.20
Region map	--	--	1	.53	1	.20
Flow diagram	4	1.31	4	2.13	8	1.62
Cyclical sequence	4	1.31	2	1.06	6	1.21
Linear sequence	--		2	1.06	2	.40
Graph	3	.98	4	2.13	4	.81
Bar graph	2	.65	1	.53	3	.61
Line graph	1	.33	1	.53	2	.40
Pie chart	--	--	2	1.06	2	.40
Table	3	.98	1	.53	4	.81
Column table	1	.33	--	--	1	.20
Row and column table	2	.65	1	.53	3	.61
Timeline	2	.65	1	.53	3	.61
Single timeline	2	.65	1	.53	3	.61
Total	306	100	188	100	494	100

Note. "--" denotes that there is no data to report.

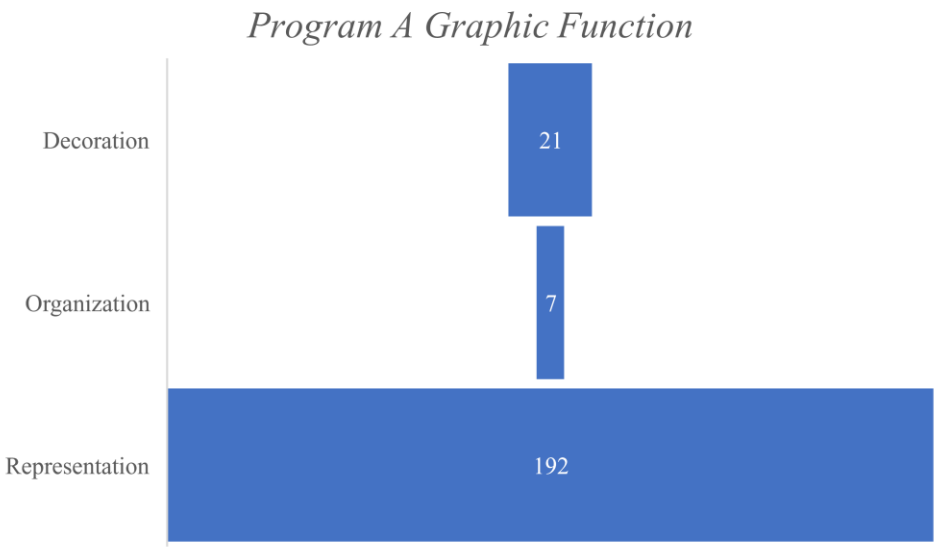
Program A

In Program A, the graphics in 21 informational texts were assessed. Two-hundred twenty graphics from those texts were analyzed for function and connection to text. The results of this analysis are reported in subsequent sections.

Graphic Function

Graphic function is defined as the purpose for the inclusion of a graphic within a text. As discussed in the Literature Review, a priori codes were established for five functions. However, throughout the coding of Program A, only three functions were identified: (a) decoration, (b) organization, and (c) representation. Based on this information, results will be reported for only those three functions. Figure 10 displays the count of graphics in relation to function.

Figure 10



Graphics coded as representation far outnumbered graphics coded as decoration or organization. However, 9.55% of graphics included in Program A were coded as decoration. Given that several graphical elements were excluded (e.g., colored backgrounds, decorative bullet points, and decorative fonts) because they served no instructional purpose, it is notable that both science (a count of 13 graphics) and social studies (a count of eight graphics) texts used graphics coded as decoration. In addition, three times as many graphics were coded as decoration than organization. Within Program A, no arts texts included a decoration graphic.

Graphic Category and Type. Program A utilized seven of the nine graphic categories and 15 of the 27 graphic types. Table 44 reports findings for graphic category and type in relation to graphic function. Across the seven categories, three of the five functions were coded. Photographs accounted for more than 67% of the graphics that were coded as representation. No photographs were coded as organization. Graphics coded as organization were categorized as diagrams, flow diagrams, maps, and timelines.

The 15 types yielded a more precise description of the graphics coded as decoration, organization, or representation. Graphics coded as simple photographs or computer enhanced/created photography and/or images represented more than 40% of the graphics coded as decoration. Graphics coded as simple photographs accounted for more than 65% of the graphics coded as representation. Finally, the graphic type, context map, was coded most often as organization. However, the graphic categories and types coded as organization (n = 7) were sparse.

Table 44

Program A Function and Graphic Category

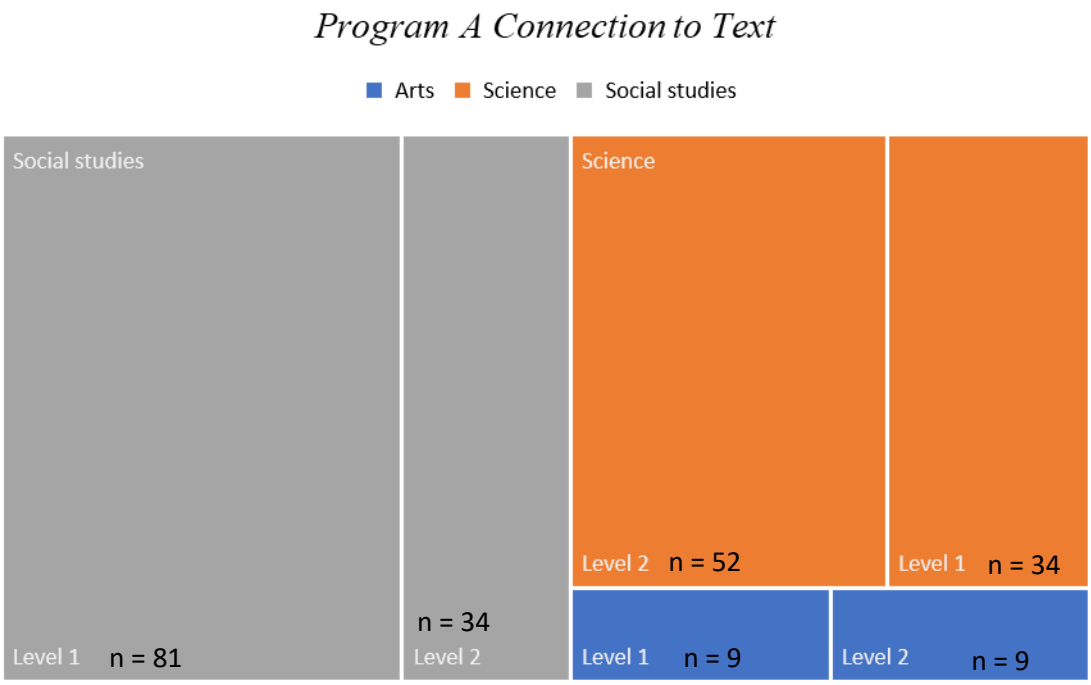
	Decoration		Organization		Representation		Total	
Category and type	Count of graphics	Percent of graphics	Count of graphics	Percent of graphics	Count of graphics	Percent of graphics	Graphics	Percent of Total (n = 220)
Photograph	9	42.86	--	--	130	67.71	139	63.18
Simple photograph	9	42.86	--	--	130	67.71	139	63.18
General image	12	57.14	--	--	49	25.52	61	27.73
Cartoon illustration	3	14.29	--	--	11	5.73	14	6.36
Collage	--	--	--	--	18	9.38	18	8.18
Computer enhanced photography/image	9	42.86	--	--	6	3.13	15	6.82
Photographs of illustrations	--	--	--	--	5	2.60	5	2.27
Realistic illustration	--	--	--	--	9	4.69	9	4.09
Map	--	--	3	42.86	6	3.13	9	4.09
Context map	--	--	3	42.86	3	1.56	6	2.75
Flow map	--	--	--	--	1	.52	1	.45
Grid map	--	--	--	--	1	.52	1	.45
Region map	--	--	--	--	1	.52	1	.45
Diagram	--	--	2	28.57	6	3.13	8	3.64
Cutaway diagram	--	--	1	14.29	2	1.04	3	1.36
Simple diagram	--	--	1	14.29	4	2.08	5	2.27
Table	--	--	--	--	1	.52	1	.45
Row and column table	--	--	--	--	1	.52	1	.45
Timeline	--	--	1	14.29	--	--	1	.45
Single timeline	--	--	1	14.29	--	--	1	.45
Flow diagram	--	--	1	14.29	--	--	--	--
Linear sequence	--	--	1	14.29	--	--	1	.45
Total	21	100	7	100	192	100	220	100

Note. "--" denotes that there is no data to report.

Connection to Text

The graphics examined in Program A were coded for connection to text-level 1 or level 2. Of the 220 graphics coded in Program A, 56.36% were coded as level 1, meaning that the information within the graphic was easily interpretable. Social studies texts included more graphics coded as level 1 (65.32%) than did arts (7.26%) or science texts (27.42%). Science texts included more graphics coded as level 2 (55.21%) than did arts (9.38%) and social studies (35.42%) texts. In Figure 11, the size of each rectangle is proportional to the frequency of connection level by disciplinary area.

Figure 11



Graphic Category and Type. An examination of connection to text with graphic category and type are presented in Table 45. Program A did not include any graphics coded as comic strip or graph. Of the seven specified categories, photographs accounted for more than 60% of the graphics coded as connection to text-level 1. This same pattern was visible for graphics coded as connection to text-level 2; photographs described more than 60% of those graphics. Graphic category was further broken down by type. Simple photographs were the foremost graphic type coded as level 1 or level 2.

Table 45

Program A Connection to Text and Graphic Category

	Level 1		Level 2		Total	
Category and type	Count of graphics	Percent of graphics	Count of graphics	Percent of graphics	Graphics	Percent of Total (n = 220)
Photograph	80	64.52	59	61.46	139	63.18
Simple photograph	80	64.52	59	61.46	139	63.18
General image	37	29.84	24	25	61	27.73
Cartoon illustration	8	6.45	6	6.25	14	6.36
Collage	17	13.71	1	1.04	18	8.18
Computer enhanced/created photography/image	2	1.61	13	13.54	15	6.82
Photographs of illustrations	5	4.03	--	--	5	2.27
Realistic illustration	5	4.03	4	4.17	9	4.09
Map	1	.81	8	8.33	9	4.09
Context map	1	.81	5	5.21	6	2.73
Flow map	--	--	1	1.04	1	.45
Grid map	--	--	1	1.04	1	.45
Region map	--	--	1	1.04	1	.45
Diagram	4	3.23	4	4.17	8	3.64
Cutaway diagram	1	.81	2	2.08	3	1.36
Simple diagram	3	2.42	2	2.08	5	2.27
Flow diagram	--	--	1	1.04	1	.45
Linear sequence	--	--	1	1.04	1	.45
Table	1	.81	--	--	1	.45
Row and column table	1	.81	--	--	1	.45
Timeline	1	.81	--	--	1	.45
Single timeline	1	.81	--	--	1	.45
Total	124	100	96	100	220	100

Note. "--" denotes that there is no data to report.

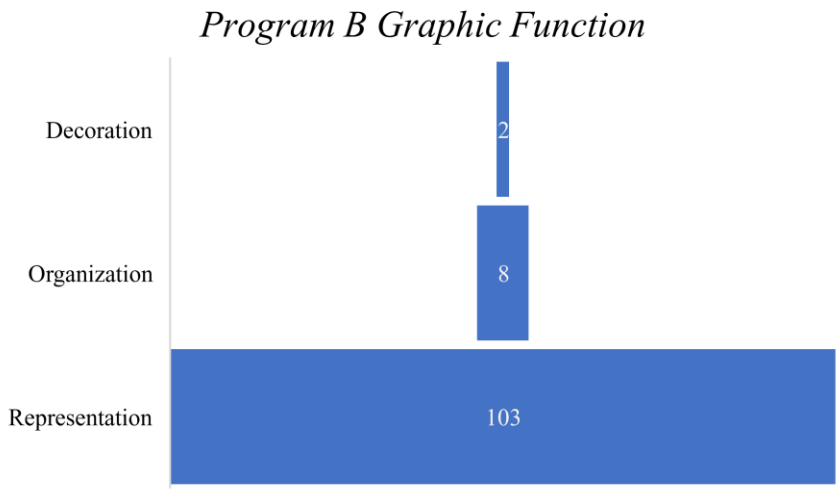
Program B

Program B consisted of 21 informational texts. Within these 21 texts, 113 graphics were identified and coded using the parameters stated in the Specific Instructional Guidance codebook as defined in the Methods section. The following sections report the data in relation to graphic function and connection to text.

Graphic Function

Graphic function was previously discussed in the Literature Review and, as with Program A, Program B featured three of the five functions considered, (a) decoration, (b) organization, and (c) representation. Every informational text in Program B (n = 21) included at least one graphic coded as representation, two texts contained a graphic coded as decoration, and five texts utilized graphics coded as organization. Figure 12 presents the count of graphics for Program B. Of the 113 graphics, 91.15% were coded as representation meaning that they concretized the written text.

Figure 12



Graphic Category and Type. Program B incorporated graphics representing seven of the nine graphic categories (diagram, general image, graph, map, photograph, table, and timeline) and 14 of the 27 graphic types coded for in this content analysis. Photographs accounted for more than 60% of the graphics that were coded as representation and general images described another 24.27%. Table 46 reports findings for graphic category and type in relation to graphic function.

Table 46

Program B Function and Graphic Category

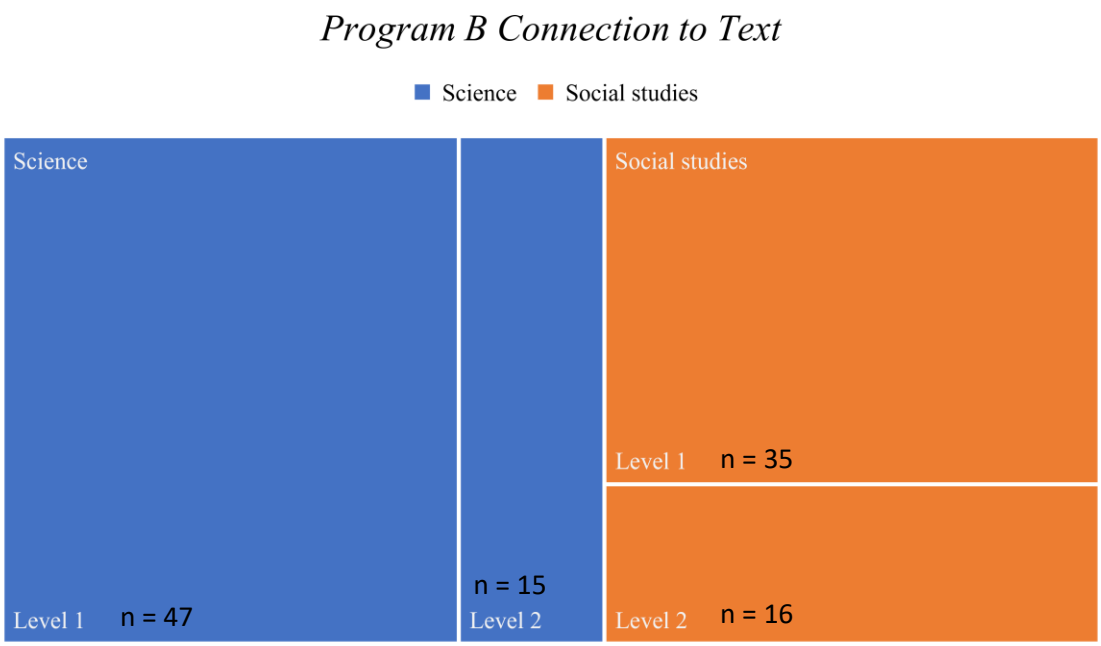
	Decoration		Organization		Representation		Total	
Category and type	Count of graphics	Percent of graphics	Count of graphics	Percent of graphics	Count of graphics	Percent of graphics	Graphics	Percent of Total (n = 113)
Photograph	1	50	3	37.50	65	63.11	69	61.06
Simple photograph	1	50	3	37.50	65	63.11	69	61.06
General image	1	50	--	--	25	24.27	26	23.01
Computer enhanced photography/image	1	50	--	--	3	2.91	4	3.54
Fine art	--	--	--	--	12	11.65	12	10.62
Photographs of illustrations	--	--	--	--	2	1.94	2	1.77
Realistic illustration	--	--	--	--	8	7.77	8	7.08
Diagram	--	--	3	37.50	4	3.88	7	6.19
Bird's eye view diagram	--	--	1	12.50	--	--	1	.88
Cutaway diagram	--	--	--	--	2	1.94	2	1.77
Scale	--	--	1	12.50	--	--	1	.88
Simple diagram	--	--	1	12.50	2	1.94	3	2.65
Graph	--	--	--	--	5	4.85	5	4.42
Bar graph	--	--	--	--	3	2.91	3	2.65
Pie chart	--	--	--	--	2	1.94	2	1.77
Map	--	--	--	--	2	1.94	2	1.77
Context map	--	--	--	--	2	1.94	2	1.77
Table	--	--	--	--	2	1.94	2	1.77
Row and column table	--	--	--	--	2	1.94	2	1.77
Timeline	--	--	2	25	--	--		1.77
Single timeline	--	--	2	25	--	--		1.77
Total	2	100	8	100	103	100	113	100

Note. "--" denotes that there is no data to report.

Connection to Text

Connection to text was defined as information within or accompanying a graphic that represents the running (written) text or adds new information. The graphics within Program B were examined using the criteria set forth in the Specific Instructional Guidance codebook described in the Methods section. In Figure 13, the size of each rectangle is proportional to the frequency of connection level by disciplinary area. Of the 113 graphics coded in Program B, 72.57% were coded as level 1. Social studies texts had more level 1 graphics than did science texts. Both disciplinary areas had about the same count of graphics coded as level 2.

Figure 13



Graphic Category and Type. An examination of connection to text by graphic category and type are presented in Table 47. Program B did not include any graphics coded as comic strip or flow diagram. Across the seven specified categories, photographs accounted for more than 65% of the graphics coded as connection to text-level 1. Photographs were also the foremost category coded as level 2 (48.39%).

Table 47

Program B Connection to Text and Graphic Category

	Level 1		Level 2		Total	
Category and type	Count of graphics	Percent of graphics	Count of graphics	Percent of graphics	Graphics	Percent of Total (n = 113)
Photograph	54	65.85	15	48.39	69	61.06
Simple photograph	54	65.85	15	48.39	69	61.06
General image	19	23.17	7	22.58	26	23.01
Computer enhanced photography/image	2	2.44	1	3.23	4	3.54
Fine art	8	9.76	4	12.9	12	10.62
Photographs of illustrations	2	2.44	--	--	2	1.77
Realistic illustration	7	8.54	2	6.45	8	7.08
Diagram	4	4.88	3	9.68	7	6.19
Bird's eye view diagram	--	--	1	3.23	1	.88
Cutaway diagram	1	1.22	1	3.23	2	1.77
Scale	--	--	1	3.23	1	.88
Simple diagram	3	3.66	--	--	3	2.65
Graph	2	2.44	3	9.68	5	4.42
Bar graph	2	2.44	1	3.23	3	2.65
Pie chart	--	--	2	6.45	2	1.77
Map	1	1.22	1	3.23	2	1.77
Context map	1	1.22	1	3.23	2	1.77
Table	1	1.22	1	3.23	2	1.77
Row and column table	1	1.22	1	3.23	2	1.77
Timeline	1	1.22	1	3.23	2	1.77
Single timeline	1	1.22	1	3.23	2	1.77
Total	82	100	31	100	113	100

Note. "--" denotes that there is no data to report.

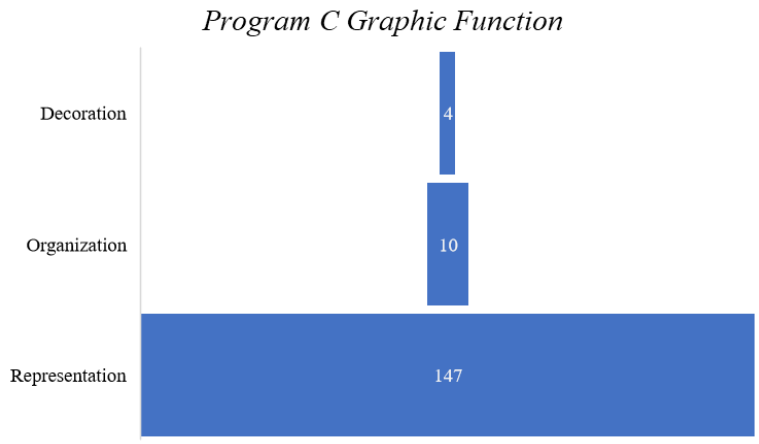
Program C

Program C consisted of 12 informational texts that met the definition used for this content analysis. The parameters set forth in the Specific Instructional Guidance codebook, as discussed in the Methods section, were used to code and identify 161 graphics used in Program C. The following sections report the data in relation to graphic function and connection to text.

Graphic Function

Graphic function was previously discussed in the Literature Review and, as with Programs A and B, Program C featured three of the five functions considered: (a) decoration, (b) organization, and (c) representation. Every informational text in Program C (n = 12) included graphics coded as representation, five texts utilized graphics coded as organization, and one text included decoration graphics. Figure 14 presents the count of graphics for Program C. Of the 161 graphics, 91.30% were coded as representation, meaning that they concretized the written text.

Figure 14



Graphic Category and Type. Program C incorporated graphics representing seven of the nine graphic categories (diagram, flow diagram, general image, graph, map, photograph, and table) and 16 of the 27 graphic types coded for in this content analysis. Table 48 reports findings for graphic category and type in relation to graphic function.

Photographs accounted for more than 55% of the graphics that were coded as representation, and general images accounted for another 32.65%. Table 48 lists the graphic types within graphic category. Graphics coded as simple photographs or realistic illustration represented more than 78% of the graphics coded as representation. The four graphics coded as decoration were also coded as simple photographs.

Table 48

Program C Function and Graphic Category

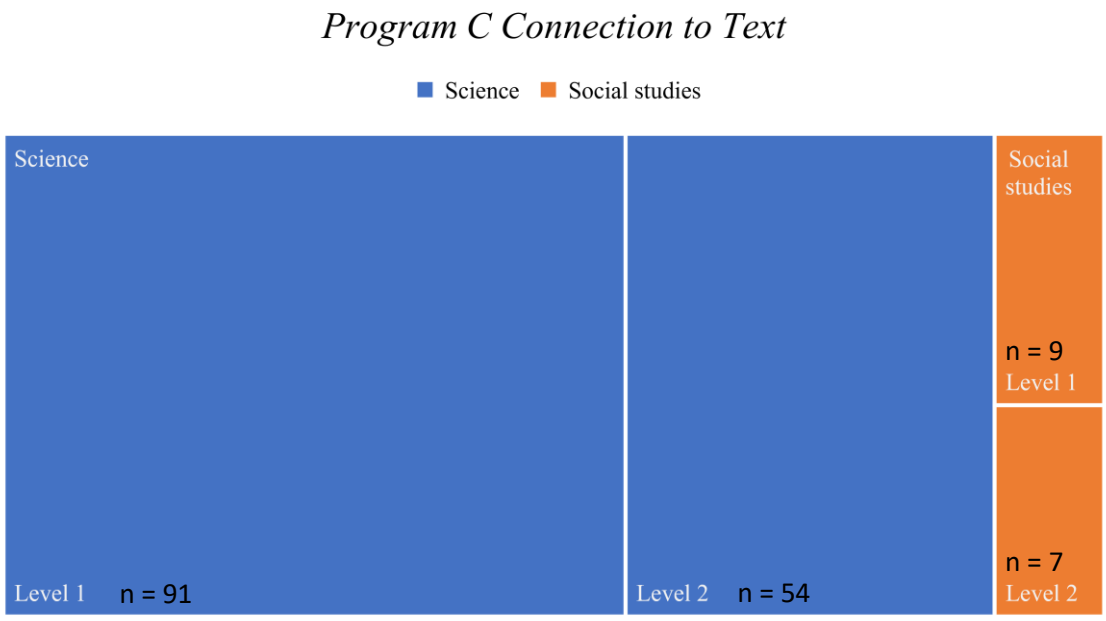
	Decoration		Organization		Representation		Total	
Category and type	Count of graphics	Percent of graphics	Count of graphics	Percent of graphics	Count of graphics	Percent of graphics	Graphics	Percent of Total (n = 161)
Photograph	4	100	--	--	82	55.78	86	53.42
Cluster photograph	--	--	--	--	7	4.76	7	4.35
Simple photograph	4	100	--	--	75	51.02	79	49.07
General image	--	--	--	--	48	32.65	48	29.81
Computer enhanced photography/image	--	--	--	--	3	2.04	3	1.86
Fine art	--	--	--	--	2	1.36	2	1.24
Magnified image	--	--	--	--	3	2.04	3	1.86
Realistic illustration	--	--	--	--	40	27.21	40	24.84
Diagram	--	--	2	20	10	6.80	12	7.45
Bird's eye view diagram	--	--	--	--	4	2.72	4	2.48
Cross-section	--	--	--	--	1	.68	1	.62
Cutaway diagram	--	--	1	10	--	--	1	.62
Picture scale diagram	--	--	--	--	1	.68	1	.62
Simple diagram	--	--	1	10	4	2.72	5	3.11
Flow diagram	--	--	7	70	--	--	7	4.35
Cyclical sequence	--	--	6	60	--	--	6	3.73
Linear sequence	--	--	1	10	--	--	1	.62
Graph	--	--	--	--	2	1.36	2	1.24
Line graph	--	--	--	--	2	1.36	2	1.24
Map	--	--	1	10	4	2.72	5	3.11
Context map	--	--	1	10	4	2.72	5	3.11
Table	--	--	--	--	1	.68	1	.62
Column table	--	--	--	--	1	.68	1	.62
Total	4	100	10	100	147	100	161	100

Note. "--" denotes that there is no data to report.

