LEARNING TO VISUALIZE: MIDDLE-LEVEL LEARNERS ANALYZING AND DESIGNING SCIENCE INFOGRAPHICS

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LEARNING TO VISUALIZE:
MIDDLE-LEVEL LEARNERS ANALYZING AND DESIGNING
SCIENCE INFOGRAPHICS
BY
MARK J. DAVIS

A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE
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AND
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DOCTOR OF PHILOSOPHY DISSERTATION

OF

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UNIVERSITY OF RHODE ISLAND AND RHODE ISLAND COLLEGE

2022
Infographics are part of daily life because of the rise of digital media and technology, as learners now encounter a barrage of images carefully designed to convey data and information through social media. But what happens in the classroom when young learners first encounter this expressive genre? This case study examined a unit of instruction on analyzing and creating infographics in a content-area middle school classroom. Data included classroom observations through video and audio recording, examination of a student graphic organizer and student-designed infographics, and semistructured interviews with students and the facilitating teacher. Results show that students learned how to analyze and reflect on infographic design elements and then apply these skills in the creation of an original infographic, using a digital platform. The research demonstrates that by using a well-structured curriculum, adolescents can analyze and design infographics even without teacher expertise in infographic literacy. This research suggests that middle school educators can introduce instructional practices that advance infographic literacy in the context of content-area instruction. Future research should examine the potential value of the infographic curriculum in broader contexts and subject areas.

*Keywords:* infographics, infographic literacy, digital literacy, middle school education
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DEDICATION

To the entire Hobbs Family,

Renee, my mentor and champion,

Randy, the passionate chef, sailor, and devoted spouse,

Rachel, an innovative educator and dedicated mother,

Roger, an outstanding writer whose talents are my aspiration.
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LEARNING TO VISUALIZE: MIDDLE-LEVEL LEARNERS
ANALYZING AND DESIGNING SCIENCE INFOGRAPHICS

Chapter 1. Introduction and Background of the Study

Infographics are a common element of modern publishing and digital distribution (Dick, 2020; Greussing & Boomgaarden, 2021). They can be found in newspapers, magazines, textbooks, and online resources. Despite frequent models of infographics in society, infographic curriculum in public education is still emerging. Primary and early secondary educators have limited experience with infographic instruction. Younger students have few opportunities for analyzing and creating infographics (Alford, 2019; Arcia et al., 2015; Bystrova, 2020). Research for infographic curriculum is limited within the adolescent spectrum, a critical transition age from elementary to secondary education. Instruction using practices of visual literacy in a content-area classroom may offer insight. Educators and students at the middle level will gain valuable insight through infographic analysis and design.

In this chapter, I highlight studies demonstrating the problem of limited adolescent instruction and learning with infographics. I make connections to the purpose of focusing on teaching and learning infographics in a middle-level content-area classroom. I propose research questions to address this problem and articulate the significance of the study for three groups: educators, researchers, and media makers. The conclusion of this chapter states clearly why the teaching and learning of infographics is worthy of investigation.
Background of the Problem

Infographics are prevalent in contemporary media and are frequently used as a mode for communicating complex information (Hätönen & Tolonen, 2021; Santos et al., 2018; Smiciklas, 2012; Yau, 2011). Infographics are embedded in numerous forms of media including textbooks, periodicals, and social media (Dick, 2020; Shreiner, 2018; Steyn et al., 2018). Today’s citizens need to understand data presented through infographics to be successful in the modern world (Alford, 2019; Partnership for 21st Century Learning, 2016). Contemporary education lacks frequent and robust learning experiences with infographics (Alyahya, 2019; E. K. Anderson et al., 2019; Bystrova, 2020; Darcy, 2019; Ismaeel & Al Mulhim, 2021). Research is needed to examine how educators incorporate infographic instruction for younger learners.

Content-area teachers in elementary and secondary education have ideal opportunities to incorporate infographic instruction. Textbooks and classroom resources include infographics in numerous subjects, including the social and natural sciences (Berson & Berson, 2009; Shreiner, 2018; Staurseth & Håland, 2019). Significant research on content-area infographic instructional practice is often limited to upper secondary and college-level coursework (Alyahya, 2019; Bradshaw & Porter, 2017; Fadzil, 2018; Grieger & Leontyev, 2021; Hearst, 2017; Ozdamli & Ozdal, 2018; Steyn et al., 2018). Though studies support the positive impact of infographic instruction in the elementary curriculum (Jung & Lim, 2018; Thacker et al., 2019), further examination in the middle or intermediate-level years requires continued study (Gormley & McDermott, 2015; Habeeb, 2020; Jeong & Kang, 2021; Yearta et al., 2018).
A continuous trend of visual literacy skills instruction in secondary school classrooms has existed for many years (Fransecky & Debes, 1972; Mbelani, 2008). Research has demonstrated that infographics as visual literacy improves students’ connections to prior knowledge (Cook, 2006; Dur, 2018; Eilam, 2012) and develops deeper understanding of complex topics (Alford, 2019; Gebre, 2018; Smith & Robertson, 2021; Yarbrough, 2019). An examination of teaching and learning about infographics can address the knowledge gap.

There is little agreement about how to best adapt the curriculum to include teaching and learning with infographics (Alyahya, 2019; Bystrova, 2020; Darcy, 2019; Kibar & Akkoyunlu, 2014; Kibar et al., 2019; Ozdamli & Ozdal, 2018; Smith & Robertson, 2021). Educational standards adopted by numerous educational institutions have recommended visual literacy skills (Hattwig et al., 2011; National Council of Teachers of English & International Reading Association, 2012). In the United States, the Common Core State Standards (CCSS) introduced several grade-level benchmarks with visual literacy elements (National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010). Numerous educational organizations have recommended visual literacy instruction across all disciplines (Crompton, 2017; Hattwig et al., 2011). The need for an infographic curriculum that can be replicated and modified is critical.

Statement of the Problem

Elementary and intermediate educators have a limited understanding of incorporating infographic instruction into the core curriculum (Kibar & Akkoyunlu, 2014; Kibar et al., 2019). As infographics appear in greater frequency, students currently
lack opportunities to practice analyzing and designing infographics at an early age (Alford, 2019; Arcia et al., 2015; Bystrova, 2020). Poor infographic literacy impacts 21st century learning goals, including emphasis on students’ communication practices, collaboration with diverse thinkers, and solving complex problems with critical thinking (Beetham & Sharpe, 2013; National Research Council of the National Academies, 2013; Partnership for 21st Century Learning, 2019). Students are unprepared to analyze infographic elements and apply this knowledge to the design of their own infographics (Bystrova, 2020; Smith & Robertson, 2021). Infographic analysis and design are critical skills for secondary and postsecondary success (Anderson & Bishop, 2021; Pazilah & Hashim, 2018). Contemporary education must address adolescents’ infographic literacy to ensure that they become informed and capable citizens.

**Purpose of the Study**

The purpose of my case study was to explore adolescent teaching and learning for analyzing and designing infographics, using a purposive sample of four students and one teacher located in a public middle school in the southern New England region of the United States, informed by recorded observations, reflective graphic organizers, self-designed infographics, and semistructured interviews.

**Research Questions**

The study addresses two research questions:

- How did sixth grade learners at Shale Middle School analyze the design elements of science infographics?
- How did sixth grade learners at Shale Middle School design a science infographic using data they had collected themselves?
Methodology and Research Design

The research was conducted as an instrumental case study, an empirical inquiry into the phenomenon of infographics in education (Yin, 2009). The case study was bound by time, activity, and context by focusing on a 4-day infographic lesson within a sixth grade science classroom (Lenzin & Guba, 2008). I conducted a thematic analysis (Braun et al., 2019) using four units of observation: (a) recorded observations, (b) a think-pair-share graphic organizer that students completed with a partner, (c) student-designed infographics, and (d) semistructured interviews. The investigation was analyzed through triangulation of the four units of observation (Saldaña, 2009).

The sample consisted of four students and one teacher in a Grade 6 science classroom in a suburban, upper middle class, public middle school in the southern New England region of the United States. This sample group was selected purposefully to engage adolescent learners making the critical transition from elementary to secondary levels of learning. The study closely observed how the content-area teacher and four randomly assigned students analyzed and then designed a science infographic using a sociocultural theory of instructional approach (Vygotsky, 1978). Discussion of sociocultural theory, educational learning objectives, and other applied theoretical frameworks are elaborated in Chapter 2.

Significance of the Study

Researchers have examined infographics through a business or scientific lens (Barlow et al., 2021; Chaudhury, 2021), but less is known about how children interpret and create infographics during adolescent education (Staurseth & Håland, 2019). Through this investigation, the study examined teaching and learning with the analysis
and design of infographics in an intermediate classroom. The results informed findings relevant to (a) teacher practice, (b) scholarly research in education, and (c) digital composition of multimodal texts.

The study addressed teacher practice in the intermediate-level teacher community. As an experienced middle school educator with previous teaching experience for analyzing and designing infographics, I crafted a constructivist learning experience built on facilitated instruction for analysis and a scaffolded design process. Research has validated constructivist learning principles in the creation of infographics with technology at the intermediate level, but it is important to address the implementation practices of a nonexpert educator (Gebre, 2018). The results of this research study demonstrate that a content-area educator, with limited understanding of the infographics genre, can facilitate the work of learners who analyze and design infographics through a novel instructional process.

This research contributes to the global scholarship on infographics for younger learners and offers insights about what teachers and students both need to be collaborators in multimodal communication. Infographics have generally been treated as an ancillary, unimportant form. Although existing research has examined the instructional framework for infographics, scholars have generally conceptualized infographics as a dependent accessory to written text (Smith & Robertson, 2021). The study confronts this assumption with the belief that infographics are standalone, multimodal texts incorporating higher order processes of composition. The results of this study contribute to the growing research investigating infographic literacy in education and offer potentially replicable resources to build on this scholarship.
This study examined adolescents’ design concepts of multimodal composition through the critique and design of subject-specific infographics. Contemporary research has demonstrated that intermediate-level learners are capable producers of infographics as knowledge visualization (Kibar et al., 2019). The research supported peer collaborative engagement in the design process, but it also raises questions about how the learners prioritized design elements for importance.

My research elaborated on adolescents’ infographic design choices through the synthesis of an original composition and through students’ peer and self-feedback. The conclusions of the study identify some themes for improving the design elements of novice infographic designers.

**Assumptions, Limitations, and Delimitations**

Qualitative research offers researchers the opportunity to observe at close hand a complex phenomenon that is situated in time, space, and activity; as a result, there are inherent assumptions, limitations, and delimitations in the structure of this case study (Patton, 2002; Yin, 2009). In my research, I acknowledged the existence of the following conditions.

**Assumptions**

The study assumed that participants were intrinsically motivated to contribute to the teaching and learning of infographics. In the recruitment stages, no incentives or rewards were offered for participation. The participants readily accepted a role in a nongraded instructional unit requiring infographic analysis and design of a science report. This supports the assumption that the educator and adolescent learners were genuinely interested in a learning experience with infographics.
The research was grounded in a social constructivist philosophy as a developmentally appropriate selection for middle-level education. Both the teacher and students were familiar with the practices of a teacher-facilitated learning environment. The teacher had confidence and experience in teaching from this perspective. Students were engaged in frequent dialogue and peer-mediated instruction in prior lessons. Given participants’ prior experience, the research assumed that constructivist learning was an applicable choice.

Limitations

The study was limited by the amount of time available to conduct the research within the classroom setting. An initial proposal requested 6 days of instruction to allow for ample reflection and revision of the student-designed infographics. Conflicting elements of the school’s and educator’s schedules limited the study to 4 days. This required restructuring some of the time needed to teach the digital tool, respond to peer feedback, and present a revised draft for public display.

Delimitations

The use of a case study research design was delimited given its focus on the phenomenon through direct observations of the teacher and student experiences. The coded and analyzed observation provided insight that would not be available in alternative designs but would be challenging to replicate and craft generalizations. This was an acceptable selection because the data produced provided rich details that can be studied for future instrumentation research and the topic of visual literacy.

The study was delimited by student participants’ age level, self-reported prior knowledge, and community where they were educated. The students were purposively
selected as sixth grade students between the ages of 10 and 11 years old. These students, who could be described as adolescents, have recently transitioned into a middle school setting. Students at this age are beginning the mental and physical transition into their teenage years. This is a critical time to provide direct instruction that moves comprehension and application into analysis and synthesis of learning (Anderson et al., 2013).

Participants in the sample come from a mostly homogenous community site selected for convenience. This site allowed me to conduct the investigation as a full-time employee in the school. In this affluent suburb with limited diversity, most students have inherent privilege including access to a flexible curriculum and access to technology. For educators, this privilege included access to high-quality learning materials, varieties of digital tools, and multitiered systems of support. The teacher had a total caseload of 78 students. Instruction was supported with differentiated instruction and integrated professional development in universal design for learning and deep learning competencies. Coupled with technology, the teacher and students frequently and comfortably used robust online resources, including interactive simulations and networked communication for enhanced inquiry.

The purposive sample of four student participants were observed in a science instructional classroom led by the teacher facilitator. The purposive selection was guided by four criteria: (a) students were not previous or current students of the researcher, (b) students self-reported “limited or no experience with infographics” prior to the study, (c) students who provided assent for the study, and (d) students with parental consent.
Definition of Terms

Before the presentation of the literature review, it is important to first clarify how I have chosen to frame the terms that are most used in the disciplines of education, graphic design, and communication. If a singular denotation existed for these terms, my research lens might have been different. For the purposes of this study, I have contextualized the definition of these terms to represent two of my core identities: an educator and a media maker. I want to challenge my readers to see how the two are not mutually exclusive. A learner can be an artist, just as a designer can be an educator. If readers can readily identify these terms beyond the scope of this research, I believe they will make similar conclusions about their efficacy. From the list of terms below, the reader can better understand my perspective on a rich and complicated terminology that has its roots in an array of disciplines and fields.

Infographics

I define an infographic as a visual representation of data and information captured by graphics, imagery, and symbols (Lankow et al., 2012). Data visualization signifies charts, diagrams, and tables that elaborate on quantifiable data (Krum, 2013; Lengler & Eppler, 2007; Tufte, 2001; Whitney, 2012; Yau, 2013). These are referred to by the term “graphics.” Information visualization focuses on more qualitative elements, including pictures, design layouts, and stylized written text (Cairo, 2012; Ware, 2013). Infographics can be presented in static or print formats as well as dynamic or digital modes (McCandless, 2012; Moreno et al., 2012). In this study, I examined students encountering infographics in a static format created using digital technology.
Visual Literacy

A concise definition of visual literacy must draw from numerous sources. Elkins (2009) proposed that researchers defining visual literacy must “acknowledge the inbuilt awkwardness that language and usage impose on the subject at hand” (p. 2). Most definitions of visual literacy include the ability to locate, interpret, evaluate, and create visual media to improve understanding and communication with others (Ausburn & Ausburn, 1978; Bristor & Drake, 1994; Eilam, 2012; Hattwig et al., 2011). Dondis (1973) further stated that “visual literacy [is] more than just seeing, more than just making visual messages. Visual literacy implied understanding, the means for seeing and sharing meaning with some level of predictable universality” (p. 182). This belief reinforced the idea that visual literacy is not based solely on subjective interpretations.

Text

The meaning of “text” has progressed beyond written language (Callow, 2003; Lapp et al., 2008; Serafini, 2010). As literacy has been redefined, images are being accepted as forms of text (Callow, 1999; Kress & van Leeuwen, 2006). Infographics synthesize several forms of text that are noted as multimodal texts. This study is guided by the belief that infographics are a standalone form of a multimodal text.

Multimodality

Multimodality or multimodal texts may consist of words, pictures, or graphs supporting more than one mode of delivery (Kress, 2010; Serafini, 2022; Van Leeuwen, 2021). Information and data visualizations incorporate multiple modes simultaneously in the form of infographics (Krum, 2013). Given multiple representations within a single text, these multiple modes relay complex messages. Multimodal texts, including
infographic texts, incorporate other modes including typography, imagery, graphs and
tables, and iconography in a single document (Jewitt, 2008; Kress, 2010; Serafini, 2010).
These texts can vary in elements from simple symbolic images (Bertin, 2010) to
multifaceted representations of data visualization (Tufte, 2001).

**Imagery**

In this context, “imagery” is not limited to the literary device whereby figurative
language evokes a visual (National Council of Teachers of English & International
Reading Association, 2012). In this context, imagery is defined as graphic representations
that supported understanding (National Council of Teachers of English, 2022). Studies
have demonstrated that imagery provides connections between the text and the reader’s
prior knowledge and experiences (Barton et al., 2007; Cook, 2006). In this study, imagery
is represented by specific elements including clip art and photographs, graphics and
charts, and pictograms. These forms of imagery are the building blocks of most
infographics. The distinction is necessary to address how the infographic serves as a
complete text rather than as a supplement to written text.

**Researcher Positionality**

I acknowledge that I am passionate about the subject of infographics and the need
to teach it. My experience as a current middle-level educator with prior experience
teaching infographics is inseparable from my research. I strongly believe that technology
in teaching and learning is an essential and supportive practice. I was actively employed
at the research site, although I did not teach the participants before or during the time of
observation. As noted in the next section, I adhered to several practices to ensure
trustworthiness of my findings.


**Reseacher Trustworthiness**

The qualitative study approach requires trustworthiness in the researcher, given the subjective nature of the process (Fraenkel et al., 2011; Patton, 2002). Trustworthiness is measured through four features: (a) credibility, the ability to conduct member checking and triangulation; (b) transferability, providing a context that can be replicated; (c) dependability, the use of consistent practices supported by similar research when collecting evidence, and (d) conformability, which involves corroboration with other authorities in the field of study (Creswell, 2009). Table 1 is a summary of how I established trustworthiness as the primary investigator.

**Table 1**

*Overview of My Trustworthiness*

<table>
<thead>
<tr>
<th>Trustworthiness quality</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credibility</td>
<td>Credibility was established through peer-reviewed literature from the fields of graphic design, teaching and learning theory, and infographics instruction at all levels. The coding process was built with codes supported by the literature and then triangulated into themes (Patton, 2002). The final coding process was corroborated with an expert qualitative researcher. Member checks of my observations, including review of my analytical notes and transcripts, were reviewed with the participants (Miles et al., 2020).</td>
</tr>
<tr>
<td>Trustworthiness</td>
<td>Method</td>
</tr>
<tr>
<td>-----------------</td>
<td>-------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>quality</td>
<td></td>
</tr>
<tr>
<td>Transferability</td>
<td>Transferability was created in a thematic analysis of multiple units of observations that could be replicated by other researchers. Inductive reasoning was built with a codebook and is available for review in Appendix F to support replication (Braun et al., 2019).</td>
</tr>
<tr>
<td>Dependability</td>
<td>Dependability is ensured through consistent application of qualitative observation and interview techniques. Analytical notes were maintained and member-checked with the study participants (Creswell, 2009).</td>
</tr>
<tr>
<td>Confirmability</td>
<td>I followed a strict observer role that was established at the beginning of the study when meeting with the participants. Daily post-observation reviews were examined by an experienced site administrator and included member checks.</td>
</tr>
</tbody>
</table>

**Conclusion**

Infographics are an essential learning skill necessary for postsecondary success in the modern world. In the pages that follow, I examine scholarly literature and build a theoretical framework grounded in several areas of research. I outline methodology for conducting a case study using a thematic analysis. The research design demonstrates how I achieved a new understanding about how students analyzed and designed infographics in a core-content classroom. I review the results of my data collection using four units of observation. I analyze the data with connections to themes and the research questions. I conclude with interpretations and recommendations for future examination of this topic.
A final task was the synthesis of these chapters as a standalone infographic, presented at the end of Chapter 6.

I intended for this study to help improve teaching and learning at the adolescent level of education. My findings included a mix of expected and unexpected results, which I hope will spark new investigations in the educational research community and support partnerships between designers and educators. I hope that educators and researchers recognize the intentions of this study to establish a pathway of growth for all learners. This research can be the first step in planning a scaffolded learning continuum around infographics beginning at an early age and continuing into postsecondary life.
Chapter 2. Literature Review

In this review of the literature, I identify three areas of scholarship that support the design of this study: (a) context of infographics, (b) educational theory and pedagogy, and (c) infographics in education. The literature review was conducted with a general to specific flow of ideas, illustrated in Figure 1. In the first section, I present the definition and categories of infographics with historical and contemporary examples. The examples are supported with scholarly examination of design features and a discussion of semiotic contexts. The second section examines both educational theory and pedagogy grounded in constructivism, emphasizing the sociocultural theory and the project-based learning approach. The final section addresses how infographics are incorporated into contemporary education. This includes a discussion of expanding concepts of literacy, informed by professional teaching standards and existing instructional practices supporting infographic literacy.
Figure 1

Hierarchy of the Literature Review

Context of Infographics
- Definition and Categories
- Scholarship of Infographics
- Semiotic Contexts

Educational Theory and Pedagogy
- Constructivism
- Sociocultural Theory
- Project-based Learning

Infographics in Education
- Expanded Conceptualizations of Literacy
- Educational Standards
- Instructional Practices

Context of Infographics

Definition

The word “infographic” is a portmanteau of the words “information” and “graphic.” An infographic is a visual representation using graphics, images, or symbols to convey data and information (Lankow et al., 2012; Smiciklas, 2012). Infographics have been defined with the inclusion of other characteristics, including appealing design (Cairo, 2012; McCandless, 2012) and visualizing complex data patterns (Tufte, 2006; Wong, 2013). Infographics may stand alone as a text, although numerous applications of infographics are embedded in other modes of communication (Dick, 2020; Greussing & Boomgaarderen, 2021). Infographics are characterized by modes of delivery.

Infographics are presented in either static or dynamic modes. A static infographic is produced in a printed form, such as books, periodicals, plaques, or posters (Alrajhi,
Dynamic infographics are interactive or animated projections that appear in online media platforms, digital devices, television and video programs, and educational and scientific models (Chiu & Linn, 2012; Fouh et al., 2012; Zhang & Linn, 2011). The goal of dynamic infographics demonstrated how data can be manipulated and modified to provide clarity and varied perspective (Dick, 2014; Ismaeel & Al Mulhim, 2021; Tufte, 2006; Zwinger & Zeiller, 2016).

Infographics have historical origins and are ubiquitous in modern media (McCandless, 2012; Sutherland, 2021). Infographics impart new knowledge and offer diverse perspectives with rich content (Cairo, 2012; Few, 2012). Subjects of infographics can range from journalism (Dick, 2020; Zwinger & Zeiller, 2016) to social justice (Yearta et al., 2018), medical research and public health (Arcia et al., 2015; Barlow et al., 2021; Darcy, 2019; Hätönen & Tolonen, 2021), and education (Bystrova, 2020; Ismaeel & Al Mulhim, 2021).

As a visual medium, infographics impart aesthetics of art, illustrated data analysis, and syntactic design elements (Baer & Vacarra, 2008; Krum, 2013). Infographics lend themselves to both the aesthetic qualities of art and the scientific and mathematical merit of data analysis (Burns et al., 2020; Tuft, 1997), enabling the communication of messages and ideas inherent in the humanities (Barlow et al., 2021; Dick, 2020; Serafini, 2013). The messages of infographics can be divided into visual compositions, data analysis, or communication.

**Infographics as Referential Compositions**

Infographics are rooted in the growth of referential compositions (Cairo, 2012; Lankow et al., 2012). Infographics stem from advancements in mathematics and graphic
design over several millennia (Rosenberg & Grafton, 2013). Early diagrams and illustrations were the primers of infographic literacy. As printed forms of text grew, hand-drawn illustrations with visualization emerged (Tufte, 1997). One visual reference composition, the “hand of Guido” (di Arezzo, 1274, as cited in Meirelles, 2013), evolved into an accepted learning text. The hand of Guido exhibited relationships between harmonic notes in a musical scale (Meirelles, 2013, p. 85). By creating a printed visual and kinesthetic device common to most users, di Arezzo innovated data visualization as a music reference tool. As illustrated in Figure 2, Joachim of Fiore represented the three ages of the biblical references of apocalypse as an early Venn diagram (Rosenberg & Grafton, 2013). This image is significant as it illustrated biblical interpretations for the masses who lacked formal education in reading and writing. These examples are early evidence of multifaceted visualizations designed to engage people of varied social and educational status.
Infographics as Data Analytics

Infographics are an important mode of analyzing complex information (Otten et al., 2015; Parsons & Sedig, 2014). Infographics containing data visualization consist of charts, diagrams, and tables that elaborate on quantifiable information (Szoltyzik, 2017; Tufte, 2001; Whitney, 2012). Infographics use information visualization that is related to qualitative data (Bederson & Shneiderman, 2002; Card et al., 1999; Sorapure, 2010; Ware, 2013). Combining data and information visualization produces visual ensembles
that build meaning, impact comprehension of the subject, and offer diverse perspectives (Burns et al., 2020; De Aizpurua, 2017; Featherstone, 2014; Glaw et al., 2017; Kibar & Akkoyunlu, 2014; Lamb & Johnson, 2014; Otten et al., 2015; Tufte, 1997).

