

AN INVESTIGATION OF TOOL MEDIATION
IN THE RESEARCH ACTIVITY OF
EIGHTH-GRADE STUDENTS

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ABSTRACT

Technology and a variety of resources play an important role in students' educational lives. Vygotsky's (1987) theory of tool mediation suggests that cultural tools, such as computer software influence individuals' thinking and action. However, it is not completely understood how technology and other resources influence student action. Middle school students are a particularly an understudied population. This qualitative study examined how material and psychological tools, including the presentational software tools *PowerPoint* and *Prezi* mediate middle school students' actions when conducting research for two Earth Science research projects. Six eighth-grade students recorded computer screencasts and dialogue while conducting their research. I collected data from transcripts of computer screencasts, student interviews, and artifacts. Prior to coding, I established four major themes with 20 sub-categories. The four themes were content knowledge, previous tool use, resource use, and tool use. I segmented and coded the transcripts to reflect which different tools mediated student action. An analysis of the data revealed that library resources and the special features of *PowerPoint* and *Prezi* programs did not influence actions. Instead, I discovered that the assignment requirements and research topic content were the primary mediators of actions and behavior. However, despite the overall influence of the assignment requirements and topic content, each student employed different tools to complete each assignment. The results suggest that a variety of resources should be available to meet the individualistic tool use of students. The results also suggest that educators design less structured assignments that promote and encourage student centered learning and tool use.

Keywords: school libraries, technology, tool mediation, Vygotsky

I dedicate this work
to my wonderful husband, Bill,
whose patience, devotion, and support was
above and beyond the call of duty.

In memory of my parents,

Jim and Linn Comer.

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CHAPTER 1: INTRODUCTION

As a middle school librarian, I have witnessed a significant change in the types of resources located in a school library. When I first became a school librarian, everything available in a school library was in print. Students checked out books by signing their names and homerooms on a card in the book's back cover. The state of the art in technology was an electric typewriter I used to type the cards for the card catalog. As time progressed, I began to see a slow evolution in types of resources and delivery formats. The first breakthrough in technology for libraries was a statewide catalog of library resources called ACCESS PA. The students accessed the statewide catalog on eight CD-ROMS in a CD tower. The students were excited to use the product, and the thought of borrowing books from across the state was overwhelming. It was during this time I began thinking: how do new resources and delivery methods influence student learning? I could see that students were interested in and willing to use new resources. They learned the procedures for doing so and became self-sufficient in locating titles of interest but did those resources influence students' critical thinking and learning?

The mission of any school library is to engage and teach students to become critical thinkers and effective users of information. This is the cornerstone of a productive member of today's global community (American Association of School Librarians [AASL], 2007). Undergraduate and/or graduate library science coursework and training addresses three areas of responsibility for a school librarian: learning and teaching, information access, and program administration (AASL, 1998). Library training focuses developing is on teaching, learning, and our role as teacher-librarians

who instruct students on information literacy skills or traditional library skills. Kuhlthau (2004) encourages librarians to design in collaboration with a content teacher student-centered, hands-on learning experiences where students apply information literacy skills in a real-life application. During my undergraduate and graduate coursework, my college instructors glossed over educational theorists and theories. As teachers and I planned collaborative units, the teachers used terms such as scaffolding and social constructivism. Though I had not encountered these terms in my coursework, I knew enough from my own professional reading their definitions and use. The Russian sociocultural theorist, Lev S. Vygotsky appeared in many library professional publications in connection with social constructivism and student-centered learning. However, the journal article authors did not explain how his theoretical foundation influenced teaching strategies used in the classroom and library. There was a definite gap in my knowledge and experiences. I needed to learn more about educational theories and concluded it had to be outside the library science field.

Shortly after I made the decision to further my education, I began doctoral coursework at Temple University. Vygotsky appeared very early in my class readings. As I explored his theory in-depth, it was an eye opening experience. I witnessed in my students the behaviors and actions that Vygotsky (1987) outlines in his research. For example, Vygotsky (1987) explains that oral language is the ultimate tool that mediates social activity and thinking, or as he says, “Speech is *a means of social interaction*, means of expression and understanding” (p. 48). Mediation, as Vygotsky defines it, is how culturally developed tools such as language in this example, acts as an influencing agent on an individual’s actions. With that idea in mind, I observed students discussing

assignment requirements. I overheard students rereading parts of the requirements to each other, asking each other questions, clarifying, and connecting parts of the assignment to prior projects and learning experiences. I just did not quite know what I was observing, but it was nonetheless exciting. I knew I was moving in the right direction. Though I did explore other theorists, I kept returning to Vygotsky's work. His work connected well with library research and resource use. Vygotsky's section on tool mediation on human learning stood out repeatedly.

I had the opportunity to practice what I was learning in my doctoral coursework in two mini-research apprenticeships. I discovered that how students used library resources has the capability of promoting critical thinking and learning. I still did not know exactly how the resources mediated the students' learning and I believed this warranted more study. My interests, coursework, and apprenticeships convinced me that Vygotsky's theory of tool mediation was my theoretical foundation for my future research studies. I felt this would provide the better understandings I needed to help my students in the future.