Connection to Text

The graphics in Program C were evaluated for connection to running text using the conditions set forth in the Specific Instructional Guidance codebook described in the Methods section. Of the graphics coded for connection to text, 62.11% were level 1 and 37.89% were level 2. Figure 15 depicts the frequency of graphics by disciplinary area using the relative size of the rectangle.

Figure 15



Graphic Category and Type. An examination of connection to text with graphic category and type are presented in Table 49. Program C did not include any graphics coded as comic strip or timeline. Photographs accounted for 49% of the graphics coded as connection to text-level 1 and 60.66% of the graphics coded as level 2. General images represented 36% of the graphics coded as connection to text-level 1.

Table 49

Program C Connection to Text and Graphic Category

	Level 1		Level 2		Total	
Category and type	Count of graphics	Percent of graphics	Count of graphics	Percent of graphics	Count of graphics	Percent of graphics (n = 161)
Photograph	49	49	37	60.66	86	53.42
Cluster photograph	5	5	2	3.28	7	4.35
Simple photograph	44	44	35	57.38	79	49.07
General image	36	36	12	19.67	48	29.81
Computer enhanced photography/image	2	2	1	1.64	3	1.76
Fine art	1	1	1	1.64	2	1.24
Magnified image	1	1	2	3.28	3	1.86
Realistic illustration	32	32	8	13.11	40	24.84
Diagram	7	7	5	8.20	12	7.45
Bird's eye view diagram	4	4	--	--	4	2.48
Cross-section	1	1	--	--	1	.62
Cutaway diagram	--	--	1	1.64	1	.62
Picture scale diagram	--	--	1	1.64	1	.62
Simple diagram	2	2	3	4.92	5	3.11
Flow diagram	4	4	3	4.92	7	4.35
Cyclical sequence	4	4	2	3.28	6	3.73
Linear sequence	--	--	1	1.64	1	.62
Graph	1	1	1	1.64	2	1.24
Line graph	1	1	1	1.64	2	1.24
Map	2	2	3	4.92	5	3.11
Context map	2	2	3	4.92	5	3.11
Table	1	1	--	--	1	.62
Column table	1	1	--	--	1	.62
Total	100	100	61	100	161	100

Note. "--" denotes that there is no data to report.

Comparisons

A Chi-square test was computed to determine whether there were significant differences in the proportions of graphic function and program publisher. As documented, three of the five a priori graphic functions—decoration, organization, and representation—were coded across the three publishers; graphics meeting the definition of the interpretation and transformation functions were not noted in this content analysis.

The null hypothesis for the Chi-square test stated that the distribution for graphic functions across Programs A, B, and C had the same proportions. Table 50 lists graphic functions, frequencies, and percent by program. The results from the Chi-square test indicated that there is evidence of a difference in the proportions of graphic function among the three programs, $\chi^2(4, N = 494) = 15.222$, $\rho < .05$, with a small effect size (Cramer's V = .12; Cohen, 1988).

Table 50 shows significance in the differences in the function decoration, among the programs. Program A contained 9.55% decoration while Program B contained 1.77%, and Program C contained 2.48%.

Table 50

Graphic Functions and Frequencies by Publisher for Chi-square

Category	Publisher			Total
	Program A	Program B	Program C	
Decoration	21 (9.55%)	2 (1.77%)	4 (2.48%)	27 (5.47%)
Organization	7 (3.18%)	8 (7.08%)	10 (6.21%)	25 (5.06%)
Representation	192 (87.27%)	103 (91.15%)	147 (91.30%)	442 (89.47%)
Total	220 (100%)	113 (100%)	161 (100%)	494 (100%)

A second Chi-square analysis was calculated to learn if there were differences between graphic function and disciplinary area. As art texts were minimally represented and included limited graphics, the assumptions of the Chi-square test were compromised (Gravetter & Wallnau, 2014). To address this issue, the disciplinary areas social studies and art were combined (Burstein & Knotts, 2010). The null hypothesis for the Chi-square test stated that the distribution for graphic functions across disciplinary areas have the same proportions. Table 51 lists graphic functions, frequencies and percentage by disciplinary area. The results from the Chi-square test indicated that there is no evidence of a difference in the proportions of graphic function among the disciplinary areas, $\chi^2(2, N = 494) = 4.8316$, $\rho > .05$.

Table 51

Graphic Functions and Frequencies by Discipline for Chi-square

	Disciplinary Area		
Category	Science	Art/Social Studies	Total
Decoration	17 (5.78%)	10 (5%)	27 (5.47%)
Organization	20 (6.80%)	5 (2.5%)	25 (5.06%)
Representation	257 (87.41%)	185 (92.5%)	442 (89.47%)
Total	294 (100%)	200 (100%)	494 (100%)

A Chi-square test was calculated to determine whether there were significant differences in the proportions between connection to text and program publisher. The null hypothesis for the Chi-square test stated that the distribution for connection to text across programs have the same proportions. Table 52 displays connection to text levels, counts, and percentages by CRP. Results from the Chi-square test showed that the connection to text levels significantly differed between programs, $\chi^2(2, N = 494) = 8.316$, $\rho < .05$, with a small effect size (Cramer's V = .09; Cohen, 1988).

Significant differences are observed in the percentages of level 1 and level 2 graphics. Program B included more graphics coded as level 1 (72.57%) and fewer graphics coded as level 2 (27.43%) when compared with Program A, level 1 (56.36%) and level 2 (43.64%) and Program C, level 1 (62.11%) and level 2 (37.89%).

Table 52

Connection to Text and Frequencies by Publisher for Chi-square

	Publisher			
Connection	Program A	Program B	Program C	Total
Level 1	124 (56.36%)	82 (72.57%)	100 (62.11%)	306 (61.94%)
Level 2	96 (43.64%)	31 (27.43%)	61 (37.89%)	188 (38.06%)
Total	220 (100%)	113 (100%)	161 (100%)	494 (100%)

A second chi square test was computed to ascertain whether a significant difference in the proportions between connection to text and disciplinary area existed. As art texts had a minimal number of graphics, the assumptions of the chi square test could not be met; thus, disciplinary areas social studies and art were combined (Burstein & Knotts, 2010; Gravetter & Wallnau, 2014). Table 53 details connection to text levels, frequencies, and percentages, in relation to disciplinary area.

The null hypothesis for the chi-square test stated that the distribution for connection to text levels across disciplinary areas have the same proportions. The results from the chi square test showed that there was no difference in the proportion of level 1 and level 2 graphics between disciplinary areas, $\chi^2(2, N = 494) = 3.645$, $\rho > .05$.

Table 53

Connection to Text and Frequencies by Disciplinary for Chi-square

	Disciplinary Area		
Connection	Science	Art/Social Studies	Total
Level 1	172 (58.50%)	134 (67%)	306 (61.94%)
Level 2	122 (41.50%)	66 (33%)	188 (38.06%)
Total	294 (100%)	200 (100%)	494 (100%)

Graphical Literacy Skills Instruction

Graphical literacy skills instruction was defined as systematic instruction provided by a teacher to assist students in developing their ability to read, interpret, and create graphics as modes of communication. Graphical literacy skills instruction was coded first for instructional guidance and then, if applicable, explicit instruction element. A discussion of graphical literacy skills instruction was undertaken in the section titled "Literature Review. "

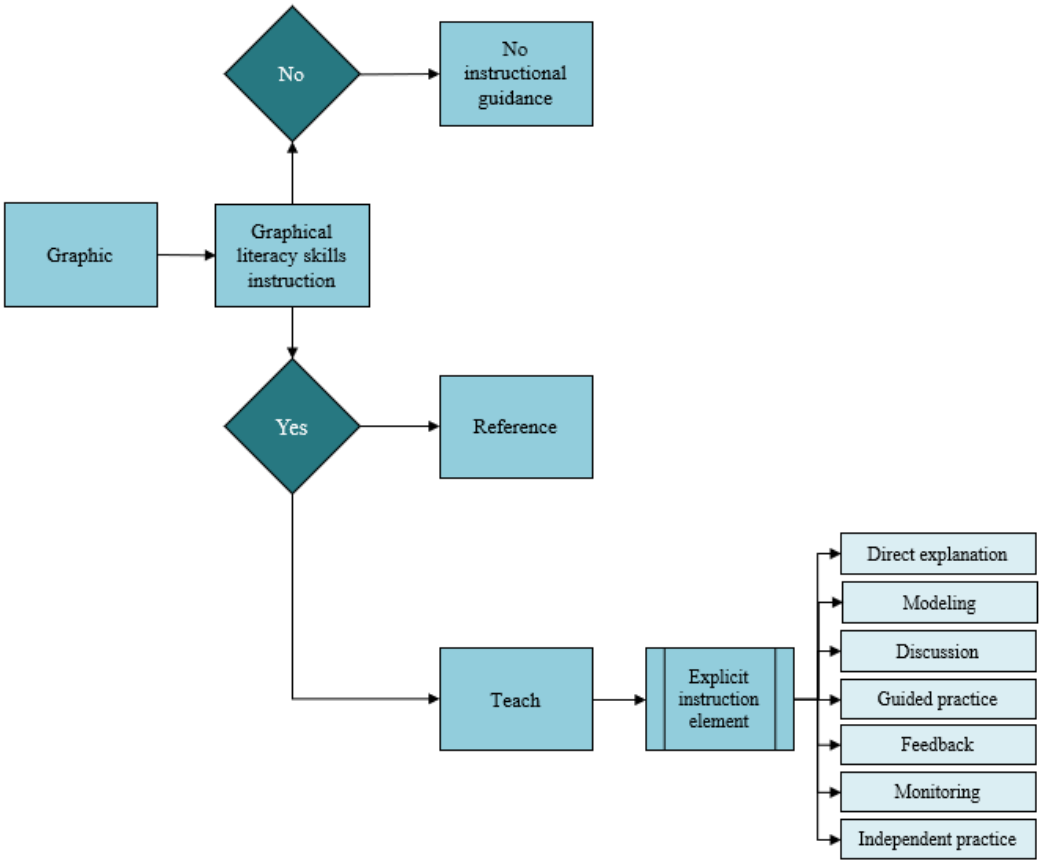
Graphics featured in the informational texts were coded using criteria detailed in the Specific Instructional Guidance codebook as outlined in the Methods section. Graphical literacy skills instruction reported in this section is associated with a particular graphic within a certain informational text. Metadata (CRP publisher, teacher's manual number, page number of instructional guidance, and instructional guidance number) were collected for identification purposes and are not presented here. Data reported in this section provide details about instructional guidance (e.g., no instructional guidance, reference, or teach) and explicit instruction element (e.g., direct explanation, discussion, etc.).

The graphics identified in the informational texts were first coded as "yes" or "no" for graphical literacy skills instruction. No indicated that there was instructional guidance associated with a particular graphic within the teacher's manual. Yes showed that there was graphical literacy skills instruction, either reference or teach. Graphics coded as reference revealed that the teacher was directed to only draw students' attention to the graphic without further instruction. If a graphic was coded as teach, this signified

that explicit instruction was indicated for that graphic. Figure 16 outlines the coding process.

Figure 16

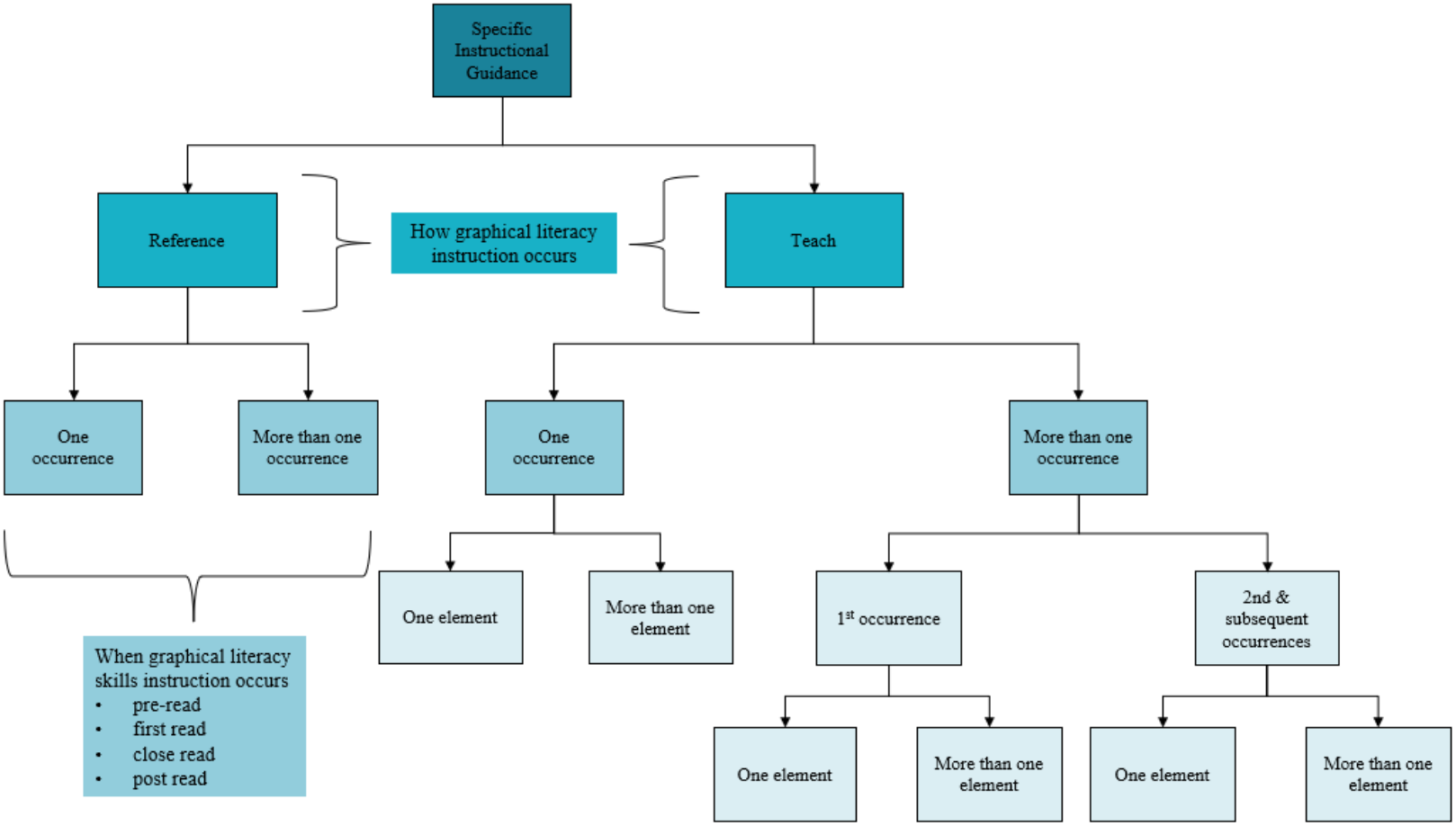
Graphical Literacy Skills Instruction Coding Process



As coding commenced for instructional guidance, it became apparent that there were two types of reference and teach data—the count of graphics and the occurrence of graphics. Count indicated the individual graphic that had instructional guidance. Occurrence designated when the teacher was directed to provide instructional guidance for a precise graphic. In addition, graphics coded with instructional guidance teach, were further coded for explicit instruction element. Figure 17 outlines the reporting process for occurrence and explicit instruction element.

Figure 17

Instructional Guidance Occurrence



Instructional guidance occurred at four distinct times as teachers and students engaged with the text. Those times were labeled as

- pre-read—a preview or introduction of the text
- first read—the first reading of the text
- close read—any reading after the first reading of the text
- post read—after the text has been read.

As an example, during the pre-read of the text, the teacher was directed to "Point out these examples of each text feature: photo with caption" (Ada et al., 2020b, p. 46). The photo with caption was coded as reference, the first occurrence of instructional guidance. Graphical literacy skills instruction was indicated a second time for the same graphic during the post reading of the text when the teacher was guided to, "direct students to review the diagram on page 89" (Ada et al., 2020b, pg. T73). The graphic was coded for reference twice, two occurrences, as the instructional guidance was provided at two distinct times during the reading of the text, the pre-read and the post read.

Graphics could also be coded for one occurrence (e.g., close read), but for multiple elements of explicit instruction. For instance, the teacher was instructed to provide instructional guidance about a timeline during the close read of the text (August et al., 2020c). The teacher was guided to

- explain that the major information in the running text is shown on the timeline
- remind students that timelines organize information in chronological order

- ask students to discuss how the timeline helps the reader understand the events described in the text
- circulate around the room as the students work with partners to locate information on the timeline from the text and discuss why timelines are useful

The graphic, a timeline, was coded for teach, one occurrence because graphical literacy skills instruction was provided during the close read of the text. The graphic was then coded for explicit instruction element. In the above example, the timeline was coded for four elements of explicit instruction for the one occurrence of teach as follows: (a) direct explanation, (b) discussion, (c) guided practice, and (d) monitoring.

This content analysis examined three CRPs, 54 informational texts, and 494 graphics. Of the 54 informational texts, 38 (70.37%) featured graphics that had specific instructional guidance associated with them. More than 29% of the informational texts did not include any pedagogical guidance for the teacher regarding the graphics contained therein. Of the 494 graphics, 169 graphics (34.21%) were coded as having specific instructional guidance and 325 graphics (65.79%) were coded as having no specific instructional guidance. Table 54 lists the count of informational texts and the count of graphics with and without instructional guidance.

Table 54

Census Instructional Guidance (IG)

Program	Count of texts with IG (percent)	Count of texts without IG (percent)	Count of graphics with IG (percent)	Count of graphics without IG (percent)
A	13 (61.90)	8 (38.09)	73 (33.18)	147 (66.82)
B	17 (80.95)	4 (19.05)	38 (33.63)	75 (66.37)
C	8 (66.66)	4 (33.33)	58 (36.02)	103 (63.96)
Total	38 (70.37)	16 (29.63)	169 (34.21)	325 (65.79)

Note. "--" denotes that there is no data to report. Percent in paratheses for Program was calculated using Program grand total. Program A: 21 texts, 220 graphics; Program B: 21 texts, 113 graphics; Program C: 12 texts, 161 graphics. Percent for Total was calculated using census totals (N = 54, N = 494).

Detailed information about graphic category, graphic function, and the connection of the graphic to the running text without instructional guidance are reported in Table 55. Level 1 representation photographs accounted for more than 39% of the graphics without instructional guidance. There was a substantial portion of level 2 graphics without instructional guidance (40%) and most of those were representation photographs (22.46%). In addition, there were several level 2 complex graphics (e.g., flow diagram, graph, map, and timeline) without instructional guidance. Level 2 graphics require the reader to make inferences and may require background knowledge for comprehension to occur.

Table 55

Census No Instructional Guidance

	Connection to Text		
Category and Function	Level 1 (Percent, n =325)	Level 2 (Percent, n =325)	Total (Percent, N = 494)
Decoration	--	27 (8.31)	27 (5.47)
General image	--	13 (4.00)	13 (2.63)
Photograph	--	14 (4.31)	14 (2.83)
Organization	3 (.92)	4 (1.23)	7 (1.42)
Flow diagram	2 (.62)	3 (.92)	5 (1.01)
Map	--	1 (.31)	1 (.20)
Timeline	1 (.31)	--	1 (.20)
Representation	192 (59.08)	99 (30.46)	291 (58.91)
Diagram	--	1 (.31)	1 (.20)
General image	61 (18.77)	21 (6.46)	82 (16.60)
Graph	--	1 (.31)	1 (.20)
Map	2 (.62)	3 (.92)	5 (1.01)
Photograph	129 (39.69)	73 (22.46)	202 (40.89)
Total	195 (60.00)	130 (40.00)	325 (65.79)

Note. "--" denotes that there is no data to report. Percent for Level 1 and Level 2 was calculated using the total of graphics with no instructional guidance (n = 325). Percent for Total was calculated using census total count (N = 494).

Table 56 relates the results by graphic category, graphic function, and connection to text for the graphics that had instructional guidance. This table provides an overall report of the census. The teacher was directed to teach primarily about representation graphics (89.35%) and most of those were photographs (44.38%). Additionally, most of the graphics were easily interpretable (connection to text-level 1). There were also a percentage of complex graphics that featured instructional guidance, both representation and organization. Many of these were level 1, but there were several level 2 complex graphics with instructional guidance. Detailed information about instructional guidance in relation to reference and teach is addressed in the following sections: (a) "Program A," (b) "Program B," and (c) "Program C. "

Table 56

Census Instructional Guidance and Connection to Text

	Connection to Text		
Category and Function	Level 1 (Percent, n =169)	Level 2 (Percent, n =169)	Total (Percent, N = 494)
Organization	9 (5.33)	9 (5.33)	18 (3.64)
Diagram	3 (1.78)	4 (2.37)	7 (1.42)
Flow diagram	2 (1.18)	1 (.59)	3 (.61)
Map	--	3 (1.78)	3 (.61)
Photograph	3 (1.78)	--	3 (.61)
Timeline	1 (.59)	1 (.59)	2 (.40)
Representation	102 (60.36)	49 (28.99)	151 (30.57)
Diagram	12 (7.10)	7 (4.14)	19 (3.85)
General image	31 (18.34)	9 (5.33)	40 (8.10)
Graph	3 (1.78)	3 (1.78)	6 (1.21)
Map	2 (1.18)	5 (2.96)	7 (1.42)
Photograph	51 (30.18)	24 (14.20)	75 (15.18)
Table	3 (1.78)	1 (.59)	4 (.81)
Total	111 (65.58)	58 (34.32)	169 (34.21)

Note. "--" denotes that there is no data to report. Percent for Level 1 and Level 2 was calculated using the total of graphics with instructional guidance (n = 169) and only the first occurrence of instructional guidance. Percent for Total was calculated using census total count (N = 494).

Program A

Program A contained 21 texts, including a total of 220 graphics that were coded for graphical literacy skills instruction. Within Program A, 13 (61.90%) informational texts included graphics that had accompanying graphical literacy skills instruction; eight texts did not have instructional guidance associated with the graphics they contained.

Three categories of instructional guidance were defined for coding: (a) no instructional guidance, (b) reference (i.e., the teacher is instructed to verbally mention the graphic, but no other instruction is provided), and (c) teach (i.e., the teacher is directed to provide explicit instruction about the graphic). In addition to information related to those categories listed above, data addressing graphics that combined both reference and teach instructional guidance are reported. Detailed information is presented in subsequent sections.

No Instructional Guidance

Of the 220 graphics coded for in Program A, 147 (66.82%) were coded as having no instructional guidance, or graphical literacy skills instruction, associated with them in the teacher's manual. Graphic category and type were examined in relation to the graphics for which there was no instructional guidance. Graphic categories comic strip, diagram, flow diagram, graph, and table are excluded from the table because there were no data to report. In addition, of the 15 types of graphics used in Program A, 11 types were coded as having no instructional guidance. Table 57 reports graphic category and type by count and percentage in relation to the total number of graphics used in CRP A.