Infographics are notable for containing both information and data visualization to build meaning from raw data. Singular forms of data visualization have been researched with suggested analytical characteristics (Steele & Iliinsky, 2010; Whitney, 2012; Yau, 2011). Data visualizations, as defined by Tufte (2001), “visually display measured quantities by means of the combined use of points, lines, a coordinate system, numbers, symbols, words, shading, and color” (p. 37). Few (2012) suggested eight types of quantitative categories: time-series, ranking, part-to-whole, deviation, frequency distribution, correlation, nominal comparison, and geographic or geospatial. These categories, though far from comprehensive, are rooted in statistical methods and are the common forms of data visualization found in an infographic.

During the 17th and 18th centuries, maps grew in interest for improving comprehension of a subject. Descartes (1644, as cited in Meirelles, 2013) proposed a map of the known universe, and Ogilby (1675, as cited in Meirelles, 2013) produced road maps of Great Britain. Ogilby’s maps, in the first modern atlas, Britannia, included uniform scales, landmarks, and construction information on scrolls. Meanwhile, in the scientific fields, Joseph Priestley produced timelines of collected datasets (Rosenberg & Grafton, 2013), and Playfair captivated scholars with statistical graphs (Few, 2012). In Figure 3, Playfair (1786, as cited in Tufte, 2001) demonstrated a rise in government spending during the 18th century. This illustration mirrored many contemporary charts developed to illustrate finance and business analytics.
In the 19th century, visualizations were developed to examine diverse perspectives about contemporary issues. Diagrams by Guerry (1829, as cited in Rosenberg & Grafton, 2013) examined social behaviors, whereas Hewes and Gannett (1883, as cited in Rosenberg & Grafton, 2013) designed some of the earliest records of presidential election exit poll data, using color categorization and district-specific correspondences. Florence Nightingale’s innovative coxcomb diagrams (Figure 4) developed multiaxis correlations for government leaders who sought to understand rising
fatalities (Rosenberg & Grafton, 2013). Her illustration drew attention the importance of hygiene and medical care in the Crimean War.

**Figure 4**

*Florence Nightingale’s Coxcomb Graph (1858)*

In Minard’s *Figurative Map of the Successive Losses in Men of the French Army in the Russian Campaign 1812–1813*, the visual represented a failed campaign of Napoleon Bonaparte (Tufte, 2006). During a critical push into Eastern Europe, Napoleon Bonaparte sent over 400,000 troops to conquer Moscow, but only returned with 10,000. Several critical factors crippled Napoleon’s army, including changing weather conditions, distance, and noncombat deaths of soldiers (Tufte, 2006). The time-series plot included no fewer than seven variables illustrated simultaneously. The worthy illustration preceded the dynamic, multivariate charts common in digital age. As shown in Figure 5, a single infographic illustrated seven data points to demonstrate why the campaign failed (Tufte, 1997).

**Figure 5**

*Figurative Map of the Successive Losses in Men of the French Army in the Russian Campaign 1812–1813* by Charles Joseph Minard (1869)

Infographics as Communication

Infographics are a communicative device for multiple audiences and across a wide variety of media (Lankow et al., 2012; Smiciklas, 2012). Information visualization is the application of visual elements and data to reinforce comprehension (Kraidy, 2002). By this definition, information visualization is a tool used to convey knowledge (Card et al., 1999). Unlike in data visualization, raw data are not simply illustrated for increased interpretation (Tufte, 2001). Rather, information visualization presents any combination of illustrations, syntactic text, and data visualization to explain the author’s purpose or the subject (Tufte, 1990; Ware, 2013; Wen & Zhou, 2008).

During the Bronze Age, the ancient Sumerians developed unique characters for written language (Smiciklas, 2012). These early pictographs developed into cuneiform and transitioned into ideograms, clusters of symbols representing ideas and requiring minimal knowledge of the language (Aparicio & Costa, 2015). A modern ideogram would be the visual of a stick figure in a wheelchair, representing a person with a physical disability. There is evidence of similar symbolic languages in Egyptian, Mayan, and Chinese texts (Meirelles, 2013). These early forms of language gave rise to information visualization in the 20th and 21st centuries.

In the 1970s, the National Aeronautics and Space Administration (NASA) launched several interstellar satellites to better understand the universe. Beginning with the Pioneer 10 and 11 launches, each spacecraft included a metallic plaque with imagery about the origins of the spacecraft, as shown in Figure 6 (NASA, 1972). The intention was to provide a decodable message that could be interpreted by another life form. Astronomer Carl Sagan and a diverse scientific team thought of infographics as a
universal form of communication that others might be able to interpret and understand
(Bell, 2016). Starting with the Voyager missions in 1977, the satellites were equipped
with protected golden records that offered an array of images and sounds from our planet.
An infographic on the exterior of the record, similar to the Pioneer plaques, explained
how to play back the data and from where the satellite was launched. As of 2022, both
the Voyager 1 and Voyager 2 satellites have exited the heliosphere and are still
transmitting information back to NASA’s Jet Propulsion Lab. These instances were the
first purposeful interstellar messages designed as an infographic with critical
communication possibilities for the future.
Throughout the 20th century, infographics paralleled the advent of mass communication as a popular method of creating visual literacy (Dick, 2020; Greussing & Boomgaard, 2021). In addition to journalism, mathematic and scientific visualization, and mapping, modern designers incorporated infographics into everyday practices (Steele & Iliinsky, 2010; Wong, 2013). Weather reports, transportation signage, and instruction manuals adopted infographics to make use of multimodal methods of communication.
Infographics were now part of the zeitgeist of modern communication (Dick, 2014; Waddell & Clariza, 2018; Zwinger & Zeiller, 2016). Infographics become commonplace in numerous digital publications and presentations used for business, government, medicine, and education (Krum, 2013; Lankow et al., 2012; McCandless, 2009; Silver & Cook, 2014; Smiciklas, 2012; Yau, 2013).

Multivariate compositions through infographics are essential to publishing big data in smaller formats. The limited space in publications and shorter attention spans of readers added credence to infographics in communications (Greussing & Boomgaarden, 2021). In Figure 7, a two-page spread visualizes numerous variables of the U.S. economy (Holmes, 2008). The infographic follows a century-long line graph of national debt and gross national product. The author included parallel information about generations, financial events, growth and loss, and essential definitions. Pictograms and a global map detail the variables in a user-friendly format. Rather than appearing ancillary to larger written manuscript, the infographic becomes a standalone text.
In the 21st century, infographics are omnipresent in periodicals, television broadcast, video games, and social media. The exponential pace of emerging technologies has ushered in emergent forms of media (M. Anderson & Jiang, 2018; Hobbs & Jensen, 2013; National Council of Teachers of English, 2022; Sutherland, 2021). Infographics are now dynamic and interactive compositions with controls for manipulating the data (Reddivari et al., 2014; Zhang & Linn, 2011). Dynamic infographics appear as interactive animations (Tarkhova et al., 2020; Tei-Narh & Nantwi, 2022) and three-dimensional projections of augmented reality (Dehghani et al., 2020; Yantong et al., 2020).
Graphics design and modeling software has created greater opportunities for contemporary infographic design. Professional software has led to low-cost and online solutions that are accessible by a wider design community (Salim et al., 2021). The infographic in Figure 8 was designed and published as an online, dynamic document. The user is encouraged to use point-and-click interaction with the various data points and draw conclusions about gay rights across the United States. Pop-up windows, a colorful legend, and cited data allow quick comparison and contextualization of the data.

**Figure 8**

*Snapshot of Gay Rights in the U.S., State by State*

The breadth of tools for creating infographics enhanced the range of creativity in communication. The design of infographics as emerging digital text continues to be a significant area for study (Alyahya, 2019; E. K. Anderson et al., 2019; Barlow et al., 2021).

**Scholarship of Infographic Design**

Scholars of infographics build on established design elements when examining the characteristics of infographics (Lankow et al., 2012; Malamed, 2011; Ware, 2013). These design elements follow principles of data visualization (Krum, 2013; Steele & Iliinsky, 2010; Tufte, 2001; Yau, 2011) and information visualization (Bederson & Shneiderman, 2002; Cairo, 2012; Card et al., 1999; Ware, 2013). This research has drawn upon contemporary scholarship, with an emphasis on the collective works of Tufte, Lankow, Richie, and Crooks grounded in Vitruvian design principles, and McCandless. I first review their central contributions before presenting a synthesis of their key ideas as they apply to my interests in teaching and learning about infographics.

Significant research in the field of data visualization was led by Tufte (1990, 1997, 2001, 2006) for several decades. Tufte provided expert advice to government agencies, publishers, and scholars with his own doctrine of simplicity (Susanka & Kramer, 2021; Szoltysek, 2017). Tufte wrote of six principles of design integrity: (a) comparison, (b) causality, (c) multivariate, (d) integration, (e) documentation, and (f) context. The first two principles, comparison and causality, are specific to data visualizations. These principles examine data with compare-and-contrast illustrations (comparison) and the influence of dependent and independent variables (causality).
The remaining four principles closely resemble elements of both data and information visualization found in infographics. The multivariate principle addresses the synthesis of multiple elements of information to interpret complex data. Integration uses a multimodal approach to build understanding of the evidence. Documentation insures that evidence and citations are included to provide the source material of the visual. Context exhibits the direction of the author’s interpretation. These four elements are most applicable to the design of an infographic, although they are intended as primarily data visualization characteristics.

Some scholars have harkened back to the ancients to examine infographics. Lankow et al. (2012) framed infographic design elements using ancient architectural principles. In *De architectura*, Marcus Vitruvius Pollio (as cited in Lankow et al., 2012) used three principles for exemplary architectural design that are applicable to infographics: firmatas (soundness), venustas (beauty), and utilitas (utility). A review of this triad provided foundation to infographic design to three design elements named by Lankow et al. (2012).

The firmatas of the image conveys meaningful information worthy of the reader’s attention (Lankow et al., 2012). The importance of a robust message, with purposeful design, demonstrates the value of subject matter for an audience (Few, 2012; Tufte, 1997). Firmatas directs the reader toward the designer’s intended message. This research will expand on this description to encompass the author’s design choices for an infographic.

The venustas of the visual design is the appeal to the audience (Lankow et al., 2012). Unlike a text feature, where images accompany and rely on written text, the image
has a quality that stands alone (Smiciklas, 2012). The importance of beauty is inestimable in terms of the reader’s attention, a concept that is pervasive in the viewing of infographics.

The *utilitas*, or purpose, is the objective of the image in relation to its style or genre of writing. Visual elements follow patterns and conditions that can be read in the same way as written language (Kress & van Leeuwen, 2006). For a study on infographics, determining a genre associated with an infographic is crucial. If the purpose is to inform without bias, a simple, explorative data visualization might suffice (Tufte, 1997). However, infographics tend to have multiple visualizations to add clarity or perspective to the topic (Cairo, 2012). The *utilitas* is situated in making known the author’s intention or purpose in designing the visualization.

Other scholars emphasize the power of story. McCandless (2014) suggested that a strong visualization consists of information, story, goal, and visual form. Each of these elements is presented as having both an explicit and implicit characteristic (Figure 9). McCandless (2012) articulated that the information is the data, usually quantitative in nature, visualized with accuracy and consistency. The story is the concept of the visualization, how it well it impacted relevance and meaning (McCandless, 2014). The goal pertained to function and usability for cognitive tasks. The visual form or metaphor pertained to the aesthetic features of beauty and balance. The four elements are essential to create a “good visualization,” whereas the absence of one or more determined less desirable results (McCandless, 2012). This model is not intended to be formulaic. It may serve better guidelines for effective data and information visualizations, the backbone of infographics.
A comprehensive examination of varied design principles is beyond the scope of this research, but I offer a synthesis of design scholarship in infographics by comparing the work of Tufte, Vitruvius, Lankow et al., and McCandless in Table 2. The table organizes the design elements of these experts and attempts to correlate them into a set of new, inductive codes. The first three rows have parallel language addressing structure, beauty, and purpose. McCandless (2012) included story, which might be specific to a
narrative genre of infographics, an area that was not investigated in this study. The remaining three rows include Tufte’s design elements, which are more specific to data visualization rather than infographics as a whole. However his use of “documentation” closely resembles citation of evidence (Tufte, 2006), which is an important element for all types of infographics. Based on these common threads, a priori codes for inductive reasoning are presented in Chapter 3.

Table 2

Comparative Table of Four Expert Interpretations of Visual Design

<table>
<thead>
<tr>
<th>Common thread</th>
<th>Tufte</th>
<th>Vitruvius</th>
<th>Lankow et al.</th>
<th>McCandless</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structure, development</td>
<td>Multivariate</td>
<td><em>Firmitas</em></td>
<td>Comprehension</td>
<td>Information</td>
</tr>
<tr>
<td>Beautiful, pleasing</td>
<td>Integration</td>
<td><em>Venustas</em></td>
<td>Appeal</td>
<td>Visual form</td>
</tr>
<tr>
<td>Purpose, direction</td>
<td>Context</td>
<td><em>Utilitas</em></td>
<td>Retention</td>
<td>Goal</td>
</tr>
<tr>
<td>Insight, logic</td>
<td></td>
<td></td>
<td></td>
<td>Story</td>
</tr>
<tr>
<td></td>
<td>Comparisons</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Causality</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evidence</td>
<td>Documentation</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

McCandless (2012) referenced story as an essential element of visualizations, but this did not serve the purpose of this research study. As noted earlier, infographics may
be categorized into distinct genres. The story element closely resembled the narrative, which was not the subject of this research study. Students may be inclined to tell a story with their data, but the scope of this project was to report informational conclusions through science infographics.

Tufte (2006) challenged designers with six characteristics of effective visualizations. The elements strongly favored the design of better data visualization. Though several of his design characteristics are applicable, comparisons and causality diverged from generalization in infographic design (Tufte, 2001). In some cases, information visualization is the dominant format for an infographic. Infographics are not expected to be comparisons or examinations of causality. In this study, I made a conscious choice to exclude these elements as nonessential to the creative design of the science infographics produced in this case study.

**Semiotic Contexts**

Before I conclude this first section of the literature review, I want to briefly explain how semiotics theory has influenced my scholarship on infographic education. Although precivilization humans produced early imagery, semiotics is likely rooted in Sumerian and Egyptian writings and the teachings of Greek philosopher Plato (Hall, 2012). Ancient artifacts indicated that symbolic text had been critical to the progress of civilization (Cairo, 2012; Salvo & Rosinki, 2010). In the second millennium, illustrations profoundly impacted the production of new texts. The printings included hand-drawn illustrations accompanying religious texts, scientific discoveries, and records (Tufte, 1997). In the 19th and 20th centuries, semiotic theory was accepted in the field of social
science. Several scholars developed the field of semiotics with varying adaptations of its definition.

In the 19th and 20th centuries, semiotic theory emerged from several different sources, including Ferdinand de Saussure, Charles Sanders Peirce, Charles Morris, and scholars of the Gestalt Institute in Berlin (Few, 2012; Gee, 2008). In general, semiotic theory investigated the relationship between the learner and signs and symbols (Bertin, 2010). Depending on the framework of each researcher, the context of semiotics may be influenced by cognitive or social influences (Kress, 2010). When examining semiotics, multiple interpretations compete for the viewer’s perspective. However, most semioticians agreed that the field investigates how signs have varying dependencies.

A universal premise of semiotics is that pictures contain messages with denotative and contextual dependencies (Bertin, 2010). These dependencies separate visuals into concrete visualizations with fluid purposes. Semioticians accept that signs and symbols are a form of reading and writing that often contain synchronous transmission of multiple meanings (Hall, 2012). Semiotic theory supports the exploration of how infographics are complex forms of literacy. In this study, I have chosen the social–cultural perspective of semiotics, as it closely aligns with the teaching and learning practices of the study.

Semiotic theory in the social sciences domain may be classified into two camps: the linguistic studies of Ferdinand de Saussure and the logical works of Charles Sanders Peirce. Both individuals offered parallel ideas, but Peirce approached semiotics with a more social context scope (Few, 2012). Determining the message required an active social experience, hence the conflict between the Saussurian cognitive approach versus
the Peircian social context. For this study, I have grounded my research in semiotics with Peirce’s interpretation of signs.

Semiotic theory investigates the relationship between the learner’s interpretation of the signs and the interpretation of its meaning (Bertin, 1967/1983). Charles Sanders Peirce defined his 19th-century theory using three terms: a sign, an object, and an interpretant (Short, 2007). The sign is the image, such as a picture of the three-bladed radiation warning icon. The object is the signifier, as in the concept that radioactivity is present. The interpretant is the relationship between the sign and the object. In this example, the relationship between the appearance of a radiating atom (sign) and the presence of radiation (object) supports the interpretant that activities are occurring with radioactivity.

Learning efficacy increases when learners interpret and conceptualize ideas through signs and symbols (Stokes, 2002). Scholars of semiotics accept that symbolic representations are a form of reading and writing that often contains synchronous transmission of multiple meanings (Hall, 2012). Depending on the framework of each researcher, the context of semiotics may be influenced by cognition, linguistic, and social influences (Kress, 2010).

Peirce’s triadic relationship of semiotics contrasts with Ferdinand de Saussure’s dyadic model of semiotics, which holds that signs and the object, referred to as the signifier, act simultaneously in presenting and interpreting meaning (Hall, 2012). Both models rely on some social acquisition, but Saussure’s is strongly entrenched in linguistics (Gee, 2008). The social interpretation component aligns with educational pedagogy of social constructivism. For the purposes of this study, preference is given to
Peircian logic, which more closely aligns with the sociocultural theory discussed in the next section. Thus, Saussurian semiotics often address the nonsocial interpretations of signs when compared to the Peircian model, as illustrated in Figure 10. As the image is an infographic, the medium itself presents ideas with an ironic sensibility: It uses language and imagery to present ideas about the interplay of language and imagery as symbol systems.
Educational Theory and Pedagogy

This study emphasizes a social rather than cognitive approach to teaching and learning with adolescents. Social experiences are facilitated by educators through teacher and with adolescent peer interaction (Watson, 2001). Social experiences in education are the events that lead to dialogue around a topic or idea (Kim, 2001). Such interactions are collaborative by nature and enrich the learning experience. Dewey (1938/2007) suggested
that the “development of experience comes about through interaction [which] means that education is essentially a social process” (p. 58). Dewey (1938/2007) argued that educators should seek opportunities beyond imparting content and allow students to develop and interpret concepts through personal experience. Dewey elaborated on the social process by proposing that learners are participants in a community. He noted that the educator has a responsibility to facilitate the group interactions that strengthen a community. In return, the social interactions provide an educative experience for the community of learners (Dewey, 1938/2007, p. 59). Dewey discussed habitual experience that included reflection only when the learner’s experience was contradicted (Dewey & Bentley, 1949). This re-examination of prior experience is fundamental in social constructivism, which I elaborate on later. Therefore, education is a process of social interaction where learners are supported by authentic learning experiences. In this section of the literature review, I examine sociocultural theory and explore key instructional strategies related to the use of digital media in the classroom.

**Sociocultural Theory**

Decades after Dewey, social scientists continued to research social learning principles. In the latter half of the 20th century, the sociocultural writings of Vygotsky resurfaced. Working in the same era as Dewey, Vygotsky (1978) posited a framework of sociocultural transmission, a process of communication among members of the learning community to develop knowledge collaborative (p. 17). The sociocultural theory embeds constructivist practices where the teacher facilitates students’ learning, as opposed to direct instruction where the learner is treated as a vessel for knowledge. A social experience with a community of learners incorporates new knowledge by adding to each
learner’s own experience and allowing them to understand the perspectives of others. As learners incorporate new perspectives and ideas, they encode the knowledge within their existing schema. This transformation of a social experience into individual knowledge is close to Vygotsky’s (1978, p. 21) concept of internalization. Internalization is the practice where learners gradually seek comprehension of the experience by incorporating knowledge into existing thoughts. The internalized learning experience is essential to meeting the needs of diverse learners.

If these principles are accepted as critical in education, a social experience can be applied to instruction with information visualization as an educative process. A social experience encourages learners to question what has changed or what new information requires consideration. Social constructivism empowers learners through experience with other collaborators; they learn through the assistance of others and strengthen community connections. By having knowledge through shared meaning and creation, the learner is empowered. Visualizations support empowerment in taking raw data and making it more broadly meaningful in a social dialogue. There are several elements of sociocultural theory that support this pedagogy: (a) zone of proximal development (ZPD), (b) more knowledgeable learner, and (c) scaffolding.

**Zone of Proximal Development.** The ZPD is “the distance between the actual development level as determined by independent problem-solving and the level of potential development as determined through problem-solving under adult guidance or in collaboration with more capable peers” (Vygotsky, 1978, p. 86). Vygotsky’s model is best illustrated as a series of expanding concentric circles, where the learners have an independent level of knowledge in the center. As they move outward, they are challenged
to build on their knowledge with the assistance of the more knowledgeable other (MKO) in the form of peer collaborators and resources provided by the teacher. Learning interdependence continues to enhance their knowledge before reaching difficulty and frustration. The ZPD, reinforced with the MKO, and scaffolded with prior knowledge synthesized a social constructivist method.

**More Knowledgeable Other.** Learning is mediated by the educator while students learn through discovery and collaborative dialogue. In sociocultural theory, the teacher is a facilitator who guides and supports students’ growth. Vygotsky (1978) defined this role as the MKO, an individual with expert content or skill knowledge. As Erbil (2020) noted, students benefit positively from the guidance of an MKO, initially in the form of the teacher who curates resources of instruction. Then students are empowered to work cooperatively with their peers “as a group and benefit optimally from each other in terms of information” (Erbil, p. 4, 2020). Students have themselves become the MKO within their peer groups and are challenged in the ZPD (Vygostky, 1978). Students’ development with collaborative learning parallels the sociocultural approach. Vygotsky (1978) developed a framework around collaborative dialogue, a process of interaction between members of the learning community (p. 17). Educators function as the MKOs and serve as facilitators of learning while students are collaborators in the discovery process.

**Zone of Proximal Development (ZPD).** Learners start with teacher support and prior knowledge and move toward new perspectives through increasing levels of independent practice. ZPD is “the distance between the actual developmental level as determined by independent problem-solving and the level of potential development as
determined through problem-solving under adult guidance, or in collaboration with more capable peers” (Vygotsky, 1978, p. 86). Students challenge themselves by engaging with expert learners to acquire new knowledge and perspectives.

**Scaffolding.** Educators facilitate supportive activities to unpack learning and build new perspectives within learners. An experience with a community of learners incorporates new knowledge by understanding the perspective of others. As learners incorporate new perspectives and ideas, they scaffold the knowledge within their existing schema. This transformation of a social experience into individual knowledge is closely link to Vygotsky’s (1978, p. 21) internalization. Through social experiences, learners process knowledge, leading to the development of higher order thinking skills.

**Project-Based Learning**

The format of analyzing and creating infographics closely resembled project-based learning practices. Project-based is defined by “a method in which students’ deliverables and assessment are produced through social learning” (Erdogan & Bozeman, 2015, p. 13). Though several competing models of project-based learning exist, the approach designed by Larmer and Mergendoller (2010) was applied to this research study. Larmer and Mergendoller identified seven principles of project-based learning: (a) a need to know, (b) a driving question, (c) student voice and choice, (d) 21st century learning skills, (e) inquiry and innovation, (f) feedback and revision, and (g) a publicly presented product. In brief, the project would be guided by required prior knowledge, guiding questions, opportunities for students to decide how to develop learning, use skills such as collaboration and critical thinking, investigate new or original ideas, receive criticism and improve, and exhibit their learning to a larger audience. Next, I consider the
range of scholarly literature that directly supports the practice of analyzing and creating infographics as practices of teaching and learning.

**Infographics in Education**

When students engage in the analysis and composition of infographics, they engage in learning strategies including close reading (Callow, 2003; Serafini, 2013), identifying author’s purpose and tone (Davis & Quinn, 2014), and assessing evidence with bias (Hearst, 2017; Yearta et al., 2018). Socially constructed learning experiences using infographics have demonstrated improved communication and accommodated diverse learners (Hearst, 2017; Ismaeel & Al Mulhim, 2021). In this section, I explore (a) how infographic literacy is grounded in existing literacy paradigms, (b) how it relates to contemporary teaching standards and skills, and (c) the existing framework and best practices in education.