The purpose of my qualitative study is to explore how the presentational software programs *Prezi* and *PowerPoint* mediate middle school students' actions during Earth Science class. Wertsch (1985), a pioneering neo-Vygotskian justifies this focus when he explains that Vygotsky's most significant contribution to psychology is his exploration of tool mediation and its influence on human development. Wertsch (1985) explains, "Vygotsky's account of social interaction and mental processes is heavily dependent on the forms of mediation (such as language) involved" (p. 15). I needed to understand middle school students' tool use in order to design learning experiences that encourage

critical thinking, learning, and effective use of information. By using a neo-Vygotskian lens in this qualitative study, I explored tool mediation and middle school students' thinking by using student interviews, observations, and analysis of student work.

Vygotsky and his colleagues initiated a new approach to studying how human mental growth occurs. Their goal was to understand how new learning develops within the parameters of their theoretical framework. Vygotsky's (1987) theoretical framework has three strands: genetic development, social impact on human development, and tool mediation. Vygotsky was concerned about the societal forms, such as oral language that had the most impact on human thought. Wertsch (1985) argues that tool mediation is the most important contribution of the three strands. Wertsch believes that tool mediation has the ability to stand alone when it comes to influencing cognitive development. On the other hand, the Vygotsky's other two strands need the impact of tool mediation for a complete understanding of their influence on human development. Wertsch notes that tool mediation was a continual theme throughout Vygotsky's writings. However, Wertsch also states that Vygotsky's theoretical idea of tool mediation changed from cultural sign use without meaning to a meaningful and communicative role in the development of human thinking. Ultimately, as Wertsch outlines, the meaningful sign became the center of Vygotsky's tool mediation theory. In 1933, Vygotsky stated, "The central fact about our psychology is the fact of mediation" (as cited in Wertsch, 1985, p. 15).

Vygotsky (1987) surmises that the only way the human thought process is understood is when the tools, symbols, and signs used in thinking are clearly defined and comprehended. He argues that tools, symbols, and signs are the agents that aim and

guide an individual towards higher cognitive development. As cited by Wertsch (1985), Vygotsky explains, “A tool...serves as a conductor of human influence on the object of their activity” (p. 78). Vygotsky continues by stating that human activity needs an intermediary to achieve the goals that normally would not happen. Tools and signs serve as that intermediary, and they are products of past and present culture not of nature. Signs and symbols encourage individuals to think, evaluate the sign’s meaning, and then take the appropriate action. For example, hallway directional signs mediate middle school students’ thinking to select the correct hallway to get to their next class. The mediational process is conditional and is dependent on how individuals invest meaning into the signs and symbols. Signs and symbols are the representation that evokes a unique framework for communication and interaction that guides human development. One example of a symbolic tool used in a school library is the physical signage throughout the facility that identifies areas of the collection and directs students to the location that they are seeking.

Vygotsky (1987) advocates that human thought is associated with tool use. He believes that signs, tools, and symbols in a specific situation or unique context mediate human contact with society. The signs, tools, and symbols act as conductors between society and human thinking. According to Wertsch (1985), Vygotsky envisioned tools as the man-made symbols and signs that encourage individuals to think and act. They are the links between societal processes and an individual’s mental process. Vygotsky cites several examples of tools in his time: language and speech, writing methods, works of art and literature, mathematical formulas, and mnemonic devices. Middle school students rely on memory for the everyday operating procedures of a school library such as the

research pass process. For instance, students know when they have an assignment that requires the use of library resources; they must get a research pass. The assignment requirements act as a mediator on the students' actions by encouraging them to obtain a research pass. The school library webpage is another example of a tool, with its electronic resource hyperlinks that are available for middle school students when seeking information for personal reasons or curriculum related assignments. The hyperlinks that are available on the library homepage serve as bridges to additional signs that mediate students' thinking. For example, a database such as *SIRS Discoverer* provides search fields and icons that promote thinking and decision making by the students as they search for information.

Signs, symbols, and tools also act as a connector between lower and higher thinking. Vygotsky (1987) defines lower or natural thinking as those processes that are part of an individual's ontogenetic growth and maturation. Examples of natural thinking processes according to Vygotsky, include memory, perception, or attention. However, the environment controls and prompts the natural thinking processes. Society transforms natural thinking processes to higher or cultural thinking processes by using culturally accepted signs and symbols to mediate action and thought. Instead of the environment stimulating action, higher mental processes are self-controlled by the individual.

Vygotsky emphasizes that tools promote a complete change in an individual's thinking. He argues that tool mediation is the move from natural memory use to active control by the individuals of their thoughts and actions. Vygotsky (1987) explains this as, "The basic difference between these two qualitatively different kinds of intellectual activity consists in the *transition from unmediated intellectual processes to operations that are*

mediated by signs” (p. 133). He concludes that the bridging of an individual’s thoughts and society by tools is the beginning of human behavior. Smagorinsky (2011) points out that the mediation process is dependent on how individuals apply meaning to the context in which the tools are used. For example, students are required to use specifically color-coded and designed graphic organizers for recording their resources prior to creating a works consulted page. The graphic organizers require a deliberate response from the student to select the correct color and format depending on the library resource they used. The color-coded graphic organizers act as a mediational means between the library resource used and the proper format for the works consulted citations. The students use the completed cards to select and create the correct citation formats using a software program titled *NoodleTools*.