Table 57

Program A No Instructional Guidance and Graphic Category

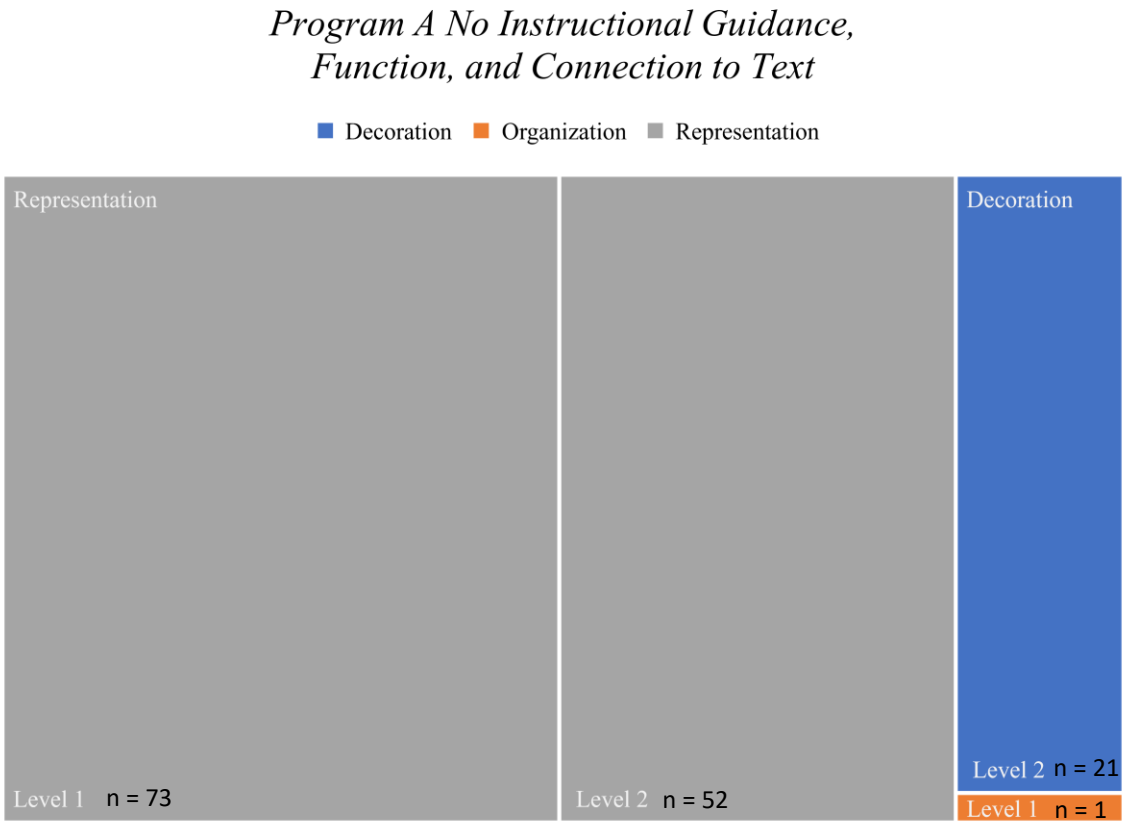
Category and type	Count of graphics	Percent (n = 147)	Percent (n = 220)
Photograph	104	70.75	47.47
Simple photograph	104	70.75	47.27
General image	39	26.53	17.73
Cartoon illustration	12	8.16	5.45
Collage	9	6.12	4.09
Computer enhanced/created photography/image	12	8.16	5.45
Realistic illustration	3	4.08	4.08
Map	3	2.04	1.36
Context map	1	.68	.45
Grid map	1	.68	.45
Region map	1	.68	.45
Timeline	1	.68	.45
Single timeline	1	.68	.45
Total	147	100	66.82

Of the graphics (n = 147) for which the teacher received no direction to provide graphical literacy skills instruction, 104 (70.75%) were photographs and 39 (26.53%) were general images. The teacher was not directed to reference or teach about several maps and one timeline. Those general images without instructional guidance were coded as cartoon illustration, collage, computer enhanced/created photography/image, or realistic illustration.

In addition to evaluating by graphic category and type, the coder evaluated the graphics by graphic function and connection to text. Figure 18 depicts the frequency of graphics with no instructional guidance in relation to function and connection to text using the relative size of the rectangle. Transformation and interpretation were omitted from the figure because there were no data to report. Most of the graphics (85.03%) were coded as representation. Within representation, graphics were also coded as connection to

text-level 1 (n=-73) and level 2 (n = 52). Graphics coded as decoration were also coded as connection to text-level 2.

Figure 18



Reference

When graphical literacy skills instruction accompanied a graphic in the teacher's manual, and the teacher was directed to refer to the graphic or acknowledge the presence of the graphic, the instructional guidance was coded as reference. For Program A, 51 graphics were coded as reference. Thus, of the 220 graphics identified, the teacher was directed to mention 23.18%.

Graphic category and type were analyzed in relation to reference. Table 58 reports these findings by count of graphic. Seven of the nine graphic categories (diagram, flow diagram, general image, map, photograph, table, and timeline) were identified in Program A. Of those seven categories, six contained graphics that were coded as reference.

Table 58

Program A Reference and Graphic Category

Category and type	Count	Percent (n = 51)
Photograph	30	58.82
Simple photograph	30	58.82
Diagram	8	11.69
Cutaway diagram	3	5.88
Simple diagram	5	9.80
General image	6	11.76
Cartoon illustration	2	3.92
Computer enhanced/created photography/image	2	3.92
Realistic illustration	2	3.92
Map	5	9.80
Context map	4	7.84
Flow map	1	1.96
Table	1	1.96
Row and column table	1	1.96
Flow diagram	1	1.96
Linear sequence	1	1.96
Total	51	100

Reference, graphic category, graphic function, and connection to text were also evaluated (results reported in Table 59). No graphics coded as reference were also coded as decoration. The 51 graphics coded as reference for instructional guidance were categorized as organization or representation. Most of the graphics (88.24%) were representation, meaning that they illustrated all or part of the written text. The remaining six graphics were organization (11.76%).

Additionally, connection to text was reviewed in relation to reference (See Table 59 for the reported results). Of the 51 graphics, 32 (62.75%) were connection to text-level 1 and most of those 32 were photographs. The remaining 19 graphics (37.25%) were connection to text-level 2. Although numerous graphics were easily interpretable (level 1), a large percentage of graphics were coded as level 2, meaning that they contained language or concepts not found in the running text, and only cursory references were made to graphical literacy skills instruction.

Table 59

Program A Reference, Category, Function, and Connection

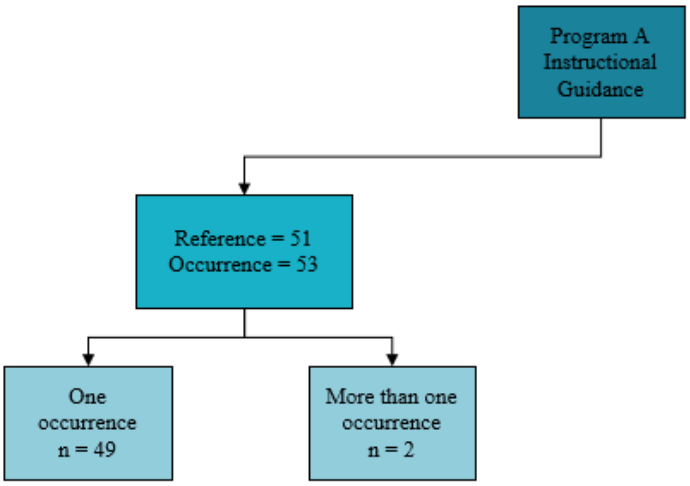
	Connection to Text		
Category and Function	Level 1 (Percent of total)	Level 2 (Percent of total)	Total (Percent of total)
Organization	1 (1.96)	5 (9.80)	6 (11.76)
Diagram	1	1 (1.96)	2 (3.92)
Flow diagram	--	1 (1.96)	1 (1.96)
Map	--	3 (5.88)	3 (5.88)
Representation	31 (60.78)	14 (27.45)	45 (88.24)
Diagram	3 (5.88)	3 (5.88)	6 (11.76)
General image	5 (9.80)	1 (1.96)	6 (11.76)
Map	--	2 (3.92)	2 (3.92)
Photograph	22 (43.14)	8 (15.69)	30 (58.82)
Table	1 (1.96)	--	1 (1.96)
Total	32 (62.75)	19 (37.25)	51 (100)

Note. "--" denotes that there is no data to report.

Regarding occurrence, the teacher was directed to refer to two graphics (both cut-away diagrams) at two distinct times during engagement with the text. For both diagrams, the first occurrence was at pre-read and the second occurrence was at post read of the text. Thus, there were 51 counts of reference and 53 occurrences of reference in Program A (Figure 19 uses a tree diagram to show the counts of reference and the occurrence of reference).

Figure 19

Program A Reference Occurrence



Teach

The final classification for instructional guidance was teach—the teacher is directed to provide explicit instruction about a graphic (Brugar & Roberts, 2017). Within Program A, 46 out of a total of 220 graphics were coded as teach. Thus, the teacher was guided to provide explicit instruction for 20.91% of the total graphics in Program A. Data in this section are reported for teach and then for explicit instruction element.

Graphics coded as teach were compared in relation to graphic category and type. Table 60 lists the graphic categories and types coded for within Program A along with the count of graphics coded as teach. Of the seven graphic categories, the following five featured graphics coded for teach: (a) diagram, (b) general image, (c) map, (d) photograph, and (e) table. The teacher was directed to explicitly teach about general images more often than about any other category of graphics, with collage being the graphic type most frequently indicated for explicit instruction. There was no guidance to teach about flow diagrams or timelines.

Table 60

Program A Teach and Graphic Category

Category and type	Count	Percent (n = 46)
Photograph	16	34.78
Simple photograph	16	34.78
Diagram	7	15.22
Cutaway diagram	3	6.52
Simple diagram	4	8.70
General image	18	39.13
Cartoon illustration	1	2.17
Collage	9	19.57
Computer enhanced/created photography/image	1	2.17
Photographs of illustrations	5	10.87
Realistic illustration	2	4.35
Map	4	8.70
Context map	3	2.17
Flow map	1	2.17
Table	1	2.17
Row and column table	1	2.17
Total	46	100

Graphic category, graphic function, connection to text, and teach were also examined and the findings are reported in Table 61. The 46 graphics designated as teach for instructional guidance were also categorized as function, organization or representation. Most of the graphics (91.30%) were representation, meaning that they concretized the running text. The remaining four graphics (8.70%) were organization. Of the 46 graphics, 34 (73.91%) were connection to text-level 1. The remaining 12 graphics (26.09%) were connection to text-level 2. Most of the graphics that featured graphical literacy skills instruction were representation general images, level 1.

Table 61

Program A Teach, Category, Function, and Connection

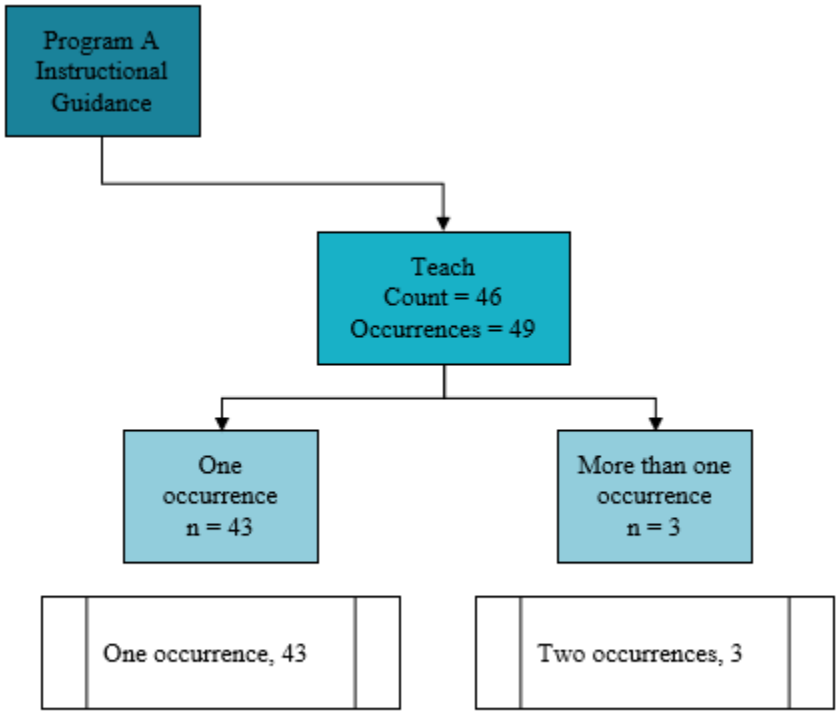
	Connection to Text		
Category and Function	Level 1 (Percent of total teach)	Level 2 (Percent of total teach)	Total (Percent of teach)
Organization	1 (2.17)	3 (6.52)	4 (8.69)
Diagram	1 (2.17)	1 (2.17)	2 (4.35)
Map	--	2 (4.35)	2 (4.35)
Representation	33 (71.74)	9 (19.57)	42 (91.30)
Diagram	3 (6.52)	2 (4.35)	5 (10.87)
General image	17 (36.96)	1 (2.17)	19 (41.30)
Map	--	2 (4.35)	2 (4.35)
Photograph	12 (26.08)	4 (8.69)	15 (32.61)
Table	1 (2.17)	--	1 (2.17)
Total	34 (73.91)	12 (26.09)	46 (100)

Note. "--" denotes that there is no data to report.

Finally, the count of occurrences was also collected and Figure 20 reports these findings. Three graphics (i.e., the graphics were coded as general image, photograph of illustration, representation, and connection to text-level 1) had associated graphical literacy skills instruction at two distinct times during repeated interactions with the informational text.

Figure 20

Program A Teach Occurrence



Explicit Instruction Element. Seven a priori codes for explicit instruction were introduced and discussed in the Literature Review. Analyses of Program A showed that three elements were used in the teachers' manuals to provide graphical literacy skills instruction: (a) discussion, (b) guided practice, and (c) independent practice.

Teacher prompts coded as discussion were questions. For example, the teacher was prompted to ask "Based on this drawing, why do you think Christo named his art The Gates?" (Ada, et. al., 2020b, p. 21). Instructional guidance coded as guided practice made use of scaffolding and involved the whole class or student partners. For example, students, working with a partner, were directed to review a graphic and then share "how the posters shown on these pages support the information in the text" (Ada, et. al., 2020b, p. 329). Graphical literacy skills instruction for independent practice guided the teacher to have students analyze the graphic; thus, the students applied newly learned knowledge. For instance, the teacher was directed to "Have students review the map on page 223 to analyze how it works together with details in the text" (Ada, et. al., 2020b, p. 223).

Program A included 46 graphics that were coded teach and then for explicit instruction element. Figure 21 summarizes the findings by occurrence and then explicit instruction element. Three general images had more than one occurrence of teach and were coded for one explicit instruction element at each occurrence. Two graphics were coded for one occurrence of teach and for two explicit instruction elements. For example, in one manual, when the students read the text for the second time (i.e., close read), the teacher was guided to provide explicit instruction about the row and column table. The teacher was directed to "Have students review the chart on page 231 to analyze how it shows categories of information at a glance" and to ask "What information does the chart

provide?" (Ada, et. al., 2020b, p. 231). This one occurrence of teach was coded for two elements of explicit instruction—independent practice and discussion.

Figure 21

Program A Explicit Instruction Element

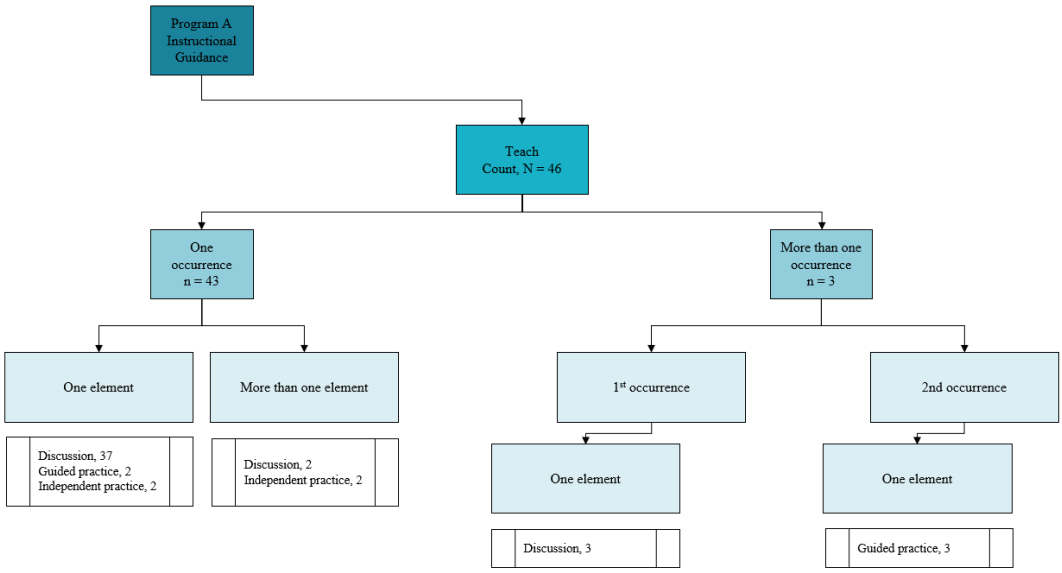


Table 62 reports the findings in relation to graphic function and category by count of explicit instruction element. Graphics categorized as flow diagram, general image, or table were indicated for two elements of explicit instruction within the same occurrence of teach or for a second occurrence of teach. For most of the graphics, however, there was only one occurrence of teach accompanied by one explicit instruction element. The element was usually discussion, and it was associated primarily with graphics with the function representation, in other words, those that replicated the running text.

Table 62

Program A Explicit Instruction, Function, and Category

Function and category	Count of graphics	Discussion	Guided practice	Independent practice
Organization	4	4	--	1
Diagram	2	2	--	--
Map	2	--	--	--
Flow diagram	--	2[b]	--	1
Representation	42	38	5	3
Diagram	5	4	--	1
General image	18	16[a]	5[a]	--
Map	2	1	--	1
Photograph	16	16	--	--
Table	1	1[b]	--	1
Total	46	42	5	4

Note. "--" denotes that there is no data to report.
[a] Second occurrence of teach.
[b] Second element of explicit instruction.

Explicit instruction element and connection to text were examined across graphic categories. Those findings are detailed by explicit instruction element in Table 63. Most of the graphics coded for discussion were also coded as connection to text-level 1. Graphics coded as level 1 were easily interpretable and may have included a caption to assist with graphic interpretation. Several graphics coded as level 2 were also coded as discussion.

Table 63

Program A Explicit Instruction, Connection, and Category

Connection and category	Count of graphics	Discussion	Guided practice	Independent practice
Level 1	34	32	5	1
Diagram	4	4	--	--
General image	17	15	5[a]	--
Photograph	12	12	--	--
Table	1	1[b]	--	1
Level 2	12	10	--	3
Diagram	3	2	--	1
General image	1	1	--	--
Map	4	3[b]	--	2
Photograph	4	4	--	--
Total	46	42	5	4

Note. "--" denotes that there is no data to report.
[a] Second occurrence of teach.
[b] Second element of explicit instruction.

Reference and Teach

There was a subset of graphics coded for both reference and teach graphical literacy skills instruction. Of the 73 graphics coded for specific instructional guidance within Program A, the teacher was directed to reference and teach 24 (i.e., each count of instructional guidance was also reported in data for reference or teach) at two distinct times during engagement with the informational text. For example, in one teacher's manual, the teacher was directed to introduce the text and point out a map on a specific page when pre-reading the text (Ada, et. al., 2020). This was coded as reference because no explicit instruction was indicated. The teacher was then instructed to teach about the same map during the first read of the text by asking, "What does this map show? (Ada, et. al., 2020, p. 223). Thus, the graphic was coded for both reference and teach. Table 64 lists the graphics that were coded as both reference and teach.

Table 64

Program A Reference and Teach Graphics

Graphic category and type	Function	Connection to text	Count
Diagram			
Cutaway diagram	Representation	Level 1	1
		Level 2	2
Simple diagram	Organization	Level 1	2
	Representation	Level 1	1
		Level 2	1
General image			
Cartoon illustration	Representation	Level 1	2
Map			
Context map	Organization	Level 2	2
Flow map	Representation	Level 2	1
Photograph			
Simple photograph	Representation	Level 1	9
		Level 2	2
Table			
Row and column	Representation	Level 1	1

Most of the graphics that the teacher was directed to reference and then teach about were photographs designated as representation (i.e., graphics that concretized the running text) and connection to text-level 1, meaning that they were easily interpretable. A fair number of maps and diagrams were also indicated for reference and then teach. In one teacher's manual, the teacher was directed to reference the two cutaway diagrams twice, and then teach about the graphic.

The types of instructional guidance associated with the graphics included in Program A were classified in one of the following three ways: (a) no instructional guidance, (b) reference, and (c) teach. For most of the graphics (n = 147), the teacher was not directed to provide graphical literacy skills instruction. A small percentage of graphics (10.91%)—half of which were diagrams, maps, and tables—were coded for both reference and teach.

Program B

Program B was comprised of 21 informational texts, which included 113 graphics that were coded for associated graphical literacy skills instruction. Within Program B, 17 informational texts (80.95%) included graphics for which the teacher was directed to provide graphical literacy skills instruction. This section reports the data gathered for Program B regarding (a) no instructional guidance, (b) reference, (c) teach, and (d) reference and teach.

No Instructional Guidance

Of the 113 graphics, 75 (66.37%) were coded as having no graphical literacy skills instruction associated with them in the teachers' manuals. Graphics without

instructional guidance were assessed in relation to graphic category and type. Table 65 reports the count of graphics and the percentage of category and type per total number of graphics coded as no instructional guidance. Of the seven graphic categories employed by Program B (no graphics were coded as comic strip or flow diagram), photographs and general images were the only two for which graphics were not supplemented with graphical literacy skills instruction. Within those two categories, five graphic types had no instructional guidance.

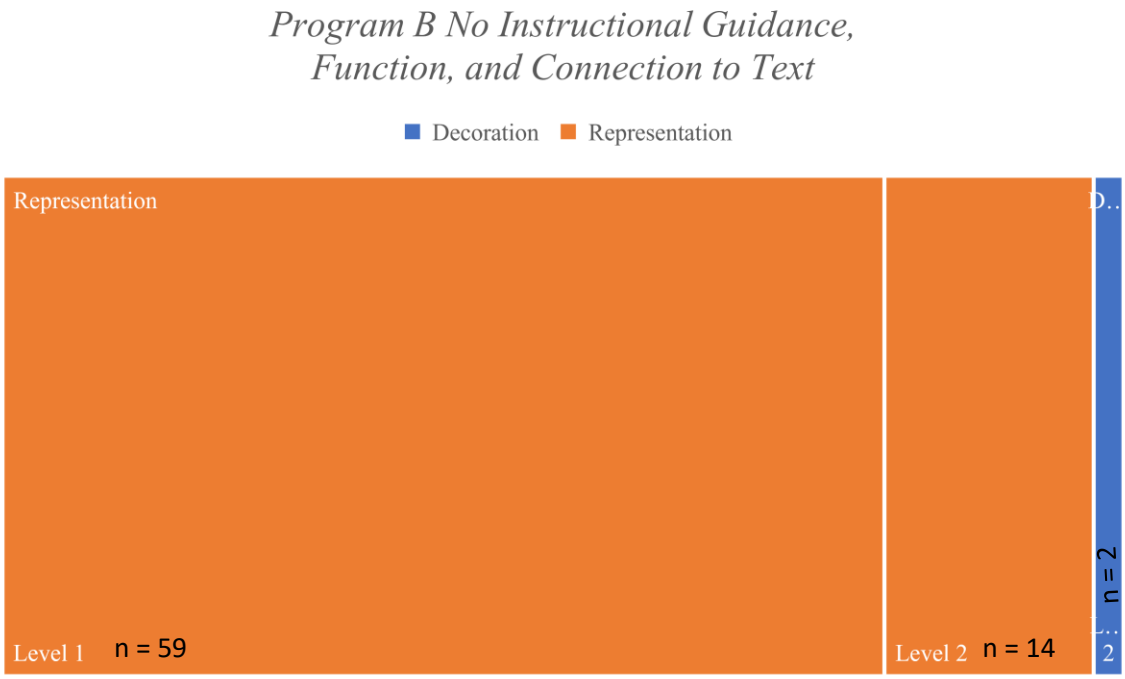
Table 65

Program B No Instructional Guidance and Graphic Category

Category and type	Count of graphics	Percent (n =75)	Percent (n = 113)
General image	22	29.33	19.47
Computer enhanced/created hotography/image	3	4	2.65
Fine art	10	13.33	8.85
Photographs of illustrations	2	2.67	1.77
Realistic illustration	7	9.33	6.19
Photograph	53	70.67	46.90
Simple photograph	53	70.67	46.90
Total	75	100	66.37

The graphics that did not have associated instructional guidance were also evaluated for graphic function and connection to text. Figure 22 depicts the frequency of graphics without instructional guidance in relation to function and connection level using the relative size of the rectangle. The graphics without instructional guidance (n = 75) within Program B featured two of the five a priori functions—decoration and representation. More than 75% of the graphics with no graphical literacy skills instruction were representation and connection to text-level 1. Several graphics (18.67%) that represented the text were connection to text-level 2. These graphics required inferencing or background knowledge for interpretation. No decoration graphics were coded as connection to text-level 1.

Figure 22



Reference

Graphics coded as reference comprised 4.42% of the total count of graphics in the informational texts for Program B (n= 113). The following five graphics were coded reference:

- general image: fine art (n = 1)
- photograph: simple photograph (n = 3)
- timeline: single timeline (n = 1).