**Expanded Conceptualizations of Literacy**

Contemporary researchers support the importance of conceptualizing literacy beyond the printed word (Apkon, 2013; Buckingham, 2013; Davidson, 2010; Flood et al., 2015; Spires et al., 2019; Warlick, 2009). Hobbs (2010) noted that the “concept of literacy is beginning to be defined as the ability to share meaning through symbol systems in order to fully participate in society” (p. 16). In the early 20th century, scholars have tried to rectify the changing concepts of literacy in parallel with expanding digital technologies. Simultaneous interpretations of literacy were investigated as new literacies (Leu et al., 2013; Livingstone et al., 2008; Mills, 2010; Street, 2003) and multiliteracies (Anstey & Bull, 2006; Cazden et al., 1996; Cope & Kalantzis, 2000; Unsworth, 2008). Research from experts in new literacies and multiliteracies provides the foundation for
modern digital teaching and learning. These contributions are acknowledged as critical concepts, although research in the field of media and digital literacy was the primary focus of this study.

Researchers have demonstrated that not all aspects of literacy education are addressing the needs of teachers and students (Bluestein, 2010; Breakstone et al., 2018; Hicks & Turner, 2013). The domain of new literacies and multiliteracies was grounded in traditional concepts of literacy: reading, writing, and speaking (National Reading Panel, 2000). The rise of modern media, including infographics, necessitated explicit instruction in new forms and genres (Brusilovsky et al., 2010; Kress & van Leeuwen, 2006; Serafini, 2013). Over time, the expanding field of literacy is adapting to support a growing taxonomy of learning with visual media.

Research has shown that readers use the parallel processes of analysis for both written text and images (Eilam, 2012; Malamed, 2011). Readers might apply similar strategies to visual media in order to support various learning taxonomies (Cromley et al., 2010). As readers create inferences by interpreting visual media, they deepen their understanding of a whole text (Hobbs, 2011; Unsworth, 2008). Visual literacy addressed the ability to locate, interpret, evaluate, and create visual media to improve understanding and communication with others (Ausburn & Ausburn, 1978; Bristor & Drake, 1994; Eilam, 2012; Hattwig et al., 2011). Scholars have acknowledged that infographics are forms of visual media requiring continued investigation (Dur, 2018; Yarbrough, 2019). Therefore, attention must be given to an understanding of how visual literacy has evolved within the parallel fields of digital and media literacy.
Digital and Media Literacy and Learning

Digital and media literacy are essential skills of contemporary learners (Hicks & Turner, 2013; National Council of Teachers of English, 2022). Hobbs (2011) wrote that digital and media literacy “help us more deeply engage with ideas and information to make decisions and participate in cultural life” (p. ix). Media literacy acknowledged that forms of media are constructed, described and defined in social, cultural, and political contexts, and impacted our society as a whole (Buckingham, 2013). The concept of digital literacy built on this definition and included the networked and participatory aspects of encountering and producing media (Gilster, 1997; Jenkins, 2009). A strong definition of digital literacy would include curating, consuming, producing, and communicating about digital content (Spires et al., 2019).

Educators are applying digital literacy in promotion of new practices for teaching and learning (Ananiadou & Claro, 2009; Dede, 2010; National Research Council of the National Academies, 2013; Kibar et al., 2019; Saavedra & Opfer, 2012). The digital literacy language is often usurped in the field of 21st century learning, the skills required to be successful in contemporary society (Partnership for 21st Century Learning, 2019; Silber-Varod et al., 2019; Trilling & Fadel, 2009). This supported research where explicit instruction in digital literacy occurred through educators with some proficiency in information and communication technology (Breakstone et al., 2018; Falloon, 2020; Záhorec et al., 2019). Educators who demonstrated confidence in digital literacy instruction were those who created authentic purpose facilitated with appropriately chosen digital design tools (Hobbs & Coiro, 2019; Reddy et al., 2020). Teaching
educators how to become facilitators of digital authorship is one essential factor of digital literacy.

Digital literacy is defined by the American Library Association (as cited in Meyers et al., 2013) as “the ability to use information and communication technologies to find, evaluate, create, and communicate information, requiring both cognitive and technical skills.” Digital literacy as a field of study has divergent means depending on existing notions of literacy (Hobbs, 2017; Reddy et al., 2020; Spires et al., 2019). Apkon (2013) wrote that “literacy is always a two-way transaction. We don’t just consume; we produce. We don’t just read; we write” (p. 39). Digital literacy pedagogy is supported by participation in the creation of learning with and from others using digital tools (Hobbs, 2017; Záhorec et al., 2019).

In Create to Learn, Hobbs (2017) provided instruction for how several authentic media ensembles could be used to develop students’ digital literacy. Comparing infographics to other genres, she noted that infographics lacked “the same standards of verification” as other modes of communication (Hobbs, 2017, p. 167). That is because infographic creators may (or may not) explain or document the sources of the information they represent in visual form. Digital literacy generally includes the analysis and design of digital ensembles across multiple modes (Breakstone et al., 2018; Eshet-Alkalai, 2004; Falloon, 2020; Jones & Hafner, 2012). Researchers have connected infographics to digital literacy as a unique area of study (Darcy, 2019; Smith & Robertson, 2021), linked the genre to the concept of multimodality.
**Multimodality**

Multimodality is critical to understanding how information visualization varies in visual complexity (Jewitt, 2008; Kress, 2000; Van Leeuwen, 2021). Infographics are unique collections of multimodal forms of communication (Beegel, 2014; Krum, 2013; Lamb & Johnson, 2014; Lyra et al., 2016; Smiciklas, 2012). Multimodal texts may consist of words, pictures, or graphs (Kress & van Leeuwen, 2006; Lamb & Johnson, 2014; Serafini, 2022; Snow, 2002). Multimodal texts incorporate other modes, including typography, imagery, and graphic design in a single document (Serafini, 2013; Van Leeuwen, 2021). Multimodal texts include visualizations that vary in elements from simple symbolic images (Bertin, 2010), to multifaceted representations of data visualization (Tufte, 2001) and information visualization represented simultaneously (Krum, 2013).

Multimodality has been investigated as a common framework of the infographic structure requiring explicit instruction (Almunive & Alshammari, 2018; De Aizpurua, 2017; Santos et al., 2018; Yarbrough, 2019). As early as 2005, the National Council of Teachers of English declared that “students should be invited to collaborate with their teachers in the study of [multimodal] literacies and in the practical aspects of integrating those literacies into the curriculum” (National Council of Teachers of English, 2005). Multimodal texts continue to be essential resources in contemporary education and are included in existing curriculum (de Oliveira et al., 2016; Howell, 2016; Jewitt, 2008; Serafini, 2022; Wilson, 2008).
Educational Technology

Using technology in teaching and learning is an essential skill for both educators and students (Crompton, 2017; Falloon, 2020; Fullan, 2012; Silber-Varod et al., 2019). Specifically, 21st century education is expected to reinforce technology skills in the analysis and design of a learning artifact (M. Anderson & Jiang, 2018; Spires et al., 2019; Wertz & Saine, 2014). Contemporary educational practices have shifted from teaching technology in isolation and have moved toward parallel work in all subjects (E. K. Anderson et al., 2019; Fadzil, 2018; Gebre, 2018; Pazilah & Hashim, 2018; Steyn et al., 2018). The use of design tools and accompanying templates as a starting point is one consideration, and project-based learning is another method.

Design Tools and Templates. Becoming an informed and knowledgeable user of infographics is supported by learning to create them (Beegel, 2014; Krum, 2013; Lankow et al., 2012; Smiciklas, 2012). Digital design technology has moved from professional tools requiring significant expertise to consumer-level usability (Wright, 2016). Research continued to support efficient practices for acquiring new technology skills with models and templates (M. Anderson & Jiang, 2018). Templates offer models of digital design for both educators and learners (Joshi & Gupta, 2021; Raviolo et al., 2021; Salim et al., 2021). Research has continued to demonstrate positive outcomes for students engaged in design by starting with a template (Ramli et al., 2019; Smith & Robertson, 2021; Zaqoot & Oh, 2018).
The Influence of School Contexts

Infographic Instructional Framework

The investigation of structured infographic teaching and learning is emerging. In Smith and Robertson’s (2021) *Infographic Instructional Framework*, the authors examined a multipart instructional framework for infographics. The research focused on four efforts to increase comprehension of infographics: exploration, investigation, creation, and integration. Exploration activated background knowledge for infographics through existing samples. Investigation examined “how specific infographics represent information in both print and graphic form” (Smith & Robertson, 2021, p. 442). Creation engaged learners in the design of infographics using technology. Integration addressed how the infographic can be incorporated into a traditional written text. These four components composed the authors’ infographic instruction framework.

The concept of the infographic instruction framework contributed to the limited curriculum for teaching and learning with infographics at a young age. The sample used in Smith and Robertson’s (2021) study consisted of elementary students with prior experience with graphical representations in reading. The model provided guided questions and adopted constructivist approaches for infographic literacy. The findings suggested support for an “innovative alternative to [a] traditional written piece” (Smith & Robertson, 2021, p. 444). The authors further suggested that infographics can be used to summarize other texts and parallel multiple genres of text. These conclusions address positive contributions in pedagogy but do not address alternative perspectives of the framework.
The framework of Smith and Robertson (2021) noted that infographics can serve a dependent role in a larger, syntactic text. Visualization experts challenged this context, given that infographics are intended to offer perspective and clarity independently (Krum, 2013; Smiciklas, 2011; Tufte, 2001). The infographic is a standalone text because it incorporates several modes of communication and is purposefully designed to be primarily illustrative (Santos et al., 2018; Steyn et al., 2018; Sutherland, 2021; Yarbrough, 2019; Yildirim, 2016).

Infographics appear in great frequency in content-area-specific education ranging from collegiate level (E. K. Anderson et al., 2019; Barlow et al., 2021; Fadzil, 2018; Chaudhury, 2021; Steyn et al., 2018) to the kindergarten to secondary level (Habeeb, 2020; Ismaeel & Al Mulhim, 2021; Jeong & Kang, 2021; Kibar et al., 2019; Smith & Robertson, 2021). Infographics are prevalent in all subjects including science (Gebre, 2018; Jung & Lim, 2018), language arts and secondary languages (Maamuujav et al., 2020; Pazilah & Hashim, 2018; Pisarenko & Bondarev, 2016; Rezaei & Sayadian, 2015), mathematics (Baglama et al., 2017; Mamalo & Ibeh, 2021), social sciences (Bystrova, 2020; Habeeb, 2020; Yearta et al., 2018), health and physical education (Arcia et al., 2015), and library and informational sciences (Fattouh, 2021; Fredrick, 2013; Trost, 2019; Waddell & Clariza, 2018).

**Standards**

Visual literacy, critical to understanding infographics, is a fundamental learning skill addressed by 21st century learning standards. Teacher education in visual literacy rose in popularity in the 1970s (Ausburn & Ausburn, 1978; Dondis, 1973; Fransecky & Debes, 1972). This era of mass communication and information processing gave rise to
visual-centric media in the following decades (Lapp et al., 1999; Stokes, 2002). The parallel field of media literacy has renewed interest in visual literacy and the context of imagery (Buckingham, 2013; Hobbs, 2011; National Council of Teachers of English, 2022). However, instruction in media and visual literacy tends to be isolated from core-content instruction, occurring most commonly in elective courses in art and design production (Dur, 2018; Flood et al., 2015; Lyra et al., 2016). The field of education recognized the importance of visual literacy in the evolving standards-based movement.

In the U.S. education reform in the early 21st century, a series of standards were designed to guide teacher pedagogy and assess students’ proficiency. The CCSS were developed in partnership with the National Governors Association Center for Best Practices and Council of Chief State School Officers (2010). In the section titled “English Language Arts and Literacy in History/Social Studies, Science, and Technical Subjects,” the framers detailed spiraled language for visual literacy practices. In Table 3, the cited standards reference the sixth grade expectations and were chosen for their alignment to the age of my study’s participants.
<table>
<thead>
<tr>
<th>Section</th>
<th>Strand</th>
<th>Specific language</th>
</tr>
</thead>
<tbody>
<tr>
<td>Writing</td>
<td>CCSS.ELA-LITERACY.W.</td>
<td>“Introduce a topic; organize complex ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aid comprehension.”</td>
</tr>
<tr>
<td>Reading:</td>
<td>CCSS.ELA-LITERACY.RI.</td>
<td>“Integrate information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue.”</td>
</tr>
<tr>
<td>Informational Text</td>
<td>6.7</td>
<td></td>
</tr>
<tr>
<td>Speaking and</td>
<td>CCSS.ELA-LITERACY.SL.</td>
<td>“Analyze the purpose of information presented in diverse media and formats (e.g., visually, quantitatively, orally) and evaluate the motives (e.g., social, commercial, political) behind its presentation.”</td>
</tr>
<tr>
<td>Listening</td>
<td>6.2</td>
<td></td>
</tr>
<tr>
<td>Science and</td>
<td>CCSS.ELA-LITERACY.RS</td>
<td>“Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table)”</td>
</tr>
<tr>
<td>Technical</td>
<td>T.6-8.7</td>
<td></td>
</tr>
</tbody>
</table>

Common to these four standards is the reinforcements of visual literacy in several core subjects. Students should be able to integrate, analyze, and develop their knowledge through visual representations (National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010). The emphasis on graphics is especially important for research in visual learning with information and data visualization.

The noteworthy addition in the speaking and listening portion of the standards may have impacted other standards framework. In 1996 and revised in 2012, the National Council of Teachers of English and International Reading Association established Standards for the Language Arts (National Council of Teachers of English and International Reading Association, 2012). The fourth and 12th standards include similar language to CCSS that emphasize the importance of examining visual texts with an emphasis on purpose and credibility.

**Instructional Strategies**

I briefly review instructional strategies that enable students’ ownership of the learning experience. Table 4 shows three strategies that were employed in this study and identifies key practices and the alignment with constructivism.
Table 4

*Overview of Key Constructivist Instructional Strategies Used in This Study*

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Key practice</th>
<th>Constructivist alignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gradual release of responsibility</td>
<td>Learning moves from teacher modeling, to guided practice, to independent performance.</td>
<td>Facilitated learning.</td>
</tr>
<tr>
<td>(Pearson &amp; Gallagher, 1983)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Think-pair-share</td>
<td>Examine existing knowledge and reflect, partnered dialogue, and group reflection.</td>
<td>Activating prior knowledge and collaborative dialogue for scaffolding.</td>
</tr>
<tr>
<td>(Lyman et al., 2017)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flipped classroom</td>
<td>Direct instruction is mostly independent and occurs prior to class.</td>
<td>Minimal direct instruction and experiential learning.</td>
</tr>
<tr>
<td>(Bergmann &amp; Sams, 2012)</td>
<td>Teacher models and facilitates practice during class time.</td>
<td></td>
</tr>
</tbody>
</table>

The instructional lesson plan included in Appendix B was created using three instructional strategies: gradual release of responsibility, think-pair-share, and the flipped classroom model. The gradual release of responsibility method was designed with teachers modeling, followed by collaborative practice, and then individual mastery.
(Pearson & Gallagher, 1983). The process closely resembles the Vygotskian approach of MKO and the ZPD discussed earlier. Students practiced the gradual release of responsibility through group, paired, and individual reflection using a think-pair-share graphic organizer (Lyman et al., 2017). Think-pair-share is a technique providing guided questions based on a teacher model. Students consider their prior knowledge, participate in dialogue with a peer, then reflect on their results individually and with the whole group. These two strategies were the basis for the analysis segment of the instructional plan.

One model of socially constructed learning is the flipped classroom that was employed for the infographic design phase of the study. This method removed direct instruction and supported the teacher to facilitate collaborative learning among peer learners (Bergmann & Sams, 2012). Erbil (2020) examined the flipped classroom model and applied Vygotsky’s sociocultural theory. The flipped classroom is an instruction strategy where learning occurs with resources outside of the classroom and students participate in practice within the classroom (Cheng et al., 2019). The practice is rooted in Vygotsky’s reinforcement that “language plays an important role as a culture transmission tool” (Erbil, 2020, p. 3). Language occurs when new knowledge is delivered from the MKO, a person with the experience and knowledge to shape a learner (Vygotsky, 1978). In the flipped classroom, the teacher transmits the social interactions and values through external media or educational technology. The flipped classroom refutes the notion that learners are receptacles of new knowledge, transmitted through lecture or passive activities from the instructor.
Conclusion

Middle-level educators are underprepared to deliver infographic instruction in the core curriculum. Adolescents are encountering infographics at a frequent rate but have limited educative experience with analyzing and designing infographics (Alford, 2019; Arcia et al., 2015; Bystrova, 2020). A limited knowledge of infographics negatively impacts their formative education and their ability to meet the 21st-century challenges of their postsecondary life (E. K. Anderson et al., 2019; Pazilah & Hashim, 2018). Educators must focus their attention on infographic literacy at an earlier age and with multiple opportunities of engagement.

The review of scholarly literature addressed the context of infographics, educational theory and pedagogy, and how infographics education is aligned with K–12 educational contexts. By examining characteristics of infographics with examples, I offered some insight on this complex and exceptional mode of semiotics. Grounded in constructivism, the literature review reveals how students’ learning is socially situated and rooted in the tenets of sociocultural theory. The study of infographics is relevant to a variety of fields of educational research and levels of instruction. Infographic literacy is an emerging field that draws heavily on scholarly research in parallel fields of study. This literature review provides the foundation for the methodological decisions of the study that are elaborated in next chapter.
Chapter 3. Methodology

An effective qualitative study is the result of careful planning and execution (Creswell, 2009). This study included the design, implementation, and assessment of a 4-day instructional unit on infographic in a science classroom. In this chapter, I describe the research design I used for a case study observing four middle-level learners in a sixth grade science classroom. I offer details to help the reader understand the sample and context, the instructional design being examined, and the measures used.

The study used qualitative, instrumental case study research for the investigation (Yin, 2009) using a purposive sample of four sixth grade students in a suburban public school. The student participants were supported by a teacher facilitator in a classroom setting who implemented a 4-day instructional unit that I developed to demonstrate how socially constructed learning activities supported the analysis and design of infographics.

Context, Sampling, and Technology Considerations

Context

The environment for this research was an affluent suburban public school district in Rhode Island where I am employed as a middle school teacher. The district is recognized at both the state and national levels for providing an accredited curriculum and progressive learning initiatives.

Shale Middle School has a student-to-teacher ratio of 11:1. The school has 6% of students eligible for subsidized lunches, and 9% of the population receives special education services. The district has an abundance of technology and community support for faculty and students. All research participants had access to both a school-provided and a personal computing device. This technology-rich and high-performing academic
environment differs from most other public school systems in the region and throughout
the United States. Although my study permits only limited generalization beyond this
site, the school serves as an appropriate environment for examining instructional
practices and adolescent behavior associated with analyzing and designing infographics.

**Sampling**

All sixth grade students available during a common instructional period at Shale
Middle School were invited to participate without coercion or compensation. The sixth
grade student population in this school consists of 223 students who are between 10 and
11 years old. The teacher facilitator is an experienced teacher with over 20 years in a
middle school setting. The teacher is certified to teach both language arts and science in
middle school.

In support of the units of observation, a purposive selection of four sixth grade
learners was made to closely approximate the setting’s population. Illustrated in Figure
11, the purposive sample of four student were selected by four criteria: (a) students were
not previous or current students of the researcher, (b) students self-reported “limited or no
experience with infographics” prior to the study, (c) students who provided assent for the
study, and (d) students with parental consent.
**Figure 11**

**Sampling Method**

Student assent and parental consent were attained for participation in the study using documentation approved by the Institutional Review Board (IRB) at the University of Rhode Island (see Appendices C and D). Details about the study were provided to parents and students via an infographic, shown in Appendix E. I developed a recruitment poster with the intention of demonstrating infographics to potential adolescent participants. The purpose of captivating adolescents with a format that was both familiar and instructive was an additional goal. Some infographic design elements were used, but the final product included more printed text than visualizations to meet the IRB expectations. The poster required language about the study’s importance, purpose, procedures, benefits, and contact information. The poster served its main purpose of recruitment given the constraint of time.

**Technology Considerations**

The instructional practices used in this study include both reading and writing of infographics. To create infographics, students use a digital tool called Piktochart, which enabled them to modify and adapt infographic templates. The ease and relative simplicity of this tool makes it appropriate for use by middle school children, but some features of
Piktochart created challenges for me in the context of school district policies regarding the use of technology.

Piktochart users are required to enter any personally identifiable information, including name, gender, age, organization, home or mailing address, or e-mail address. In the United States, where the study was conducted, children under the age of 13 are protected against unlawful collection and use of personally identifiable information. The Children’s Online Privacy Protection Act of 1998 (COPPA) provides protections against “unlawful or deceptive acts or practices in connection with the collection, use and/or disclosure of personal information from and about children on the Internet” (Children’s Online Privacy Protection Act, 1998). The law defines children as users under the age of 13 and is regulated by the United States Federal Trade Commission. The COPPA regulations ensure that organizations may not knowingly collect personally identifiable information without parental consent and supervision.

The school committee for the research site established a policy that adhered to the COPPA law and forbade educators and administrators from using technologies that were not COPPA compliant. This policy would have prevented the use of Piktochart, the main digital design tool used to create the infographics. Piktochart informs users of data use and collection in its Privacy Policy. Piktochart revised the policy on May 25, 2018, to reflect public concern about data privacy. Section 3.1 of the policy states that creating an account required the collection of an e-mail address and the user’s name. The policy further clarified that the product is “directed only to users who are at least 13 years of age or older” (Piktochart, 2022). For these reasons, Piktochart would not be approved for use by the school district hosting the research study.
However, the product manager and development team at Piktochart volunteered access to the production platform to accommodate the needs of the research site. The production version allowed for the exclusion of personally identifiable information and a closed environment for the underage users. I used random numerical usernames to maintain the confidentiality of participants. The completed projects were not housed on the Piktochart servers after the study and were not examined by the company for marketing or other purposes.

The completed findings of this study were made available to the Piktochart team in a follow-up conversation. Those findings were in summary form and did not include any of the recordings, personally identifiable information, or raw data collected during the study. Piktochart and its employees did not receive compensation for the use of the product. However, Piktochart may use the experience to support future upgrades to the product with an educational lens.

**Instructional Practices Under Examination**

It is important to note some of the differences between the instructional plan as designed and the instructional plan as implemented. This project was conducted near the end of the Spring 2019 semester. The teacher facilitator used the curriculum I designed in a middle school science classroom. The unit I designed, as illustrated in Figure 12, was intended to provide a learning experience over the course of 6 days that involved students in the process of analyzing and designing infographics. Using a social constructivist approach, learners practice analyzing, designing, and reflecting, both individually and with peers. This facilitated instruction enables students to formulate and practice design elements that are commonly used in infographics. In this section, I describe the
instructional plan as it was designed to be implemented when submitted as a research proposal, and in Chapter 4, I explain revisions to the instructional plan that were made by the teacher who implemented it. In the pages that follow, I use future tense to emphasize the plan as it was designed and past tense to describe what actually occurred.

Figure 12

*Timeline for Infographic Instruction*

![Timeline for Infographic Instruction](image)

**Analysis Activities**

During the analyzing task on the first 2 days, the teacher facilitator will review two examples of infographics as a whole-group task. The teacher will present the two samples as an intentional sequence of simple to complex. Students will be encouraged to annotate a copy of the infographic and provide oral feedback on their interpretations. Students will consider the design and context of infographics. This dialogue includes discussion of how people create and understand infographics (varying interpretations, bias, cultural differences).

The teacher facilitator will have students work in pairs using the think-pair-share guide to record their conversation about a third infographic sample. This presents an
opportunity to create a working list of their findings. By posting the results on a poster or in a shared document, the teacher creates a visual analysis of the infographic. For some students, distractors will be more obvious and similarities may become clearer. Struggling students may need more time to examine infographics with the aid of this chart.

These findings will be mapped onto a poster paper or shared document by the instructor using the parking lot strategy. The teacher will ask each group to share two discoveries made while reviewing the infographic sample. The teacher will record these as brief statements in the public document that can be grouped by similarity. This will aid students in connecting both convergent and divergent design elements that the group observed.

**Group Reflection and Digital Tool Exploration**

Prior to this unit, the teacher will receive instruction on the essential tasks for using the Piktochart tool and developing an infographic as an observable lesson. The teacher will be given a working format for providing instruction on using the tool that is an example of both direct instruction and blended learning. The teacher will be expected to modify this format for equity within the classroom.