However, not all tools become mediating agents of human actions. An example of a tool that has not mediated student thinking is the spine label prefix for paperback books. Middle school students first experienced resource spine labels in an elementary school library. Labels such as E FIC for easy fiction, QN for Quick Nonfiction are common labels that students easily use when locating books in an elementary library. At the middle school level, a classification of PB FIC for paperback fiction titles caused confusion among the students. Middle school students, not familiar with this particular label, struggled to locate book titles in the new school library environment. The PB prefix had the capacity to mediate students’ actions and thinking, but it did not.

Tools assume a collective use and symbolic representation. Smagorinsky (2011) clarifies that Vygotsky’s tools were not the typical devices used to construct or repair but rather the means by which individuals act and respond. Material tools have very little

impact on mental thought. Their purpose is to direct human action. However, they do put new conditions on human mental functions. Tools located in a school library that have a symbolic representation to middle school students, direct their actions, and ultimately shape their thinking include electronic databases, due date cards, and the online public access catalog (OPAC). OPAC provides access to several tools that mediate student thinking and learning. Besides access to the online catalog, the program also provides access to electronic databases, websites, and specialized reading lists for extra-curricular reading programs. An example of a specialized reading list of historical fiction titles for seventh grade World History located on the OPAC is *Joust Read*. Students use the specialized list of acceptable titles as a material tool to evaluate, select, and then locate a title of interest.

The types of tools available have undoubtedly expanded since Vygotsky's time. The types range from something as simple as the spoken the word, an individual's cultural and personal understandings, to physical tools such as a calculator. A few examples of the new tools available are electronic resources such as the World Wide Web, social networking, databases, e-books, computer icons, gaming software, television programs, and graphic novels. Today's middle school students have access to a wide variety of tools in a school library that can mediate their thinking and behavior. An example of one of the more common tools located in a school library is the Dewey Decimal Classification (DDC) system. The DDC system organizes and arranges the variety of library resources available for middle school students. Students use the DDC to locate and access resources in the library collection. The DDC reflects symbolic organization but also physically direct students to the intended titles. The DCC opens the

door to mediating human thought and behavior by acting as a stimulant. Students no longer rely on memory to locate resources in a library. Instead, they use the OPAC and the DDC system to promote thinking in order to locate, evaluate, and access resources to meet their individual information needs.

Vygotsky's (1987) intent is to understand how tool mediation influences cognitive development. Middle school students are at the age during which Vygotsky believes concept development begins in earnest. Vygotsky (1998) argues, "The fact that the period of sexual maturation is a period of a powerful rise of intellectual development and that during this period, thinking moves to the forefront for the first time" (p. 31).

Research assignments or activities allow students to communicate, collaborate, and practice using tools such as reference, nonfiction, electronic, and human resources to mediate their thinking and learning. Educators can observe and document how middle school students' tool use mediates their thinking and learning in the instructional environment that Vygotsky suggests. Writing assignments and research activities also allow educators to capture evidence of what tools middle school students used. For example, a writing assignment for an American History class requires that students produce a personal diary or journal of a fictional character that reflects the people, events, and emotions of the American Revolution era. Their own creativity as well as the assignment requirements, library resources, class notes, and class discussions all mediate the students' writing and thinking. Simultaneously, educators can discover what tools and signs that middle school students do not use. The knowledge gained when studying middle school students' presentational software tool use through the lens of Vygotsky's theory provides a look at cognitive growth in a socially collaborative, situated learning

environment. As Vygotsky advised, educators should determine what tools middle school students use or do not use effectively to plan future instructional activities.

My teaching experiences over the years with middle school students have been wide and varied. The increase in information, electronic delivery, and communication devices has added to that variety. Students have to be critical thinkers and effective users of information to be successful in today's global community. Historically, the instructional delivery of information literacy skills and resource use to students has focused on a collaborative, hands-on learning environment has been as the mission of a school librarian. As noted by Vygotsky, student educational experiences occur in specific social arenas using acceptable resources. Teachers and I need to address all aspects of middle school students' cultural and social experiences in tandem with tool use in order to make them successful in all their endeavors. A school library provides an ideal setting for such diverse learning experiences to occur. In a school library, students have access to print and electronic resources to meet their informational needs.

As the types of available resources have changed and increased, I have noticed that some students use these resources better than other students do. Many students select and use resources that meet their informational needs no matter the format. However, some students struggle when faced with a variety of resources. How do resources mediate students' learning and critical thinking, if at all? Students come to school with many learning experiences and tool use that provide a foundation for teachers and me to build upon. Their outside tool acquisition mediates their tool use experiences in the classroom and school library. However, it is unclear exactly what are those experiences are and how can we as educators can use them effectively in our instructional

delivery. Keeping that in mind, I wanted to have a better grasp on what types of tools middle school students use or do not use in the course of the educational experiences that occur in the school library. In conjunction, an additional question came to mind of what specific tools promote critical thinking and learning in students. If I have a better understanding of the types of tools that mediate critical thinking and play a part in my students' learning, I could provide more effective instructional delivery and learning experiences.