The general image and photographs were coded as representation for graphic function. The photographs were connection to text-level 1 and the general image was level 2. The single timeline was coded as organization and connection to text-level 1. There was only one occurrence of reference per graphic.

Teach

Program B featured 113 graphics, 35 (29.20%) of which were coded as teach. Graphics were coded as teach when associated guidance in the teacher's manual indicated explicit instruction. In addition to data regarding teach, data for explicit instruction element are also presented.

A comparison among graphics coded as teach for instructional guidance and graphic category and type was conducted, and the results are shown in Table 66. All seven graphic categories coded for in Program B had at least two graphics with graphical literacy skills instruction, teach. In addition, Program B featured 13 graphic types for which graphical literacy skills instruction was specified in the teacher's manual. Computer enhanced/created photography/image and fine art, were indicated for only one

instance of instructional guidance. For the remaining 11 types, pedagogical guidance was to teach about the graphic at least twice.

Table 66

Program B Teach and Graphic Category

Category and type	Count	Percent (n =35)
Diagram	7	20
Bird's eye view diagram	1	2.86
Cutaway diagram	2	5.71
Scale	1	2.86
Simple diagram	3	8.57
General image	3	8.57
Computer enhanced/created photography/image	1	2.86
Fine art	1	2.86
Realistic illustration	1	2.86
Graph	5	14.29
Bar graph	3	8.57
Pie chart	2	5.71
Map	2	5.71
Context map	2	5.71
Photograph	14	40.00
Simple photograph	14	40.00
Table	2	5.71
Row and column table	2	5.71
Timeline	2	5.71
Single timeline	2	5.71
Total	35	100

Teach, graphic category, function, and connection to text were also examined and the results are reported in Table 67. The 35 graphics designated as teach for instructional guidance were also characterized with functions organization or representation; no graphics were coded as decoration. Most of the graphics (77.14%) were representation, meaning that they concretized the running text. However, several of these graphics were coded as level 2, meaning that the association between the running text and the graphic was not easily recognized and students may require background knowledge to assist with interpretation. The remaining eight graphics were organization (22.86%), with three coded as level 2 and five coded as level 1. Of the 35 graphics, 21 (60.00%) were connection to text-level 1. The remaining 14 graphics (40.00%) were connection to text-level 2.

The informational texts within Program B utilized graphics that represented seven of the nine a priori graphic categories (No graphics were coded as comic strip or flow diagram in Program B.) Graphical literacy skills instruction was associated with at least one graphic representing each of those categories. The teacher was directed to provide instructional guidance about level 1 photographs (n = 11) more often than other graphics. Within each category, there were several level 2 graphics about which the teacher was directed to provide explicit instruction.

Table 67

Program B Teach, Category, Function, and Connection

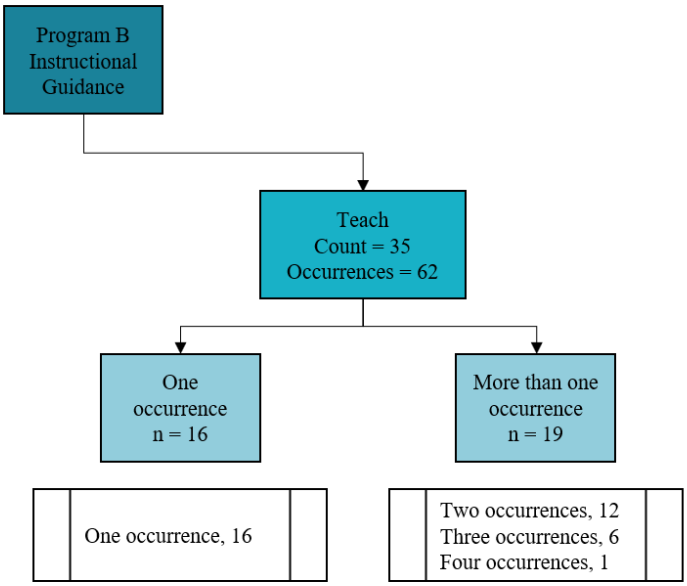
	Connection to Text		
Category and Function	Level 1 (Percent of total teach)	Level 2 (Percent of total teach)	Total (Percent of teach)
Organization	5 (14.29)	3 (8.57)	8 (22.86)
Diagram	1 (2.86)	2 (5.71)	3 (8.57)
Photograph	3 (8.57)	--	3 (8.57)
Timeline	1 (2.86)	1 (2.86)	2 (5.71)
Representation	16 (45.71)	11 (31.43)	27 (77.14)
Diagram	3 (8.57)	1 (2.86)	4 (11.43)
General image	1 (2.86)	2 (5.71)	3 (8.57)
Graph	2 (5.71)	3 (8.57)	5 (14.29)
Map	1 (2.86)	1 (2.86)	2 (5.71)
Photograph	8 (22.86)	3 (8.57)	11 (31.43)
Table	1 (2.86)	1 (2.86)	2 (5.71)
Total	21 (60.00)	14 (40.00)	35 (100.00)

Note. "--" denotes that there is no data to report.

Finally, the graphics were coded for by occurrence—the number of times that the teacher was directed to provide graphical literacy skills instruction about a particular graphic at distinct times during instruction. Figure 23 describes the results. For example, in one manual, the teacher was directed to teach about a cutaway diagram at two discrete times during the reading of one particular text (August et al., 2020c). The first time, during the close reading of the text, the teacher was prompted to ask, "How does the diagram on page 223 help you understand how scientists find and analyze artifacts?" (August et. al., 2020c, p. T239A). The second occurrence was during a second close reading of the text when the teacher was directed to have the students, with a partner, discuss the features of the diagram on page 223.

Figure 23

Program B Teach Occurrence



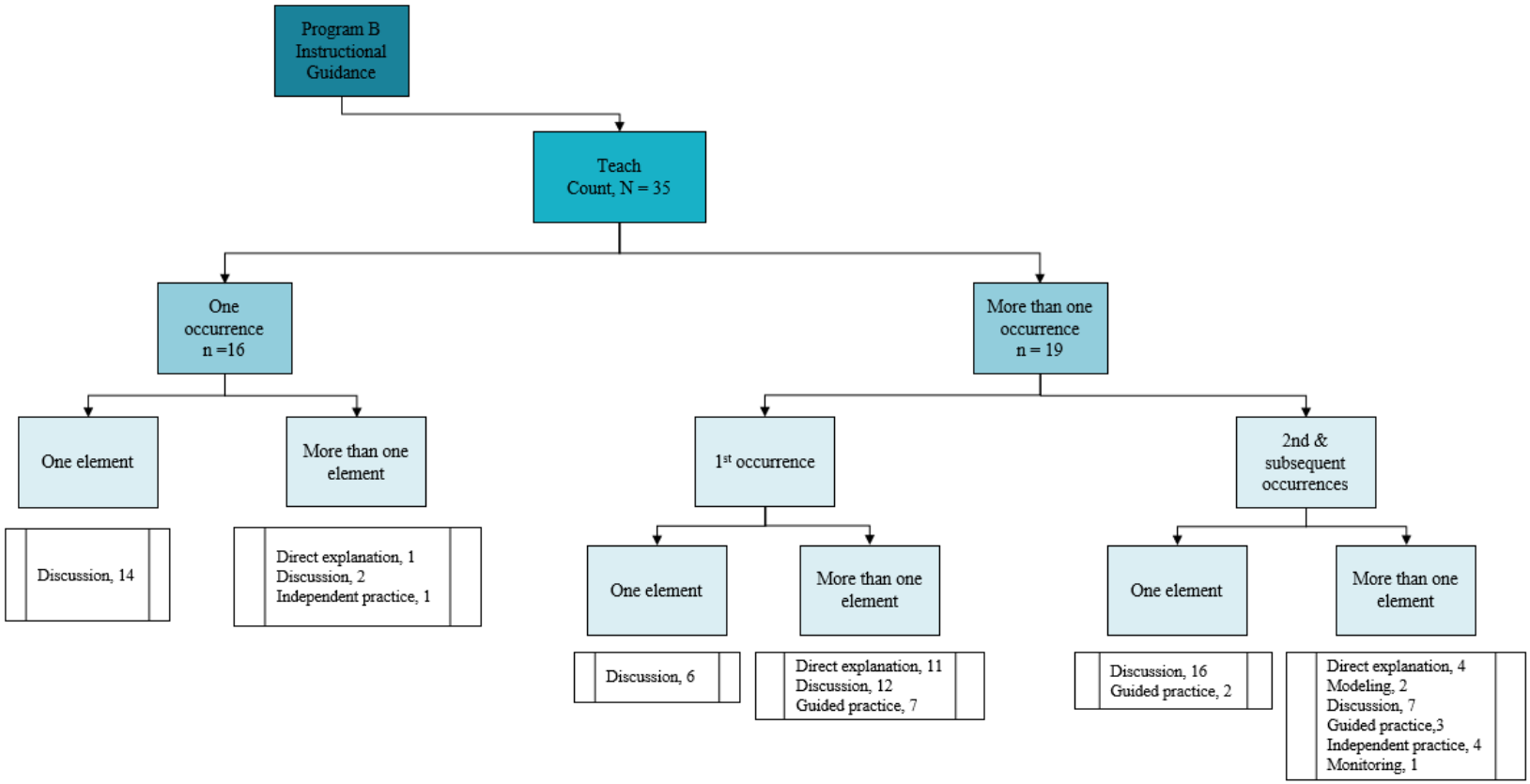
Within the informational texts of Program B, there were 62 occurrences of teach in relation to 35 graphics; 19 graphics (54.29%) had a second, third, or fourth occurrence. When graphical literacy skills instruction occurred, it varied among the 19 graphics coded for multiple occurrences of teach. For example, for several graphics, graphical literacy skills instruction occurred at two separate intervals: (a) first reading of the text and (b) final reading of the text. One graphic, a row and column table, was unique in that the teacher was directed to teach about it at four different times as the students interacted with the informational text.

Explicit Instruction. Graphics coded as teach were also coded for explicit instruction element. Seven a priori codes were identified and Program B incorporated six of them: (a) direct explanation, (b) modeling, (c) discussion, (d) guided practice, (e) monitoring, and (f) independent practice. The only explicit instruction element not coded for in this CRP was feedback.

Figure 24 outlines the counts of explicit instruction elements by occurrence. In Program B, 19 (54.29%) of the 35 graphics had more than one occurrence of teach and more than one element of explicit instruction. Of the 16 graphics that had one occurrence, only two had more than one explicit instruction element.

Figure 24

Program B Explicit Instruction Element



Explicit instruction element by graphic function and category is reported in Table 68. The first column reports the count of graphics for each category. The functions decoration, interpretation, and transformation were omitted because no graphics coded as decoration were also coded for explicit instruction and because no graphics within the census were coded as interpretation or transformation.

The other columns report data by element of explicit instruction. Numerous graphics had more than one element of explicit instruction. There were also several instances in which more than one occurrence of teach had more than one element of explicit instruction. Most of the graphics coded for discussion represented the running text (i.e., were representation function).

Table 68

Program B Explicit Instruction, Function, and Category

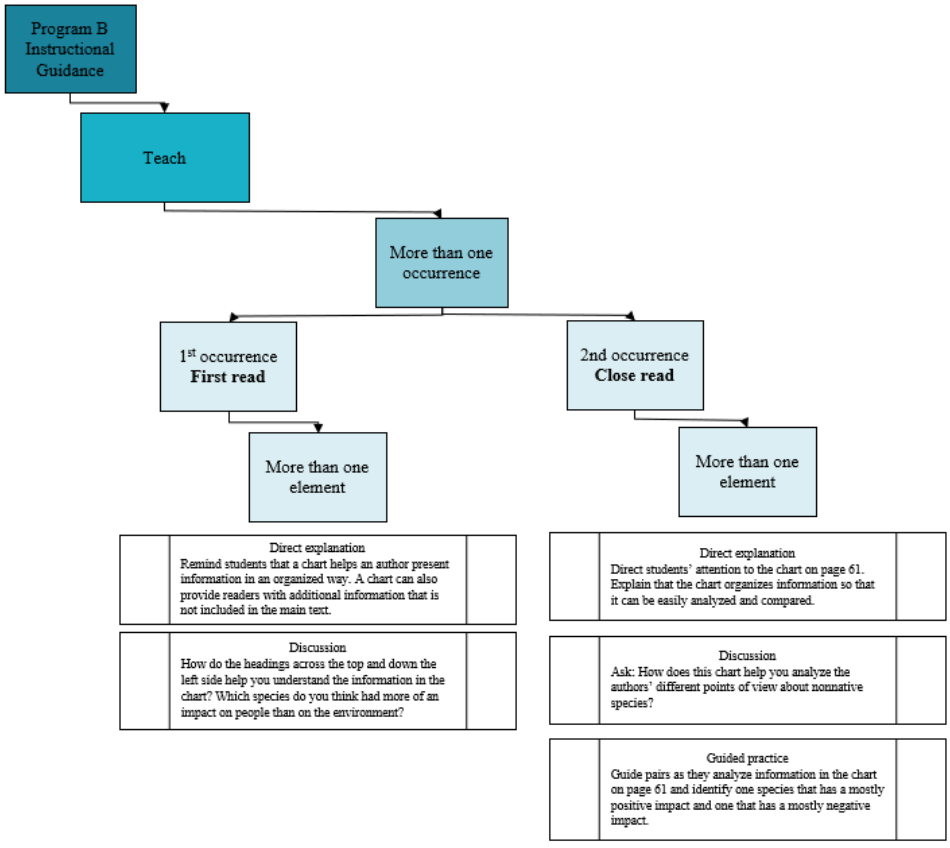
Category	Count of graphics	Direct explanation	Modeling	Discussion	Guided practice	Monitoring	Independent practice
Organization	5	5	--	14	4	--	--
Diagram	3	4	--	8[b]	3[b]	--	--
General image	--	--	--	--	--	--	--
Graph	--	--	--	--	--	--	--
Map	--	--	--	--	--	--	--
Photograph	--	--	--	--	--	--	--
Timeline	2	1[a]	-	3[a,b]	1[a]	--	--
Representation	30	11	2	43	8	1	5
Diagram	4	2[b]	--	7[b]	2[b]	--	1[b]
General image	4	2[a]	--	3[a,b]	1[a,b]	--	1
Graph	5	--	--	8	2[b]	--	--
Map	2	1[b]	1[b]	3[a]	1[b]	1[b]	--
Photograph	13	3[a]	1[a]	17[a,b]	--	--	2[a,b]
Table	2	3[a]	--	5[a,b]	2[b]	--	1[b]
Total	35	16	2	57	12	1	5

Note. "--" denotes that there is no data to report.
[a] Second and subsequent occurrences of teach.
[b] Additional explicit instruction element.

To clarify the findings reported in Table 68, Figure 25 shows an example of the coding of one graphic, a row and column table. In this example, for the first occurrence of teach—the first read—there were two elements of explicit instruction: direct explanation and discussion. The second occurrence of teach—the close read—had three elements of explicit instruction: direct explanation, discussion, and guided practice. Thus, one graphic could be associated with multiple occurrences of teach and multiple elements of explicit instruction as shown in Table 68 and Table 69.

Figure 25

Example of Occurrence and Explicit Instruction, Program B



Note. This model shows one occurrence of teach with more than one explicit instruction element. The model also shows more than one occurrence of teach with more than one explicit instruction element. From "Should Plants and Animals from Other Places Live Here?" by Time for Kids, 2020, *Wonders Teacher's Edition* (Unit 5), p T221 and T226, McGraw-Hill Education.

Explicit instruction was also examined in relation to graphic category and connection to text. Table 69 reports these findings and notes which graphics were indicated for more than one occurrence of teach and more than one element of explicit instruction. Most of the explicit instruction associated with level 1 and level 2 graphics was discussion. Several graphics coded as level 2 were accompanied by direction to provide direct explanation and guided practice. One table coded as connection to text-level 2 had three elements of direct explanation, four elements of discussion, and one element of guided practice. Those explicit instruction elements were spread over four occurrences of teach.

Table 69

Program B Explicit Instruction, Connection, and Category

Category	Count of graphics	Direct explanation	Modeling	Discussion	Guided practice	Monitoring	Independent practice
Level 1	21	8	2	33	7	1	5
Diagram	4	2[a,b]	--	8[a,b]	3[a,b]	--	1[a]
General image	1	1[a]	--	1[a,b]	1[a,b]	--	1[a]
Graph	2	--	--	2	--	--	--
Map	1	1[a]	1[a]	2[a,b]	1[a,b]	1[a,b]	--
Photograph	11	3[a]	1[a]	17[a,b]	--	--	2[a,b]
Table	1	--	--	1[a]	1[a]	--	1[a,b]
Timeline	1	1[a,b]	--	2[a,b]	1[a,b]	--	--
Level 2	14	8	--	24	5	--	--
Diagram	3	4[a]	--	7[a,b]	2[a,b]	--	--
General image	2	1	--	2[b]	--	--	--
Graph	3	--	--	6[a]	2[a,b]	--	--
Map	1	--	--	1	--	--	--
Photograph	3	--	--	3	--	--	--
Table	1	3[a]	--	4[a,b]	1[a,b]	--	--
Timeline	1	--	--	1		--	--
Total	35	16	2	57	12	1	5

Note. "--" denotes that there is no data to report.
[a] Second and subsequent occurrences of teach.
[b] Additional explicit instruction element.

Reference and Teach

Program B had only two graphics that were coded as both reference and teach. One graphic was a single timeline that organized the written text and was easily interpretable (i.e., connection to text-level 1). The teacher was instructed to reference the timeline during the prereading of the text and then teach about the graphic during the first reading. The second graphic coded for both reference and teach was a simple photograph. It was also coded as representation and connection to text-level 1. As with the timeline, the teacher was guided first to direct students' attention to the graphic when introducing the text. The teacher was then advised to teach about the timeline as the students engaged in the first reading of the text.

Program B included 21 informational texts featuring 113 graphics that were coded for graphical literacy skills instruction. Of those 113 graphics, 75 had no instructional guidance and 38 had specific instructional guidance; three were reference, and 35 were teach.

Program C

The final program analyzed for this research was Program C. This CRP included 12 informational texts including 161 graphics that were coded for specific instructional guidance. Of the 12 informational texts, eight (66.67%) included graphics for which the teacher was guided to provide graphical literacy skills instruction. Within Program C, graphics were affiliated with all three categories, (a) no instructional guidance, (b) reference, and (c) teach. The following sections report the data in relation to those

categories as well as data for graphics that were associated with both reference and teach graphical literacy skills instruction.

No Instructional Guidance

As reported, Program C included 161 graphics that met the coding criteria stipulated in the Methods section. Of those 161 graphics, 103 (63.98%) were coded as having no instructional guidance connected to the graphic in the teacher's manual. Nine graphic categories were adopted for the initial analyses. Program C utilized seven of those categories (No graphics were coded as timeline or comic strip.) within the informational texts, and six of those categories were found to have graphics with no instructional guidance. Table 71 displays the following results: a) the count of graphics per graphic category and type, b) the percentage of graphics by total number of graphics coded as no instructional guidance, and c) the percentage of graphics by total number of graphics in Program C.

Table 70

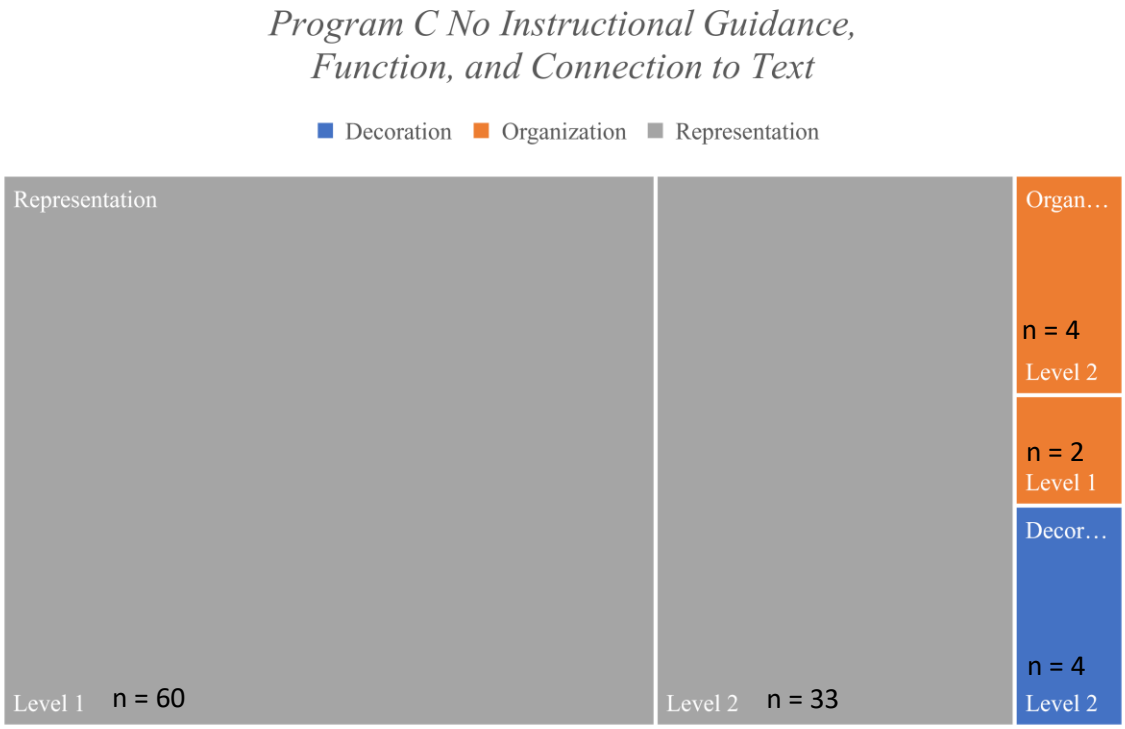
Program C No Instructional Guidance and Graphic Category

Category and type	Count of graphics	Percent (n = 103)	Percent (n = 161)
Photograph	59	57.28	36.65
Cluster photograph	5	4.85	3.11
Simple photograph	54	52.43	33.54
General image	34	33.01	21.12
Computer enhanced/created photography/image	2	1.94	1.24
Magnified image	1	.97	.62
Realistic illustration	31	30.10	19.25
Map	3	2.91	.97
Context map	3	2.91	.97
Diagram	1	.97	.62
Simple diagram	1	.97	.62
Flow diagram	5	4.85	3.11
Cyclical sequence	4	3.88	2.48
Linear sequence	1	.97	.60
Graph	1	.97	.62
Line graph	1	.97	.62
Total	103	100.00	63.98

Most of the graphics coded for no instructional guidance were photographs (n = 59) and general images (n = 34). There were several flow diagrams and maps that also had no instructional guidance associated with them. Analysis of data by graphic type shows that simple photographs and realistic illustrations accounted for more than 80% of the graphics without instructional guidance. These same graphic types also comprised more than 50% of the total number of graphics featured in Program C.

Graphics with no instructional guidance were also evaluated in relation to function and connection to text. Program C included graphics coded as functions decoration, organization, and representation. Data are displayed in Figure 26.

Figure 26



Most of the graphics were representation (90.29%), meaning that they concretized the written text. However, about a third of those graphics coded as representation were also coded as connection to text-level 2. Level 2 graphics are not easily interpretable and require more inferencing. A minimal number of graphics were coded organization and connection to text-level 2.

Reference

In Program C, 66 (40.99%) graphics out 161 total were designated for graphical literacy skills instruction in the teacher's manual. Of those 66 graphics, 15 (22.73%) were indicated for basic instructional guidance, reference, where the teacher was directed to merely acknowledge the presence of the graphic during student engagement with the text.

In relation to those 15 graphics coded as reference, data were compiled by graphic category and type. Table 71 recounts those findings by count of graphic. In addition, percentage of reference total and percentage of program total are reported. Three categories emerged from the data: photograph, general image, and diagram. Photographs, simple photographs, accounted for more than 65% of the graphics that the teacher was directed to point out to the students. Several more complex graphic types were coded for reference, magnified image, bird's eye view diagram, or picture scale diagram.