On the third day, the teacher will provide an overview of the key tools in Piktochart using a brief instructional video and a student handout. Both items were available on the Google Classroom at all times, so students could refer back to them during the writing task. The teacher helped students to be familiar with the key features and know how to log into the Production Mode environment. Students were given time to explore the tool and practice with a simple example.
Designing Activities

During the fourth and fifth days, students will be tasked with creating an original infographic. Students will be provided with a copy of the class-constructed rubric and a basic set of criteria for the expected infographic design. They will have access to science data collected from an earlier class regarding an unidentified fossil. The goal is for students to take this dataset and produce an original infographic describing the fossil and its distinguishing characteristics.

The teacher facilitator will provide students with a similar dataset, where each student receives one of four types of fossils. The students were randomly assigned the dataset by the teacher facilitator earlier in the teaching unit. The students understand that the labeled categories are the same for all students but with different data results. This leaves students with room to choose different perspectives for the focus and design of the infographic but a clear guideline of data to be included. The teacher facilitator will take care to draw parallels between the design and the previous questions during the instructions.

Students will be given two class periods (approximately 42 minutes per session, or 84 minutes total) to create and finalize a draft infographic in Piktochart. The students will export their final product as a PDF file and submit it on a research-study-specific Google Classroom.

Peer and Self-Reflection

On the sixth and final day, the teacher will upload completed infographics, collected from the Google Classroom, in the Peergrade application. Students’ anonymous submissions and data privacy are protected by the Eduflow designers by default. Student
participants will be given an overview of how to access the features in Peergrade by the teacher facilitator. Then, students will be responsible for examining and reflecting on three peer-designed infographics and self-reflect on their own. These reflections will use the student-constructed rubric that will be visible on the screen as they type their reflections. Students will also be asked to share any open-ended commentary that will clarify their scoring selections.

The teacher will collect these data by exporting the results into a spreadsheet file and reviewing the results in the online interface of Peergrade. These copies will be coded using the researcher’s coding protocol. The four participants will participate in a semi-structured interview. The participants will have access to their think-pair-share graphic organizer, self-created infographic, and peer- and self-feedback during the interview process. Each student will be interviewed for up to 15 minutes and responses will be audio recorded and transcribed.

The instructional plan I have just described represented a synthesis of my understanding of best practices pedagogy for teaching about infographics to middle-grade learners. The curriculum was informed by the learning theories and instructional strategies noted in the literature review. In the next section, I outline my data collection and analysis methods.

Data Collection and Analysis Methods

Although I designed the instructional practices, the lessons were implemented by a science teacher in his own classroom. This made it possible for me to collect a variety of evidence through observation, a think-pair-share graphic organizer, student-created infographics, and student interviews.
Classroom Observation

Observation allowed me to see demonstrative evidence of the learning process as it occurred. It was my primary tool for assessing student learning. Before the study began, I explained to all participants that I was observing the learning process and would not interfere or interact with them. I further reminded student participants and the teacher facilitator that anything observed would not be used to grade, punish, or evaluate them.

To support my observations, I also made video and audio recordings and composed field notes after each session. I focused my attention on the four student participants and the teacher facilitator. After each observation, I made analytical field notes about student and teacher behaviors. Data collection included transcripts of the classroom observations supported by my field notes, the students’ think-pair-share graphic organizer, the student-designed infographics, and transcriptions of the interviews. I also maintained a reflective journal to capture my personal impressions during the research.

During the lessons, I used nonparticipant observation to examine the learning experience with a goal of “develop[ing] a holistic understanding of the phenomena under study” (Baxter & Jack, 2008). Nonparticipant observation methodology allowed me to witness situations and participants where other forms would be too intrusive or inappropriate (Fraenkel et al., 2011). The method provided opportunities to explain the meaning and context of social constructivism in the content-area classroom. Though the method had strong validity, critics have pointed out that observational data may be viewed as subjective or biased (Patton, 2002). For this reason, I consider my researcher positionality and transferability more fully in Chapter 6 (Creswell, 2009).
The research used video and audio recording on digital devices. These devices had the capacity to continuously record footage of the student participants in the learning environment with controlled sound leveling. I used two digital camcorders with mini-shotgun microphones to capture the classroom environment and close-ups of students at work. I also used a portable multitrack audio recorder to capture backup environmental sounds and for the interviews. The audio recorder was small enough to not create a distraction during the one-on-one interview process. These recordings were placed on a secure hard disk drive and cloud server at the end of each session. The portable hard drive was encoded and stored at the University of Rhode Island, and the cloud storage was protected by two-part authentication.

**Think-Pair-Share Graphic Organizer**

An important source of evidence for this research is student performance on a think-pair-share experience, where students work collaboratively to analyze an infographic. Figure 13 shows the process of this instructional strategy. In the analyzing portion of the instruction, students were provided with a digital copy of the think-pair-share graphic organizer as a Google document (Appendix F). The students accessed the file on Google Classroom and opened it in Google Docs. The document was reviewed by the teacher facilitator, who explained each section to students to minimize information overload.

The first section was suggested by the teacher facilitator to closely resemble activities familiar to the group. The section is titled “Goals” and includes a stem statement. The stem states, “By the end of the lesson, you should be confident that” and
ends with a comma. The stem is followed by two numbered statements that begin with “I can”:

1. I can define what an infographic is, explain why it is used, and why we will be studying it.
2. I can describe essential design elements of an infographic.

Next, the teacher facilitator provided two infographic examples linked in Google Classroom. With a peer partner, the students were asked to analyze the sample using the think-pair-share strategy. The teacher facilitator reviewed this strategy with the whole class.

**Figure 13**

*Think-Pair-Share Process*

The graphic organizer, shown in Figure 14, includes a two-column table that allows students to record their initial impressions. The teacher facilitator directed the students toward an infographic titled “Halloween by the Numbers.” Students used the digital copy of the worksheet and toggled between web browser tabs. They could also
request a printed copy. The Think table has two columns, one labeled “Guiding Questions” and one labeled “Your Thoughts.” Students were given 10 minutes to complete this table for two teacher-shared infographics.

**Figure 14**

*Think Segment of the Think-Pair-Share Document*

**Think-Pair-Share: Reading Narrative Infographics**

**THINK:** Record your responses using complete sentences in the “Your Thoughts” column. Aim for a MINIMUM of 2 sentences for each box.

**Sample #1:**

<table>
<thead>
<tr>
<th>Guiding Question</th>
<th>Your Thoughts</th>
</tr>
</thead>
<tbody>
<tr>
<td>How would you describe the design of the sample?</td>
<td></td>
</tr>
<tr>
<td>What is the big picture?</td>
<td></td>
</tr>
<tr>
<td>How does the author clarify or analyze the information?</td>
<td></td>
</tr>
<tr>
<td>How does the author present facts or evidence?</td>
<td></td>
</tr>
</tbody>
</table>

Students were assigned to work with their adjacent peer partner. Students were given up to 10 minutes to review what they recorded in the two-column tables from the Think activity. Students reviewed the rows one by one while having copies of infographics available. A blank text box was provided for students to record notes. Students were asked to use this section rather than modify what they recorded in the tables earlier.
Students were redirected by the teacher facilitator as a whole group. The teacher facilitator asked student dyads to volunteer to share their findings for the Share segment (Figure 15). Students responded to the task while referencing their graphic organizer. The teacher facilitator used a blank copy of this segment posted in view of all students or digitally projected and accessible on students’ computers. The teacher facilitator will take bulleted notes about what was shared. The notes will include similar and different findings recorded by the students. The teacher facilitator provided time to ensure that all students who wished to share were given the opportunity.

**Figure 15**

*Share Segment of the Think-Pair-Share Graphic Organizer*

<table>
<thead>
<tr>
<th>SIMILAR</th>
<th>DIFFERENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>•</td>
<td>•</td>
</tr>
</tbody>
</table>

**SELF-REFLECTION:** How would you describe your thinking process when reading narrative infographics instead of regular text? Explain why with details. *Minimum of 5 sentences.*

**Student-Created Infographics**

The infographics that students created functioned as an important form of data for this project. Because students used digital tools to create these works, a description of the technology and platform is required. The school district has adopted a one-to-one student
ratio of distribution of computer technology. Beginning in sixth grade, where the subjects of the research were placed, each student received a personal HP Chromebook laptop. The Chromebooks require an Internet connection provided by a wireless router using the district’s network connection. The district monitors concurrent connections using the Cisco Maraki environment and filters web connections using the Chromebooks run on the ChromeOS platform. This system limits inappropriate and distracting sites and apps. In this study, the platform gave access to Piktochart to the participants, teacher facilitator, and researcher only.

Students accessed productivity tools through the Google G Suite for Education services provided to the district. During the study, the Google Classroom feature was used as a prompting site for daily activities, tutorials, and submissions. The digital classroom was only accessible to the teacher facilitator, the student subjects, and the researcher.

Students used Piktochart to create their infographics. At the time of the study, Piktochart was one of several online applications for infographic creation. The application was selected for the study based on several factors that are worthy of examination. The features and functionality of Piktochart closely aligned with my hope for a robust tool for infographic creation. Piktochart willingly provided the research platform that met the following guidelines of the study. For the study, the Piktochart design team gave me access to a developer version of the application. The developer version is a complete version of the Piktochart application with controlled access to several features of the product.
Piktochart users begin with an option for using a blank canvas or selecting a template from a library of 600 predesigned formats. Study participants were discouraged from using dynamic features during the design process. Dynamic designs would complicate the study. Facilitators informed students that the final product would be exported as a static PDF file. Therefore, participants understood that the product should be designed with a two-dimensional framework.

The user interface of Piktochart was explained during the third day of instruction. Students were provided with video playlists that demonstrated common tools in Piktochart. The tools included the Graphics, Uploads, Background, Text, and Tools tabs. Figure 16 shows a screenshot of the Piktochart platform.

**Figure 16**

*Piktochart Design Interface*

![Piktochart Design Interface](image)

**Features of the Platform.** The Graphics tab provided a library of preset vector and raster clipart that could be imported into the design. Vector graphics are digital
images based on calculated pathways. The image can be resized and edited with no size limitations while maintaining sharpness. Raster graphics are an array of pixels—colored blocks of information—that form a picture. Unlike vector graphics, raster images are limited by the number of pixels when resizing. An image with too few pixels will appear blurry when resized larger than the original. In Piktochart, the vector graphics library consisted of shapes, icons, and lines, and the raster graphics library consisted of stock photos.

The Uploads tab supports the user’s uploads of a variety of image formats. Participants were encouraged to use the option of importing graphics located online during the design process.

The Text tab supports the inclusion of syntactic text with a variety of styles and colors. The tab provides samples of the font and formatting of the text. Participants can drag and drop these elements into the design and edit them in a text box. The text box can then be resized, rotated, and grouped into the design project.

The Data tab provides the data visualization functions of Piktochart. The participants have the option to manually enter data into an on-screen spreadsheet or import a data file in three formats: Google Sheets, JSON, and CSV. The research study used research collected by the students. If desired, the participants could include evidence in quantitative form.

At the conclusion of the drafting process, students were asked to export the product. Exporting the product provided an artifact of the student’s writing for further analysis. Piktochart included three options for exporting the project: format, quality, and blocking.
The format options include PDF or Portable Network Graphics (PNG). PDF is widely accepted in both industry and educational standards for digitizing documents and providing accessibility features. The metadata component of PDFs allowed me to maintain critical identifiable information within the document without impacting the actual product. PDF documents can be viewed on most digital devices or printed as a hard copy.

Piktochart users can export the project at various levels of quality, either for on-screen viewing or for printing. Participants were asked to select the PDF option and choose High in the quality setting. The Whole Page option was selected to provide students with a single-page format. This allowed final copies to be printed on 8.5” by 14” paper.

Although dynamic designs allow an audience to interact with the product using various methods and Piktochart supported dynamic design by default and included tools to customize these capabilities, dynamic designs would complicate the nature of this study. These features were deliberately discouraged during the research study. The teacher facilitator informed students that the final product would be exported as a static PDF. Therefore, participants understood that the product should be designed with a two-dimensional framework. In Chapter 6, the decision to exclude dynamic design from the product is analyzed as a limitation.

**Student Interviews**

I used informal interviews with the four participants to further understand their perceptions of the tasks and learning experiences. Interviews generally lasted no more than 15 min. After explaining the purpose of the research and obtaining asset, I said:
Let’s begin by reviewing the procedures. I will be asking you about the infographic you designed using Piktochart and the feedback you received from your peers. You will have as much time as you need to respond to a series of open-ended questions. The questions do not have right or wrong answers. They will help me to understand how you designed the parts of your infographic. Please try to explain your answers as completely as possible. If you do not understand the question or need clarification, please ask me at any time. Are you ready to begin?

Then, I displayed the participant’s digital infographic design on the laptop facing both the researcher and participant, and asked them to confirm that it was their original work. I used the following questions, asking students to elaborate as needed.

1. What can you tell me about your understanding of the topic of this infographic?
2. Which parts of the topic did you use focus on in your design?
3. What was the process you used to design your infographic? Please be specific.
4. What element of the infographic was easiest to create?
5. What element of the infographic was challenging to create?
6. What peer feedback would you like to respond to?

**Approach to Data Analysis**

Here I briefly describe how I handled the different data sources to produce research findings. Starting with the a priori codes from the literature review, I modified my collection of codes to resemble discoveries made as I examined the data. Figure 17 shows how each potential new code was examined against my existing codes. If deemed
a new code, all prior content was reviewed with the new codes (Maxwell, 2012). The process insured that new and existing codes were part of the analysis process in multiple instances. The frequency of identified codes was analyzed and mapped for clarity. The resulting codes would become the basis for focusing on (a) observations, (b) think-pair-share graphic organizer, (c) the students’ infographic design elements, and (d) student and teacher interviews.

Figure 17

*Coding Practice Following the Miles and Huberman (2020) Model*

**Analysis of Observation Data.** To analyze the observation data, I rewatched the videos of classroom practice and made analytic notes that included the behaviors of students. The first video recordings included a wide shot of the majority of the classroom and the teacher during whole-group discussion. The second video recording used both cameras to focus on two student subjects during their discussion and design process. While filming, I retained analytical notes of my observations. Then I used my revised codes to mark noteworthy learning processes including questioning, on or off task,
collaboration, asking for help from others, and problem-solving. I used this process to construct a representation of what happened in the classroom.

**Analysis of Think-Pair-Share Data.** I examined the four participants’ think-pair-share graphic organizer and coded my observations. The intention was to closely examine the learning practice of analysis within the sample. To analyze this data, I reviewed student responses on the graphic organizer using the a priori codes: (a) format, (b) appeal, (c) clarity, and (d) evidence. The use of these four codes was part of the graphic organizer’s design whereby the Think questions aligned to each of these components. Noteworthy phrases written by students were added to the checked against my codebook and recorded for frequency.

**Analysis of Student-Designed Infographics.** I examined and coded students’ self-designed infographics. I reviewed video evidence, when possible, that demonstrated the practice of creating the infographic on Piktochart. These four samples were intended to align with the video observation, think-pair-share document, peer feedback, and eventually the one-on-one interview. Student feedback and member checking were conducted during post-study interviews. I returned to the student-designed infographics as new ideas emerged. My rationale here was to keep collecting the codes as they appeared and then add and review new codes.

**Analysis of Interview Data.** Interviews were recorded one-on-one and were transcribed at a later date. The phrasing of questions were designed using the a priori codes. Subjects were encouraged to elaborate and new codes were reviewed against the existing codebook. Prior to the interview, students had reviewed their infographic and
peer feedback. Opportunities to clarify responses were supported by a digital copy of the student’s infographic and peer feedback.

**Researcher Trustworthiness**

The qualitative approach requires trustworthiness in the researcher, given the subjective nature of the process (Fraenkel et al., 2011; Patton, 2002). The concept of trustworthiness parallels quantitative traditions of reliability and validity. Trustworthiness is measured through four features: (a) credibility, the ability to conduct member checking and triangulation; (b) transferability, providing a context that can be replicated; (c) dependability, the use of consistent practices supported by similar research when collecting evidence, and (d) conformability, which involves corroboration with other authorities in the field of study (Creswell, 2009).

To establish credibility, informal preobservations were conducted with students at the research site within a classroom of sixth grade students. Preobservations allowed me to suggest a priori codes for my analytical notes. An accredited social scientist with qualitative research experience supported the corroboration of the coding process. The Follow-up member checks took place at the end of the interview by reviewing my observations and notes for clarity with the subjects.

Given that the researcher is the primary reviewer, examination of the intrarater reliability is essential here (Krippendorf, 2012). I systematically re-examined all sampled data multiple times as new codes were added. Each sampled text was compared against any new codes and recorded accordingly. This process may or may not produce similar results but will account for intrarater reliability until a peer-reviewed, research-based coding scheme can be designed and additional coders corroborate the process.
To establish transferability, the study relied on a purposive sampling of four students in a sixth grade content classroom. The grade level was chosen to support transference between the elementary- and secondary-level experiences of students. An explanation of the sampling process and repeated coding of data collection will be detailed in this study to support replication. Multiple observations will be checked against codes to ensure the likelihood of the same kinds of observed behaviors in future studies. These codes will be available in an Appendix A to support replication.

To establish dependability, consistent observation techniques, supported by audio and video recordings and analytical notes, were used throughout instructional observation. The socially constructed rubric of design elements was used by students during the encoding and reflection processes. A semistructured interview protocol was established for follow-up questioning. The interview protocol closely resembled the a priori codes and allowed for divergent code possibilities.

To establish conformability, interview questions were designed with support from texts written by leading infographic experts and feedback from fellow researchers. Analytical notes and student samples were corroborated with the teacher facilitator and an accredited qualitative researcher to ensure that the coding process closely aligned with the suggested categories and codes. A site administrator reviewed data collection for evidence of conflicts in research positionality.

**Conclusion**

The mark of a strong research study is its ability to account for the conditions and methods necessary for sound implementation and analysis. In providing an explicit explanation of the instructional practices and data collection processes, I have provided a
framework for individuals interested in replicating this study. In the next chapter, I report observational and interview findings.
Chapter 4. Results

The middle school classroom observed in this study buzzed with excitement from start to finish. Creating infographics about their fossil project was a relevant culminating experience for learners. For days, they had been collecting fossils and role-playing the job of a paleontologist. Mr. Sandgren buried fossil models in an outdoor garden on the school campus, and students brought them into the classroom, using research texts provided by the teacher to identify them. Now the expectation was that students would create an infographic that would capture the characteristics of their fossils. Students were anxious to begin opening Piktochart and designing infographics on their own. The teacher had first given them the chance to analyze the structure of an infographic, and now they were ready to take the reins. Meanwhile, the teacher approached this unit with reasonable concern but clear optimism that this would be a beneficial learning approach. He was genuinely praising students each day as he moved about the classroom. It seemed that both students and teacher were finding value to this learning experience.

In Chapter 4, I examine the evidence collected using the methodology described in Chapter 3. First, I reflect on adaptations that occurred during the implementation of the instructional unit that occurred. I offer my observations in chronological order as they occurred to help readers visualize the changes to the instructional practices as they occurred. Then, I provide descriptions of the research evidence and then examine several samples of student work that provide evidence about the participants’ process and the produced materials.
Adaptations to the Instructional Plan

Coordination with the instructor regarding the implementation of this unit proved to be an unexpectedly pivotal part of the research process. Prior to the implementation of the instructional unit, I met with the teacher facilitator, Mr. Sandgren, to review the lesson plans created for this research project. These two meetings took place in his classroom during a planning period, the first occurring 2 weeks before the observation and the other occurring 2 days before the observation. The purpose of these meetings was to review the logistical operation of my observations and the lesson plans. Mr. Sandgren expressed some hesitation about how to implement the lesson provided. Before our meeting, I delivered a slide deck that provided an overview of the key steps in this lesson. We used these slides as a reference in our conversation at both meetings. Mr. Sandgren added his personal notes and made suggestions for revisions.

Mr. Sandgren appreciated how the slides provided a framework and expressed confidence that it resembled instruction at his comfort level. He noted that the lesson followed practices that were normative to his science instruction and used language that was mostly familiar to students. However, Mr. Sandgren shared concerns that he was not as confident about implementing the technology portion of this unit. In particular, he was concerned that students’ use of Piktochart would be challenging for him. He wondered how he could troubleshoot with students, given his lack of user experience.

Based on this conversation, I offered some revisions to the instructional process that would resolve his concerns. We determined that three action steps needed to occur in advance: a third model infographic should be provided, the language in the graphic
organizer needed revision, and supplemental resources for Piktochart instruction should be included.

The first task was to select an infographic model that met our criteria. Mr. Sandgren wanted the model to address a familiar scientific subject. He also wanted the illustrative nature of the infographic to be evident. After some discussion, we agreed upon an infographic from a student-friendly resource. The infographic demonstrated a cyclical process that would be familiar from students’ science curriculum earlier in the year. Mr. Sandgren chose this model to be the introductory example for whole-group dialogue prior to the think-pair-share activity. We agreed that this created an appropriate warmup and model for the analyzing lesson.

The second action step focused on revising the language in the think-pair-share graphic organizer. The existing graphic organizer followed best practices of this strategy for collecting, discussing, and exhibiting evidence of learning. Mr. Sandgren expressed concern about the original language of the fourth question, “What is the gist of the infographic?” He noted that students were familiar with the frequently asked question “What is the big picture?” This question had been modeled throughout the sixth grade curriculum and would reinforce students’ expectations for questioning. The statement provided an age-appropriate modification and did not detract from the intent of the original question.

The third task was to locate and include additional teaching resources for the Piktochart tool. Mr. Sandgren believed that students would have questions that he would not be fully able to answer as they engaged in digital design. Though he believed that Piktochart was appropriate and user-friendly for sixth graders, the students would have
limited time to practice with the tool’s features. I consulted a Piktochart representative for ideas and experience with this problem. The suggestion was made to include brief video tutorials demonstrating the basic features and controls for designing an infographic. Students could select the videos in a playlist format from their Google Classroom course page. Mr. Sandgren shared his satisfaction with this solution for addressing students’ questions about technical concerns.

Mr. Sandgren intended to use the video tutorials to supplement direct instruction in infographic production. Before releasing students to design their own infographic, Mr. Sandgren would provide a brief instructional lesson about the user interface and tools. Then, he would respond to general questions and note the video playlist in the Google Classroom course. However, on the day of the production lesson, Mr. Sandgren pivoted by providing a very brief introduction to Piktochart. Rather than giving the direct step-by-step instructions as we planned, Mr. Sandgren opted to show a portion of the first video in the playlist. When the video concluded, he remarked that the video playlist was expected viewing for all students. Mr. Sandgren expressed confidence in their abilities, and the students’ reactions indicated that they were anxious to get started. Mr. Sandgren indicated to students that as they confronted technical challenges about the tool, we would solve problems along with them. Analytical notes of video observation reflected some evidence that Mr. Sandgren provided one-on-one support.

Scheduled Instructional Timeline

A final and important modification to the scheduled instructional timeline was necessary because of the classroom teacher’s scheduling conflicts. In the original timeline shown in Chapter 3, the unit lasted 6 days. The goal was to provide double the
instructional days for the analyzing and designing process and 2 separate days of reflection at the midpoint and conclusion of the unit. Scheduling conflicts made it necessary to revise the schedule to a 4-day instructional unit. The revised model embedded a full reflection day at the end, with briefer reflection practices embedded during the analyzing and designing, as shown in Figure 18.

**Figure 18**

*Revised Instructional Timeline*

![Revised Instructional Timeline](image)

Mr. Sandgren suggested that this model had the benefit of less noninstructional time between steps. Students might be more likely to provide rich feedback in the moment rather than the following day. Each class period was purposely selected because they were part of the block schedule. In a block schedule, students meet with their content teacher for a 95-minute instructional period and then have a 15-minute snack break before leaving for their next class. Therefore, each class met for approximately 110 minutes each day of this research project.
Observations of Curriculum Implementation

On the first day of the unit, I introduced myself to the participants and clarified the purpose of the research. I reviewed the expectations of an observer, including that I could not interfere in the lesson or respond to students’ inquiries. I reiterated that this work would be ungraded and would not be used to judge students’ performance. I offered an opportunity for questions but only received one inquiry about where the final self-produced infographic would be displayed. I directed this to Mr. Sandgren, who informed students that they would have their final products printed in color and displayed in the classroom. With no further questions, I moved to a corner of the room, where I began taking analytical notes and maintaining the video recording devices. Mr. Sandgren introduced students to a sample infographic, “How a Bottle Is Recycled” (Figure 19).
How a Bottle Is Recycled

The infographic was displayed on an LCD projector in the front of the classroom. Students were also guided to open a copy on the Google Classroom course page. The access code had been provided by Mr. Sandgren on a prior day, and all students appeared to be enrolled and accessing the site. Mr. Sandgren asked students to “take a moment” and examine the sample. After approximately 1 min, he began with, “What do we see in this infographic?”