As I was preparing this study, a good friend asked me what the purpose of the study was and how was it going to help the educational world, particularly school libraries. My initial thought was my own professional interest on the topic of tool mediation, but upon further review, there was more than just that. My qualitative study has the opportunity to bring a new perspective to the field in regarding the extent to which tools mediate critical thinking and promote learning in a school library. Most educators would agree that growth occurs but exactly how it occurs is the question. If there were a better understanding of this question, teachers and librarians could use this information to their advantage. Technology has an important role in classrooms and libraries and it will most likely continue to do so in the future. It stands to reason that the exploration of how electronic tools such as *Prezi* or *PowerPoint* impact student learning will only add to the discussion on effective teaching strategies and activities.

Research studies on tool mediation on learning have examined all types of tools, but there are few research studies at the middle school level. For the most part, studies at the high school level such as Thompson (2012) or Jacobs (2006) have shown that tool use mediates critical thinking but such studies have not fully documented the process by

which that mediation occurs. For example, at the college level Ball (2012) and Kinchin and Cabot (2007) examine presentational software tool use and focus on the presentation and not how, whether, and for whom the software promotes critical thinking. The studies do acknowledge the tool's influence but fail to delve into the subject more deeply.

The implications uncovered in current study will aid in filling this gap by providing more insight into tool mediation on student learning. Vygotsky advocated for such studies in this area that is, not on the final mature product but on the student's journey using the tools that played a meaningful role in their critical thinking. Finally, this qualitative study provides additional discussion on student achievement by drawing connections between tool use and previous learning experiences to information literacy skills, technology, and human development.

Using Vygotsky's theoretical framework on tool mediation and my interests in how tools mediate student learning as the driving force, the following research question guided my study:

1. How do cultural tools mediate research activities in eighth-grade students?
2. How does the use of presentational software tools mediate eighth-grade students' approaches to conducting research?

CHAPTER 2: REVIEW OF LITERATURE

Long before the emergence of the information age and the myriad of new devices that came with it, educators struggled with understanding tool mediation and its impact on student learning. The *Pennsylvania Academic Standards, English Language Arts Grades 6-12* (2013) outlines using technology, a variety of resources, and other tools that are available in classrooms and libraries to encourage learning. A position paper on the *Common Core State Standards* by the American Association of School Librarians (AASL, 2007) supports the use of a variety of print and electronic resources in classrooms and school libraries. The authors of the AASL position paper argue that students who are well versed in the use of multiple resources are on their way to becoming lifelong learners and effective users of information. With the concern of how to integrate the many resources that are available into the classroom facing the educational landscape, I examined research studies that explore how tools mediate student learning through the theoretical framework of Lev Vygotsky as well as studies by Vygotskian literacy researchers. This literature review has three parts: 1) what studies say about how tool use mediates individuals' actions, 2) how tool use mediates individuals' actions in school libraries, and 3) how presentational tools mediate individuals' actions and learning.

General Tool Mediation

Vygotsky's (1987) theory has three strands that relate when working with adolescents. According to Wertsch (1985), Vygotsky's most important strand is that the cultural signs, tools, and symbols of society mediate human growth and development. Wertsch (1985) argues, "Mental processes can be understood only if we understand the

tools and signs that mediate them” (p. 15). Vygotsky (1998) defined adolescents as individuals who are ages 12 to 16 and who are in a transitional stage of physical, emotional, and mental growth. Adolescents are becoming more socially aware of themselves and the tools that are available within the world around them. This is the time when, according to Vygotsky, conceptual thinking begins to develop and mature in adolescents. Their thinking begins to move from the intrapersonal to the interpersonal level. Vygotsky (1987) explains, “That the development of his [adolescent’s] intellect, *that he reaches the point where he is thinking in concepts*” (p.160). Vygotsky (1987) advocates studying this time in adolescents’ lives to gain an understanding of the transition and growth. He continues by noting the best method for studying is, “If we look at it [adolescent thinking] in action, that is, if we submit it to a functional analysis rather than taking the adolescent’s concept in its developed form” (p. 161). In my study, I examined how tools mediate adolescent or middle school students’ actions when researching in a school library for Earth Science assignments.

A number of studies have examined how tools mediate student behavior both inside the classroom and out. Students arrive at the school’s door with a vast and varied array of life and tool use experiences. I argue that educators need to have a grasp on student’s experiences in order to gain a better of picture of how that varied tool use mediate student behavior. This is part of Vygotsky’s (1987) tool mediation theory that needs to be acknowledged and explored. The following studies provide a small snapshot of adolescents as their conceptual thinking begins to mature.