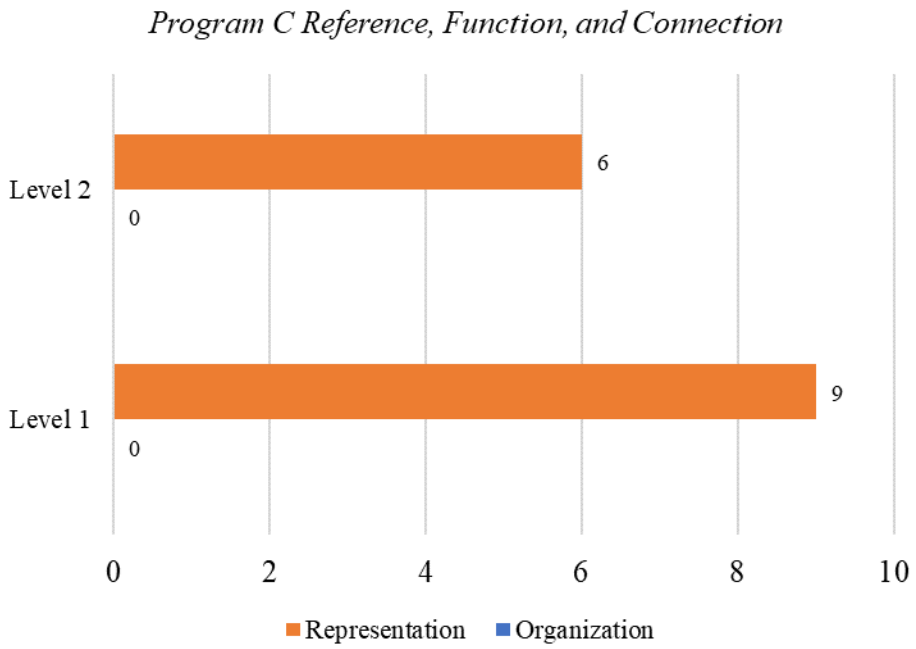
Table 71

Program C Reference and Graphic Category

Category and type	Count of graphics	Percent (n = 15)	Percent (n = 161)
Photograph	10	66.67	6.21
Simple photograph	10	66.67	6.21
General image	2	13.33	1.24
Magnified image	1	6.67	.62
Realistic illustration	1	6.67	.62
Diagram	3	20	1.86
Bird's eye view	1	6.67	.62
Picture scale diagram	1	6.67	.62
Simple diagram	1	6.67	.62
Total	15	100	9.32

Data that evaluated reference, graphic function, and connection to text by graphic count were compiled and Figure 27 shows that only representation graphics were coded as reference. Regarding occurrence of reference (i.e., when the instructional guidance was indicated in the teacher's manual), there was only one occurrence of reference for each graphic coded for reference. Thus, there were 15 occurrences of reference and 15 counts of reference in Program C.

Figure 27



Teach

Program C included 161 graphics from 12 informational texts, and 51 of those graphics were coded for instructional guidance, teach. An overview of the graphics coded as teach is presented, and then data for explicit instruction element are shared.

Table 72 shares the data collected for count of graphic category and type in relation to teach. Within the texts of Program C, seven of the nine a priori graphic categories were identified. (No graphics were coded as comic strip or timeline.) All seven categories included at least one graphic that was accompanied by graphical literacy skills instruction. There was only one table in Program C, and for that graphic the teacher was directed to provide instructional guidance. One of the two maps was also indicated for teach. Photographs accounted for 43.14% of the graphics that the teacher was directed to explicitly teach about. There were also 10 diagrams that were indicated for graphical literacy skills instruction. Those diagrams represented 83.33% of the total count of graphics coded as diagram within Program C.

Of the 16 graphic types utilized within Program C, fifteen were coded as having instructional guidance, teach. The only type not found was linear sequence, and only one was coded for in this CRP.

Table 72

Program C Teach and Graphic Category

Category and type	Count of graphics	Percent (n = 51)
Photograph	22	43.14
Cluster photograph	2	3.92
Simple photograph	20	39.22
General image	13	25.49
Computer enhanced/created photography/image	1	1.96
Fine art	2	3.92
Magnified image	2	3.92
Realistic illustration	8	15.69
Diagram	10	19.61
Bird's eye view diagram	3	5.88
Cross-section	1	1.96
Cutaway diagram	1	1.96
Picture scale	1	1.96
Simple diagram	4	15.69
Flow diagram	2	3.92
Cyclical sequence	2	3.92
Map	2	3.92
Context map	2	3.92
Graph	1	1.96
Line graph	1	1.96
Table	1	1.96
Column table	1	1.96
Total	51	100

Teach, graphic category, graphic function, and connection to text were evaluated, and the calculations are shown in Table 73 by count of graphic. Two of the three graphic functions (organization and representation) coded for across the census were assigned to the graphics also designated for teach. Graphics coded as representation accounted for more than 90% of the graphics that were indicated for instructional guidance, teach. In addition, more than 60% of the graphics were coded connection to text-level 1. A substantial count of graphics coded for teach (31.37%) were also coded as connection to text-level 2 and representation.

Graphical literacy skills instruction was associated with connection to text-level 1 graphics for 35 (68.63%) of the graphics. The teacher was instructed to teach about fewer level 2 graphics. In addition, photographs classified as connection to text-level 1 received more attention than did other types of graphics.

Table 73

Program C Teach, Category, Function, and Connection

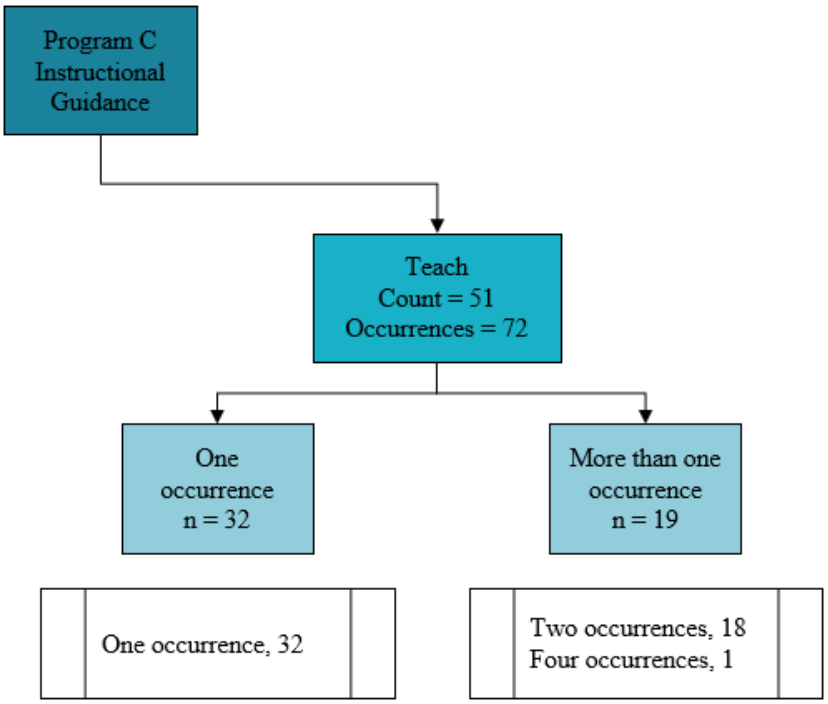
	Connection to Text		
Category and Function	Level 1 (Percent of total teach)	Level 2 (Percent of total teach)	Total (Percent of teach)
Organization	3 (5.88)	1 (1.96)	4 (7.84)
Diagram	1 (1.96)	1 (1.96)	2 (3.92)
Flow diagram	2 (3.92)	--	2 (3.92)
Representation	32 (62.75)	15 (29.41)	47 (92.16)
Diagram	5 (9.80)	3 (5.88)	8 (15.69)
General image	10 (19.61)	3 (5.88)	13 (25.49)
Graph	1 (1.96)	--	1 (1.96)
Map	1 (1.96)	1 (1.96)	2 (3.92)
Photograph	14 (27.45)	8 (15.69)	22 (43.14)
Table	1 (1.96)	--	1 (1.96)
Total	35 (68.63)	16 (31.37)	51 (100.00)

Note. "--" denotes that there is no data to report.

Lastly, the graphics coded for teach were then coded for by occurrence, the count of times when the teacher was directed by the teacher's manual to provide graphical literacy skills instruction about a specific graphic within the teacher's manual. Figure 28 presents the result using a tree diagram. The following is an example of a situation in which a graphic was coded for more than one occurrence of teach. The teacher was directed to teach about a photograph during the first reading of the text and then again during the close reading of the text; thus, the photograph had two occurrences of teach (Coir et al., 2020).

Figure 28

Program C Teach Occurrence

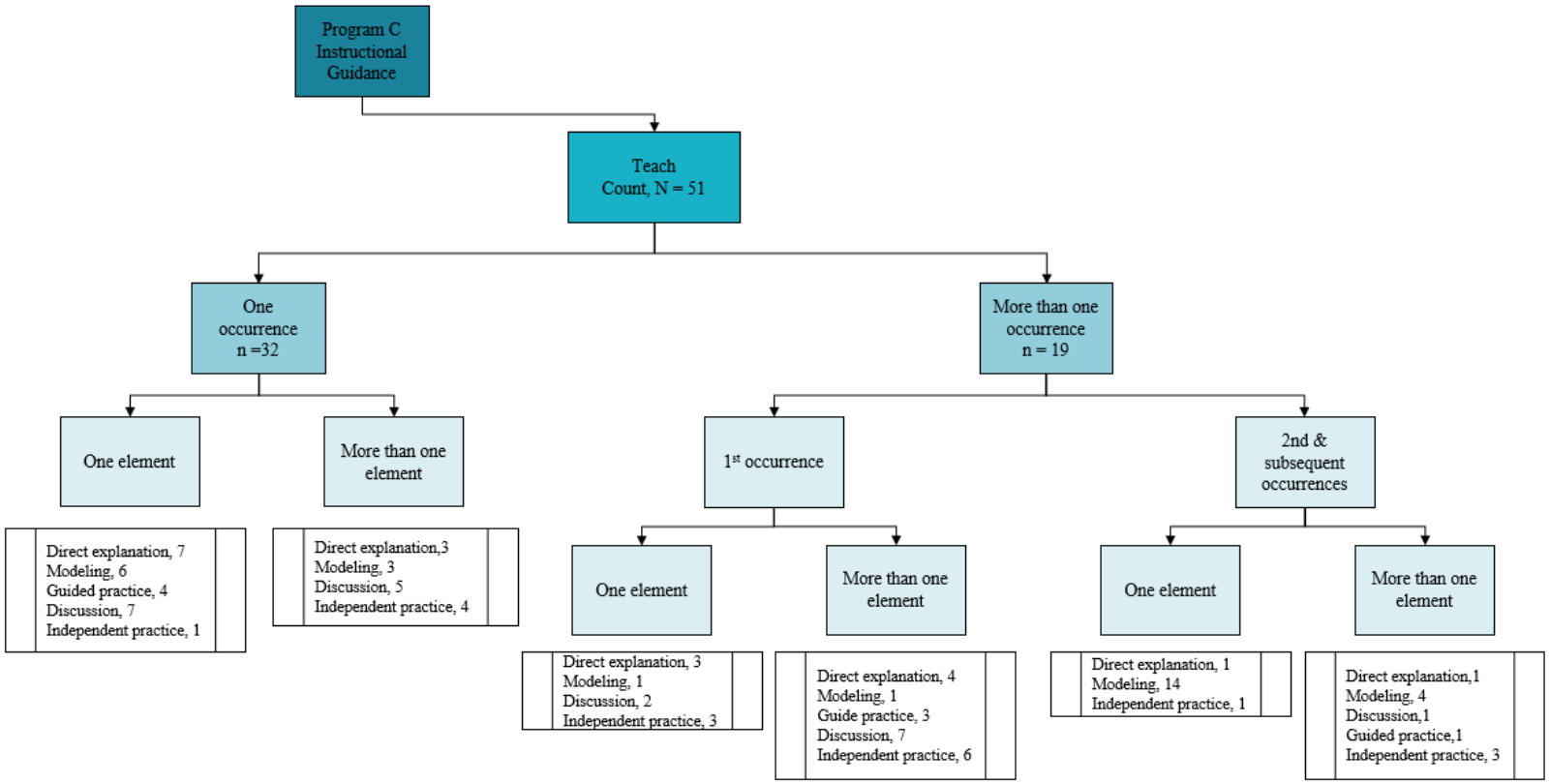


Explicit Instruction. In addition to being coded for instructional guidance, those graphics denoted as teach were coded for explicit instruction element. Of the seven a priori codes selected for this research, Program C used the following five explicit instruction elements: (a) direct explanation, (b) modeling, (c) guided practice, (d) discussion, and (e) independent practice. Figure 29 relates the count of explicit instruction element by occurrence. Most of the explicit instruction indicated for the 51 graphics was for one occurrence of teach and one element. However, there were a few instances when more than one explicit instruction element was indicated.

Nineteen graphics were coded for more than one occurrence of teach. Among these graphics, modeling, discussion, and independent practice figured prominently as explicit instruction elements. Direct explanation and guided practice were not as prevalent in the guidance provided to teachers.

Figure 29

Program C Explicit Instruction Element



The count of explicit instruction element in relation to graphic category and function is outlined in Table 74. The first column states the count of graphics that were coded for an element. The other columns detail the count by element. The count of elements exceeds the count of graphics because more than one element was attributed to several graphics. Only graphic functions and graphic categories with data to report are included in the table.

Most of the graphics for which the teacher was directed to deliver explicit instruction were classified as representation and modeling. A few graphics designated as organization had corresponding instructional guidance, and those graphics had several elements of explicit instruction associated with them. For example, the two organization diagrams reported in Table 74 show that more than one occurrence of teach was associated with each diagram (i.e., independent practice shows $2^{a,b}$ and the superscript a indicates second and subsequent occurrences of teach). Along with those multiple occurrences of teach, the teacher utilized more than one explicit instruction element to teach about the diagram.

Table 74

Program C Explicit Instruction, Function, and Category

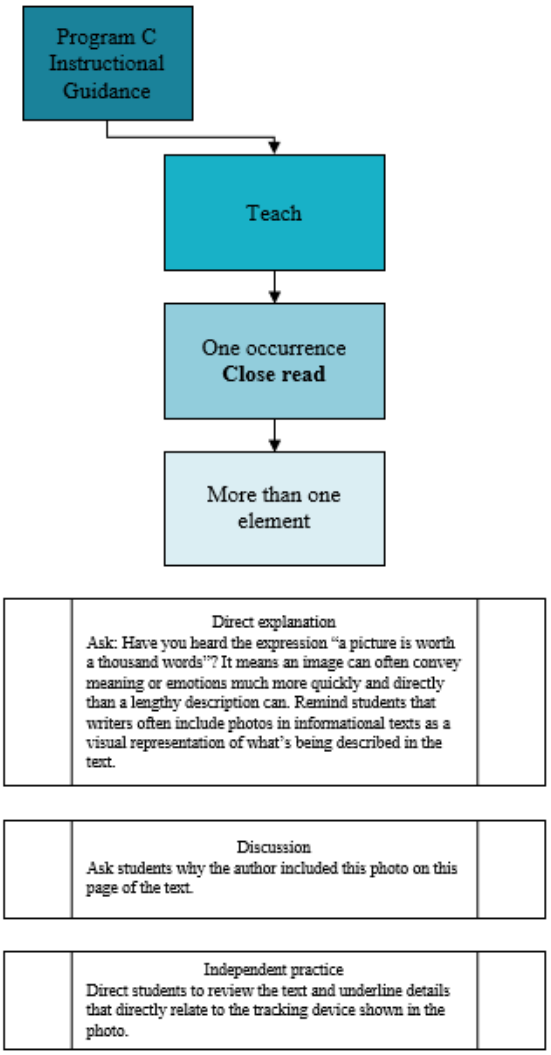
Category	Count of graphics	Direct explanation	Modeling	Discussion	Guided practice	Independent practice
Organization	4	2	3	2	1	4
Diagram	2	2[b]	2[b]	--	--	2[a,b]
Flow diagram	2	--	1	2[a,b]	1	2[a,b]
Representation	47	16	26	21	7	14
Diagram	8	1	2[b]	6[a,b]	1	3[b]
General image	13	10[a]	4	3[a,b]	1[a,b]	2[b]
Graph	1	1	--	--	--	--
Map	2	--	4[a]	1[a]	2[a,b]	--
Photograph	22	4[a]	15[a]	11[a,b]	3	9[a,b]
Table	1	--	1	--	--	--
Total	51	18	29	23	8	18

Note. "--" denotes that there is no data to report.
[a] Second and subsequent occurrences of teach.
[b] Additional explicit instruction element.

To illustrate why the count of elements is greater than the count of graphics, Figure 30 showcases an example of a photograph that was coded for one occurrence of teach and three elements of explicit instruction. Thus, in Table 74 a photograph was coded for direct explanation, discussion, and independent practice with a superscript of "a," indicating additional explicit instruction elements.

Figure 30

Program C Example of Teach with Explicit Instruction



Note. This model shows one occurrence of teach with more than one explicit instruction element. From "Tracking Monsters," M. K. Carson, 2020, *my View Literacy Teacher's Manual* (Unit 2), p. T247, Pearson Education.

Explicit instruction element was also assessed in relation to connection to text and graphic category. Table 75 reports the count of graphics for which explicit instruction was indicated, as well as the count of explicit instruction reported for each element. As with explicit instruction, graphic function, and graphic category, for some graphics (See superscript notation), more than one occurrence of teach and explicit instruction element were observed. Table 76 reflects these data. Most of the instruction associated with connection to text-level 1 and level 2 graphics was modeling.

Table 75

Program C Explicit Instruction, Connection, and Category

Category	Count of graphics	Direct explanation	Modeling	Discussion	Guided practice	Independent practice
Level 1	33	14	16	15	4	11
Diagram	6	2	3[b]	4[a,b]	--	3[b]
Flow diagram	2	--	1	2[a.b]	1	2[a.b]
General image	9	8[b]	2[a.b]	2	1[a,b]	1[a,b]
Graph	1	1	--	--	--	--
Map	1	--	1	--	--	--
Photograph	14	3[b]	8[b]	7[a,b]	2	5[a,b]
Table	1	--	1	--	--	--
Level 2	18	4	13	8	4	7
Diagram	4	1[b]	1	2	1	2[a.b]
General image	4	2	2	1[b]	--	1[b]
Map	1	--	3[a]	1[a]	2[a.b]	--
Photograph	8	1	7[a]	4[a,b]	1	4[a,b]
Total	51	18	29	23	8	18

[a] Second and subsequent occurrences of teach.
[b] Additional explicit instruction element.

Reference and Teach

A subset of graphics were coded as both reference and teach within Program C. Across the 65 graphics coded for graphical literacy skills instruction (i.e., specific instructional guidance), the teacher was guided to reference and teach about eight (i.e., each count of instructional guidance was also reported in data for reference or teach) at two distinct times during engagement with the informational text. For example, instruction about a simple diagram was first indicated for the first reading of the text when the teacher was directed to mention that there is a diagram on page 232 (Coiro, J. et al., 2020b). This was coded as reference. The second time the teacher was directed to provide instruction was during the close reading of the text as the teacher engaged the students in discussion about the simple diagram. Table 76 reports the classifications for those graphics that were coded as both reference and teach.

Table 76

Program C Reference and Teach Graphics

Graphic category and type	Function	Connection to text	Count
Diagram			
Picture scale diagram	Representation	Level 2	1
Simple diagram	Representation	Level 1	1
General image			
Magnified image	Representation	Level 2	1
Photograph			
Simple photograph	Representation	Level 1	4
Simple photograph	Representation	Level 2	1

Several multifaceted graphics, picture scales and magnified images, were first referenced before the teacher provided more explicit instruction in relation to the graphic. However, half of the graphics coded for reference and teach were representation photographs and were easily connected to the running text.

Graphical literacy skills instruction was associated with 58 (36.25%) graphics in Program C. The teacher was guided to reference and teach about a small number of graphics (4.97%). For most of the graphics (n = 103), no instructional guidance was indicated.

Comparisons

A Chi-square test was performed to establish whether a difference existed in the proportions of graphics coded for the kinds of instructional guidance (e.g., no instructional guidance, reference, teach) and publisher. The calculation was computed for graphic and a single occurrence. For the graphics coded with instructional guidance reference or teach, this was the initial coding of instruction; subsequent instruction (i.e., more than one occurrence of reference or teach) was not addressed in the Chi-square analysis. That is a limitation of this study.

The null hypothesis stated that there was no difference in proportions of instructional guidance between publishers. However, the results from the Chi-square test show that there is a difference in the proportions of instructional guidance across publishers, $\chi^2(4, N = 494) = 52.483$, $\rho < .05$, with a medium effect (Cramer's V = .23; Cohen, 1988). Table 77 indicates type of instructional guidance, frequency, first occurrence, and percentage by publisher.

Table 77

Instructional Guidance Frequencies by Publisher for Chi-square

Instructional Guidance	Publisher			Total
	Program A	Program B	Program C	
No instructional guidance	147 (66.18%)	75 (66.37%)	103 (63.98%)	325 (65.79%)
Reference	51 (23.18%)	3 (2.65%)	12 (7.45%)	66 (13.36%)
Teach	22 (10%)	35 (30.97%)	46 (28.57%)	103 (20.85%)
Total	220 (100%)	113 (100%)	161 (100%)	494 (100%)

Examination of Table 77 indicates that Programs A, B, and C had functionally equivalent counts of graphics coded with no instructional guidance. In addition, Program B and Program C had similar proportions of reference and teach. However, Program A had more occurrences of reference (23.18%) than did either Program B (2.65%) or Program C (7.45%) and fewer occurrences of teach (10%) when compared with Program B (30.97%) and Program C (28.57%).

Interrater Reliability

Systematic interrater reliability checks were conducted on 20% of the census using Cohen's kappa. Detailed information about the process was outlined in the "Coding" section of Chapter III, Methods. All reliability results (presented in Table 78) were above acceptable limits.

Table 78

Interrater Reliability

Text	Graphic Category kappa	Graphic Type kappa	Graphic function kappa	Connection to text kappa	Instructional guidance kappa	Explicit instruction element kappa
3 and 8	1	1	1	.7	1	.87
13 and 15	.86	.84	1	.82	1	.89
29 and 30	1	1	1	.85	1	1
37 and 40	1	1	.89	.81	1	1
45 and 49	.87	.83	1	.82	1	.83

Conclusion

The results reported for this content analysis show that several types of graphics were present in the informational texts included in the fifth-grade core reading programs analyzed. In addition, the function of said graphics were identified as decoration, organization, or representation. The other two functions, interpretational and transformational, were not found. This analysis also showed that the connection of graphics to the running text was variable among graphic types and across programs. Furthermore, graphical literacy skills instruction as a component of literacy instruction in the CRP teachers' manuals was documented for a limited number of graphics, most of which were representation photographs.

A synthesis and review of the results is presented in the section titled "Discussion." In this section, this study's research questions are addressed in light of the findings and how the results relate to prior research as identified in the literature review.

CHAPTER V

DISCUSSION

This research examined the graphics used in the informational text selections of the 2020 editions of three fifth-grade CRPs that were published by the dominant publishing companies in the United States (Brown, 2017; Dewitz et al., 2009). The researcher used Neuendorf's (2017) model for content analysis research to address the following questions:

1. What types of graphics are presented in the informational texts included in CRP student textbooks?
2. What are the functions of the graphics in these informational texts?
3. To what extent are graphical literacy skills presented as a component of literacy instruction in the CRP teachers' manuals related to these graphics?

The following sections discuss the findings from this study: (a) "Summary of Results," (b) "Themes", (c) "Recommendations," (d) "Future Research," (e) "Limitations and Delimitations," and (f) "Conclusion."

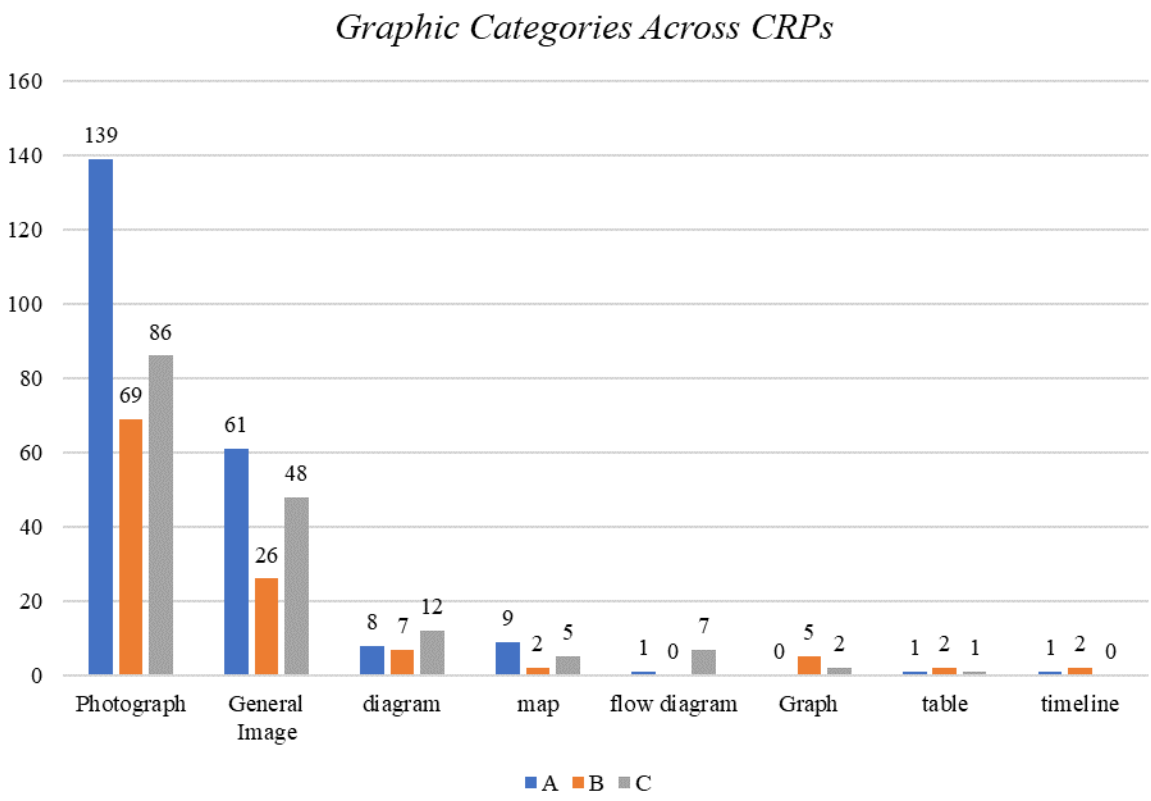
Summary of Results

This section summarizes the data from the study in relation to the three research questions that guided this analysis. The data are presented in the following sub-sections: (a) "Graphic Category and Type," (b) "Graphic Function and Connection to Text," and (c) "Graphical Literacy Skills Instruction."