The first student he called on referred to the sample as a “poster” for how a bottle is recycled. Mr. Sandgren gave a positive acknowledgment and called on another student whose hand was raised. The student stated that the image “has a lot of color and arrows to show you what is happening.” Mr. Sandgren took a moment to acknowledge this comment by pointing toward the projection.

After two more brief responses about the look of the infographic, Mr. Sandgren asked, “How could we define the word ‘infographic’?” Initially, students seemed to pause and remained unresponsive. He repeated the question with a different intonation and waited for a raised hand from the participants. One student raised his hand, and when called on by Mr. Sandgren, he stated that an infographic “is something that shows information in an interesting way.” Mr. Sandgren agreed and immediately asked a follow-up question: “Where else have we seen infographics?” The student responses included magazines, websites, and television. Mr. Sandgren suggested that infographics are being used all the time. He encouraged students to find examples of infographics online for the next few minutes. Mr. Sandgren suggested that students go to the Google search engine and locate an infographic that appealed to them. He gave them free rein to go online and find examples of their own using the Google search engine. Together,
students spent a few minutes doing this. I observed that most students looked for infographics by starting with a search engine, then went to the image tab as opposed to a specific website and browsed the gallery of images that appeared. They tended to look for infographics around subjects that they were either familiar with or interested in. For instance, sports came up quite often. He then asked the students to share their findings with tablemates, which for most groups consisted of three or four peers. Mr. Sandgren then asked the students to end their conversations and focus on him.

He stated that each infographic is unique and expected that they observed this in conversation with their peers. He moved swiftly to explaining the instructions of the think-pair-share activity. Mr. Sandgren asked students to open their individual copies of the think-pair-share Google document (Figure 20) in their web browser.

**Figure 20**

*Snapshot of Think-Pair-Share Cover Page*

**GOAL**

By the end of the lesson, I CAN...
1. define what a narrative infographic is,
2. explain why it is used,
3. describe design features of a narrative infographic.

**TASK**

You will look at several narrative infographic examples linked in the Google Classroom.
With a partner, analyze the sample in a THINK-PAIR-SHARE. Use the tables below to record your answers to the Guiding Questions.

**DIRECTIONS**

A Think-Pair-Share activity starts by yourself, then continues with a partner. Complete the steps in the following order and repeat for each infographic sample:

1. By yourself, review the narrative infographic sample. Record what you THINK after each Guiding Question.
2. Discuss your responses as a PAIR with your partner and take notes.
3. SHARE what you discussed in the Compare and Contrast boxes. Then, write your own conclusions box in the Self-Reflection.

He also asked them to open a copy of the Infographic Samples 1 (Figure 21) and 2 (Figure 22) in separate browser tabs.
Figure 21

Infographic Sample 1

**Climate Change Impacts People**

In drought-prone countries, children under five are up to 50% more likely to be malnourished if born during a drought.

More than 80% of natural disasters are climate related.

Climate change will result in 150 million to 2 billion migrants.

Very poor people spend 50-75% of their income on food.

If women had access to resources, on-farm yields could increase by 20-30%.

This extra output could reduce the number of hungry people in the world by 12-17%.

Figure 22

Infographic Sample 2

Note. From Manitoba Fossil Facts, Canadian Geographic

The teacher asked how many students were familiar with the think-pair-share model. Three students reluctantly raised their hands. The first student response was off-topic. The second student tried to continue discussing the previous infographic sample. Although students were eager to share ideas, the few students raising their hands were more interested in sharing anecdotal responses rather than developing a working explanation of the think-pair-share strategy. Mr. Sandgren had to redirect this behavior to stay on task. This behavior is not uncommon in middle school students who are still maturing in their ability to stay on topic.

Mr. Sandgren explained that the three steps of a think-pair-share activity consist of examining a document, discussing the findings with a partner, and then sharing with the whole group. Mr. Sandgren said that the first segment should be completely individual. He continued by stating that they would next have a chance to compare their findings with a partner. Mr. Sandgren concluded his overview by saying that students would last have a group share-out and an “exit ticket.”

Mr. Sandgren read aloud page 1 of the think-pair-share activity guide. He stated that students should review the first sample while completing the table on the graphic organizer. As he read each guiding question, he provided a paraphrased follow-up. For instance, he reminded students that “What is the big picture?” is asking for students to state the main idea of the infographic. After he checked for questions, only one student raised their hand to ask if they “should record [their] responses in complete sentences.” Mr. Sandgren responded in the affirmative. He then told students they should work independently and quietly for the next 15 min. They understood that they were to
complete the “Think” tables for the two infographic samples provided and then wait for further instructions.

As students were working, Mr. Sandgren circulated the room. Students frequently looked at the on-screen sample and switched tabs to record in the graphic organizer. Student responses were recorded as complete sentences in the column labeled “Your Thoughts.” In the first row of the table, several students remarked about design features including “color,” “pictures,” and “organization.” For example, in Figure 23, Sally identified the design as “very colorful” and explained that the main idea was that “climate change is very bad and affects people greatly,” even leading to death. In responding to the question, “How does the author clarify or analyze the information?” the student took note of the “quick little facts” and observed that pictures are used to define “hard words.” When describing how the author presented facts and evidence, the student recognized how lists are used to present information.
Several students asked Mr. Sandgren to clarify the meaning of the fourth statement, “How does the author present facts or evidence?” Mr. Sandgren decided to address the entire class with this question. He asked for a volunteer to paraphrase the question. A student stated, “The information that was collected to prove [the author’s] point.” Mr. Sandgren expressed satisfaction with her statement. However, Mr. Sandgren clarified that he was not expecting students to provide citations of the evidence. He reasoned that in-class data were given to them and did not require academic references.

For example, in Figure 24, Tom identified the design as having “many pictures with words around them” and believed that this design “helps the reader better understand the words.” The student explained that the main idea was that “Manitoba is a region with much fossil history.” In responding to the question, “How does the author clarify or analyze the information?” the student noted that the author placed pictures next
to words. When describing how the author presented facts and evidence, the student recognized how color was used to organize information, with blue indicating sea and tan indicating land.

**Figure 24**

*Think-Pair-Share Individual Response Sample From Tom*

<table>
<thead>
<tr>
<th>Guiding Question</th>
<th>Your Thoughts</th>
</tr>
</thead>
<tbody>
<tr>
<td>How would you describe the design of the sample?</td>
<td>The design of the sample has many pictures with words around them. The pictures show what the words are explaining, which helps the reader better understand the words.</td>
</tr>
<tr>
<td>What is the big picture?</td>
<td>The big picture is that Manitoba is a region with much fossil history. The pictures and words each explain something about fossils found or not found in Manitoba or facts about Manitoba itself.</td>
</tr>
<tr>
<td>How does the author clarify or analyze the information?</td>
<td>The author clarifies and analyzes the information by placing words next to pictures that describe what the words are saying. By putting many pictures of the infographic, it is easier for the reader to understand.</td>
</tr>
<tr>
<td>How does the author present facts or evidence?</td>
<td>The facts in the blue area are facts about Manitoba in the sea and the facts in the tan area are about facts above land and fossils found in Manitoba.</td>
</tr>
</tbody>
</table>

After nearly 15 min, Mr. Sandgren asked students to stop and give their attention to him. He asked students to begin the pair section of the activity guide and encouraged students to partner with their shoulder seatmate, a behavior that appeared to be a familiar practice to students. He explained that students should record their dialogue in the “Pair” response box. Students readily started conversations about their observations, referring to the “Think” segment of the document. Students were given approximately 9 minutes to complete this activity with their partners. Almost all students appeared actively engaged in this task.
At the end of the segment, Mr. Sandgren drew the smaller conversations to a close and directed attention to him. At this point, he asked students to scroll down to the “Share” segment of the activity. Mr. Sandgren directed students to record their upcoming group conversation in the table on the third page of the graphic organizer. The table has several rows with a single column. The first row is split into two columns, one for “Similar” and one for “Different.” Students were expected to record commonalities and differences with regard to the two infographic samples under discussion.

Mr. Sandgren reviewed the directions for students to record bullet-point entries about their partner’s dialogue. Student responses in the facilitated dialogue included remarks about similarities including “bolded or emphasized the facts/words,” “images or photos,” “colorful, color scheme,” or “hard to read, crowded.” Students also noted differences that included “chunked sentences of ideas,” “were hard to read, crowded,” or “lacked a central idea, no big picture.”

Mr. Sandgren asked students to share their findings and called on students with raised hands. As students shared an idea from their document, Mr. Sandgren began writing a summary in a small corner of the whiteboard. As the conversations progressed, he recorded the following words in a vertical stack: “Visual,” “Evidence,” “How It Looks, Appeal” and “Clarity.” Next to each word, he grouped a single word from each student’s response. The strategy presented the appearance of grouping frequently mentioned ideas from students, but the categorization was directed by the teacher.

After 3 minutes of responses, Mr. Sandgren stated, “Perhaps there is a pattern here.” He returned to the four words and rephrased them as “Format,” “Evidence,” “Appeal,” and “Clarity.” He drew arrows indicating that he was moving the order of the
names around. He stated that in this new order, it created the word “FACE” from the first letter of each category. Mr. Sandgren then suggested that “perhaps we can remember FACE for the things needed in an infographic.”

Mr. Sandgren checked the time for the class period and stated that it would be time to wrap up. He indicated that students needed to complete an “exit ticket” in the form of a self-reflection using a graphic organizer. Mr. Sandgren stated the question in the self-reflection row where students would “describe [their] thinking process.” He noted that he included the FACE acronym on the graphic organizer to cue their writing. He suggested that students look to the FACE parts if they were having difficulty stating their reasoning in the self-reflection.

A student raised their hand and, when called upon, asked if Mr. Sandgren could explain the self-reflection in different words. Mr. Sandgren rephrased the question using the initial infographic as a model, saying, “If you had to read an article on climate change or fossils, how would it be different in the presentation of those two different types . . . infographics versus an article?” The student acknowledged his suggestion and returned to viewing his screen.

Another student asked if they needed to “record anything in the last box” where the FACE appeared as an acrostic in red print. The student appeared confused by the appearance of this acronym. Mr. Sandgren restated that it was just for reference and they only needed to include complete sentences in the “self-reflection” box. Students were given approximately 8 minutes to complete this segment.

When students completed the document, they used the “Turn In” button on the Google document to submit their work. Several students who completed the task earlier
than their peers began to put away materials and prepare for a scheduled break. All students completed the task before being dismissed and ending the first day of observation.

**Learning to Create Infographics**

The second day of class time was focused on learning the Piktochart production tool and exploring the first draft of a student-designed infographic. As noted earlier, Mr. Sandgren felt less confident about teaching the production tool to students. After initial exploration, he found that he was only moderately comfortable answering students’ questions. For this reason, I curated a series of video tutorials for review. Mr. Sandgren included these in a category titled “Help Videos” on the Google Classroom. Mr. Sandgren decided that the topics addressed in the videos would serve as an appropriate learning process for his students. The videos were produced by the Piktochart team and were divided into six essential skills: (a) editing blocks, (b) adding items, (c) changing backgrounds, (d) adding text, (e) customizing charts, and (f) publishing your infographic. Each video had an approximate running time of 1.5–2 min. At the start of class, he drew attention to an introduction video that was also included.

The introduction video, titled “Overview of Piktochart,” allowed Mr. Sandgren to preview the Piktochart program in a concise format. The video had a running time of 2 min, and Mr. Sandgren turned on the closed captioning feature before projecting it on the whiteboard in front of the classroom. Students listened attentively and were immediately raising their hands for questions at its completion. Most students were interested in using some of the features of the program, which Mr. Sandgren was able to briefly explain. For technical design questions, he noted that he linked videos that students would be expected
to watch independently. Mr. Sandgren displayed the links on the Google Classroom through his video projection.

Mr. Sandgren shifted the lesson to discuss what students should include in their infographics. He referenced the previous day’s discussion about the FACE elements. He asked the class, “Why would we not include everything from our research?” At this stage, Mr. Sandgren was redirecting students to examine the raw data they had been collecting in the days before the instructional unit on infographics began. Immediately prior to the infographics activity, each student had been asked to roleplay as a paleontologist. Students worked together to dig up four fossil models that Mr. Sandgren had buried in an outdoor garden on the school campus. Four different fossils were discovered by the students and brought into the classroom. Students then spent several days researching fossilized organisms using research texts provided by the teacher to identify them. Now the expectation was that students would create infographics that would capture the characteristics of their fossils.

There were varied responses from students to the question, “Why would we not include everything from our research?” One student responded that they “would only need to summarize what we found.” Another student elaborated that “we are not writing a report but making a kind of poster.” Mr. Sandgren encouraged this statement by asking, “How might we make this look different than one of our lab reports?” A student volunteered that “using smaller captions” might help. Mr. Sandgren then called upon a student who said, “It wouldn’t have paragraphs, just a few sentences with lots of pictures.”
Mr. Sandgren complimented the group and asked what kinds of elements might appear in their infographics. Students suggested that “statistics,” “facts,” and “timelines” would be helpful to the audience. Mr. Sandgren encouraged these suggestions and drew a parallel to the examples used in the think-pair-share activity. He then pivoted to the sign-in process for the Piktochart program.

Mr. Sandgren demonstrated where to click on the specialized login link included on the Google Classroom site. He explained that the link provided a unique site that would only be used by his students. This was a reminder that for the purpose of research, students could only use this version of the program. He demonstrated how to log in using a sample username. Then, he distributed small paper cards that included students’ research identification username and a password.

After a few minutes of settling into quiet concentration, students completed the login to the website. Many opened a new web browser tab or window for the Google Classroom–linked tutorial videos. A few students used headphones they had brought to class. I was able to verify that they were using the headphones for the tutorial video only. All students used the remaining class time, about 35 min, to practice using the Piktochart features.

Most students approached this task by copying and pasting information from the research document into the infographic template. In a previous paleontology lesson, students had been given a graphic organizer in which they documented the characteristics and data of their fossil. Using Piktochart, many students created a text box, copying their writing from the graphic organizer and pasting it into the textbox. This process was observed in nearly all the students, with the exception of a few who created less focused
prototypes. Throughout this time, Mr. Sandgren circulated through the classroom, observing and offering advice, including suggestions about specific details from the graphic organizer.

I observed that most students appeared confident with the tool’s basic features. All students chose to begin with a template. Observed behaviors included deleting segments of the template, changing colors of objects, and resizing the font. Most students seemed comfortable with exploring the tool with only the aid of the tutorial videos. This provided an effective insight into the mindset of students, who appeared eager to use the tool rather than first becoming proficient in its functions. Students were motivated to immediately apply their learning to the creative practice of composing an original infographic.

**Editing and Revising**

The following day, students were given the entire length of the class to work on finalizing their infographic designs. Mr. Sandgren started the class by stating the objective of trying to complete the drafts that day, with the intention of publishing them before the next class. A student asked, “Can we work on our infographic at home if we don’t have enough time?”

Mr. Sandgren firmly said “No” and elaborated on the reason: “We have special permission to use Piktograph [sic] on our school computers. It only works during our class time and then shuts off until the following day.” He also reassured them that they would have more than enough time. The total design time of the previous day’s class was approximately 35 minutes, and they would be given the entire remaining class period to work today.
However, students were only able to work for 85 minutes of the block period and subsequent break because they were interrupted by a fire drill. The alarm sounded about 10 minutes before the end of the block period. Students were asked to leave their computers as they were and to exit the class without taking any materials. The classroom was locked during this time and no one was able to tamper with the technology, as I observed through an exterior window.

When students returned to the classroom, it was decided to end the lesson for the day. Students were asked to save their work and told they would be given time to finalize their drafts the following day. Students had completed 120 minutes of total design time over 2 days.

Reflection

On the fourth day, Mr. Sandgren began the class by reminding students that they would be completing their draft infographic and giving peer feedback that day, using a digital tool called Peergrade that enables students to comment on each other’s work. He explained that they would be given 10 minutes to “put the finishing touches” on their design. Mr. Sandgren then projected a video tutorial linked on the Google Classroom. The video was labeled “7. Peergrade How to Submit Your Assignment.”

The video demonstrated how students would log into the Peergrade website using their existing research username and password. The student would see a classroom link and an assignment titled “Infographic.” Students would follow the on-screen instructions for uploading the saved PDF of their draft infographic. At the end of the video, Mr. Sandgren reviewed the steps and asked students for questions. There were no responses, but several students were eagerly logging into Piktochart to return to their project. Mr.
Sandgren directed students to begin working on their infographics and set a 30-minute timer that displayed a countdown on the whiteboard.

When the timer sounded, Mr. Sandgren called for the students’ attention. He asked that each student complete the publishing steps in Piktochart, if they had not already completed this task. Approximately half of the class appeared to be engaged in completing this process. One student asked, “Do we save this to our Google Drive?” Mr. Sandgren replied that it was an acceptable option for the next step. After about a minute of waiting, Mr. Sandgren asked students to return to the Google Classroom and click on the “Peergrade” link under the Tools category. He reminded students to pull out their research username cards and enter this information into the login screen. Mr. Sandgren suggested that all students complete the steps for submitting their assignment immediately. When they were finished, he directed them to take their 15-minute break early.

All but three students were able to complete the task of logging in and submitting their sample to the Peergrade program. Mr. Sandgren went directly to the other three students, who raised their hands requesting assistance. The students asked questions about the Peergrade interface that created momentary confusion. Mr. Sandgren was able to easily answer their questions, and they were able to catch up with their classmates for the break.

During the break, Mr. Sandgren met with me to check on the progress of submissions. The Peergrade tool requires submissions to be finalized before moving on to the next step of peer feedback. I was able to access the system and see that the entire classroom of students had properly submitted their PDFs. I directed the program to
randomly assign each student three peer products to review. Each assigned copy was anonymous for both the reviewer and the digital author.

Mr. Sandgren explained that they were going to watch a brief video tutorial on how to complete the peer feedback in Peergrade. The video labeled “8. Peergrade: How To Give Feedback” was projected on the whiteboard. The video demonstrated how students would click on a link titled “Peer Submission” followed by a number. Three links would be available for each user. When the link was clicked, the browser would split vertically into two sides. The left side would contain the image of the peer’s infographic, and the right side would provide a simple rubric. After completing the rubric form, they would click on the “Next” button to cycle through the remaining feedback.

After the video, Mr. Sandgren noted that there would be an additional step not featured in the tutorial. After the three peer reviews, students would then complete a self-reflection for their submission. At the conclusion, they would see a Submit button that would complete the Peergrade assignment. Mr. Sandgren asked if there were any questions, and one student asked, “What if our infographic wasn’t finished and someone gives it a bad score?” Mr. Sandgren reminded all students that this was a draft and that “peer feedback will tell you how you can improve your design.” When they received the feedback the following day, they would have time to make revisions before resubmitting a version for printing.

Students appeared satisfied with this answer and were directed to begin the peer-reviewing process. Students were observed to frequently zoom in and scroll the infographics in the browser window. Many leaned into their Chromebook screens, appearing to scan details or read the text on the display. Most completed the radio buttons
input on the FACE rubric before completing the two commentary boxes. The first box
instructed students to “Mention something that your classmate did well,” and the second
box instructed them to “Mention something that your classmate could improve at.”
Students appeared to type responses as brief phrases with limited use of punctuation.
(Specific statements are reviewed later in this chapter.)

Students completed anonymous peer feedback for three classmates using the
Peergrade web application. Students received instruction on Day 4 on how to submit a
PDF of their project to the site. The program randomly assigned each student to review
three peer infographic exhibits and reflect on their own submission. The protocol for
reflection asked students to provide positive feedback and constructive criticism for
improvement. These indicators were labeled as “warm” and “cool” feedback and
demonstrated by Mr. Sandgren.

Interview Results

Mr. Sandgren and I met for a semistructured interview about the instructional unit
the day after it had been completed. The interview was conducted in an empty classroom,
with our laptops opened to the Google Classroom course. After reading the interview
protocol introduction, I asked Mr. Sandgren, “What can you tell me about your students’
understanding of the infographic unit?” Mr. Sandgren stated, “The kids looked really
engaged, just excited to have this tool to express themselves.”

He further explained that he “would have liked to see students make deeper
connections between the content and the data they collected.” When asked to elaborate,
Mr. Sandgren said, “Well, I noticed that the students were just regurgitating the data they
collected. They do this in their reports too. They give these concrete answers, but you
have to press them to dig deeper into its meaning, you know? Like, how does the data tell
you about the kind of environment [a dinosaur] thrives in?”

I reiterated, “So in other words, you felt like students were providing good
answers, but they lacked analysis?”

He nodded in the affirmative. “Yes, it’s always what we as teachers are hoping
for, but I’m still glad they got the gist of science behind it.” During member checking,
Mr. Sandgren elaborated that teachers hope for higher levels of thinking.

I moved on with another question: “Which parts of the unit’s design did you
modify, and why?” Mr. Sandgren restated my previously mentioned pivot toward a 4-day
set of lessons instead of 6 days. He spoke of the shifting schedule making it difficult to
find consistent class time for the research as it was originally planned. He also expressed
relief at having the video tutorials to fall back on for specific instruction. Mr. Sandgren
noted, “When a student would ask me a specific question about Piktochart, I could direct
them to the video and we could find a solution together, so that helped me learn more.”

I had an opportunity to ask why he modified the think-pair-share with the
inclusion of the FACE codes. At first, he did not recall making the change. When I
clarified with a copy of the original document, he stated, “I remember, we had asked the
students to do a chalk talk and record what the characteristics of an infographic were.
That’s when we grouped their ideas under the FACE label. I thought it would be a helpful
context clue for the reflection.” This statement supported my understanding that Mr.
Sandgren believed that students needed this level of scaffolding. His decision was in the
best interest of students and a common practice among constructivist-designed materials.
As will be demonstrated later, this decision had a critical impact on the organic nature of students’ socially constructed design elements of an infographic.

Next, I asked Mr. Sandgren, “How did your students demonstrate communication?” He asked for clarification about whether I meant communication with him or with fellow students. I responded that either one was sufficient for his response. Mr. Sandgren discussed the ease of his class when communicating with him and each other. “I will be curious to see what they think about communicating through the process,” he said. I asked him to elaborate, and he said that many students at this age are not fully comfortable with self-evaluation or giving peer feedback. He believed that students were not simply self-conscious but “were still learning how to give critical feedback.”

The following question was “How did your students demonstrate collaboration?” Mr. Sandgren drew attention to the think-pair-share activity. He said, “They seemed to have a lot of ideas about how the message was designed.” I asked him for a specific example, and Mr. Sandgren said, “The language they used was expressive. They showed a real passion for making sense of the infographics.” His affect demonstrated pride and satisfaction when he responded.

I asked Mr. Sandgren to “talk about how the students demonstrate creativity, with any examples you can think of.” He stated that most students seemed to start with templates but added “colorful or creative touches to their design.” He specifically addressed how one student added iconography to show the subjects that were included in the original graphic organizer.
I continued by asking, “How did your students demonstrate critical thinking?” Mr. Sandgren asked for clarification of this question. I reframed it twice, stating first, “Are there examples of the students using critical thinking skills?” followed by, “How did the students problem solve?”

Mr. Sandgren hesitated, stating, “I am not really sure I know how to point to evidence of that.” He indicated that connections were made to the science concepts, but it would be challenging to show how the design supported critical thinking. I explained that I was interested in how students might use the infographic to unpack the data with improved understanding. He stated that this might be possible, but he “could not point to a specific moment where [he] saw that yet.” It is worth noting that Mr. Sandgren had not yet fully reviewed each student’s infographic submissions prior to this interview.

When I asked, “What instances of positive and negative social learning experience did you witness?” Mr. Sandgren reiterated that students worked well together and collected good evidence of understanding the infographic samples. He could not express a specific example of negative interaction. He did express disappointment that he could not “spare more time for those teachable moments.” I believed he was expressing that the time allocated limited the ability to reflect more on the students’ ideas.

I concluded by asking him, “What feedback would you give to your colleagues about teaching this unit?” Mr. Sandgren excitedly responded that he would encourage his fellow colleagues to use infographics as an alternative method for presenting information. He felt that students were so engaged and produced less “cookie-cutter” results. Mr. Sandgren suggested that having a colleague like me who could help manage the technology instruction would also be helpful. He noted that having an opportunity to co-
teach the design skills concurrent with the science skills would probably increase the students’ proficiency in both areas.

At the conclusion of the interview, Mr. Sandgren continued to express enthusiasm about continuing to use infographics as a resource for learning. He noted that he was eager to print color copies of the students’ infographics to be shared at a parent exhibition. I made some recommendations on how this might be accomplished. Mr. Sandgren also wanted to appoint time for discussing methods for introducing this practice schoolwide in the following academic year.