As an example of the changes in adolescence, that Vygotsky (1987) outlines, Meyers, Fisher, and Marcoux (2009) conducted a qualitative study on 34 students ages 9

to 13 on how “tweens” (p. 301) gather and use everyday information. Today’s tools have expanded to include a vast array of electronic and telecommunication devices. In focus group discussions, students reported using tools such as print and electronic resources, collaboration, discussion with others, reading strategies, text patterns, smartphones, electronic signs and symbols, journaling, and mnemonics. Meyers et al. (2009) note that despite that students are considered “digital natives” (p. 302), their physical, emotional, and mental development is the same as the tweens of past generations. The students used technology such as smart phones to gather information, but overall, they favored face-to-face interaction with others. Meyers et al. continue by noting that adolescents are very social and rely on their experiences and understandings, which in turn mediate their thoughts and actions. Luria stated that the ultimate tool for mediation is language and speech by describing speech as the, “tool of tools” (as cited by Smagorinsky, 2011, p. 13). Vygotsky likewise states, “The primary function of speech, both for the adult and for the child, is the function of communication, social contact, influencing surrounding individuals” (as cited by Wertsch, 1985, p. 81). Meyers et al. noted that the students put their trust in others with whom they had long-standing relationships, as well as in the social identity attached to those relationships, when gathering information. The students’ face-to-face interactions and conversations mediated their actions in three ways: 1) who to seek for information, 2) the type of information they were gathering, and 3) aided in developing their social identities.

Meyers et al.’s (2009) aim was to understand the situations and context that adolescents prefer when seeking information. The authors only reported the tools used to gather everyday information and did not use the opportunity to examine how the tools

used mediated the students' actions. Meyers et al. did highlight important insights into how students' everyday tool use mediated their behavior. However, school activities and research mediation were not part of the study. Using Meyers et al.'s understanding of the importance of adolescent face-to-face interaction, I went beyond focus groups and instead, I interviewed students in-depth about their tool use and the tools that mediated their actions.

In contrast with Meyers et al. (2009), who studied the tools that mediate everyday information, use Grisham and Wolsey (2006) demonstrated how prior knowledge encourages students' reading in an English class setting in a qualitative study of 99, eighth-grade students. The self-selected reading texts were of high interest and connected to the student lives. The students pulled from life experiences to compare and contrast the story text they were reading in class. Smagorinsky (2011) argues that student-centered, hands-on activities where the students have a common interest and connection contribute to the appropriation of tools and problem solving. Grisham and Wolsey continue after individual reading and face-to-face discussions, the students responded to their classmates in an online asynchronous threaded discussion. The online discussions mediated students' actions by providing special symbols and signs to express meaning beyond the printed word and their social identities that are not available in face-to-face conversations. The other feature that asynchronous threaded discussions offered students was the opportunity to think and reflect before responding. Students were able to make further authentic connections to their lives, deeper reflection on the reading, and then share their thoughts later in the online discussion. Face-to-face conversations do not necessarily have this wait time feature.

Grisham and Wolsey's (2006) study neglected to explore how the special signs and symbols of the threaded discussion program specifically mediated students' behaviors. McDonald, Le, Higgins, and Podmore (2005) argue that similar studies only refer to tools by name. Such studies fail to examine how the particular tools, their features, and their history mediate student behavior. Grisham and Wolsey did examine how print, discussion, and electronic tools blend to mediate student action but not how the individual tools or their blended features mediate student action. In my study, I examine how tools and their special features mediate students' actions and thoughts while conducting research on Earth Science projects.

Continuing in the classroom arena, Smagorinsky (2011) presented examples of nonverbal sign and writing mediation in a qualitative study conducted with two students in a Southwest high school horse management class. The students were required to demonstrate their knowledge of horses by designing a set of readable, real-life horse ranch blueprints, as well as a companion essay describing the horse ranch operations. Smagorinsky discovered more than just class content mediated students' thinking and actions. He examined in detail how individual tools mediated the students' decisions and thinking. For example, the assignment requirements, writing strategies, and the diagram symbols mediated the students' actions. Smagorinsky argued that the real life requirements of operating a horse ranch, in and out-of-school knowledge, mentorship discussions, blueprint diagram features, and life experiences also mediated the students' thinking, emotions, and behaviors as they designed their horse ranch diagrams. Vygotsky views writing as, "The most complex device of cultural behavior" (as cited in Smagorinsky, 2011, p. 167). The students' previously learned writing strategies and their

specialized equine knowledge, business decisions, and life experiences mediated how they communicated their expertise on the subject in the companion essay. Unlike Meyers et al. (2009), Smagorinsky focused on high school students who may be at the end of the transitional stage that Vygotsky (1987) describes. For the current study, I focused on middle school students who are at the beginning of the transitional stage. Any insights gained will provide not only a better understanding of the how tool mediates action but also how adolescents' conceptual thinking develops and matures.