Graphic Category and Type

The researcher used graphic category, a broad descriptor, to classify the different graphics used in the informational texts in CRPs. Of the nine a priori categories (See Appendix A, "Detailed Coding Scheme for Graphic Categories and Types," for descriptions.), only eight were found: (a) diagram, (b) flow diagram, (c) general image, (d) graph, (e) map, (f) photograph, (g) table, and (h) timeline. The researcher identified no graphics that aligned with the definition of comic strip. Figure 31 shows the count of graphics by CRP.

Figure 31



CRPs used photographs more often in their informational text selections than other categories of graphics. Of the 494 graphics coded, 59.51% were photographs. Program A and Program B featured functionally equivalent percentages of photographs, at 63.18% and 61.05% respectively. In Program C, there was a smaller percentage of photographs (53.42%), but those photographs still accounted for more than 50% of the graphics used by the publisher. Fingeret (2012) and Guo et al. (2018) reported similar findings in their research.

General image was the second most common category found in the informational texts of CRPs. Across the census, 27.33% of the graphics were general images. Programs A and C included functionally equivalent percentages of general images (27.73% and 29.81%, respectively) and Program B featured a smaller percentage of general images (23.01%).

The remaining graphic categories—diagram, flow diagram, graph, map, table, timeline—accounted for only 13.17% of the total graphics across the three CRPs. Within the three programs, Program A contained the lowest percentage of these types of graphics at 9.08% combined. Programs B and C had similar percentages at 15.92% and 16.77%. One notable difference between the programs is which graphics they omitted. Program A had no graphs, Program B had no flow diagrams, and Program C had no timelines. Fingeret (2012) reported like findings with 13.57% of the remaining graphics being comprised of diagrams, flow diagrams, graphs, maps, tables, and timelines.

The researcher also examined graphic categories as they were used in disciplinary area texts: (a) art, (b) science, and (c) social studies. There were only three texts about the arts, and photographs were primarily used. Both science and social studies texts featured

more photographs (57.82% of graphics in science texts and 60.44% of graphics in social studies texts) than any other category. Fingeret (2012) and Guo et al. (2018) reported like findings.

As with Fingeret's (2012) and Guo et al.'s (2018) content analyses, this study further delineated graphic category into graphic type—a more precise descriptor used to identify each graphic (See Appendix A, "Detailed Coding Scheme for Graphic Categories and Types," for descriptions.) There were 48 a priori codes for graphic type, but the researcher found only 27 in the CRPs analyzed for this study. Simple photographs were the predominant graphic type used in all three programs. The second most common type of graphic differed by program. The graphic type collage was found only in Program A, and it was the second most common type after simple photograph. In Program B, fine art was the second most common type of graphic and in Program C, realistic illustration.

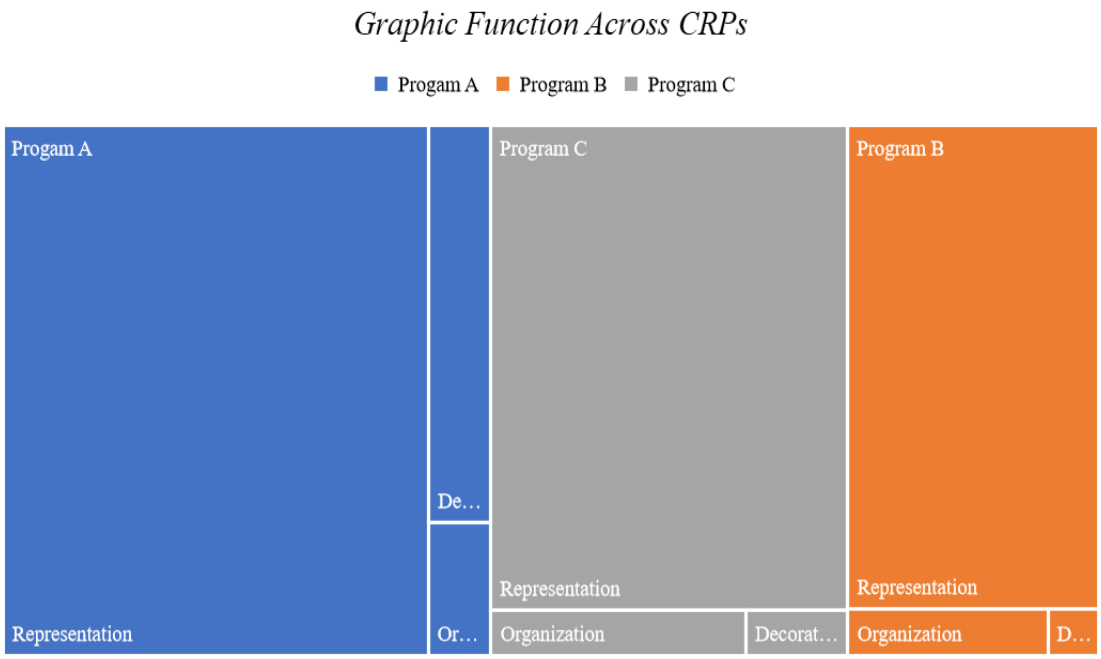
The results of this study support the findings from previous research that photographs are the primary graphic used in informational texts to convey information (Fingeret, 2012, Guo et al., 2018, Saynay, 2014). In addition, this research reinforces prior findings that general images are the second most common type of graphic (Fingeret, 2012, Guo et al., 2018, Saynay, 2014). The next section reviews the findings from this study for graphic function and connection to text.

Graphic Function and Connection to Text

The researcher also examined the graphics for graphic function (See Table 15, "Coding Scheme for Graphic Functions," for definitions.) The researcher adopted the following five a priori categories based on prior research: (a) decoration, (b) interpretation, (c) organization, (d) representation, and (e) transformation (Levin, 1979;

Fingeret, 2012; Guo et al., 2018; Saynay, 2014; Slough & McTigue, 2013). The purposes for including graphics in the informational texts aligned with three of these functions: decoration, organization, and representation. The results from this study found no graphics that functioned as interpretation (i.e., clarified difficult-to-understand text and abstract concepts) or transformation (i.e., utilized mnemonics to make text more memorable). Figure 32 shows the relative proportion of graphic function by CRP in relation to the size of the rectangle.

Figure 32



Across the three CRPs, the most frequent graphic function was representation, and representation graphics concretize the written text (Carney & Levin, 2002). The coders coded 89.47% if the graphics as representation. The percentage of graphics coded as representation was similar across programs. In Program A, 87.27% of the graphics were representation, in Program B 91.15% were representation, and in Program C 91.30% were representation. In addition, photographs (61.09%) and general images (24.69 %) were the most common categories for representation graphics. This research supports the findings from previous studies (Fingeret, 2012; Guo et al., 2018; Saynay, 2014).

Organization graphics (those that structuralize the written text) accounted for 5.06% of the total graphics used by CRP publishers. The types of graphics that functioned as organization were primarily diagrams and flow diagrams. The results from this study supplement the findings reported by Fingeret (2012).

Decoration was the final graphic function identified. Of the 494 graphics coded in total, 5.47% were decoration. This finding is surprising given that the researcher adopted several exclusions (explained in Table 14), like those employed by Fingeret (2012) and Guo et al. (2018), to eliminate graphics that had no instructional purpose. It is notable that the only graphics coded as decoration were either photographs or general images. For decoration graphics, this study's findings are consistent with those reported by Fingeret and Guo et al.

The results from this study support previous research, which also found representation to be the most common function of the graphics included in informational texts. In addition, like in other research, this study found few graphics that function as

organization, and no graphics that functioned as interpretation or transformation. These findings are consistent with those of Fingeret (2012) and Guo et al. (2018).

The researcher also analyzed the graphics for connection to text. Two levels were identified, a) level 1—information in the graphic could easily be interpreted by the reader and connected easily with the running text and b) level 2—information in the graphic may be difficult to interpret and required inferencing or background knowledge to make a connection (Guo et al., 2018).

Across the census, most of the graphics were level 1 (61.94%) and the results by CRP also indicated level 1 prevalence. However, the percentages of level 1 and level 2 graphics varied by program and disciplinary area. Program B featured the highest percentage of graphics coded as level 1, 72.57% and the lowest percentage of graphics coded as level 2, 27.43%. In Program A, 56.36% of the graphics were level 1 and 43.64% were level 2. Of the graphics featured in Program C, 62.11% were level 1 and 37.89% were level 2.

Regarding disciplinary area, the results for Program A found that social studies texts included a higher percentage of level 1 graphics (36.82%), and science texts featured a higher percentage of level 2 graphics (24.09%). Program B used a higher percentage of level 1 graphics in science texts (41.59%), but functionally equivalent percentages of level 2 graphics in science (13.27%) and social studies (14.16%) texts. Program C used a higher percentage of level 1 (56.52%) and level 2 (33.54%) graphics in science texts than social studies texts (level 1, 5.59% and level 2, 4.35%). Guo et al. (2018) reported similar findings in their analysis of social studies and science textbooks.

This section reviewed the results for graphic function and connection to text. The next section summarizes the findings regarding graphical literacy skills instruction included in the CRPs' teachers' manuals that were associated with the identified graphics.

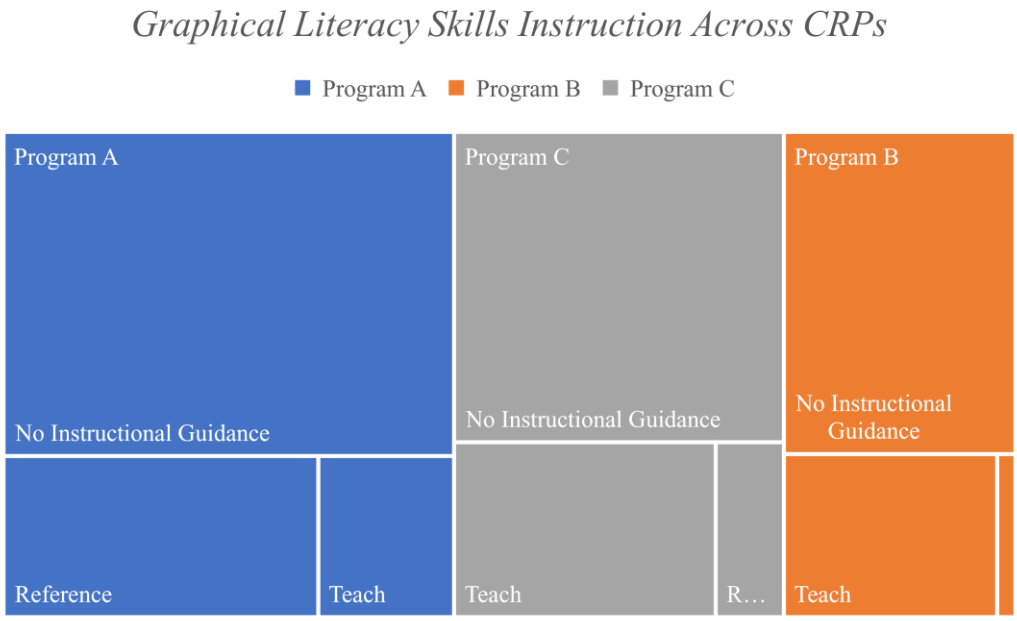
Graphical Literacy Skills Instruction

This study examined graphical literacy skills instruction in the CRP teachers' manuals in relation to the graphics initially identified in the students' textbooks. The researcher assessed graphical literacy skills instruction using the following categories:

- no instructional guidance—there was no pedagogical guidance associated with the graphic in the teacher's manual.
- reference—the pedagogical guidance directed the teacher to verbally reference the graphic, but no other instruction took place.
- teach—the pedagogical guidance directed the teacher to provide explicit instruction about the graphic.

Figure 33 shows the relative proportion, in relation to the size of the rectangle, of specific graphical literacy skills instruction in each CRP. The following sub-sections, (a) "No Instructional Guidance," (b) "Reference," and (c) "Teach," summarize the findings.

Figure 33



No Instructional Guidance

The census consisted of 494 graphics for which 65.79% had no instructional guidance associated with them. The results by CRP are similar to those of the census. In Program A, 66.82% of graphics had no instructional guidance, in Program B 66.27% had no instructional guidance, and in Program C 63.98% had no instructional guidance.

Program B was unique in that the only graphics without instructional guidance were photographs and general images. Program A featured maps and timelines that were not indicated for graphical literacy skills instruction, and Program C had the greatest number of categories of graphics without instructional guidance. The categories excluded in Program C were the following: (a) diagram, (b) flow diagram, (c) general image, (e) graph, (f) map, (g) photograph, and (h) timeline. Of those graphics without instructional guidance in Program C, several were classified as complex graphics.

Most of the graphics (39.47% across the census) coded with no graphical literacy skills instruction were representation photographs and connection to text-level 1. In Program A, the researcher found that 37.41% of level 1 representation photographs had no instructional guidance. Program C included 32.04% level 1 representation photographs, and Program B featured the largest percentage at 54.57%.

The researcher also determined that connection to text-level 2 graphics without instructional guidance were as follows: (a) Program A, 49.66%; (b) Program B, 21.33%; and (c) Program C, 39.81%. Most of the level 2 graphics were representation photographs. Program C had more variability among level 2 graphic categories without instructional guidance. Graphics included flow diagrams, maps, and one graph. This research study supports research by Saynay (2014), who found that there is limited pedagogical guidance in teachers' manuals to promote graphical literacy skills instruction.

Reference

Reference was the code used to describe graphical literacy skills instruction that guided the teacher to refer to a graphic. Of the 169 graphics in the census that were selected for instructional guidance, the teacher was directed to reference 42.01% at least once. In addition, most of those graphics were level 1 representation photographs.

The results vary by CRP and are more nuanced. In Program A, 23.18% of the total count of graphics were indicated for reference. Most of these were level 1 photographs that connected easily to the written text (43.14%). However, there was a percentage of complex graphics (19.61%) that were connection to text-level 2, and they required additional inferencing or background knowledge for understanding to occur.

Graphics designated for instructional guidance, reference in Program B accounted for 4.42% of the total count of graphics in this CRP. Of those graphics, most were level 1 representation photographs. There was only one complex graphic, a single timeline, that was indicated for reference.

Program C also included reference as a component of graphical literacy skills instruction. The teacher was directed to provide basic instructional guidance for 9.37% of the total count of graphics, and representation graphics were the only graphics coded for reference. A subset of reference graphics was connection to text-level 2 and 16.67% were complex graphics.

The findings for Programs B and C align with the results of Saynay's (2014) study which found that for less than 10% of the graphics, the teacher was directed to provide basic instructional guidance. Program A had more graphics that were reference, basic instructional guidance, than did Programs B or C.

Teach

The final categorization for instructional guidance was teach—explicit instruction elements were specified for a particular graphic. Across the census, 132 graphics (26.72%) were designated for teach. Most of these graphics (39.39%) were photographs, but general images also accounted for a substantial portion (25.75%). In addition, for several of these graphics, the teacher was directed to teach about the graphic several times during students' engagement with the text. This resulted in 183 occurrences of explicit instruction across 132 graphics. Although repeated instructional guidance was associated with a few graphics, the researcher found that most of these graphics were representation photographs that were easily interpretable.

The findings across CRPs were similar to those of the census. Program A featured 46 graphics (20.91% of the total count of graphics in Program A) denoted for teach, and they were primarily level 1 representation general images (36.96%). For three of those graphics, there were two instances of explicit instruction. Thus, there were 49 occurrences of teach in Program A.

A notable finding was the number of complex graphics that were specified for teach. In Program A, 66.67% of complex graphics were indicated for specific instructional guidance. They included seven out of a total of eight diagrams, four out of a total of nine maps, and the lone table. In addition, Program A also featured the greatest number of graphics for which graphical literacy skills instruction was two-fold, reference then teach. The teacher was directed to reference and teach about 24 (30.83%) of the 73 graphics identified for instructional guidance.

In Program B, 35 graphics (30.97% of the total count of graphics in Program B) were indicated for teach and representation photographs accounted for 31.43% of these. In addition, 19 graphics had more than one occurrence of teach associated with them. (Twelve graphics had two occurrences, six graphics had three occurrences, and one graphic had four occurrences.) Thus, across the 35 graphics there were 62 occurrences of teach. In addition, the teacher was directed to teach about all 18 complex graphics that were featured in Program B. Finally, there were only two graphics in Program B, a timeline and photograph, that received both types of instructional guidance, reference and teach.

The teachers' manuals for Program C directed the teacher to provide instructional guidance teach for 31.68% of the total count of graphics. Of the 51 graphics designated

for teach, Program C had 19 graphics that had more than one occurrence of teach, which resulted in 72 occurrences. (Eighteen graphics had two occurrences of teach. One graphic had four occurrences of teach.) In addition, out of the 65 graphics that had associated graphical literacy skills instruction (either reference or teach), the teacher was guided to reference and then teach about eight at two distinct times during engagement with the informational text.

Of the graphics in Program C that had associated specific instructional guidance, most were photographs (43.14%). There was also a portion of complex graphics that were indicated for teach. The pedagogical guidance in the teachers' manuals of Program C directed the teacher to explicitly teach about 51.85% of these graphics.

Programs B and C featured functionally equivalent percentages of graphics where the teacher was directed to explicitly teach about the graphic. This finding supports prior research by Saynay (2014). Saynay reported that 32% of graphics in a second-grade basal reader had good or excellent support. Instructional guidance, teach would be comparable to Saynay's category. Program A, however, featured the least number of graphics that were designated for instructional guidance, teach.

Teach was further delineated into explicit instruction element to ascertain the level of instructional guidance the teacher was directed to provide. The researcher considered seven elements of explicit instruction. They were (a) direct explanation, (b) modeling, (c) discussion, (d) guided practice, (e) feedback, (f) monitoring, and (g) independent practice (Reutzel et al., 2014). The researcher also assessed every teach graphic for elements of explicit instruction. The researcher found that the most common element was discussion (i.e., the teacher was directed to ask a question to elicit discourse

about a graphic). This was the case for 71.21% of the graphics. Feedback was the only explicit instruction element not used in any CRP, and the presence of the remaining explicit instruction elements varied by CRP.

In Program A, three explicit instruction elements were used to teach about the graphics, (a) discussion, (b) guided practice, and (c) independent practice. Of the 46 graphics that were selected for graphical literacy skills instruction, 89.13% had only one element of explicit instruction. Discussion was the primary element used to teach about a graphic, and 80.43% of graphics were accompanied by instructions for a whole group and/or partner discussion.

Program B incorporated six of the seven elements: (a) direct explanation, (b) modeling, (c) discussion, (d) guided practice, (e) monitoring, and (f) independent practice. Though most of the elements were utilized, they were used in different proportions. Of the 35 graphics designated for instructional guidance, teach, 100% featured the explicit instruction element discussion. This finding was unique to Program B.

The second most common explicit instruction element in Program B was direct explanation, meaning that the teacher clearly and concisely explained how to read and interpret the graphic. The instructional guidance for 34.29% of teach graphics was direct explanation. There was minimal use of the other three elements. There were two instances of modeling, one instance of monitoring, and five instances of independent practice. All three of these elements occurred in combination with another element (i.e., a map with direct explanation and independent practice). In addition, Program B combined explicit instruction elements (i.e., discussion and direct explanation were used in

conjunction to teach about a timeline) for 60% of the graphics that had associated graphical literacy skills instruction.

Program C incorporated five of the seven explicit instruction elements to provide graphical literacy skills instruction. Those five elements were (a) direct explanation, (b) modeling, (c) guided practice, (d) discussion, and (e) independent practice. In Program C, the teacher was directed to provide explicit instruction using modeling for 50.98% of the teach graphics; discussion was indicated for 41.17%, and direct explanation was specified for 31.37%. Although most of the graphic interpretation that was modeled (meaning that the teacher demonstrated and described how to read and analyze the graphic) was for photographs or general images, there was also a subset of more complex graphics including diagrams, flow diagrams, tables, and maps that were indicated for modeling. Program C also combined explicit instruction elements for graphical literacy skills instruction. Of the 51 graphics that were to be explicitly taught, 50.98% had more than one element.

The results from this analysis found that discussion was the explicit instruction element most often used for instructional guidance, teach. The use of other explicit instruction elements varied by program. However, no program included feedback as a component of graphical literacy skills instruction. There are similarities regarding implementation of explicit instruction elements when the findings are compared with those reported by Reutzel et al. (2014). These researchers reported that discussion was one of the elements most often recommended in CRP lessons for reading instruction, and the least recommended element was feedback.

The findings from this study do not align with the recommendations of several researchers (Archer & Hughes, 2011; Fien et al., 2015: Graham et al., 2012; Graham et al., 2016; Hughes et al., 2017; Kamil et al., 2008), who have argued that explicit instruction is one of the most effective methods for educators to use for instruction.

This section summarized the findings from this analysis of fifth-grade CRP students' textbooks and teachers' manuals. The next section discusses the themes of this research in relation to these results.

Themes

Upper-elementary students are being tasked with reading increasingly complex informational texts in preparation for the writings they will encounter in secondary education disciplinary area classrooms (Shanahan & Shanahan, 2014) and for college and careers (NGA & CCSSO, 2010). Included in these texts are diverse types of multifaceted graphics that represent, organize, and transform the written text (Fingeret, 2012; Guo et al., 2018; Meyers, 1993; Walpole, 1998). This study categorized the graphics used in the informational texts of fifth-grade CRPs for category, type, and function. In addition, this study identified the inclusion of graphical literacy skills instruction as pedagogical guidance for upper-elementary school teachers. This section synthesizes the research findings and presents the themes that emerged.

Theme One: A Uniform Graphics Typology is Needed in Education

The results of this study confirm that eight of the nine a priori terms used to distinguish graphics by category are consistent across disciplinary areas. These categories are: (a) diagram, (b) flow diagram, (c) general image, (d) graph, (e) map, (f) photograph,

(g) table, and (h) timeline. (See Appendix A, "Detailed Coding Scheme for Graphic Categories and Types," for descriptions.) The researcher found no graphics that met the definition of comic strip in the informational texts assessed for this content analysis. However, prior research has documented the inclusion of comic strip in social studies and science trade books and textbooks (Fingeret, 2012; Guo et al., 2018). Thus, a graphics typology to be used by teachers and educational researchers should include the category comic strip.

Textbook publishers, educational researchers, teacher educators, and teachers need to use these nine categories to describe and discuss the various types of graphics students encounter. By incorporating a graphics typology across grade levels and disciplinary areas, students' learning should increase because they will receive repeated exposure to and practice with these graphics. In addition, a uniform typology should solidify the concept that the core subjects are interrelated.

Theme Two: CRPs Need More Disciplinary Area Informational Texts

The results from this study confirm that the informational texts in CRPs are primarily about social studies and science topics. No CRPs used in this study included informational texts focusing on math or mathematical concepts. Program A did feature texts about the arts. However, they represented only a seventh of the texts in that program.

CRPs need to include more informational texts about the arts and math. The inclusion of these topics will show students that the graphics used in disciplinary areas are consistent across the curriculum. In addition, the inclusion of diverse types of

disciplinary area texts will assist upper-elementary teachers in preparing students for the literacy demands of secondary school (Shanahan & Shanahan, 2014).