**Student Interviews: Sally and Tom**

Sally is a cheerful and precocious Caucasian student with blonde hair and blue eyes. She presents as mature for an 11-year-old, given her responsiveness to the challenges in the instructional unit. Her prior experience in using infographics was self-described as “familiar but not able to understand them yet.” During the interview, she was eager to demonstrate her growth in the form and function of infographics.

The interview with Sally began by sharing the infographic exhibit that she had created on the branch coral fossil. Figure 25 shows her work, which used the “All About Me” template to present information from the fossil’s point of view using first-person voice.

The first question I asked was, “What can you tell me about your understanding of the way an infographic is designed?” Sally indicated that the first step was to “collect my information,” which referred to her fossil data from a prior lesson. She said that her next step was to open Piktochart and “see all the different templates, which gave me ideas of how I wanted to set up mine. The template I used is, like, set up for me.” When asked
what she did next, she stated, “I just need to change the information,” referring to the illustration of her infographic.

When asked “Which design elements of an infographic did you use focus on in your design?” Sally asked for clarification. I explained that she should elaborate on how she addressed her peers’ reflection on her work. She noted that she “got peer feedback. And then I revised it.” Without more elaboration from her, I moved on to the next question.
I asked, “What did you learn about the feedback you received on your infographic and try to be specific?” Sally responded that “comparing my work to someone else” was helpful because “it was nice to see other people’s work.” She did note that “at the
time, it wasn’t finished, so it was hard for them to completely judge it.” She referenced a specific portion of the infographic that included three circular images in a horizontal layout at the bottom of her exhibit. She noted that this was added at the last minute because she did not want to leave white space and ran out of time.

For the next question, I asked, “In what ways was your understanding affected by creating an infographic?” Sally explained, “I think the easiest to create was the pictures . . . they had nice cool backgrounds and borders.” She elaborated, “Trying to move the shapes around because some of them that were already there in the template [meant] you had to copy it and paste it and then delete the original one because it wouldn’t move. It took a little more effort.” I asked her to expand on how this affected her understanding. She continued, “A lot of people said that I need to make the text bigger or add more images. When I was reading people’s infographics, I looked at their story more than how the pictures were placed.”

She noted that she did not have any additional response to the peer feedback she received, only reiterating that time was a factor in her design decisions. I asked if she had any additional questions or comments, and she responded, “This was a lot of fun to do!”

The interview ended after approximately 8 minutes of dialogue.

Tom is 10 years old, brown haired, and brown eyed. His school record describes him as a Caucasian boy with no specified disabilities or health concerns. Tom exudes confidence in his mannerisms and conversation. In our interview, he appeared confident that he understood the tasks of the instructional unit despite prior statements that he was “not sure what an infographic [was].” Tom also expressed a willingness to create the best exhibit for Mr. Sandgren, whom he admired as a teacher.
After reviewing the interview protocols, I asked him to verify that the illustration presented before him was his original work. Figure 26 shows his infographic about his fossil, the ammonite.

**Figure 26**

*Tom’s Infographic Draft (Cropped)*
When asked, “What can you tell me about your understanding of the way an infographic is designed?” Tom answered, “I really tried to focus on the visualization” and “how appealing it was to other people.” I asked him to elaborate on how he demonstrated appeal in his artifact. He said, “I know that I like looking at things that are colorful and have pictures in them.” Tom said, “I focused on trying to find images to go with the data” and lamented that “I didn’t really have an organization [method].”

When asked, “Which design elements of an infographic did you use focus on in your design?” Tom pointed to his illustration and said, “I mainly focused on the color.” He was then focused on “finding images to go along with the data because there’s so many images out there and not all of them are accurate on the data that you’re putting in.” I asked him to elaborate with an example, and he pointed to his colorful timeline reflecting geological eras.

I continued by asking, “What did you learn about the feedback you received on your infographic?” Tom noted, “People were saying that mine was colorful, which was mainly what I was going for.” He continued, “A lot of people said that I had a lot of data on, which was good.”

Finally, I asked, “In what ways was your understanding affected by creating an infographic?” Tom said, “I always find rubrics helpful because they tell you what you need to put in.” I asked him to explain this further. He said, “So the FACE thing, it said, so that was helpful and so using the appealing thing because I was really going for how it looked.” The interview ended after approximately 11 minutes of dialogue.
Conclusion

Observation and interview data reveal that students gained knowledge about the key elements of infographics as they activated digital literacy competencies through a create-to-learn activity. A teacher with no expertise in media production can lead a media production activity. Students were supported by emphasis on FACE components of an infographic when they are explicitly taught it. The evidence did not address the implicit knowledge expectation of the original study design. The pedagogical experience did make the tacit knowledge explicit.

In this chapter, I have aimed to provide an authentic record of the teaching, collaboration, and discussion that occurred before, during, and after the implementation. The samples of student work and interviews included are indicative of the trend among the entire set of student-produced infographics and responses. In the next chapter, I offer more detailed analysis of student-produced infographics, using the FACE themes to reflect on the relationship between students’ experience and the lessons objectives.
Chapter 5. Data Analysis and Interpretation

In Chapter 5, I revisit recorded observations, student work products, and interview transcripts and apply analysis and interpretation based on qualitative research protocols. I begin by reviewing the examination of infographic instruction as experienced via students and the teacher facilitator at Shale Middle School. I review the infographic work products findings based on four decoded themes: (a) format, (b) appeal, (c) clarity, and (d) evidence. The four common themes, supported by the units of observation, are examined individually. I then address the research questions and synthesize the research evidence to address them.

The competencies activated in this instructional unit could be described as an infographic literacy unit, where instruction emphasized analyzing and designing data and information visualization. The sixth grade students demonstrated that they could analyze and design infographics. The conversations from whole-peer-group settings demonstrated that students actively engaged in discussion of infographic design elements. When students worked in pairs, the results were brief and addressed limited details of the design format.

As stated previously, the objectives of this lesson were defined using “I can” statements. This approach was familiar to students, whereby the stem of the phrase “I can” is followed by ellipses and then a series of strategies or skills that students should be able to complete by the end of the lesson. In this lesson, there were three learning targets:

1. I can define what an infographic is.
2. I can explain why it is used.
3. I can describe design features of an infographic.
I first offer an overview of my examination of research questions and then show how I applied the FACE codes from the literature review to the analysis of student learning.

**Research Question 1: How do sixth grade learners at Shale Middle School analyze infographics from socially constructed design elements?**

Students in middle school struggle with an important developmental milestone as they balance the inherent tension between “fitting in” and “standing out.” In learning to analyze infographics, this activity aimed to explore convergent and divergent interpretations of infographics. But this task was challenging for young students, who seemed reluctant to offer divergent interpretations. “Fitting in” was more important than “standing out,” it seems. For example, the final element of the think-pair-share is the share section. At this point, students had worked individually on examining the two examples of infographics and then shared their observations in a pair. With their partners and also with the whole class, the students were now asked to take the final information that they’d gathered and synthesize it in a new table. The table begins with two elements: what is similar and what is different. This similar section is what students saw that matched their own observations. In other words, during the peer activity, what elements they and their peers found in common. The second column gives them the opportunity to record things that were new or different from what they had thought. This is a form of self-reflection and gives them a chance to once again synthesize their overall understanding of the illustration.

It is most noteworthy that students who recorded things in the “different” section tended to record what was shared during the overall group discussion, rather than the
differences that came up during the individual pair activity. When students worked with their peers, they did not effectively record the areas that were different between the two of them, but more the things that they had in common. This suggests that students wanted to fit in with one another rather than offer a divergent opinion. I believe there is a possibility that students in this circumstance would prefer not to disagree. In other words, they might want the illustration to have a clear and distinctive nature that is based in concrete design choices and themes. Very few students seemed to want to bring up a differing opinion or perspective on the illustration. The reason for this is worthy of additional investigation.

Students also struggled with self-reflection. Few students were able to respond in a meaningful way to a question about what they notice about their thinking process when reading infographics instead of regular text. It’s important to point out that this was a written task, where students were asked to explain why with details and use a minimum of five sentences. The students were being asked to think about how they process this information. This was the most challenging part because students often have difficulty taking a complex series of ideas and synthesizing them into a language that talks about what mental process they used to complete their understanding. It is possible that this self-reflection, designed to move past what was observed in the students’ examination of the infographics and to promote metacognitive thinking, might have come through in a classroom discussion.

Research Question 2: How do sixth grade learners at Shale Middle School design an infographic from socially constructed design elements?
Students at Shale Middle School have sufficient levels of digital literacy to be able to complete a draft infographic using the Piktochart application, even though the teacher was himself only a beginner at using the digital platform and students relied on video tutorials to learn how to use key design features of the program. To examine this research question, I randomly selected six artifacts for additional analysis and interviewed the student authors. At the conclusion of the interviews, all student participants expressed some level of regret that they did not have more time or opportunity to revise their work.

Students mentioned adding images and replacing text in existing templates with their own words. The infographics designed often relied on adding copies of existing text from a classroom graphic organizer in its entirety. Students appeared to be rushed in their effort to encode the infographic and resorted to cut-and-paste techniques as the main strategy of design. Therefore many of the student-designed infographics remixed existing templates, with their own writing replacing the original text.

As reported in their peer review activity and interviews, students were comfortable connecting ideas to the four parts of FACE. A checklist of questions was constructed around themes of the analyzing steps in the think-pair-share document. Given that the teacher facilitator used FACE, the acronym was incorporated into four distinct responses from student reviewers. The responses were mostly complimentary and offered little actionable suggestions for improvement. Based on interview discussion, this paralleled the phenomenon of reluctance from the adolescent learners. Students did not willingly offer constructive criticism despite the anonymous format. With limited time to
revise, most students ignored the comments and were more excited to share their product with the teacher and their families.

Nearly all the student participants would have benefited from additional practice with the Piktochart tool. Students appeared to gain insight in digital construction by working with the Piktochart templates. Evidence of their learning of the tool came in the form of interview responses. A few expressed that the primary focus was on creating a visually appealing infographic using a color scheme, images and clip art, and a distinct text layout. Several students noted that peer feedback had identified their strengths in design and provided valuable constructive criticism.

**Applying the FACE Themes to Analyzing and Designing Infographics**

To further address my research questions, I offer a transparent description of the identification of themes, exploring how children’s actions and words demonstrated their emerging understanding of FACE as related to the research questions. I discuss the adolescent infographic design elements as related to the social constructivist classroom. A close examination of the samples is discussed as evidence of the findings. Figure 27 demonstrates the progression from my initial a priori codes based on the literature review, followed by codes that emerged from my observations. The resulting codes were reduced to three categories that become the infographic design elements discussed in Chapter 5 and included in Appendix A.
Theme 1: Format Matters

Format referred to the structure of a work, as layout and other design elements help a reader with sense-making and the ability to follow ideas in a sequence. Analysis of the data revealed three key themes associated with understanding format: the symbolic use of color, the relationship between visual and verbal components, and the use of design to structure temporal processes to create an organizational flow.
**Pictures.** In the analyzing task, students were asked to consider how the infographic is illustrated. Students’ analysis of qualitative data revealed how the pictures served as signs and symbols for constructing meaning. For example, when viewing the second sample infographic in the think-pair-share activity, many students noted that it had a cyclical pattern and that it used color and arrows to show how things were moving and what had happened. This illustrated a good understanding of design methods used to depict processes over time. In other words, students took into consideration that the illustration had a structure for depicting a sequence of actions. The structure consisted of a clockwise cycle illustrating a series of steps to be followed in order. The fact that the students acknowledged this is to be expected for their age, but it also occurred without prior prompting, which suggested that these students understood a key component of infographic structure: An infographic often employs pictures and images to emphasize some feature of the data. Some students acknowledged that there was a sequence of operations based on the numbering and the construction of the arrows.

**Visual Arrangement.** A key feature of an infographic is the relationship between words and images or graphic design, as organization is used to structure how readers interpret the work. Students noticed the idea of an organized format as they analyzed infographics. They understood the need to create a common field of view to make it easy for the reader to navigate the overall illustration. Students examining the infographic samples in the think-pair-share activity noticed that it had “many pictures with words around them.” A student explained that “the pictures show what the words are explaining, which helps the reader better understand the words.” This quote again emphasizes the basics of the infographics, that the design should involve a series of illustrations that
complement the words that are written inside them or nearby. Thus, both syntax and illustration help create a balanced understanding of the design.

Several students found that the infographic overly used the space and perhaps might have generalized the information too much rather than focusing in on a few key points. At one point, a student noted that the first sample that they looked at, about climate action, was quickly understood. It was noted that it was a cycle and that there were five elements to look at, and they could quickly review and scan it.

In the case of the two examples used for analysis, some students noticed that the organizational pattern was a little more scattered in these examples. In comparing the two infographics, some students notice that the strong organization structure of the samples provided a quick entrance point to making sense of the infographic and supported their ability to follow the flow through the reading. This process was a little bit more challenging, and some students noticed that several of their classmates approached it differently than they did, and thus interpreted the infographic differently.

In this case, the balance of illustration and text was more critical to being considered an infographic and also did a good job of illustrating the idea for students. The students noted that “both were hard to read, crowded” and both illustrations “used a lot of space” in their designs. There are a lot of conversations around reducing white space in the design field. White space means that there are parts of the page that are not fully used and as a result, the image can appear less crowded. It was noteworthy that students noticed that infographics try to pack a lot of information into the available space.
Theme 2: Appeal Is the Key to Holding Audience Interest

Analysis of the data revealed that appeal was a second key theme associated with colorful illustration and bold and emphasized illustrations and text. These elements were grouped under appeal as they closely paralleled the subjective nature of the infographic design.

Color. The students tended to be interested in infographics that were heavy on illustration. This is, of course, a fundamental part of an infographic, to be visually appealing. Some students noted that there was a color scheme, heavy on green and blue. Many students noticed the symbolic meanings associated with color. They emphasized that an effective infographic is one that uses color effectively. All the illustrations were provided in color and on a color screen, even though many infographics could be presented in black and white. However, in some cases, the quality of the data being presented may have been overshadowed by the quality of its design. The students said that the design of one example is “very colorful, neat and very well organized and bold.” They also began to say, “It caught my eye and a very…” but did not complete the thought. It is clear that the students were most drawn to anything that had emphasis on color, that the example appeared to be organized or formatted in a way that was easy to follow, and that there was emphasis on things using bold print. This would make for an interesting concern if the illustration was simply in black and white or grayscale shading.

Font. Emphasis was also made using the size of certain fonts or text and similar visual cues. This is important because this suggests that students are looking for several things. Students are drawn toward boldness, larger, and eye-catching pieces made it clear that students were looking for something with visual appeal. Illustrations with a higher
degree of graphic design, to some degree, motivated students to engage in viewing the infographics. In future interviews, students would comment on how enticing these features were.

**Visual Appeal.** Often students noted in their peer reviews about the visual appeal of the student-designed infographics. One student stated positive remarks about the “nice appeal” of the images; other students used similar references to appealing imagery. When responding to the comments of peers, Tom noted that he created an “appealing thing because I was really going for how it looked.” When asked for elaboration, the student spoke about being conscious of what his audience would like. The language of appeal from students was almost always stated as a positive attribute. One student also noted that Tom’s infographic was “aesthetically pleasing” in his review. Several additional references clearly emphasized students’ desire to add visuals to the infographic to make it more appealing.

**Theme 3: Clarity Is How Content Is Conveyed**

The data related to clarity demonstrated a focus on illustration and addressing a larger question in the design. Students sought clarity through supporting imagery and context clues. This was largely informed by the next question, “How does the author clarify or analyze the information?”

**Information: Main Idea.** Students noted that the author presented how the climate action can affect people by using illustrations and “quick little facts.” This, again, seems to show that the students are quite knowledgeable about the emphasis of the characteristics in an infographic. The students believe that the infographic does not thoroughly explain the captured information through words. As one student noted, it is
“important to include pictures so you can get an idea of what the author is trying to say.”

Once again, this emphasis on illustration over syntax is a critical area of interest to students in reading an infographic.

During the analysis phase, the most common characteristic that students acknowledged were the following: “bold or emphasized the facts or words.” This again, drew attention to how students’ design choices are used to denote more important or critical ideas. Students also noted that both had images or photos and said that the commonality between the two illustrated samples was that imagery was a critical part of their design.

Students also noted that “chunked sentences of ideas or condensed and less complex sentences were used.” Here, students noticed that an infographic tended to use fewer words and more imagery. This reminded students of picture books, in which the illustrations are as important to the storytelling as the text.

This was an important idea that students realized because it emphasized how infographics can serve as a standalone text. For instance, a history textbook several informational paragraphs with the occasional text feature, which might be a simple graphic or a photo. In the case observed, some students discovered that the infographic was stating the same information with fewer words. This observation seemed to dismiss the belief that infographics are best appropriated as text features.

**Text.** Several students talked about how images were used to define words that were challenging in a sentence. It is interesting that students were beginning to note that infographics can support the comprehension of the text to meet the needs of multiple users. In other words, a challenging series of words might require a student to go to a
dictionary. In contrast, the picture provides context clues that might help a struggling reader understand the message better.

In Question 4, one student responded that the author “clarifies and analyzes the information by placing words next to pictures that describe what the words are saying, period.” The student recognized that the illustrations provide context clues about the meaning and the importance of the text or syntax provided. In fact, the student said, “By putting many pictures inside of the infographic, it is easier for the reader to understand.” The student explicitly mentioned that comprehension is improved through the illustration.

Finally, several students noted, “It lacked a central idea. No big picture.” Students looking at the second illustration, the one about Manitoba fossils, noticed that a lot of information was presented, but it did not seem to fall into a clear or thematic method. This is interesting because, again, infographics should have a thematic element where students can understand that looking at these illustrations provided them with an overall idea or thematic element that can be easily identified. A lot of the textual information in the Manitoba fossils sample felt scattered to students. The infographic “moved around, talking about the region of Manitoba, and was not grouped in a way that made it easy to understand.” That difficulty made it seem to many students that there was no central idea, theme, or “big picture.”

**Theme 4: Evidence Is the Use of Data and Information Sources**

Analysis of the data revealed that evidence was associated with incorporation of raw data in visual form and providing sources of the data. I noticed that students were interested in showing infographics that provided quick and manageable pieces of quantified data. This is called data visualization, taking raw data and then putting it into a
graphic form (e.g., a pie chart). Students seemed confident that the data visualizations paralleled what would be considered an infographic.

Evidence Provided. On the subject of evidence, a student described it as “the information that was collected to prove the author’s point.” Mr. Sandgren appeared satisfied with that statement but clarified that he was not expecting students to provide citations of the evidence. This is an area that contrasted my original research intentions. I believe that one of the key elements missing from the Vitruvian principles applied to infographics is evidence. The data should be properly cited, for example, by naming the source or reference. The source is almost always cited in the corner or in the line of the visualization, the idea being that if somebody wanted to fact-check the graphic, they could examine the original data.

Students appeared to assume that the audience was their teacher and that the evidence from the classroom was understood to be the raw data. I wanted students to understand that for an illustration in an infographic, it would be ideal for the data to be cited in some format; however, Mr. Sandgren said that citing their evidence explicitly was not required. The element of evidence was discussed in our initial meetings and Mr. Sandgren agreed that citing sources was important. However, by contradicting this in his answer, students were less likely to see citations as a critical design element. I found that students simply pointed back to the data they created without actually talking about the source of the data.

Fact Sources. The two illustrated examples that the students used in the think-pair-share came with their own model and source cited at the bottom of the page. For example, in the “Climate Change for People” illustration, the sources included the United
Nations and several other organizations. The illustration also said that the research program that produced the infographic was supported through the Climate Change, Agriculture and Food Security Organization. These science infographics also closely resembled the kind of infographics that the students were going to be producing in their science classroom after collecting raw evidence about a fossil that they unearthed. This is important because almost no students who produced an infographic cited their information.

The next question was, “How does the author present facts or evidence?” Once again, the students noted that they present these facts by listing examples under a picture to help support their understanding. One student used the words, “This is important because it can help people understand facts more than just reading the listed facts.” This response illustrates that visual

One student noted that “the facts in the blue area are facts about Manitoba in the sea. And the facts in the tan area are about the facts above land and fossils around found in Manitoba.” However, this strikes me as more of a design response. The student’s emphasis on how the structure shows evidence is less about understanding the raw data and more about how the overall format makes the illustration easier to understand.

I believed that the students’ responses here would have made more sense in response to Question 3, “How does the author clarify or analyze the information?” since the emphasis was less on students having to provide citations or explicit evidence of the source of the data. It is not surprising that the student did not discuss that in this particular statement. Students were specifically told they would not need to cite their original raw data source. Students noted that at least in one of these examples, there was a specific
citation so that they would know this was scientifically supported. It was a curious behavior when most content-area teachers require citations to minimize academic dishonesty.

**Researcher Reflection**

Students were learning a little about data visualization in other courses. Scientific and mathematic data could be manipulated in a graphic to tell a story very differently. For instance, the size of a particular bar in a bar graph, depending on the number of units presented, could skew information dramatically. An often-used example shows an graphic with a very small series of units; therefore the bar graph data looks closely packed together. When a larger scale of units is used, illustrations appear to have a greater impact because the unit of measure is so much further apart. Interestingly, the students did not note any specific examples of this but did often record that they found evidence even if they could not explicitly point out the data.

Adolescent students are attuned to social cues among peers. In this unit, a moment of social cues regarding acceptance was evident. In responding to whole-group, teacher-led questions, students were reluctant to offer ideas that might not receive acceptance from peers and the teacher. In several instances of the think-pair-share remarks, students presented challenges to the codes created as a whole group. A student might have presented a divergent opinion on the graphic organizer and chose to remain silent during the peer and group share-out. The desire for acceptance in a socially constructed lesson might warrant more explicit observation and evidence in future studies.
Conclusion

In this chapter, I used a priori coding to analyze students’ understanding of the four features of infographics: format, appeal, clarity, and evidence. Then I addressed the two research questions of the study, discovering that for students to appreciate the role of interpretation in the meaning-making process, it may need to be explicitly modeled by the teacher. In science classes, the general tendency to find the “right answer” may preclude attention to the interpretive process of reading that lead to divergent responses. Very few students took the initiative to present a counterpoint or divergent view when classmates presented their ideas. I examined how the inclusion of the FACE acronym in student documentation may have impacted the organic nature of students’ discovery process. I also noted that student responses to the teacher seemed to focus on pointing out correct answers or creating infographic models that aligned with existing template.
Chapter 6. Conclusions and Recommendations

In this chapter, I offer reflections on the findings along with attention to my researcher positionality and conclude with some implications of this study for educators, educational technology professionals, and teacher educators. But first, I consider the relevance of infographics to science teachers, who will find plenty of examples of infographics on numerous websites and in periodicals. Social studies and science educators may even have encountered examples within the textbook and curriculum materials from educational publishers. Because infographics are data and information visualizations that capture an idea with both alphanumeric text and imagery, they require distinctive practices of reading and writing (Lankow et al., 2012).

This study’s findings clearly transcend the practice of middle school science education. Social studies instruction using infographics can serve as another model for the use of infographics embedded in the practice of visual learning. Students might be learning about the Napoleonic Wars in the early 19th century. Students could be assigned to small groups with copies of this illustration and a classification chart. Classification charts are tables in which students can record characteristics or evidence (Marzano, 2007). With brief direct instruction, the social studies teacher could ask a guiding question: “What conditions contributed to the severe loss of life in Napoleon’s march to Moscow?” Each pair or small group would examine the visual elements of the translated infographic and record evidence in a classification chart. The headers of the chart would include “Visual Evidence,” “Purpose,” and “Your Conclusion.” Students would annotate the visual element from the infographic, the purpose of the element, and what conclusions can be drawn from the infographic to support the guiding question.
Some teachers present educational technology as an asset they have not attained. A familiar axiom for these educators is how being a “techno-Luddite” limits their ability to teach differently. They lament that students are natives of technology, even though many students access technology with a limited understanding of how it works. Teaching infographic literacy does not create an obstacle for educators with limited technology proficiency. The development of static, printed infographics requires the same design process used in writing and project-based learning. From this perspective, educators can embrace the development of infographic literacy without an expectation that technology proficiency is a prerequisite.

Diverse learners should be grouped heterogeneously to support involvement and peer modeling. Each group would select one dimension that could be shared with the whole class in response to the guiding question. The instructor might provide additional support by listing several dimensions, including distance, location, date, and temperature. By using an infographic, social studies teachers could support analyzing of an image and deeper thinking. An extension activity might include the design of a simple infographic using a web-based tool. Digital platforms like Piktochart and Infogram provide templates that could expedite student exhibits and be shared easily through social media. Infographics are important to engaging learners and increasing their understanding of visual literacy.