Prior to Meyers' et al. (2009) work, McDonald et al. (2005) pointed out that an individual's tools include the cultural beliefs, practices, and life experiences that mediate understanding and perceptions. They argue that personal experiences and tools play an important part in how individuals appropriate or as Smagorinsky (2011) defines it, "take up and make use of" (p. 32) tools. McDonald et al. defined tools as those cultural tools that have stood the test of time and connect the past to the future. McDonald et al.'s study examined three types of traditional tools: flipcharts and easels, jigsaw puzzles, and textbooks in three small studies that focused on how the traditional tools mediated students' actions. The authors proposed that tools such as textbook vocabulary mediate students' perceptions and emotions when acquiring new knowledge. Vygotsky (1987) argues that learning only occurs when tool mediates changed action and clarifies by stating, "All higher mental functions are mediated processes. A central and basic aspect of their structure is the use of the sign as means of directing and mastering mental processes" (p. 126). McDonald et al. included the idea that mediation is not limited to human development but could be part of the connection between people and places. For example, McDonald et al. discovered in their first study that the location of the flipchart,

easel, and classroom reading procedures mediated the behaviors of 5-year old girls. The chart and its location mediated two points in the girls' understanding: the context of the activity, in this case reading and that reading is a shared activity. Meyers et al. also noted that tweens connect location and people when seeking everyday information.

Smagorinsky likewise discovered a connection between people and place in his qualitative study of students designing horse ranches for an equine management class.

McDonald et al. (2005) noted similar implications with the two other studies, the jigsaw puzzle, and the textbook studies. In the textbook study, English vocabulary mediated Vietnamese high school students' emotions. The vocabulary provoked anxiety and stress in the students as they negotiated the text. Vygotsky (1987) briefly discusses how emotions are a part of human development and mediate thinking. In McDonald et al.'s three cases, the tools controlled the students' actions, perceptions, emotions, and behaviors. McDonald et al. explored how particular tools mediated understanding and the emotional responses of the students whereas other studies did not. The authors examined three types of traditional tools that mediated elementary and university students' thoughts, but not middle school students. Additionally, their study only focused on non-electronic tools, omitting any discussion on how electronic tools mediate thinking. However, in the current study, I expand McDonald et al.'s examination of tool mediation by exploring how student tool use, including electronic tools such as, *Prezi* and *PowerPoint* mediate middle school students' understanding, emotional behavior, and actions.

Continuing the focus on how emotions mediate action, Kuhlthau (2004) explored how high school and college students transverse through an Information Search Process

(ISP) when conducting research. Kuhlthau addressed the emotional impact on thinking through her ISP. Through surveys and interviews, the author discovered that despite the diverse populations, there were similar emotional, cognitive, and physical patterns present. The students' emotional reactions mediated their behaviors as well as their discussion, reading, writing, and information throughout the ISP. For example, students experienced a high level of anxiety and apprehension when initially faced with a research assignment. The apprehension mediated how the students approached the assignment and their decision-making strategies. The students brainstormed and had small group discussions to select a research topic. Kuhlthau focused her study on how the emotional reactions mediated the students' actions and how the students navigated the research process. She did not address what particular tools the students used in their research. Similar to McDonald et al. (2005), Kuhlthau limited her study to college and adult students. In the limitations section, Kuhlthau suggested additional studies be conducted with middle school students. To meet this suggestion, I look closely at how middle school students' emotions mediate their tool use in a school library setting.

In a recent study, Spires, Harvey, Morris, and Stelpflug (2012) reflect on how students' reading and writing strategies mediated how they used a variety of tools such as a flip camera, video making software, electronic and print resources, reading and writing strategies, and nonverbal diagrams for an assignment. Students created research questions for a compelling, high interest, real world issue. Vygotsky (1987) promotes the use of interesting real world problems to motivate and encourage individuals to promote mental growth. He also advocates collaboration as an important mediation tool in human development. Spires et al. note how students' interest mediated how they discussed,

brainstormed, outlined, and planned their final project, a short video. The assignment required students to gather and evaluate information. The students used previously learned strategies in evaluating and selecting information found on the World Wide Web. For example, one web evaluation strategy on how to differentiate between domain names mediated how the students selected a website for accuracy and reliability. Previously, students would select the first website returned in the search. The web evaluation strategy encouraged them to be more critical in their website selection. A wiki provided a wider collaborative workspace for students to collect, share, and make decisions as they progressed through the project. Special features of the wiki guided how the students recorded, shared, and stored their information. The asynchronous feature of the wiki mediated the students' actions by providing time to reflect before adding the wiki contents.

The Spires et al. (2012) study was different from the previous studies. The students were middle school students, my target population. Spires et al. also included electronic tools that other earlier studies omitted. However, Spires et al. did not go into detail about the types or the special features of the tools. Similar to Grisham and Wolsey's (2006) and Smagorinsky's (2011) examination of nonverbal symbols, Spires et al. highlighted how wikis and website domains mediated student actions. However, Spires et al. did not examine how the special features and symbols mediated the students' actions. In the current study, I include how the special features of collaborative tools such as *PowerPoint* mediate how students write, share, and use information in Earth Science research assignments.