Theme Three: Graphic Types Used in Disciplinary Area Texts Need to be Used in the Informational Texts in CRPs

The results from this study confirm that there are discrepancies between the types of graphics featured in social studies and science textbooks and those used in the informational texts found in CRPs. This study used 47 a priori codes to analyze the graphics used in the CRP students' textbooks (Collage, the 48th type, was added during coding.), and only 27 were used in the informational text selections. The following 21 graphic types were not included: (a) content comic strip, (b) entertainment comic strip, (c) forked sequence, (d) tree diagram, (e) web diagram, (f) characters, (g) image cluster, (h) logo, (i) radar image, (j) scientific model, (k) screen shot, (l) stop motion, (m) x-rays, (n) pyramid chart, (o) Venn diagram, (p) landmark map, (q) street map, (r) topographical map, (s) pictorial table, (t) row table, and (u) multiple timeline. (See Appendix A, "Detailed Coding Scheme for Graphic Categories and Types," for descriptions.)

CRPs are not including numerous types of graphics (see the list above) that students will encounter in secondary school disciplinary area classrooms and texts for college and careers. Upper-elementary school literacy classrooms should be preparing students for disciplinary area literacy demands (McTigue & Flowers, 2011; Roberts et al., 2018). Adequate preparation includes experience in reading and interpreting the various types of graphics included in disciplinary area texts (Shanahan and Shanahan, 2014).

Theme Four: The Informational Texts in CRPs Need More Complex Graphics

The results from this study confirm that there are very few complex graphics (e.g., diagrams, flow diagrams, graphs, maps, tables, and timelines) used in the informational texts found in CRPs. (Across the census, only 13% of the graphics used were maps, graphs, tables, etc.) In addition, several types of complex graphics appeared only once in a CRP or were excluded all together. For example, Program A included only one table in one informational text, and no graphs were used in any informational text. These data are cause for concern because CRPs are typically used in the literacy classroom over a nine-month school year. Therefore, students saw only one table in one informational text over the course of nine months of instruction, and they did not see any graphs used in any informational text.

CRPs are the primary educational resource for reading instruction in upper-elementary literacy classrooms (Brown, 2017; Dewitz, 2009) and, for many students, the only exposure they receive to informational texts is in the literacy classroom (Blank, 2013; Heafner & Pitchitt, 2012). The dearth of complex graphics in CRPs is problematic because these graphics are increasingly used in contemporary informational trade books (Smith & Robertson, 2019), multi-modal texts (Kress, 2003), standardized assessments (Wixon, 2014; Yeh & McTigue, 2009), and texts for college and careers (Meyer, 2005; Shanahan & Shanahan, 2014).

Furthermore, students need repeated exposure to, and practice with, the different types of graphics for optimal learning to occur (Cromley et al., 2013; McTigue & Flowers, 2011; Roberts et al., 2013). The scarcity of complex graphics in informational texts is insufficiently preparing students to read disciplinary area texts in preparation for secondary education (Shanahan & Shanahan, 2014) and college and careers.

Theme Five: Graphics Need to Do More than Represent the Written Text

The results of this study confirm that the predominant function of graphics appearing in the informational texts of CRPs is representation. The inclusion of representation graphics is beneficial to most students. Prior research shows they positively affect reading comprehension (Guo et al., 2020; Hannus & Hyona, 1999; Levie & Lentz, 1982; Peeck, 1999) because the graphic reinforces the information being presented in the written text (Levin et al., 1987). However, the abundance of representation graphics restricts the inclusion of graphics that organize, interpret, or transform the written text.

The results of this study also confirm the scarcity of organization graphics and the absence of interpretation and transformation graphics in informational texts. Publishers need to include more organization graphics in the informational texts included in CRPs because these types of graphics consolidate verbose written descriptions into a more concise format. In addition, organization graphics can depict the scale and proportion of extremely large and extremely small systems and objects. For example, a scale diagram of the solar system can illustrate the size differences between planets more effectively than a photograph.

CRP publishers also need to include more graphics whose purpose is interpretation or transformation to aid students' learning. Prior research shows that the most advantageous graphics are interpretation or transformation as they clarify abstract concepts, make the running text more comprehensible (Carney & Levin, 2002), and provide the reader with a concrete visual representation (Coleman & Dantzler, 2016). In addition, the disciplinary area texts that students encounter in secondary school include

graphics that serve a variety of functions (Carney & Levin, 2002), and preparation for attending to these graphics should begin in elementary school (McTigue & Flowers, 2011; NGA & CCSSO, 2010; Roberts et al., 2013; Shanahan & Shanahan, 2014).

Theme Six: Graphics that Extend the Written Text Require Graphical Literacy Sills Instruction

The results from this study confirm that a substantial percentage (38%) of the graphics in the informational texts of CRPs are connection to text-level 2. Level 2 graphics extend the written text because they require the reader to make inferences and use background knowledge for interpretation (Guo et al., 2018; Slough & McTigue, 2013). Of these level 2 graphics, a large percentage (69.15%) were without instructional guidance. This is concerning because some students rarely attend to graphics without explicit instruction (McTigue & Flowers, 2011), others may misinterpret the information presented in graphics (Watkins et al., 2004), and still others may lack self-regulation strategies for reading and analyzing graphics (Brugar & Roberts, 2018).

Theme Seven: Graphical Literacy Skills Need to be a Component of Literacy Instruction in CRPs

The results of this study confirm that most of the graphics (more than 65%) included in the informational text selections of CRPs are not indicated for graphical literacy skills instruction. Although most of these graphics were representation photographs and general images, instructional guidance is still warranted. Students should be taught to scrutinize photographs and general images for potential biases as objectivity should not be assumed (i.e., the photographer and editor made choices about

what to include or omit from the photograph and individual readers may attend to different aspects of the photograph or general image).

Research shows that teachers usually rely on the pedagogical guidance included in CRPs to guide their instruction (Al Otaiba et al., 2005). The absence of instructional guidance in CRPs suggests that graphical literacy skills instruction is not being implemented in upper elementary school classrooms. This is disconcerting because several prominent literacy researchers have recommended that graphical literacy skills should be a component of literacy instruction (Duke et al., 2013; McTigue & Flowers, 2011; Roberts et al., 2013). Furthermore, students that do not receive graphical literacy skills instruction are ill prepared for the demands of disciplinary literacy (Shanahan & Shanahan, 2014), standardized assessments (Wixon, 2014; Yeh & McTigue, 2009), and the reading required in college and careers (Meyer, 2005; Shanahan & Shanahan, 2014).

Theme Eight: Graphical Literacy Skills Instruction Needs a Scope and Sequence

The results of this study confirm that CRPs do not include a graphical literacy skills scope and sequence (Archer & Hughes, 2011; Hughes et al., 2017). The scope of instructional guidance is sparse. For most of the graphics, instructional guidance was limited to one instance of teach and one element of explicit instruction. In addition, discussion was the primary explicit instruction element, and the teacher was usually prompted to ask only one question about each graphic. The other seven elements were seldom employed (e.g., direct explanation, modeling, guided practice, independent practice, and monitoring) or not used at all (e.g., feedback) to teach students how to read and interpret the graphics found in the informational texts.

The order in which graphical literacy skills were to be taught, sequence of instruction, was also inadequate. There was no indication that graphical literacy skills previously taught were built upon in subsequent lessons. In addition, in the rare situation when multiple explicit instruction elements were associated with a graphic, the instruction did not follow a typical sequence as recommended by researchers (Hughes et al., 2017). For example, for several graphics, independent practice preceded modeling (Coiro et al., 2020b).

The lack of a scope and sequence in CRPs for graphical literacy skills is disconcerting because it limits the topics and concepts to be taught and a logical order for instruction. In addition, graphical literacy learning outcomes are overlooked. Thus, students' learning of graphical literacy skills may not be being adequately assessed.

Theme Nine: Graphics and Graphical Literacy Skills Instruction Differs Across CRPs

The results of this study confirm that the graphics and associated graphical literacy skills instruction (instructional guidance) in the informational texts of CRPs varies by publisher. Table 79 provides an overview of the measures that were analyzed for this study. (Detailed results for each measure are reported in the "Results" chapter.) Based on the results, each measure was quantified and assigned a relative ranking from one to three. A score of one indicates that for that measure one program was better than the other programs. A score of two indicates that there was no difference in the results between programs. A score of two may also show that, when compared to the other programs, that program's results were intermediary. A score of three means that the results for that measure were less robust when compared with the other programs. A low

total score designates a program as better when compared with the other programs analyzed for this study.

Table 79

Study Measures and CRP Rating

Measure	Program A	Program B	Program C	Comments
Graphic category	2	2	2	All three programs used seven of the nine categories. The percentages were functionally equivalent.
Complex graphics	3	2	2	Compared percentage.
Graphic type	2	2	2	Compared the count of types used by each program.
Graphic function	3	2	2	Compared the percentages.
No instructional guidance	2	1	3	Compared the percentages and graphic categories.
Teach instructional guidance	3	2	2	Compared counts of teach.
Teach complex graphics	2	1	3	Compared the percentage of complex graphics that were indicated for teach.
Occurrence teach	2	1	2	Compared multiple occurrences of teach in relation to one graphic.
Explicit instruction	3	2	2	Compared the number of elements used.
Occurrence explicit instruction	3	2	2	Compared multiple occurrences of explicit instruction in relation to one graphic.
Level 2 with instructional guidance	3	1	2	Compared teach instructional guidance.
Informational text diversity	1	2	2	Compared disciplinary areas represented.
Total	29	20	26	

The results from the comparison show that Program B is the CRP to select when the measures are rated. Program B included more occurrences of teach for individual graphics than Programs A or C. In addition, Program B incorporated instructional guidance for more level 2 graphics (Level 2 graphics are difficult to interpret without inferencing skills.) and complex graphics than the other two programs. Furthermore, Program B had fewer categories of graphics without associated instructional guidance than either Programs A or C.

Although there is a difference among the programs regarding the graphics used in the informational texts, the primary difference resides in the number of complex graphics. Programs B and C included slightly greater counts of complex graphics than Program A. Nevertheless, no program used complex graphics in proportions similar to those found in contemporary trade books (Smith & Robertson, 2019), multi-modal texts (Kress, 2003), and standardized assessments (Wixon, 2014; Yeh & McTigue, 2009).

Program B also included more robust graphical literacy skills instruction when compared with Programs A and C. However, the instruction was less frequent than recommended by literacy researchers (Brugar & Roberts, 2017; Duke et al., 2013; McTigue & Flowers, 2011; Roberts et al., 2015), and the instruction lacked effective components of explicit instruction (Archer & Hughes, 2011; Hughes et al., 2017; Reutzel et al, 2014).

This section reported the themes that emerged from an analysis of the data. The next section suggests recommendations in reference to these themes and the results from this study.

Recommendations

Informational texts are used more often in upper-elementary classrooms for reading instruction in preparation for the literacy demands of disciplinary area and college and career texts (Blank, 2013; Heafner & Fitchett, 2012; National Center for Education Statistics, 2009; NGA & CCSSO, 2010), and informational texts are replete with graphics. Several studies have found that reading comprehension is affected by the reader's ability to read and interpret the graphics included in informational texts (Brugar & Roberts, 2017; Carney & Levin, 2002; Hannus & Hyona, 1999; Levin & Barry, 1980; Levie & Lentz, 1982; Norman, 2010, 2012; Roberts et al., 2015). Although several prominent literacy researchers have noted the importance of instructional interventions to foster graphical literacy skills, the evidence base for teaching graphical literacy skills is sparse (Callow, 2008; Duke et al., 2013; McTigue & Flowers, 2011; Roberts et al., 2013). The next section presents recommendations for CRP publishers, teacher educators, and teachers.

Recommendations for CRP Publishers

This study complemented prior research that sought to validate a typology of graphics for use by educators and educational researchers (Fingeret, 2012; Guo et al., 2018; Saynay, 2014). An examination of CRPs, science and social studies textbooks, and informational trade books has shown that the terms used to label graphics by category and type are generally consistent across disciplinary areas. (See Appendix A, "Detailed Coding Scheme for Graphic Categories and Types," for descriptions.) CRP publishers should incorporate the terms used in this and prior studies to label the graphics used in

their publications. For example, a row and column table showing the average rainfall in various locales, should be referred to as a row and column table instead of a chart. In addition, CRP publishers should use this typology to clearly name the types of graphics used in both non-fiction and fictional texts. Using the same terminology when labeling the graphics used in a biographical selection and an historical text will make comparisons between text genres easier and more valid. Furthermore, the CRPs assessed for this analysis were published by the three dominant publishing firms in the United States, and these firms publish disciplinary area textbooks. Using the same terminology to define graphics across their publications is an opportunity to demonstrate that core subjects (e.g., math, science, social studies, and literacy) are not separate entities. A graphics typology that is consistent across publishers and disciplinary areas would assist teachers and students in teaching and learning about graphics.

CRP publishers should increase the number of complex graphics (e.g., diagrams, graphs, maps, etc.), and reduce the number of pictures (e.g., photographs and general images) in informational texts because students need to learn to read and interpret various types of graphics. Informational texts in CRPs should include more than just 27 of the 48 types of graphics identified. (See Appendix A, “Detailed Coding Scheme for Graphic Categories and Types,” for a detailed list of graphic types with descriptions.)

In addition, the informational texts in CRPs should include more than just science and social studies texts. Texts about the arts and mathematics would help reduce the notion that disciplinary area curriculums are isolated. Changes such as these would align the texts in CRPs more closely with trade books (Smith & Robertson, 2019) and other

publications (e.g., disciplinary area textbooks, manuals, etc.; McTigue & Flowers, 2011; Shanahan & Shanahan, 2014) that students read or will read.

In addition to more complex graphics, publishers should include more graphics whose purpose is organization, interpretation, or transformation. (Table 16 explains the graphic functions used for coding the graphics in this study.) An example of an organization graphic is a flow diagram representing the water cycle. A flow diagram organizes the information in the running text and reduces a verbose description into a coherent graphic. A graphic that functions as interpretation would explain an abstract concept, such as how the brain processes information using a diagram of a computer. Transformation graphics are mnemonic devices embedded in a graphic. For example, a crab riding a bicycle may help students remember Krebs cycle.

Prior research shows that the most advantageous graphics are interpretational and transformational as they clarify abstract concepts and make the running text more comprehensible (Carney & Levin, 2002). In addition, the disciplinary area texts that students encounter in secondary school include graphics with a variety of functions (Carney & Levin, 2002), and preparation for attending to these graphics should begin in elementary school (NGA & CCSSO, 2010; McTigue & Flowers, 2011; Roberts et al., 2013; Shanahan & Shanahan, 2014).

Publishers should also include more graphical literacy skills instruction, and the explicit instruction elements that accompany it, in their teachers' manuals. Although many of the graphics in this study were easily interpretable and concretely supported the running text (were connection to text-level 1), there were a substantial number that were more challenging (were connection to text-level 2). Research shows that students do not

always attend to the graphics unless specifically directed to do so by the teacher, and thus, they risk missing key information from the text (Brugar & Roberts, 2017; Jian, 2015; McTigue & Flowers, 2011). Furthermore, all complex graphics (e.g., diagrams, maps, timelines, etc.) should be indicated for instructional guidance as interpretation skills are not intuitive to students, and comprehension of complex graphics requires explicit instruction (Brugar & Roberts, 2014a, 2014b; Brugar & Roberts, 2015; McTigue & Flowers, 2011).

Finally, the CRP teachers' manuals should include instructional guidance that incorporates a scope and sequence for graphical literacy skills instruction (Archer & Hughes, 2011; Hughes et al., 2017). Teachers need to know the depth and breadth of the instruction associated with the graphics and the sequence in which to teach graphical literacy skills. For example, explicit instruction should not be relegated to a discussion about a graphic before direct explanation and modeling have occurred. Publishers need to include guidance in how to provide feedback, as well as more opportunities for independent practice that include the creation of graphics to facilitate learning (Roberts et al., 2013).

Recommendations for Teacher Educators

This study supports the development of a graphics typology for the field of education. Teacher educators should teach pre-service teachers the graphic categories and types (described in Table 14) associated with informational texts and use these same terms across disciplinary areas. In addition, teacher educators should include instruction about the function of graphics (described in Table 15) and how those functions can support or impede students' learning (McTigue & Flowers, 2011; Roberts et al., 2015;

Walpole, 1998). Instruction should also address connection to text level. Although a graphic may be representation, it may include information that requires inferencing and additional background knowledge.

Teacher educators should also incorporate instruction in how to read and interpret graphics including photographs, general images, and complex graphics such as diagrams, maps, and tables (Brugar & Roberts, 2014a; Brugar & Roberts, 2014b; Callow, 2008). Instruction should also incorporate the creation of graphics to increase pre-service teacher understanding of the various types of graphics (Brugar & Roberts 2017; McTigue & Flowers, 2011; Peeck, 1993; Roberts et al., 2013).

Finally, teacher educators should instruct pre-service teachers in how to teach graphical literacy skills in the literacy classroom using explicit instruction elements. (See Table 18 for a description of the explicit instruction elements coded for in this study). Teacher educators should also teach pre-service teachers that, when teaching students to read and interpret a graphic, a gradual release model, including a logical scope and sequence, is the best instructional method (Archer & Hughes, 2011; Hughes et al., 2017). Teacher educators should also teach pre-service teachers that graphical device comprehension is positively correlated with reading comprehension (Roberts et al., 2015), and that comprehension of the written text does not ensure that students have gleaned key information from the text (McTigue & Flowers, 2011; Yeh & McTigue, 2009).

Recommendations for Teachers

This study further validates the graphics typology introduced by Fingeret (2012) and implemented by Guo et al. (2018) for use by educators and educational researchers.

Teachers should incorporate category and type terms (described in Table 14) to facilitate learning from graphics in the literacy classroom, as well as in disciplinary areas. Doing so would create continuity in students' learning and prepare them for disciplinary area texts (Shanahan & Shanahan, 2014). For example, a diagram in a CRP informational text showing medieval social hierarchy should be referred to as a flow diagram, specifically a tree diagram. If the social hierarchy is portrayed in a triangular-shaped chart, divided into sections, it should be identified as a pyramid chart, a type of graph. The same terms should be used when students encounter similar tree diagrams and pyramid charts in their social studies curriculum.

The graphics utilized in the informational text selections in CRPs were primarily photographs and general images. Although there was an overrepresentation of photographs in CRPs, teachers should provide graphical literacy skills instruction in how to read and interpret them because the objectivity of a photograph should not be assumed (Guo et al., 2018).

There were very few complex graphics, like diagrams, flow diagrams, graphs, maps, tables, and timelines, included in the informational texts in CRPs. This data contradicts what students will encounter in informational trade books (Smith & Robertson, 2019) and the texts they will need to read for college and their careers (Mayer, 1993; McTigue & Flowers, 2011). Teachers need to be cognizant of these differences between CRPs, secondary education disciplinary area textbooks, and texts for college and careers. Teachers may need to supplement CRP instructional guidance to ensure that upper-elementary students are adequately prepared for these advanced texts.

Furthermore, teachers should have students plan and create graphics for their own compositions and incorporate graphics into their classroom as meaningful resources for learning (Roberts et al., 2014), thus, increasing students' exposure to varying types of graphics. Teachers should also use the scarcity of complex graphics in CRPs to their advantage by teaching students to create graphs, timelines, or maps using the information in the written text (Brugar & Roberts, 2014a, 2014b).

Representation was the principal function of graphics in CRP informational texts. (Table 15 describes the functions coded for in this study.) However, representation graphics were not simply redundant with the running text. Numerous graphics supplemented the running text with added information that required inferencing or background knowledge for interpretation (i.e., they were connection to text-level 2). Teachers should be cognizant of these graphics and provide explicit instruction in how to read and interpret them.

Graphical literacy skills were a component of literacy instruction in CRP teachers' manuals for a limited number of graphics. Teachers should incorporate the pedagogical guidance provided in the CRP teachers' manuals into their curriculum and extend it. In addition, explicit instruction elements were used to scaffold students' learning; discussion, direct explanation, and guided practice were the elements most commonly incorporated. Teachers may need to develop curriculum, with a scope and sequence, to supplement the CRP's instructional guidance to include more modeling, monitoring, independent practice, and feedback because the ability to read and interpret graphics supports students' learning and affects reading comprehension (Brugar & Roberts, 2017; Guo et al., 2020; Roberts et al., 2015). Additionally, graphical literacy

skills instruction should accompany reading comprehension instruction. As students receive daily instruction in reading comprehension, they should also receive regular instruction in how to read and interpret graphics (Brugar & Roberts, 2017; McTigue & Flowers, 2011; Norman & Roberts, 2015; Roberts et al., 2013)

Teachers should also encourage their schools' textbook adoption committees to include graphic categories and types, graphic functions, and graphical literacy skills instruction as components to review in their CRP adoption criteria. To guide teachers and other stakeholders, Roberts et al. (2014) developed a graphic rating tool for evaluation of informational texts and associated graphics. The tool includes a series of questions about the informational text and then a second section that assesses the accompanying graphics. For example, a question from section one asks, "Is the source credible and information accurate?" (Roberts et al., 2014, p. 313). A question from section two then provides an evaluation of the scale, orientation, and the inclusion of a legend/key for assessing a map (Roberts et al., 2014, p. 313). Components of this tool may be used to evaluate the informational texts and graphics included in CRPs.

Finally, when reviewing CRPs, teachers and committees should assess the types of graphics and the terms used to refer to those graphics. The inclusion of complex graphics in CRPs should reflect contemporary children's texts (Smith & Robertson, 2019) and prepare students for secondary disciplinary area texts (Shanahan & Shanahan, 2014). CRPs should use vocabulary for labeling and defining graphics that is consistent across grade levels and informational and narrative texts. The graphics should serve various functions and should include transformation and interpretation graphics as these are found in many disciplinary area texts in secondary school (Guo et al., 2018).

Future Research

This study has implications for future research about graphics in the field of education. This study supports prior research regarding the adoption of a graphics typology for teachers and educational researcher. This typology should be extended to an examination of infographics because contemporary informational texts use infographics to convey information about the natural, physical, and social world (Krauss, 2012; Smith & Robertson, 2021). In addition, some CRPs use infographics to supplement their informational and narrative texts, and these should be analyzed for graphic type and function. The typology should also examine the graphics in leveled readers, narrative texts, and biographies in CRPs to ascertain the validity of the graphics typology for various textual genres.

This study examined graphical literacy skills instruction associated with a specific graphic. Future research should assess the inclusion of general graphical literacy skills instruction in the teachers' manuals; in other words, it should analyze guidance that is not associated with a particular graphic but provides basic information about the different types and functions of graphics. Future research should also evaluate graphical literacy skills instruction using preceding grade levels of CRPs to determine whether explicit instruction is a component in earlier grades. In addition, preceding grade levels should be assessed for continuity in the use of graphic categories and types, as well as the vocabulary used to label and define them.

Finally, future research should assess instructional guidance for when it occurs during student engagement with the text. For example, the teacher is directed to teach about a graph during the pre-reading of text, before the students have seen the graph. In

addition, students need to receive frequent exposure to numerous types of graphics, and they need repeated, systematic instruction in how to read and analyze the graphics (Callow, 2008; Mayer, 1993; McTigue & Flowers, 2011; Roberts et al., 2013).

Limitations and Delimitations

There were two primary limitations to this study, (a) time and financial limitations and (b) the sample of informational texts in the CRPs. Time and finances restricted the selection of CRPs to the fifth-grade 2020 editions from the top three educational resources companies in the United States. These parameters limit the study as the results cannot be generalized to earlier publications by the same companies, to other CRP publishers, or to other grade levels. In addition, CRP publishers controlled the count of informational texts. The researcher sought to mitigate this constraint by analyzing the graphics in all the informational texts that aligned with the definition adopted for this research (Riffe et al., 2014).

The researcher identified two primary, controllable delimitations for this study (a) the coding scheme and (b) CRP resources. The researcher created the coding scheme for the analysis. Although the coding scheme incorporated typologies and classifications utilized in prior research, the primary researcher's interpretation of said research and personal biases may have influenced their adaptation. In addition, the researcher used frequency counts to assess graphical literacy skills instruction, and those counts do not adequately report the quality of the instruction or the hierarchical nature of explicit instruction (i.e., direct explanation, modeling, discussion, guided practice, etc.).

The researcher analyzed graphics in the informational texts used for whole class instruction in the CRP students' textbooks for category, type, function, and connection to

text. Informational texts (i.e., leveled readers and digital resources) indicated for small group instruction or independent reading were not included in the analysis. Excluded graphical literacy skills instructional guidance included the following: (a) as needed instruction, (b) differentiated instruction, (c) English language learner, and (d) small group/reading group instruction. As a result, the findings from this study are limited to the resources and instruction intended for the whole class.

Conclusion

The results of this study extend prior research regarding the types and functions of graphics included in elementary school textbooks. The typology of graphics suggested by Fingeret (2012) and adopted by Guo et al. (2018) was sufficient for assessing the graphics in the informational text selections of upper-elementary CRPs. In addition, the functions of graphics identified by Levin (1979), and used by other researchers (Fingeret, 2012; Guo et al., 2018; Mayer, 1993; Saynay, 2014; Slough & McTigue, 2013), fittingly describe the purpose of the graphics used in the informational texts included in the CRPs analyzed for this study.