**Best Practices in Infographic Education**

The preponderance of evidence collected in this dissertation research amply demonstrates that adolescents in this sample had the capacity to analyze and design the basic components of an infographic, using some design and formatting features that
reflected their appreciation of the importance of organization and structure. Although they struggled to reflect on their reading processes, they were able to identify key features of infographics and use digital literacy competencies to express ideas using language, imagery, and graphic design about data that they had collected in a unit on paleontology. The scope and sequence appeared reasonably designed to be relevant as a culminating activity in a middle school science classroom.

This research presented one method for teaching adolescents how to analyze and design infographics. A focus on a sophisticated product assumed that students had enough experience with the analyzing and designing process. The pedagogical practices in this study provide a foundation for introducing students to infographic literacy at an emergent level. As students continue to practice and grow in their educative experience, they may gain the experience to become sophisticated designers of infographics.

Based on this research, I have revised my conceptualization of the necessary components of teaching infographics, as shown in Figure 28. I now appreciate how the learning experience in analyzing and designing infographics includes attention to (a) content and ideas, including purpose, goals, and objectives; (b) structure, or the process of recognizing patterns and making connections between information and ideas; and (c) beauty, or the design of an appealing format that attracts and holds audience attention and helps to convey key ideas.
Adolescent Infographic Design Elements

The importance of the content and ideas of an infographic is the first focus. Readers of an infographic should be able to discern the author’s purpose or goals. The infographic may present a specific intention based on this design characteristic. Adolescent learners need experience through multiple exposures to infographics to practice identifying purpose, as they would in a traditional text. Using the infographic’s objectives, they can closely read and respond to its structure.

Structure is a second focus of infographic design that addresses patterns, connections, and inherited values. In reading and writing, adolescent learners are taught to assess the replication of ideas throughout the text. By identifying patterns, they are collecting evidence to support the concept or conclusion or the author. This produces a strong connection between the message and medium, whereby the audience is both a transmitter and receiver of communication. Communication includes inherited values,
both from the audience’s prior knowledge or experience and the author’s intention and perspective. Many forms of media accomplish this goal, but a final element of infographic design includes beauty.

The third element of the infographic design process is the inclusion of beauty. Infographics have a visual appeal, whether intentionally motivating the reader or serving as an alternate method for conceptualizing complex information. All readers of infographics consider the engagement of the infographic because it is a visual medium requiring purposeful viewing. When the imagery is evocative, the reader is likely to engage the visual closely. Therefore, enhancing infographics for visual stimulation is an essential element in the design process.

Throughout this work, I have acknowledged that studying infographics demands visual representations of the study’s results. Therefore, I attempted the design of a multifaceted infographic demonstrating the outcomes of this research. In fact, numerous conversations were devoted to the possibility of representing the entire study in a purely infographic format. Many of the figures included in these chapters reflect the elements of a more comprehensive infographics. I wonder if this research could be presented as a singular, albeit complex infographic and still create similar insight.

**Reflections on Researcher Positionality**

I want to better support the needs of all learners in my educational community. As a result, I focused on sixth grade learners and how they socially deconstructed infographic design elements and created original infographics. I acknowledge that this is a limited sample, but the design of this study incorporates infographic instruction with adolescent learners.
Students transitioning to the middle levels are developmentally ready to address inferential layers of infographics. In my experience, infographic instruction is less frequent until the later part of secondary education. At this point, students have missed a critical opportunity to develop their understanding alongside the dynamic experiences of early adolescence. Instruction in the analysis of data visualization, especially those designed as infographics, is infrequent in elementary education. In late secondary years, students have missed critical opportunities to draw initial inferences and build a schema around infographic literacy.

I am an authentic teacher–researcher and creative media maker. My experience in the classroom, conducting this study, and experience in creating media informs the following three identities: (a) teacher, (b) media maker, and (c) researcher. What have I learned?

I have dedicated the first two decades of my educational career to improving my teaching practice. I grew as a learner by learning better methods for how my students learn. I strove to improve my pedagogical practice by seeking theory compatible with best practices. I recognized that each day of teaching provided an opportunity for improvement and self-reflection. I aspired to be the kind of teacher who strengthened the development of all learners. I drew upon my prior experience in design to make connections in my second identity.

As a maker, I designed projects and exhibits to improve my understanding and enlighten others. Since an early age, I discovered how empowering my graphic design skills could be used to engage others. My earliest use of technology included the creation of cards and posters for family members. As an adolescent, I created advertisements for
my own self-employment and local businesses. In my professional life, my design skills supported student learning and motivated my colleagues. Whenever it was needed, I learned new technologies for design, programming, and communication specific to my purpose. The maker identity encouraged me to seek out new information and educate others on my process.

As a novice researcher, I wanted to contribute to the field of education with a process that supported infographic literacy. I have taught a form of study of infographic literacy to students at the secondary level for several years. The topic needed to be more education-centered by emphasizing support for adolescent learners. I focused on how students would interpret infographics and then develop their own. As I sought experts, I found few who could fill the absence of infographic literacy instruction and adolescent education. This was a critical learning experience that would be a missed opportunity as students grew older. I reluctantly realized that I would have step into the role of advocate for adolescent infographic literacy education.

In these three identities, I considered several areas of interest based on my findings. I believe that as an educator, maker, and researcher, I have the training and insight to recognize patterns within the results of the study. I concluded that the following points of emphasis required examination.

**Process Is the Priority**

Educators needed to recognize and celebrate the students’ product, but not at the expense of the process. Seeing students express creativity and sophistication can tempt teachers to overlook the fact that these adolescents are novices. They are eager to share what they create, but the teacher needs to draw attention to their growth mindset.
Comparisons should not be treated as competitions. Every unit should be treated as a journey toward building understanding and reflecting on growth. If outcomes are prioritized, students may not learn as much as they could. A final product supersedes the value of how it was constructed and how it may improve the designer.

I began this research with the fixed mindset that students would create illustrative infographics as adolescent learners. I forgot the value of a growth mindset, whereby students would become skilled at articulating the learning process. Emphasizing process over product proved to be pivotal when the timeline and lesson modifications shifted. I realigned my focus toward how students were experiencing learning rather than assimilating ideas into a single product. I am more confident that teachers who focus on flexibility and differentiation will have positive outcomes for students’ growth.

**Critical Subjects**

For many students, this was the first time they were asked to develop an infographic, with limited prior knowledge of what it was. They tried to describe their process and reflect with maturity. They appeared to recognize that infographics required certain design elements. Although discussion of bias and perspective were largely ignored, they play a significant part in infographics. Infographic designs need to be representative of diversity for learners and the global community. Infographic instruction should be taught with attention to different racial or socioeconomic systems, and students and teachers (non-experts) of varied abilities need access and opportunities to engage in visual analysis. In my future work, I aim to address this topic more directly.
Simplicity Matters

I learned that non-experts need simpler points of entry to teach this lesson. I need to try to chunk the parts of the lessons into one or two components at a time and help colleagues become more proficient in parts of the unit before trying to tackle the whole product. Abdicating the role of instruction was a necessary component for maintaining researcher positionality. However, I contended with materials and instructions being modified by the facilitator. This may have impacted the research’s intended goal in positive and negative ways.

As an experienced teacher and an emerging researcher, I learned a lot about myself from conducting this research. I had not realized that I had designed a study where “my instruction” was being implemented by a colleague who may have lacked a deep understanding of the purpose and goals of the assignment. I wanted to see how the students produced infographics, and at times I wondered if this work would be beyond their capacity at this early stage. At times, I lost sight of the initial plan, that a clear demonstration of evidence for analyzing and designing infographics was important.

An illustration of my duality as an educator and researcher was evident in a revision to the think-pair-share document by Mr. Sandgren. In my curriculum materials, I designed the think-pair-share document while being informed of my a priori codes that used the FACE acronym. The literature review supported my initial codes of format, appeal, clarity, and evidence. The graphic organizer was designed with some intention to address these as questions during the think portion of the analyzing activity. The hope was that students would move toward an organic discussion with their partners during the pair section. These discussions would be guided by the questions but reveal student
perspectives that would produce an authentic evaluative model. The evaluation model, specifically a student-created rubric, would be modeled on these discussions. The rubric would be the culmination of a socially constructed experience facilitated by the teacher.

In practice, the outcome was a negotiation and disruption of purpose by the teacher facilitator, Mr. Sandgren. He is an experienced educator, with over 100 days of teaching this group of students. Mr. Sandgren was the department chair of the middle-level science department and incorporated the data collection unit in the curriculum for several years. Therefore, when presented with the opportunity to deliver an infographic literacy unit connected to science, he was passionate about the success of his students. In our initial meetings, Mr. Sandgren wanted to use language that was familiar to students and reinforced cross-curricular academic vocabulary. For instance, the language of the “big picture” in the second guiding question was his recommendation.

The teacher promoted infographics as a means of digital literacy in the classroom. The practice of designing an infographic with a digital design tool demonstrated the process of authorship in digital literacy. Mr. Sandgren welcomed another mode of digital authorship in his science classroom despite limited prior experience with the tool. He symbiotically connected with his students’ learning process as he learned the method alongside them. This experience encapsulated social constructivism as a strategic and philosophical partners between the educator and the learner.

Teaching demands flexibility when the scripted experience is impacted by variations in the classroom. In digital literacy, the phenomenon becomes evident when teachers are moved outside of their pedagogical comfort zone. Similar to the ZPD, teachers must be willing to construct new learning practices supplemented by prior
Mr. Sandgren demonstrated thoughtful metacognition about his practice and revised his expectations for delivering the lesson. His consideration for drawing on familiar language and practices were beneficial to students. As a facilitator of my research, he diverged from my prescribed lesson focused on observing a specific purpose. The shift was notable in the evidence of this study but likely had only positive outcomes for the students in his class. His effort was commendable as an educator willing to be engaged in new pedagogy. Future research might consider the potential impact of including strict adherence to the lesson structure.

**Audience**

Expect interference or pushback from colleagues who undervalue this subject due to a crowded curriculum or content-specific sentiments. Additionally, families and communities may find data analysis activities to be politically or socially charged, so topics should be carefully chosen. Curating and engaging various infographics will teach for transfer across all multiple disciplines and domains of knowledge. Learners need academic practice with infographics that demonstrate the same variety of reading and writing expectations required of them. Frequent and explicit analysis of infographics help students to become more proficient.

Educators can be resistant to implementing new practices (Knight, 2009). Educators express feelings of being overwhelmed by the continuous change in policies and practices (Valli & Buese, 2007). Implementation of new pedagogy within a learning community requires buy-in from a select few who can serve as ambassadors of the cause (DuFour & Fullan, 2012). Visual literacy and the practice of analyzing and designing infographics requires professional development. For this study, a single educator was
willing to be challenged with an unfamiliar subject. The individual may be an outlier, given that a broader group of educators might be reluctant to incorporate infographics within existing curricula.

Teachers can use their knowledge of the reading and writing process to teach about infographics with curriculum support. The study incorporated a well-educated language arts and science teacher experienced in literacy practices. The teacher facilitator worked closely with me to adapt the curriculum to meet the needs of all learners in a middle-level setting. From a sampling perspective, this limits the transferability to other teachers who have diverse qualifications. However, this also provides a teachable moment in the research: Explicit instructions cannot account for the diverse experiences of both educators and learners. More emphasis should be placed on differentiation, especially as it pertains to the delivery of the lesson and the pace of the process for students.

I wish that students could have had more time to define and discuss the term of infographics. Instead, the process occurred indirectly through the instruction by student and teacher facilitator dialogue. While reviewing my reflective notes, I recalled feeling an initial sense of confusion among students about the meaning of the term. The teacher facilitator seemed equally concerned and was able to create a teachable moment by having students offer input. This supported a social constructivist approach but might not have scaffolded the experience for all learners. Some students who were not directly involved in the study appeared to need more time to process and understand the accepted definition.
The study was conducted in a single environment in which an abundance of technology was provided to the faculty and students. All research participants had access to both a school-provided and a personal computing device. Therefore, the application of technology throughout daily experiences was abundant. The likely conclusion is that this technology-rich environment varies greatly from other public school systems in the region and throughout the United States. In this environment, access to technology was prioritized, whereas other districts may have different or more urgent focuses.

An intriguing phenomenon of the research was the incidental strength of students’ design abilities with technology. Mr. Sandgren requested that we incorporate video tutorials into the Google Classroom for students learning Piktochart. His reasoning focused on his own perceived shortcomings in the technology platform. Students were expected to view the videos before calling on him for help. Most students were observed diligently examining the brief videos before proceeding to the design process. The dynamic between the teacher’s knowledge of the tool and the students’ ability to adapt to the resource demonstrated an unexpected strength of this sample. A continued exploration of this phenomenon, including how it relates to the use of templates, would merit future investigation.

The overall classroom space of the environment was conducive to social constructivist pedagogy. The classroom displayed a student-crafted series of norms for classroom behaviors. Students were seated in groupings of two dyads, ensuring a partner for all participants. The overall class size did not feel crowded, and students had ample room and opportunity to learn in comfort. These appear to be exceptions to much public
education in the United States, where class sizes and classroom management limit some of the practices in this study.

**Implications**

I consider the implications of this study for educators by connecting the study of infographics to core education outcomes across the curriculum. Infographic lessons transfer to multiple disciplines and domains of knowledge. Learners need exposure to infographics that demonstrate the same variety of reading and writing expectations required of them. They need a chance to analyze variations in visualizations and learn how to encode them to become more proficient.

Infographic curriculum and design resources need to be representative of diversity for learners and educators. Not only should infographic instruction take into account different racial or socioeconomic systems, but students and teachers (non-experts) of varied abilities need access and opportunities to engage in diverse topics of visual analysis. How we address access to technology, cultural meaning, and perspective should be examined with a critical literacy lens and as a fundamental skill. In addition, evidence exists of growth in metacognitive awareness for science students using visualization (Chiu & Linn, 2012; Gilbert, 2005).

In the practice of science education, concept maps are frequent elements of graphic organizers in classroom texts (Rice et al., 1998; Willerman & Mac Harg, 1991). A concept map is a diagram that applies hierarchal structure to words or ideas with connected nodes of information (Clayton, 2006). In a science classroom, such as high school biology, a concept map could strengthen students’ understanding of critical topics. Students learning about the parts of a cell would benefit from more than rote learning
through note-taking or passages in a textbook. Connections between the parts of the cell, its definition, and its function could be incorporated into a single-page image (Tankersley, 2005).

The science instructor could provide a model graphic of a completed concept map for a previous topic. Through direct instruction, the teacher could provide an overview legend by reviewing common flowchart symbols. For instance, a circular icon denotes a starting place, whereas a square shape aligns to a process. The model would also demonstrate connections between different ideas, dependencies, and hierarchy in the diagram.

A cell structure concept map would begin with a circular box containing the word “cell.” A connection line might include the verb “consists of” to explain the connection to a part of the cell. This part of the cell might involve another circle with the word “mitochondria.” A sub-level connection would be connected with a line labeled “functions as” and a square shape with the words “energy storage.” The student would repeat this process for all cell parts, creating a graphic organizer covering essential information about the parts of a cell.

Some learners would benefit by providing illustrative icons rather than shapes for each part (Hill & Miller, 2013). Instead of a box for “energy storage,” the student could incorporate a battery icon to illustrate the function of mitochondria. When reviewing notes later, the student may remember the battery icon as a sign of the mitochondria’s function (Lin & Atkinson, 2011). Diverse learners could begin their investigation with a bank of icons that could be connected to their illustrations (Hill & Miller, 2013). The
The semiotic nature of this activity reinforces students’ interaction with imagery as a form of text.

For a discussion on the Great Depression, the instructor might ask students, “How were Americans affected in the political, social, and economic outcomes of the Great Depression?” As a prerequisite, students would search through the online archives of the Library of Congress (http://www.loc.gov/photos/collections) for a single image from this time period. The image criterion would be to address the human experience of living in the United States in the early 1930s. As a model, the teacher could use Dorothea Lange’s photograph entitled Migrant Mother.

If students have access to Internet-enabled computers, the instructor might incorporate the ThingLink website (http://www.thinglink.com) into an imagery discussion. ThingLink provides a simple user interface where users can embed clickable links to text, videos, or images. This student-selected image can be imported into ThingLink for digital annotation. In the case of Migrant Mother, a node could be placed near the adult’s face. The pop-up annotation could be a link to another medium inspired by the photograph, such as a recording of Peter Gabriel’s song “Don’t Give Up.” The annotation would be labeled as “social” and would include a few sentences describing social connections between Peter Gabriel’s lyrics and the mood of the image. The student’s goal would be to make a connection between the social experience of the Great Depression and the two media.

This task helps draw inferences among the three parts of the teacher’s question through an interactive, multimodal experience. In a simple fashion, students are coding an experience for a wider audience. Communication skills, including author’s purpose,
citing evidence, and formatting, are illustrated instead of written (Jewitt, 2005). Diverse learners can be supported by providing a range of potential media for inclusion. For example, modifications to the initial question could include “What political, social, and economic examples demonstrate American life in the Great Depression?”

Educators can be resistant to implementing new practices (Knight, 2009). Visual literacy and the practice of infographic literacy require some professional development. Many educators express feelings of being overwhelmed by the continuous change in policies and practices (Valli & Buese, 2007). Implementation of visual literacy within a learning community requires buy-in from a select few who can serve as ambassadors of the cause (DuFour & Fullan, 2012). As more educators have practice with infographics, visual literacy can become a more frequent component of curriculum.

**Strengths and Limitations of the Research**

An important finding of this research is that students were able to use the Piktochart digital platform to create infographics even though the teacher was a novice at using the tool himself. As noted earlier in Chapter 5, the overall user interface of the design tool appeared to be age-appropriate for the sample group but was challenging to the teacher facilitator. The teacher believed instructional videos were adequate explanation for understanding the basic features of the tool. In this case, the facilitator had limited knowledge with the tool and relied on the video tutorials to support students. Similar to educational technology instruction, learners and teachers need time to explore the tool and draft pilot products to better understand the form and function of encoding. A possibility might be to attempt to replicate an model within the tool. Pair programming might be an additional strategy, whereby one student serves as the controller of the
program while the other provides real-time suggestions and support. With these additional practices, both the educator and the students might increase skill acquisition and improve their understanding of infographic literacy.

The importance of addressing the teacher’s confidence in teaching a new unit cannot be overlooked. Building teachers’ confidence around digital literacy is an important factor in its successful implementation (Hobbs & Coiro, 2016). Infographics are a mode of digital literacy that requires continuous engagement in order to be effective (Kennedy et al., 2016). An emphasis on building frequent practice to engage teachers must be considered. In the space of this study, time was not allotted to fully educate and engage the teacher facilitator on infographic literacy. Future studies should accommodate this preparation to eliminate confounding variables.

Several other issues arose in the sampling that may have affected the research. Students had been exposed to some form of infographics, even small-scale information or data visualizations, in previous learning and personal experiences. From an early age, contemporary youth are likely to encounter infographics. These types of visualizations are likely a result of the world they live in. Technology has made information more widely accessible even in simpler terms. Students who play video games are likely to have seen some type of data visualization gauging their level of success. In early elementary years, scientific experimentation in schools usually incorporates some form of graphic representation. Texts that are designed for younger learners are likely to include elements of visual literacy, including infographics. Thus, many students already have some familiarity with infographics, even if they cannot explicitly define the term.
Students who were later interviewed were chosen as an even cross-section of students identifying as male and female. Though sex and gender were not considered for this study, they are relevant concerns for equity. In some instances, infographics rely on mathematical and linguistic aptitude. The physical and cognitive growth of boys and girls can differ during adolescence. This growth has an impact on the academic performance of students and could play a role in difficulty with the tasks required to examine infographics.

The activity of producing an infographic was extended beyond the observation group by Mr. Sandgren and grew to include an entire cluster of 78 students. For this study, only the four students’ graphic organizers, infographic artifacts, peer feedback, and interview transcripts were included in the coding process. These four students were a purposive sample based on previous cited sampling criteria and reasonable in size for a case study (Patton, 2002).

The limitation of meeting the needs of diverse learners, formerly labeled as learning disabled, is a concern. Some students may have limited vision, color or contrast difficulties, or cross-sensory dispositions. I needed to be mindful that approaches include appropriate accommodations recommended by research-based practices. The overall instructional plan might require modification to equip more learners with equitable participation.

Conclusion

The past few decades have brought visual media to the forefront of daily life. Daily decisions depend on accessing and analyzing visual data. This creates a paradox of being data rich and information poor. How will the future be decided by data and
information visualization? Will critical observations be traded for visually stimulating
design? Can future visualizations empower society to become more informed and
equitable?

These are questions that I will continue to pursue. I want my children and future
generations to be empowered by this field of study. Infographic literacy is still in its
infancy, and exploration of the subject must be nurtured. I regret that I did not fully
pursue my childhood passion for science. The famed explorers of my time are footnotes
to a new generation of learners. The anticipation of their next discovery, played across a
television special or photographs in a book, has been condensed to nebulous social media
posts. Staring into a portable screen and capturing the moment minimizes the livable
experience of conversation and public presentation.

I expect to persevere in changing the attitude that infographics are summaries and
text features. I hope to build galleries of infographics that captivate the imagination and
provoke meaningful discussion. I envision a world where infographics are displayed and
archived alongside books, music, and films with equal reverence. I am confident that
infographics will be a catalyst for new forms of intelligence worthy of our awe and
appreciation. Most of all, I want to be part of this design and collaborate in pursuit of
these goals.

I believe that studying infographics demands visual representation of the study’s
results in this form of text. Thus, I have created a draft infographic to demonstrate the
design of this research journey. The infographic will hopefully offer insight to both future
researchers and practitioners at the conclusion of the study. In contrast to the manuscript,
the infographic illustrated in Figure 29 elucidates the components of the dissertation. The
goal of the image is to show the course leading from Chapter 1 through Chapter 6 in the style of a subway map. The infographic was designed using the three infographic design elements discovered in this course of this research: (a) content and ideas, (b) beauty, and (c) structure.

The infographic makes known the content and ideas with clear labels and illustrations to develop understanding. Each segment is color coded and provides segments for detailed review, adding beauty and familiarity to modern travelers. The structure is a top-down, linear pathway, indicating a route for the reader’s gaze. Open circles indicate bigger ideas, and closed dots are specific subject points. Each open circle is outlined by a gray arch, indicate the phase of the chapter in the form of a clock face. The final step was to include a dynamic version of the infographic for better review of the complex details, available at http://www.davisclassroom.com/dissertation.

In general, the nature of the infographic demands a critical eye but opens understanding of the dissertation process for a broader audience. Infographic literacy is a process that does not aim to oversimplify nor complicate understanding. This infographic represents the initial steps of clarification of existing knowledge and revelation of unseen territories for education. I hope that my research will be the beginning of a parallel journey of understanding and growth for my fellow learners.
Figure 29

Dissertation Infographic Draft

Appendix A: Data Codebook for Units of Observation

The data codebook recorded the thematic analysis obtained from the units of observation. Data was digitized as text and image documents, including video and audio transcripts. The NVivo for Mac version 1.6 qualitative data analysis software was used to create the following data analysis table.

The columns included are name, description, artifacts, and references as assigned by the software. Name refers to the code labeled by the researcher then indented starting with the research questions, followed by the theme, then the sub-codes of those themes. The Description annotates the codes with a brief overview and including relevant literature. Artifacts is an indicator of the number of materials from the units of observation. References includes the number of indicators from the artifacts that mention to the code.

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<th>Files</th>
<th>References</th>
</tr>
</thead>
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<td></td>
<td></td>
</tr>
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<td>99</td>
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<tr>
<td>Format</td>
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<td>22</td>
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<td>18</td>
</tr>
<tr>
<td>Appeal</td>
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<td>color</td>
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<td>font</td>
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<td>7</td>
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<td>visual appeal</td>
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<td>10</td>
</tr>
<tr>
<td>Clarity</td>
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<td>23</td>
</tr>
<tr>
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<td>13</td>
</tr>
<tr>
<td>text</td>
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<td>10</td>
</tr>
<tr>
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</tr>
<tr>
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<td>fact sources</td>
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**SQ2** How did four, sixth-grade learners at Shale Middle School design a science infographic?

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</tr>
<tr>
<td><strong>Evidence</strong></td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td><strong>Format</strong></td>
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<td>5</td>
</tr>
<tr>
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</tr>
</tbody>
</table>
Appendix B: Instructional Lesson Plan

Unit Name
Analyzing and Designing Science Infographics

Timeframe
6 days (42 minutes of instructional time per day)

Task
Collect evidence from an archeological dig and produce a science infographic illustrating the discoveries.