Reading strategies mediate student behaviors in different ways. Darvin (2008) noted in his qualitative study on informational reading in vocational high school cooking classes that discussion, reading, and writing create a unique discourse community among students and teachers. Vygotsky (1987) advocates collaboration and oral discussion when learning. He explains that language is the first tool used to mediate an individual's life and thought. Darvin discovered that vocabulary, technical language, and purpose for reading encourage what reading strategies the students used. The text format and context of a recipe motivated how the students read the text and used the information. In Darvin's study, the students did not necessarily read in a sequential manner but rather in bits and pieces getting the needed information as they worked through solving the problem. Similar to Spires et al. (2012) the students used a variety of print and electronic tools in collaborative, authentic hands-on learning experiences that mediated their actions. However, Darvin did not focus on the exact tools the students used or how the various features mediated the students' work in the cooking classes. In the current study, I include how tools such as reading strategies mediate middle school students' actions and thoughts.

The qualitative studies reviewed here demonstrated how tools mediate action in a variety of ways. The studies also show how learning is as Alexander, Schallert, and Reynolds (2009) described, "inevitable, essential, and ubiquitous" (p. 178). Meyers et al. (2009) examined the tools that mediate adolescents' everyday information gathering and use. Other studies focused on school activities and assignments in high school and college aged students. For example, McDonald et al. (2005) and Kuhlthau (2004) explored how context, location, and emotions mediated students' thinking and behaviors.

Kuhlthau did not describe how the tools mediated student action. On the other hand, McDonald et al. and Smagorinsky (2011) did describe specifically how tools mediate thinking. The types of tools described encompassed all forms: human, print, and electronic in various combinations, with an emphasis on the traditional over the electronic. These studies provided a solid foundation for future studies. However, additional research needs to look more closely at how tools mediate action in middle school students. In the current study, I conduct a qualitative study to explore how student tool use including electronic tools, such as *PowerPoint* and *Prezi* mediate middle school students' actions when working in a school library on two Earth Science class assignments.

The number of tools available today that mediate an individual's actions have grown since Vygotsky's time. Computers, telecommunication, and collaborative computer programs are just a few new tools that have appeared in society that mediate thinking and mental growth as described by Vygotsky (1987). Vygotsky's work focused on tool mediation using oral language and writing as his primary tools. I expand this discussion with the next group of studies. The following five studies examine how language, reading, and writing mediate student actions. However, the studies also feature the new electronic tools that Vygotsky did not have the opportunity to experience as part of the equation that mediates student behaviors.

An example in Thompson's (2012) study demonstrates an electronic tool's impact on one student's actions. Thompson examined in a case study how out-of-school activities and technology can provide motivation for a ninth-grade student to write in an English class in the United Kingdom. Vygotsky (1987) views writing as the most

complex tool of higher order thinking in order to communicate one's thoughts on paper. Thompson's assignment for his student was to write an article for the school newspaper on his favorite subject, rugby. The author discovered that personal experiences and interests motivated the student's selection of his article topic. The student used the word processing program features to convey his knowledge of rugby to the printed page. Thompson noted the student decided specifically to use font size and capitalization features to convey emotionally what he felt needed emphasis with his audience. The computer technology mediated the student's actions by allowing him to concentrate on what he wanted to say in the article rather than struggle with his poor handwriting.

Thompson (2012) did not explore any other computer features except for font size and capital letter use and they how mediated the student's actions. I expand beyond the special features of word processing and explore the special features of other programs such as *Prezi* or *PowerPoint*. In addition, the oral discussion between Thompson and his student about the article's content mediated the student's thinking, his advanced vocabulary use, and the use of literary devices such as metaphors in his writing. Such a discussion supports Vygotsky's theory of the importance of oral language in mediating thought and mental growth. Myers et al. (2009) similarly demonstrated that discussions and interactions are highly important to middle school students' learning. Therefore, I included informal discussions similar to Thompson's with students during the course of my study.

In contrast to researching high school students, Purcell-Gates, Duke, and Martineau (2007) conducted a quantitative study to explore how authentic, genre-specific reading and writing strategies mediated 120, third-grade students' actions when writing

informational and procedural science texts. Third-grade students collaborated to create procedural steps to a science experiment for second-grade students. Students recorded their actions as they progressed through the experiment. Similar to Thompson's findings (2012), Purcell-Gates et al.'s students expressed their thoughts and actions on paper for others to read. The authors noted that the experiment materials, science vocabulary, results, audience, and problem-solving strategies mediated the students' writing. For example, students carefully recorded the experiment's sequential steps in such a manner so that the intended audience would be able to duplicate the experiment successfully.

Purcell-Gates et al.'s (2007) second class of students created and wrote an informational brochure of frequently asked questions for a local nature preserve that they had just visited. The students' personal experiences from the field trip guided their thinking as they created questions for the brochure. The brochure design, intended audience, specialized vocabulary, brainstorming, and purpose of the writing activity also mediated the strategies that the students used in the project. For example, the limited space in the brochure design encouraged students' to identify only the most important points they wished to make with their writing. Purcell-Gates et al. discovered that the experimental group reflected a collaborative, hands-on application in which students had a vested interest in the topic. The students' interest motivated them to do additional research on the nature preserves to supplement what they had learned from the field trip. The experimental group's writing was of higher quality than the control group. Purcell-Gates et al. conducted a quantitative study whereas in my study there was not a control group.