This study also supports prior research stating that graphics represent and/or add information to the running text (Fang, 1996; Fingeret, 2012; Guo et al., 2018). The researcher concluded that most of the new information was easily interpretable and easily connected to the written text (i.e., was level 1 connection). However, there was a subset of graphics that were not easily interpretable, and several of these graphics were not indicated for graphical literacy skills instruction.

The findings from this study also support previous research that found that complex graphics (e.g., diagrams, timelines, maps, etc.) are infrequently used in

informational texts. Due to the decrease in time allocated to social studies and science in elementary schools (Blank, 2013; Heafner & Fitchett, 2012), the upper-elementary school literacy classroom is where students learn how to read disciplinary area texts and associated graphics in preparation for secondary education and college and careers (Shanahan & Shanahan, 2014). Teachers need to explicitly teach students how to read and interpret complex graphics to prepare them for these educational and career demands.

This study also examined graphical literacy skills as a component of literacy instruction in CRP teachers' manuals related to the graphics evaluated for type and function. The results show that for most graphics (more than 60%), there was no instructional guidance. However, for a minimal sample of graphics, the teacher was guided to reference the graphic and/or teach about the graphic. For those graphics where teach, explicit instruction, was indicated, discussion was the most used explicit instruction element. In addition, complex graphics (e.g., diagrams, flow diagrams, tables, etc.) were designated for graphical literacy skills instruction in greater proportions than photographs and general images.

Finally, this study documents that attention given to graphical literacy skills instruction is limited, even though prior research has reported that students may not attend to the graphics without explicit instructional guidance (Brugar & Roberts, 2018; Duke et al., 2013; McTigue & Flowers, 2011; Norman & Roberts, 2015; Peeck, 1993). In addition, prior research shows that graphical device comprehension and reading comprehension are highly correlated (Roberts. et al., 2015). Thus, failure to provide comprehensive graphical literacy skills instruction may place upper-elementary students at a disadvantage as they prepare for college and careers.

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APPENDICES

Appendix A

Detailed Coding Scheme for Graphic Categories and Types

Detailed Coding Scheme for Graphic Category and Type

Code (category)	Description	Code (graphic type)	Definition
Comic strip	Traditional comic strip (Guo et al., 2018).	Content	Usually produced by the textbook authors.
		Entertainment/example	Typically produced elsewhere.
Diagram	Graphics that depict the pieces or components of a whole system or static relationship between parts; typically includes labels (Guo et al., 2018).	Bird's eye view diagram	Displays information using a top-down view.
		Cutaway diagram	A 3D diagram where pieces have been removed to make the internal features visible; a block diagram.
		Cross-section	A diagram that shows a slice through an axis. The slice reveals the unseen or internal parts or the structure. Typically shows what is inside an object, not what is in the object.
		Picture scale diagram	A diagram showing the size of something using a known object for comparison.
		Scale diagram	A diagram showing the size of something using a conventional unit of measurement (e.g., meters, centimeters, etc.) for comparison.
		Simple diagram	A diagram that does not align with other diagram types. The diagram may not be simple.
Flow diagram	Diagrams that illustrate a set of dynamic relationships within a system or static relationships between parts; usually includes arrows to show connections between parts (Guo et al., 2018).	Cyclical sequences	Circular flow diagram.
		Forked sequences	Flow diagram that shows an "either/or" choice. May not be hierarchical.
		Linear sequence	Flow diagram that has a clear start and end point.
		Tree diagrams	Flow diagram that shows hierarchical relationships or organization.
		Web diagram	Flow diagram modeling multiple, intertwined relationships.
General image	A graphic which may contain symbolic information that requires interpretation by the reader and may necessitate the use of background knowledge; does not have lines with labels	Cartoon illustration	A simplified or exaggerated drawing of something.
		Characters	Images of writing systems that use characters (e.g., Chinese).
		Collage	An image that was created using pieces of paper, fabric, or other materials and glued onto a supporting surface (Tate, 2022)

Detailed Coding Scheme for Graphic Category and Type continued

Code (category)	Description	Code (graphic type)	Definition
	or words as in common in diagrams (Guo et al., 2018).	Computer enhanced/created photography/image	Image with something added by computer including clipart and photo-shopped photographs; features added to or an image created by a computer and that does not meet the definition of comic strip, diagram, graph, map, table, timeline, or other listed general image.
		Fine art	Images of professional or historical art.
		Image cluster	Multiple images combined to create one image.
		Logo	An image that represents a company or an organization.
		Magnified image	An image of something that cannot be seen with the naked eye; requires the use of an instrument (e.g., microscope, telescope, binoculars).
		Photographs of illustrations	Photographs of previously produced illustrations, may include a citation referencing the source of the illustration—not produced by the publisher.
		Radar image	Image produced using radar technology.
		Realistic illustration	A realistic drawing or illustration that is or could be true-to-life, or literal non-photograph.
		Scientific model	Image of a model used to depict a scientific concept; does not meet the definition of a diagram.
		Screen shot	Image of the screen of a computer or other digital device (e.g., phone, tablet).
		Stop motion	Images in a series that show the same object at different points in time.
		X-rays	Images produced using x-ray technology.
Graph	A visual organization of quantities and numbers which may show comparisons (Coleman & Dantzler, 2016; Fingeret, 2012; Guo et al., 2018).	Bar graph	Graph that displays data using bars of different heights or lengths.
		Line graph	Graph that displays data over time using line segments to connect data points.
		Pie chart	Circular shaped graph that uses “pie slices” to show relative sizes of data.
		Pyramid chart	Triangular-shaped chart, divided into sections, that shows hierarchical data.

Detailed Coding Scheme for Graphic Category and Type continued

Code (category)	Description	Code (graphic type)	Definition
		Venn diagram	Illustrates a relationship between sets, usually with a piece in common where the sets overlaps.
Map	A display of social, political, physical, or geographical information on a representation of an area.	Context map	Political or geographical map that shows provides context for information presented in written text.
		Flow map	Map that has arrows representing movement or relationships.
		Grid map	Map with a grid overlay to define sections.
		Landmark map	Map that shows specific landmarks.
		Region map	Larger area map that shows specific regions.
		Street map	Map identifying the names and locations of streets.
		Topographical map	Map that displays area elevational changes.
Photograph	A picture of a real-life object produced by photography.	Cluster photograph	A group of photographs.
		Simple photograph	Photograph of a person, place, or thing/event.
Table	Data organized using rows and columns.	Column table	Table with a single column.
		Pictorial table	Table that uses pictures to display information.
		Row table	Table with a single row.
		Row and column table	Table with multiple rows and columns.
Timeline	Information organized chronologically on a line.	Multiple timelines	Two or more lines that displays concurrent information in different contexts.
		Single timeline	Displays information on a line segment.
Other	Graphic that does not fit listed categories.		

Appendix B

Coding Scheme for Instructional Guidance and Explicit Instruction Elements Combined

Coding Scheme for Instructional Guidance and Explicit Instruction Elements Combined

Code Instructional Guidance	Code Explicit Instruction Element	Description	Example
No instructional guidance		Graphics are present in the text, but no graphical literacy skills instruction is provided to the teacher.	A timeline runs across the bottom of the page identifying when Articles of the Bill of Rights were added, but the teacher is not directed to reference nor teach about the timeline.
Reference		The manual directs the teacher to verbally reference the graphic, but no other instruction about the graphic is provided (Brugar & Roberts, 2017).	Look at the timeline on page 57.
Teach		The teacher is directed to provide explicit instruction about a graphic (Brugar & Roberts, 2017).	
	Direct explanation	New material is taught in a concrete way using clear and concise language (Reutzel et al., 2014).	This is a timeline. This timeline organizes information chronologically. That means the order in which these events occurred.
	Modeling	When a teacher demonstrates (e.g., think aloud) and describes the use of a particular skill, strategy, process, or concept (Hughes et al., 2018; Hughes et al., 2017).	When I read a timeline, first I look at the title to determine what the timeline is about. Then, I scan the timeline and ask myself questions about what I am seeing.
	Guided practice	Makes use of scaffolding, teacher and peer support, and a gradual release of responsibility (Reutzel et al., 2014).	Look at the timeline on page 57. With your partner, read the timeline, making note of the features of the timeline.
	Feedback	Teacher provides corrective verbal feedback as students are learning to apply skills, strategies, processes, and concepts (Reutzel et al., 2014).	As the students are reading the timeline, walk around the room and provide feedback or assistance.
	Discussion	Teacher asks questions which elicits students' responses, either with the teacher or with peers (Child, 2012).	What kind of information is being shared on this timeline? Discuss with your neighbor how knowing the information on the timeline helps you comprehend the main text.

Coding Scheme for Instructional Guidance and Explicit Instruction Elements Combined continued

Code Instructional Guidance	Code Explicit Instruction Element	Description	Example
	Monitoring	Teacher carefully attends to students' responses through observation (Reutzel et al., 2014).	As the students read the informational text, watch and make sure that students are attending to the graphics.
	Independent practice	Teachers asks students to apply newly learned strategies, skills, or knowledge, without teacher guidance, in novel contexts or situations.	Using information from the text, create a timeline that highlights the history of national parks.
Other		Graphical literacy skills instruction that does not meet a priori codes.	

Appendix C

Screenshot Excel Coding Form

Excel Spreadsheet Coding Form

Unique ID	Graphic ID	Informational Text ID	Publish	ST book numbe	IT Title	Starting page	Ending page	Total pages*	Disciplinary area	Graphic page number	Graphi	Graphic categor	Graphic type	Graphic function	Connection to main text	Text reference same page as graphic	Location of text reference	Caption /Title	Is there IG that reference s this specifc graphic Y/N	Infograp hic y/n	IG Num	TE book numbe	Starting page	Ending page	Location of instructio nal guidanc	Page # of instructio nal guidan	Type of literacy instructio n, reading, writing	Type of instructio nal guidan	Instructio nal guidan	Element of explicit instructio n	Element of explicit instructio n	Element of explicit instructio n	Element of explicit instructio n	Direct explanati on	Modelin g	Guided practic	Discussi on	Independ ent practic	Monitori ng	Has General IG	Has Caption and/or IG
A-HMH-1-16-1-	A-HMH-1-16-1	A-HMH-1-16	A-HMH	1	Government Mu	16	17	2	social studies	16	1	Photograph	Simple photograph	Representation	Level 1	y	Side by side	n	n	n													0	0	0	0	0	0	1	1
A-HMH-1-16-17-1-	A-HMH-1-16-17-1	A-HMH-1-16	A-HMH	1	Government Mu	16	17	2	social studies	16-17	1	background	background	decoration	no connection	n/a	Not applicable	n	n	n													0	0	0	0	0	0	1	1
A-HMH-1-16-17-2-	A-HMH-1-16-17-2	A-HMH-1-16	A-HMH	1	Government Mu	16	17	2	social studies	16-17	2	General image	realistic illustration	Representation	Level 1	y	In front of	n	n	n													0	0	0	0	0	0	1	1
A-HMH-1-17-1-	A-HMH-1-17-1	A-HMH-1-16	A-HMH	1	Government Mu	16	17	2	social studies	17	1	Photograph	Simple photograph	Representation	Level 1	y	above	n	n	n													0	0	0	0	0	0	1	1
A-HMH-1-17-2-	A-HMH-1-17-2	A-HMH-1-16	A-HMH	1	Government Mu	16	17	2	social studies	17	2	Photograph	Simple photograph	Representation	Level 1	y	Side by side	n	n	n													0	0	0	0	0	0	1	1
A-HMH-1-17-3-	A-HMH-1-17-3	A-HMH-1-16	A-HMH	1	Government Mu	16	17	2	social studies	17	3	Photograph	Simple photograph	Representation	Level 2	y	Side by side	n	n	n													0	0	0	0	0	0	1	1
A-HMH-1-205-1-1	A-HMH-1-205-1	A-HMH-1-204	A-HMH	1	Quaking Earth, R	204	214	11	science	205	1	Photograph	Simple photograph	Representation	Level 2	n	Next page	n	y	n	1	6	204	217	Prereading	204	reading	specific	reference					0	0	0	0	0	0	1	1
A-HMH-1-206-1-1	A-HMH-1-206-1	A-HMH-1-204	A-HMH	1	Quaking Earth, R	204	214	11	science	206	1	Photograph	Simple photograph	Representation	Level 1	y	side by side	n	y	n	1	6	204	217	Prereading	204	reading	specific	reference					0	0	0	0	0	0	1	1
A-HMH-1-206-207-1-	A-HMH-1-206-207-1	A-HMH-1-204	A-HMH	1	Quaking Earth, R	204	214	11	science	206-207	1	background	background	decoration	no connection	n/a	Not applicable	n	n	n													0	0	0	0	0	0	1	1
A-HMH-1-207-1-1	A-HMH-1-207-1	A-HMH-1-204	A-HMH	1	Quaking Earth, R	204	214	11	science	207	1	flow diagram	Linear sequence	Organization	Level 2	y	above	y	y	n	1	6	204	217	Prereading	204	reading	specific	reference					0	0	0	0	0	0	1	1
A-HMH-1-208-1-1	A-HMH-1-208-1	A-HMH-1-204	A-HMH	1	Quaking Earth, R	204	214	11	science	208	1	Photograph	Simple photograph	Representation	Level 2	y	above	y	y	n	1	6	204	217	Prereading	204	reading	specific	reference					0	0	0	0	0	0	1	1
A-HMH-1-208-209-1-	A-HMH-1-208-209-1	A-HMH-1-204	A-HMH	1	Quaking Earth, R	204	214	11	science	208-209	1	background	background	decoration	no connection	n/a	Not applicable	n	n	n													0	0	0	0	0	0	1	1
A-HMH-1-209-1-1	A-HMH-1-209-1	A-HMH-1-204	A-HMH	1	Quaking Earth, R	204	214	11	science	209	1	diagram	simple diagram	Representation	Level 2	y	side by side	n	y	n	1	6	204	217	Prereading	204	reading	specific	reference					0	0	0	0	0	0	1	1
A-HMH-1-210-211-1-	A-HMH-1-210-211-1	A-HMH-1-204	A-HMH	1	Quaking Earth, R	204	214	11	science	210-211	1	background	background	decoration	no connection	n/a	Not applicable	n	n	n													0	0	0	0	0	0	1	1
A-HMH-1-211-1-1	A-HMH-1-211-1	A-HMH-1-204	A-HMH	1	Quaking Earth, R	204	214	11	science	211	1	map	Context map	Representation	Level 2	n	previous page	n	y	n	1	6	204	217	Prereading	204	reading	specific	reference					0	0	0	0	0	0	1	1
A-HMH-1-212-1-1	A-HMH-1-212-1	A-HMH-1-204	A-HMH	1	Quaking Earth, R	204	214	11	science	212	1	Photograph	Simple photograph	Representation	Level 1	y	above	y	y	n	1	6	204	217	Prereading	204	reading	specific	reference					0	0	0	0	0	0	1	1
A-HMH-1-212-213-1-	A-HMH-1-212-213-1	A-HMH-1-204	A-HMH	1	Quaking Earth, R	204	214	11	science	212-213	1	background	background	decoration	no connection	n/a	Not applicable	n	n	n													0	0	0	0	0	0	1	1
A-HMH-1-213-1-1	A-HMH-1-213-1	A-HMH-1-204	A-HMH	1	Quaking Earth, R	204	214	11	science	213	1	Photograph	Simple photograph	Representation	Level 1	y	above	y	y	n	1	6	204	217	Prereading	204	reading	specific	reference					0	0	0	0	0	0	1	1

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Education & Academic Background

Doctor of Philosophy, Utah State University 2022
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Dissertation: *A Content Analysis of Graphical Literacy Skills Instruction in Fifth Grade Core Reading Programs*
Chair: Marla K. Robertson, Ph.D.

Master of Education, Utah State University, 2017
Professional Specialization: Reading and Writing

Bachelor of Science, Utah State University, 2006
Major: Elementary Education
Minors: Mathematics and Science

Professional Licenses
Utah Teacher Certification, Elementary Education Level 2, Grades 1-8

Professional Educational Endorsements
Reading, Level I
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Professional Work Experience

Instructor—Teaching Language Arts and Practicum, ELED 4030 (January 2022—May 2022)
School of Teacher Education and Leadership, Utah State University
Responsibilities included instructing elementary education students in language and writing development in children using theories and research. In addition, supervising elementary education students in their elementary school practicum.

Instructor—Reading Assessment and Intervention/ USU Literacy Clinic, ELED 4040/4042 (A+ rating by NCTQ) (January 2022—May 2022)
School of Teacher Education and Leadership, Utah State University
Responsibilities include instructing elementary education students in research-based assessment administration and interpretation and literacy intervention; observing tutoring sessions and providing feedback about instructional delivery;

and communicating with parents and other Literacy Clinic instructors to register children for tutoring sessions.

Graduate Teaching Assistant, Instructor—Reading Assessment and Intervention/ USU Literacy Clinic, ELED 4040/4042 (A+ rating by NCTQ) (June 2021—December 2021)

School of Teacher Education and Leadership, Utah State University

Responsibilities include instructing elementary education students in research-based assessment administration and interpretation and literacy intervention; observing tutoring sessions and providing feedback about instructional delivery; and communicating with parents and other Literacy Clinic instructors to register children for tutoring sessions.

Instructor, Effective Writing Instruction, TEAL 6380 (June 2021—August 2021)

School of Teacher Education and Leadership, Utah State University

Responsibilities included instructing professional educators in research-based methods for teaching K-12 students to develop a range of writing skills and applications, including how to compose opinion/argumentation, informational/expository, and narrative writing.

Graduate Teaching Assistant, Instructor—USU Literacy Clinic, ELED 4042 (A+ rating by NCTQ) (August 2020—April 2021)

School of Teacher Education and Leadership, Utah State University

Responsibilities included transitioning a face-to-face literacy clinic practicum experience to a virtual format; supervising USU Literacy Clinic undergraduate tutors; instructing tutors during Professional Learning Communities; and observing tutoring sessions and providing feedback about instructional delivery.

Graduate Research Assistant (May 2020—August 2020)

School of Teacher Education and Leadership, Utah State University

Responsibilities included reviewing research about critical digital pedagogy in literacy and English education and preparation of a literature review.

Graduate Teaching Assistant, Instructor—USU Literacy Clinic, ELED 4042 (A+ rating by NCTQ) (August 2019—May 2020)

School of Teacher Education and Leadership, Utah State University

Responsibilities included supervising USU Literacy Clinic undergraduate tutors, instructing tutors during Professional Learning Communities, and observing tutoring sessions and providing feedback about instructional delivery.

Graduate Research Assistant (May 2019—August 2019)

School of Teacher Education and Leadership, Utah State University

Responsibilities included reviewing research about graphical features and informational texts in K-5 grades and preparation of a literature review. In addition, reviewing research data for analysis and editing a teacher's manual for a professional development series about e-textiles.

Graduate Teaching Assistant, Instructor—Teaching Language Arts and Practicum, ELED 4030 (January 2019—May 2019)

School of Teacher Education and Leadership, Utah State University

Responsibilities included instructing elementary education students in language and writing development in children using theories and research. In addition, supervising elementary education students in their elementary school practicum.

Graduate Research Assistant (August 2019—August 2020)

Literacy Clinic, Utah State University

Responsibilities included working on a cross-sectional, longitudinal study about the impact of undergraduate teacher training in a university-based literacy clinic and transfer of skills to their professional teacher position. Involvement included all aspects of the study: CITI certification, literature review, study design, data collection (interviews with former literacy clinic tutors), and analysis. This study also involved work with master's and undergraduate students as part of the research team.

Graduate Teaching Assistant/Literacy Clinic Tutor (September 2018—December 2018)

Literacy Clinic, Utah State University

Responsibilities included instructing a fourth-grade student in comprehension, fluency, and multisyllabic words; administering assessments: DIBELS, Basic Reading Inventory, CORE Phonics Survey, and Elementary Reading Attitude Survey. Supervisory work included observing tutors and providing written feedback about instructional delivery.

Public School Teaching Experience (2014—2018 & 2007—2009)

Scholar Academy, Tooele, UT—Grade 6

Tooele County School District, Elementary School Classroom Teacher—Grade 6

Professional Presentations (Peer-reviewed)

International/National

DeCoursey, K. and **Bunnell, G.** (2021, August). *How am I Doing? Intensive Feedback for Preservice Teachers in a Literacy Practicum Setting.* Presentation at the Association of Teacher Educators' 2021 Summer Conference (ATE), Virtual.

Jones, C. D., **Bunnell, G**., & DeCoursey, K. (2020, November). *We Recommend: Promoting Teacher Candidate Self-Efficacy Through Clinical Practice.* Presentation at the Association of Literacy Educators and Researchers Conference, Santa Fe, NM (Conference cancelled).

Plaizier, A., Greenwood, M., and **Bunnell, G.** (2020, November). *Supporting the Young Adolescent Writer: Strategies for Success in 21st Century Writing Spaces.* Panel Presentation at the annual conference of the National Council of Teachers of English (NCTE), Denver, CO (moved to virtual).

Jones, C. D., **Bunnell, G.**, & Brown, M. (2019, November). *Teacher Survey of Impact of Clinical Experience.* Presentation at the annual meeting of Association of Literacy Educators and Researchers Conference, Corpus Christie, TX.

Jones, C. D., Watson, N. & **Bunnell, G**. (2018, October). *Social and Emotional Competency Development: A Content Analysis of Third-Grade Core Reading Programs*. Presentation at the annual meeting of Northern Rocky Mountain Educational Research Association Conference, Salt Lake City, UT.

State/Local

Watson, N. and **Bunnell, G.** (2021, March). *Word Knowledge = World Knowledge.* Presentation at the annual meeting of the Utah Association for the Education of Young Children, Ogden, UT.

Watson, N. M**.**, **Bunnell, G**., & Jones, C. D. (2020, August). *Purposeful Play for Building PA: Phonological Awareness*. Presentation at the annual meeting of the Utah Association for the Education of Young Children, Ogden, UT.

Jones, C., **Bunnell, G.**, Watson, N., Breitenstein, J., & Parker, N. (2019, October). *Questions and Answers: Teaching Students to Locate and Use Text Evidence.* Presentation at the Utah Conference of the International Literacy Association, Sandy, UT.

Bunnell, G., Dennis, B., & Jenson, A. (2019, October). *Practice Guides—A Wealth of Knowledge for Classroom Instruction*. Poster presentation at the Utah Conference of the International Literacy Association, Sandy, UT.

Watson, N., Jones, C., **Bunnell, G**., & Parker, N. (2019, March). *Instructional Ideas for Supporting the Development of Phonological Awareness*. Presentation at the Utah Early Childhood Conference, Ogden, UT.

Bunnell, G., Wiley, S., & Yahne, L. (2018, November). *Phonological Awareness Instruction: Hands-on Activities for Children*. Poster presentation at the Utah Conference of the International Literacy Association, Provo, UT.

Jones, C., Watson, N., **Bunnell, G**., & Parker, N. (2018, November). *Teaching Sequential Text Structure: Books that are Exemplary Models and How to Use Them.* Presentation at the Utah Conference of the International Literacy Association, Provo, UT.

Other Presentations (Invited)

Bunnell, G., Jones, C. D., Watson, N. M., DeCoursey, K. (2020, August). *Words, Words, Words! Ideas for Effective Vocabulary Instruction*. Presentation at the annual meeting of the Jordan School District Special Educators, South Jordan, UT.

Jones, C., Breitenstein, J., & **Bunnell, G.** (2019, August). *How Teachers Can Use Text Structure to Improve Student Comprehension and Writing.* Presentation for Jordan School District Special Education Conference, West Jordan, UT.

Publications

Tofel-Grehl. C., Jex, E., Searle, K., Ball, D., Zhao, X. & **Bunnell, G.** (2020). Electrifying: One teacher's discursive and instructional changes through engagement in e-textiles to teach science content. *Contemporary Issues in Technology and Teacher Education, 20 (2), 293-314.*

Tofel-Grehl, C., Searle, K., MacDonald, B., Ball, D., & **Bunnell, G**. (under review). Using Micro:bits for Coding Physics Based Puzzles. In *Proceedings of the 8th Annual Conference on Creativity and Fabrication in Education*. New York: Association for Computing Machinery (ACM).

Awards

Graduate Teacher of the Year for the School of Teacher Education and Leadership for the 2021-2022 school year.

Service

Proposal Review Committee (2019) — Association of Literacy Educators and Researchers Conference

External Review Board (2019, 2020, 2021, 2022)

Journal of Language and Literacy Education (JoLLE)

Professional Associations

Association of Teacher Educators (ATE)

International Literacy Association (ILA)