Essential Questions
1. How do the infographics communicate similarly or differently to writing?
2. How do infographics use text, color, and imagery to creatively convey information?
3. How do infographics contribute to critical thinking?
4. How do infographics support collaboration?

Concepts (I Can…)
- I can describe the essential design elements of an infographic.
- I can cite and analyze evidence of data in infographics.
- I can synthesize raw data into a science infographic.

Power Standards
- Common Core State Standards (CCSS)
  - RI-6.7: Integrate information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue.
  - WHST-6-8.2a: Introduce a topic clearly, previewing what is to follow; organize ideas, concepts, and information into broader categories as appropriate to achieving purpose; include formatting (e.g., headings), graphics (e.g., charts, tables), and multimedia when useful to aiding comprehension.
  - WHST-6-8.2b: Develop the topic with relevant, well-chosen facts, definitions, concrete details, quotations, or other information and examples.
- WHST-6-8.4: Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
- Computer Science Teachers Association (CSTA): 2-DA-08 Collect data using computational tools and transform the data to make it more useful and reliable. (P6.3)

Learning Progressions

Prior Knowledge (What do they already know?)

Students in the sixth grade are already familiar with simple charts and diagrams found in exploratory infographics. Students may have had experience creating data visualization through timelines, bar and line graphs, and simple publications like brochures and newsletters.

Current Knowledge (What do they need to know now?)

Students need experience in understanding how narrative infographics, consisting of both information and data visualizations, can have multiple perspectives, different levels of complexity, and sociocultural implications in the design.

Future Knowledge (What will they be expected to know?)

Students must be able to read and comprehend information and data visualization to succeed in reading periodicals, cite or develop evidence in informational writing, and demonstrate knowledge on college and career entrance exams.

Academic Vocabulary

- Dialogue: focused conversations that promotes comprehension,
- Text: words, pictures, symbols, and graphs that have context,
- Bias: demonstrating favor towards an idea or interpretation.
- Infographic Essential Design Elements:
  - Format: how the layout is designed to assist in readability and flow,
  - Appeal: how captivate or focus the attention of an audience,
  - Clarity: how you will build understanding through visualization,
  - Evidence: how you document the source(s) and is bias introduced
Skills and Concepts (Students will…)
- Students will learn essential design elements of a narrative infographic through whole group dialogue.
- Students will analyze existing models of narrative infographics for design elements through paired dialogue.
- Students will produce individual narrative infographic using the essential design elements with pre-selected data.
- Students will reflect on the essential design elements of narrative infographics produced by peers and themselves.

Assessment

**Formative (Frequent, Progress Monitoring)**

Think-Pair-Share responses  
Whole group and paired dialogue

**Summative (Infrequent, Evaluative)**

Student-created design elements rubric (similar to FACE Infographic Design Rubric)  
Self-reflection and peer feedback on Peergrade

Activities

- Gradual Release of Responsibility (whole to paired groups)
- Think-Pair-Share on a sample infographic (paired groups)
- Narrative infographic drafting using Piktochart (individually)
- Self- and peer-reflection in Peergrade (individually)

Differentiation

**Intervention**

Heterogeneity will be randomly assigned but all students will have access to previously discussed models and teacher and peer support throughout. Students will practice examination as a whole group with teacher guidance and then in paired peer groupings before independent tasks.

**Enrichment**

Students may choose to add dynamic, interactive controls and hyperlinks to their exhibit. These enhancements will be focused on improving multiple perspectives and revealing new ideas within the design at the user’s discretion.
Resources

The following resources will be used on the students’ Chromebooks through an active Internet connection:

- Google Classroom
- Google Drive (Folder of Sample Science Infographics and Student Guide for Piktochart)
- Piktochart (Approved Production Mode protecting student data privacy)
- Peergrade (District-approved web application)

Daily Lessons

Analyzing Task (Day 1)

The teacher will review two examples of narrative infographics as a whole group task. The teacher will present the two samples as an intentional sequence of simple to complex.

Students will be encouraged to annotate a copy of the infographic and provide oral feedback of their interpretations. Students will consider the design and context of infographics. This dialogue includes factors on how people create and understand infographics (discussion about different interpretations, bias, cultural difference).

The teacher will have students work in pairs using the Think-Pair-Share guide to record their conversation about a third narrative infographic sample. This presents an opportunity to create a working list of their findings. By posting the results on a poster or in a shared document, the teacher creates a visual analysis of the infographic.

For some students, distractors will be more obvious and similarities may become clearer. Struggling students may need more time to examine infographics with the aid of this chart.

These findings should be mapped on to a poster paper or shared document by the instructor using the Parking Lot strategy. The teacher will ask each group to share two “discoveries” made while reviewing the infographic sample. The teacher will record these as brief statements in the public document that can be grouped by similarity. This will aid students in connecting both convergent and divergent design elements that the group observed.

Reflection and Tool Exploration (Day 2)

Prior to this unit, the teacher(s) receives instruction from the researcher on the essential tasks for using the Piktochart tool and developing an infographic as an observable lesson. The teachers will be given a working format for providing instruction on using the tool that is both an example direct instruction and blended learning. The teacher may modify this format for equity within the classroom.
The teachers will provide an overview of the key tools in Pikotchart through a brief instructional video tutorials. Videos will be available on the Google Classroom at all times, should students want to refer back to them during the Designing Task. The teacher will insure that students are familiar with the key features and how to login to the Production Mode environment of Piktochart. Students will be given time to explore the tool and practice a simple example.

**Designing Task (Days 3)**

Students will be tasked with creating an original narrative infographic. Students will be provided a copy of the FACE Infographic Design Rubric and a basic set of criteria for the expected design. Students will receive a common set of data, available on the Google Classroom as a spreadsheet document. The goal is for students to take this dataset and produce an original narrative infographic with a self-selected focus.

The teacher-selected dataset intentionally leaves students with room to choose different perspectives for the focus and design of the infographic. The teacher will take care to draw parallels between the design and the previous questions during the instructions.

Students will be given two class periods (approximately 42 minutes per session, or 84 minutes total) to create and finalize a draft narrative infographic in Piktochart. The students will submit their final product on the Google Classroom.

Student projects should be informed by the design elements discussed during the first three days of the unit. As a suggestion, the researcher believes that four potential elements may serve as groupings for narrative infographics:

- **Format**: how the layout is designed to assist in readability and flow,
- **Appeal**: how to captivate or focus the attention of an audience,
- **Clarity**: how you will build understanding through visualization,
- **Evidence**: how you document the source(s) and if there is bias introduced,

**Peer and Self-Reflection Task (Day 4)**

The teacher will upload completed infographics, collected from the Google Classroom, in the Peergrade web application. Note: Students anonymity and data privacy is protected in accordance with the District Technology Policy as verified by the Student Privacy Pledge from the The Future of Privacy Forum (FPF) and The Software & Information Industry Association (SIIA).

Students will be given an overview of how to access the features in the Peergrade by the teacher. Then, students will be responsible for examining and reflecting on three peer infographics and self-reflect on their own. These reflections will use the FACE Infographic Design Rubric (see Appendix F) which will be visible on the screen as they type their reflections. Students will also be asked to share any open-ended commentary that will clarify their scoring selections.
The teacher will collect this data by exporting the results into a spreadsheet file and reviewing the results in the online interface of Peergrade. These copies will be coded using the researcher’s coding protocol. A random selection of students will be chosen for a post-production interview.
Appendix C: Student Assent Form

WHO ARE WE AND WHAT ARE WE DOING?

My name is Mr. Mark Davis and I am the Student Investigator in this study from the University of Rhode Island. My research study is titled “Developing 21st Century Learners Through Reading and Writing Narrative Infographics in Middle School Education.” A narrative infographic is a visualization that uses images, text, and data to tell a story. I would like your permission to participate in this research because I want to understand our middle school students read and write narrative infographics.

The Principal Investigator in this study is Dr. Renee Hobbs of the School of Arts and Sciences at the University of Rhode Island. If you have any questions, you can contact her by phone (XXXXX) or e-mail (XXXXX).

WHY ARE WE ASKING YOU TO BE IN THIS RESEARCH STUDY?

Educators use narrative infographics for instruction and you may have seen them online or in magazines. I would like to know can they can improve your learning.

WHAT HAPPENS IN THIS RESEARCH STUDY?

If you agree to be involved, you will be asked to complete following the tasks:
- contribute in a six-day lesson with your peers during a class period,
- examine and discuss narrative infographic examples in whole and small groups,
- draft a narrative infographic using an online app,
- give and receive anonymous feedback on student-created narrative infographics,
- participate in a 15-minute follow-up interview.

WILL ANY PART OF THE RESEARCH STUDY HURT YOU?

There are no expected risks to you. The study does not affect your grades or will be used for discipline. You can stop at any time if you want to.

WILL THE RESEARCH STUDY HELP YOU OR ANYONE ELSE?

You may benefit from having a better understanding of narrative infographics presented in your classes, in the social and print media, and on college entrance assessments.

WHO WILL SEE THE INFORMATION ABOUT YOU?

All of the recordings about this research study will be coded without your name or personal information. Only the research team and the university’s review board will have access to your information. The final report and future publications will not include your personal identifiable information.

WHAT IF YOU HAVE QUESTIONS ABOUT THE RESEARCH STUDY?

If you have any questions, please contact Mr. Davis or Dr. Hobbs using the information at the beginning of this form. For questions concerning your rights or complaints about the research,
contact the Institutional Review Board (IRB) or Vice President for Research and Economic Development at the University of Rhode Island:

- IRB: (XXXXX) / XXXXX

DO YOU HAVE TO BE IN THE RESEARCH STUDY?

You do not have to be in this study if you don’t want to. Being in this study is up to you. No one will be upset if you don’t want to do it. Even if you say yes now, you can change your mind later and tell us you want to stop.

AGREEING TO BE IN THE STUDY

I was able to ask questions about this study at any time. Signing my name at the bottom means that I agree to participate in this study. My parent or guardian and I will be given a copy of this form after I have signed it.

________________________
Printed Name

________________________
Sign your name on this line                        Date

________________________
Printed Name of Person Obtaining Consent

________________________
Signature of Person Obtaining Consent                        Date

The following should be completed by the study member conducting the assent process if the participant agrees to be in the study. Initial the appropriate selection:

__________  The participant is capable of reading the assent form and has signed above as documentation of assent to take part in this study.

__________  The participant is not capable of reading the assent form, but the information was verbally explained to him/her. The participant signed above as documentation of assent to take part in this study.
Appendix D: Parent Consent Form

Parental / Legally Authorized Representative Permission Document for Research

STUDY TITLE
Developing 21st Century Learners Through Reading and Writing Narrative Infographics in Middle School Education

PRINCIPAL INVESTIGATORS
Principal Investigator: Renee Hobbs, Ph.D. Office: XXXXX Email: XXXXX
Student Investigator: Mark Davis Office: XXXXX Email: XXXXX

KEY INFORMATION
Your child is invited to take part in a University of Rhode Island research study titled “Developing 21st Century Learners Through Reading and Writing Narrative Infographics in Middle School Education.” My name is Mr. Mark Davis and I am the Student Investigator in this study. I am asking for your permission to include your child in this research study because I am studying how adolescent learners read and write narrative infographics. A narrative infographic is a visualization that uses images, text, and data to convey information in a storytelling fashion. Educators use narrative infographics frequently and I would like to know can they can improve their instruction. The Principal Investigator in this study is Dr. Renee Hobbs of the School of Arts and Sciences at the University of Rhode Island. If you have any questions, you can contact her by phone (XXXXX) or e-mail (XXXXX).

INVITATION
This section should inform you about what your child will have to do and what they will experience in the study. The information in this form is meant to help you decide whether or not to have your child participate. If you have any questions, please ask.

Why are you being asked to be in this research study?
Your child is being asked to be in this study because they are a sixth grader in a middle school classroom. They must be 9-11 years of age to participate.

What is the reason for doing this research study?
The study uses an action research approach to support middle school students learning about narrative infographics. Students will be learning about both the reading and writing narrative infographics in a teacher-facilitated class. The participants will practice these skills with teacher guidance, whole- and paired-group dialogue, and individual design and reflection. Through this investigation, I hope to explore the potential value of socially-constructed learning at the middle school level using narrative infographics.
What will be done during this research study?

If you allow your child to participate, your child will be asked to complete the following tasks. Your child will participate in a six-day, in-class lesson with his or her peers during their FAST period. The lesson will be facilitated by their content-area teacher and observed by Mr. Mark Davis, the Student Investigator. Your child will be asked to examine and discuss narrative infographic examples in whole and small groups. The focus will be on creating criteria for the design elements of a narrative infographic. Later, your child will draft a narrative infographic using a common dataset. This exhibit will be anonymously reviewed by his or her peers for feedback. The criteria will consist of the design elements created earlier in the lesson. After the instructional unit, Mr. Mark Davis will conduct one-on-one, recorded interviews that will last a total of 15 minutes. This interview will be recorded for audio only so that they can be transcribed and reviewed.

How will my child’s data be used?

The responses will help us to understand what s/he observed and how s/he used the portions of the image to understand its meaning. Your child’s name will not be used in any of the study’s written material and recordings will not be released. Your child will be assigned a numeric code that will only be known by the researchers.

What are the possible risks of being in this research study?

There is minimal risk that harm will come to your child as a result of participation in this study. His or her name and any other identifying characteristics will be removed from all data collected during the study, and it will be replaced with a coded number.

What are the possible benefits to you?

By participating in this study, your child will have the chance to use self-selected strategies and offer personal perspectives while observing and design narrative infographics. Your child may benefit from having a better understanding of the types of questions they can ask when exploring narrative infographics presented in secondary instruction and post-secondary placement assessments.

What are the possible benefits to other people?

This information will help teachers improve the curriculum and instruction for his or her peers and students in other schools.

What are the alternatives to being in this research study?

If you do not want your child to be in the study, you may choose not to allow your child to participate.

What will participation in this research study cost you?

There are no costs to your child for participation in this study. The study will take place during a FAST period and will not impact regularly-planned curriculum.
Will you be compensated for being in this research study?

Your child will not be compensated or receive credit for participating in this study.

What should you do if you have a problem during this research study?

Your child’s welfare is the major concern of every member of the research team. If you have a problem as a direct result of being in this study, you should immediately contact one of the people listed at the beginning of this consent form.

If you have questions, complaints or concerns about this study, you may contact Mark Davis by phone (XXXXX) or e-mail (XXXXX). You may also contact the Primary Investigator, Dr. Renee Hobbs from the School of Arts & Sciences at the University of Rhode Island, by phone (XXXXX) or e-mail (XXXX). You may contact either individual anonymously, if you choose. In addition, if you have questions about your rights as a research participant, you may contact the Office of the Vice President for Research, XXXXXX, University of Rhode Island, Kingston, RI, or by phone XXXXXX. Agreeing to this does not mean you have given up any of your legal rights.

How will information about you be protected?

All of the recordings about this research study will be maintained using the following secure method. Any records I collect will have your child’s name removed from them and replaced with a coded number. All records will be placed in a locked filing cabinet at the University of Rhode, XXXXXXX and any computer files from this study will be kept in an encrypted format on a password-protected computer. To help protect your child’s privacy, in any writing, publication, or documents resulting from this study, your child’s name will not be mentioned. Following the end of the study, all research data and assent/consent forms will be kept in a securely locked filing cabinet in the researcher’s work space for 3 years.

The only persons who will have access to your child’s research records are the study personnel, the Institutional Review Board (IRB), and any other person, agency, or sponsor as required by law. The information from this study may be published in scientific journals or presented at scientific meetings but the data will be reported as group or summarized data and your identity will be kept strictly confidential.

What are your child’s rights as a research subject?

You may ask any questions concerning this research and have those questions answered before agreeing to participate in or during the study.

For study related questions, please contact the investigator(s) listed at the beginning of this form.

For questions concerning your rights or complaints about the research contact the Institutional Review Board (IRB): XXXXXX

What will happen if you decide not to be in this research study or decide to stop participating once you start?
You can decide not to have your child be in this research study, or you can withdraw at any time before, during, or after the research begins for any reason. Deciding not to be in this research study or deciding to withdraw will not affect your relationship with the investigator or with the University of Rhode Island (list others as applicable).

You will not lose any benefits to which you are entitled.

**Documentation of informed consent**

You are voluntarily making a decision whether or not for your child to be in this research study. Signing this form means that (1) you have read and understood this consent form, (2) you have had the consent form explained to you, (3) you have had your questions answered and (4) you have decided your child will be in the research study. You will be given a copy of this consent form to keep.

**Child Name:**

______________________________________

(Name of Child: Please print)

**Parent/Guardian Name:**

______________________________________

(Name of Parent/Guardian: Please print)

**Parent/Guardian Signature:**

______________________________________  _________________

Signature of Parent/Guardian  Date

**Investigator certification:**

My signature certifies that all elements of informed consent described on this consent form have been explained fully to the parent/guardian. In my judgment, the participant possesses the capacity to give informed consent to participate in this research and is voluntarily and knowingly giving informed consent to participate.

______________________________________  _________________

Signature of Person Obtaining Consent  Date

**AUDIO/VIDEO ADDENDUM TO THE CONSENT FORM FOR RESEARCH**

By signing this consent form, I confirm that I give my permission for audio and video recording(s) of my child, to be used for the purposes listed above, and to be retained for three (3) years. Your child may still participate in this study if you are not willing to have them be recorded.
**WHAT ARE NARRATIVE INFOGRAPHICS?**

A narrative infographic is an illustration that uses words, images, and data visuals to tell a story. Infographics help illustrate complex data in meaningful images. They can be found in books and magazines, websites, social media, and television.

**IMPORTANCE**

Narrative infographics are part of your everyday experience such as predicting weather forecasts, monitoring your progress during gaming, or learning about historical or current events.

**PURPOSE OF THE STUDY**

Mr. Mark Davis is exploring how students read and write narrative infographics for his doctoral study at the University of Rhode Island. He is looking for volunteers who will add to his research study, “Developing 21st Century Learners through Reading and Writing Narrative Infographics at the Middle School Level.”

**STUDY PROCEDURE**

Volunteers will be asked to:

- examine narrative infographics in whole group discussions and with partners,
- design an original narrative infographic online and receive feedback,
- participate in a recorded interview about what was experienced.

The study will be conducted during the FAST period throughout a six-day cycle.

**BENEFITS & RISKS**

This research will help all students and teachers understand how they can improve learning with infographics. Students will practice strategies that will increase understanding on college-entrance exams, classroom texts, and popular media.

There is no compensation or reward for participating. The study is voluntary with parent permission and is not required by the school or your teachers. No personal information or

**WANT TO KNOW MORE?**

Send an e-mail or call:

- [Contact Information]

This research has been approved by The University of Rhode Island Institutional Review Board.
Appendix F: Think-Pair-Share Graphic Organizer With Sample Data

Think-Pair-Share: Reading Science Infographics

We are going to take a look at how an infographic shares information differently than written text through a Think-Pair-Share activity.

GOAL
By the end of the lesson, you should be confident that,

1. I can define what an infographic is, explain how it used, and why we will be studying it.
2. I can describe 4 design elements of an infographic.

TASK
You will look at several science infographic examples linked in the Google Classroom. With a partner, analyze the sample in a THINK-PAIR-SHARE. Use the tables below to record your answers to the Guiding Questions.

DIRECTIONS
A Think-Pair-Share activity starts by yourself, then continues with a partner. Complete the steps in the following order and repeat for each infographic sample:

1. By yourself, review the infographic sample and record what you THINK after each Guiding Question.
2. Discuss your responses as a PAIR with your partner.
3. SHARE what you discussed in the Compare and Contrast boxes. Then, write your own conclusions box in the Self-Reflection.
**THINK (5 minutes):** Record your answers using complete sentences in the “Your Thoughts” column. Aim for a MINIMUM of 2 sentences for each box.

Infographic #1: *Halloween by the Numbers*

<table>
<thead>
<tr>
<th>Key Elements</th>
<th>Guiding Question</th>
<th>Your Thoughts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Format</td>
<td>How would you describe the design of the sample?</td>
<td><em>It looks easy to read. It goes from top to bottom.</em></td>
</tr>
<tr>
<td>Appeal</td>
<td>What is the big picture?</td>
<td><em>The background is of nighttime and a spooky tree just like Halloween night.</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>They use common Halloween pictures (like a ghost, a black cat, or a tomb stone).</em></td>
</tr>
<tr>
<td>Clarity</td>
<td>How does the author clarify or analyze the information or data?</td>
<td><em>They are trying to show how much money America spends on Halloween stuff. I guess they are trying to say it is wasteful but I don’t have a clue.</em></td>
</tr>
<tr>
<td>Evidence</td>
<td>What information or data supports the evidence?</td>
<td><em>They randomly put percentages of how many people carved pumpkins which made everything sort of confusing. I don’t know where they learned this from.</em></td>
</tr>
</tbody>
</table>

**PAIR (3 minutes):** Work with your assigned partner. Take turns sharing what you recorded in your THINK columns, by reviewing each question one-by-one. If needed, bring up a copy of the infographic to help illustrate your responses. You may record your notes in the space below.

*We thought the infographic was interesting to look out. It didn’t seem to share anything that we could not have just read. We had trouble finding who gave them the numbers used in the graphs.*
**SHARE (3 minutes):** In the table below, record what was discussed and write a closing statement.

<table>
<thead>
<tr>
<th>FOUND IN COMMON</th>
<th>FOUND IN CONTRAST</th>
</tr>
</thead>
<tbody>
<tr>
<td>● Most were colorful</td>
<td>● Different topics</td>
</tr>
<tr>
<td>● Explanations were obvious</td>
<td>● Designs were really unusual</td>
</tr>
<tr>
<td>● Had a lot of pictures</td>
<td>● Understanding of information</td>
</tr>
<tr>
<td>● Many used numbers (percentages)</td>
<td></td>
</tr>
</tbody>
</table>

**SELF-REFLECTION:** What did you notice about your thinking when reading narrative infographics instead of regular text? Explain why with details. (Minimum of THREE (3) sentences)

*I think infographics are an easier way of learning because I remember the information that I get when looking at the pictures. When I read, I can be less focused to remember the information but when I look at an infographic I have to think about the picture and what it represents or is telling. The infographics’ pictures are usually interesting too so I pay more attention.*
Appendix G: Interview Protocol

Participant will be seated across from the researcher in a quiet room with a network connected laptop computer and an audio-only recording device. The researcher will begin the session by reading the following statement:

“Thank you for agreeing to participate in this research study. My name is Mark Davis and I am the student investigator on this project. Today’s interview will be recorded so that I can transcribe our discussion and review it at a later time. If you wish to stop at any point or you are uncomfortable, please let me know. We can end the interview and your statements will be removed from the research. Do you have any questions at this point?”

The researcher will respond to all inquiries before proceeding to the next statement:

“Let’s begin by reviewing the procedures. I will be asking you about the infographic you designed using Piktochart and the feedback you received from your peers. You will have as much time as you need to respond to a series of open-ended questions. The questions do not have right or wrong answers. They will help me to understand how you designed the parts of your infographic. Please try to explain your answers as completely as possible. If you do not understand the question or need clarification, please ask me at any time. Are you ready to begin?”

When all of the participant’s questions are answered and they agree to continue, the researcher will proceed to the next series of tasks.

INTERVIEW

The researcher will display the participant’s digital infographic design on the laptop facing both the researcher and participant.

“Please verify that the following document is your original work.” If the student does not verify this copy, the researcher will postpone the interview until the correct version is available. If the student verifies the document is their own, the researcher will continue.

“I am going to ask you a series of questions about what you examined. The questions are open-ended and have no right or wrong answers. I encourage you to say as much as possible to help me understand your answer. At all times, you may refer to your infographic design and point out features that will help explain your response. If you need clarification, please ask me at any time. Are you ready to begin?”

When the participant is ready, the researcher will proceed in a semi-structured fashion through the following questions. The participant may be asked to elaborate as needed. This process will last no more than 15 minutes. The semi-structured questions will be asked in the following order:

“What can you tell me about your understanding of the topic of this infographic?
Which parts of the topic did you use focus on in your design?

What was the process you used to design your infographic? Please be specific.

What element of the infographic was easiest to create?

What element of the infographic was challenging to create?

What peer feedback would you like to respond to?”

CONCLUSION

The researcher will clarify if the participant has any additional questions needing answered. If the participant is satisfied with their responses and has no additional questions, the researcher will continue.

“Thank you for your time and your thoughtful responses. This interview has now ended. If you have any questions, please feel free to ask them now. You can contact either Dr. Renee Hobbs or me at any time using the instructions on your assent form. I appreciate your time and thank you for volunteering for this study.”
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