Jacobs (2006) further exemplifies Vygotsky's (1987) theory of tool mediation in the electronic age in a two-year study with high school students. Jacobs investigated how an instant messaging (IM) program mediated the actions of four tenth-grade students. She discovered through observations, interviews, and field notes that IM mediated the students' actions as text producers, consumers, and disseminators of information. The synchronous collaboration tool's text and symbols prompted the students' decision-making such as whether to accept a message or not and whether to communicate their physical location as, "away" (Jacobs, 2006, p. 175) in the virtual world. Jacobs also discovered the IM program promoted students' text production by having special symbols and abbreviations that convey meaning and emotional nuances normally found in face-to-face conversations. The students kept the messages very short and used the special IM symbols to produce text and disseminate meaning. For example, one student used special graphic symbols to express her confusion about the topic of an AP American History test. The special symbol prompted the person that the student was communicating with to call her on the telephone for a more lengthy discussion about the test.

Similar to Grisham and Wolsey's (2006) findings, Jacobs' (2006) IM allowed students to think and reflect before responding. The practice of short responses and abbreviations mediated the student's thinking further by forcing the students to respond in an effective and meaningful text structure. The special emotional IM symbols provided an additional dimension found in face-to-face interaction but in a slightly delayed timeframe. Jacobs (2006) briefly described how some special symbols such as the confusion symbol mediated student thinking and action. However, she did not go into

detail on any other symbols that mediated student action. I expand on Jacobs' study by examining how *Prezi* and *PowerPoint* special features mediate student action and behavior. My target population was more in line with Grisham and Wolsey's (2006) but fewer than 99 students. For the current study, I recruited six eighth-grade students: three boys and three girls.

In a case study, Karlström, Cerratto-Pargman, Lindström, and Knutsson (2007) investigated how the special features of a computer assisted second language learning program mediated the actions and writing of four medical students learning Swedish. The study's objective was to gain insight into how special features such as grammar check mediate students' writing and language development. Pairs of students listened to a fictional patient's report, took notes, and then recounted the report in their own words in Swedish. The students received instructions on how to use the program and how the features could help or hinder them in their writing. What Karlström et al. discovered was that the program mediated students' actions but not in ways they expected. The grammar check aided student actions by correcting errors but only to satisfy the error-marking feature and not as language development tool. The grammar errors found by the grammar check made the students evaluate their sentence structure and meaning that they were trying to document in the patient's record. The special feature did mediate second language development by causing the students to reread their notes, reflect on their writing, and then discuss in length how to correct and revise. The students had to speak Swedish because it was the common language among the pairs. Karlström et al. believed this oral language development was an unexpected, but a valuable item that was uncovered during the study. Karlström et al. also noted the other features such as syntax

and word class highlighting, which the students said were useful but not used when revising. Vygotsky (1987) reminds us that unless individuals appropriate tools, change in human action will not occur.

Karlström et al. (2007) provided examples of tools such as the syntax and word class highlighting features that the medical students did not appropriate. Thompson (2012) and Purcell-Gates et al. (2007) noted similar oral language mediation on student actions. During the current study, I examined how oral language discussions mediate students' actions and behavior. Thompson and Karlström et al. noted individual computer features such as capitalization that encouraged student actions. I expand beyond capitalization and font size to include more special computer program features. Karlström et al. provided examples of how students did not appropriate certain tools. The other studies reviewed did not encounter findings such as this. Karlström et al. did not pursue the reasons why the medical students did not use some of the features available. Based on this, I chose to include an examination of what special features the students did not appropriate and the reasoning behind it.

Just recently in Finland, Kumpulainen, Mikkola, and Jaatinen (2014) examined how an online collaborative writing program mediated 21 fifth and sixth-grade Finnish students' creative composition of a school musical over a three-month period. By analyzing chat room discussions and interactions, revision history of the musical script, and student responses to open ended questions, Kumpulainen et al. outlined how computer program features such as the chat room mediate the students' collaborative discussions, writing, and revisions of the musical script. Kumpulainen et al. explored the additional components of where and when the students worked as another mediating

factor on student behavior. Small groups of three created a school musical to honor the anniversary of the elementary school's founding. Students were given each a laptop, wireless internet connection for school and home use, a collaborative online writing program called *VisciPad*, and access to additional online resources.

Kumpulainen et al. (2014) discovered that chat room features such as special symbols for emotion, promoted trust among the students normally found in face-to-face interactions. This trust carried over into the deep, honest, reflective discussions about the students' writing and their progress on the project. The time delay between receiving a message and responding allowed students time to think, reflect, and compose a message that conveyed their intended meaning. The simultaneous writing feature also encouraged discussions and revisions on the script by noting each of the students' contributions in different colors. The color-coding promoted further discussions in the chat room in effort to clarify each student's writing contribution and the thought process behind it. One student's questionnaire comment on the continual online access for brainstorming and ideas was helpful in moving the script writing along. The 24/7 access of *VisciPad* also supported the students' continuous thinking, reflection and sharing with their partners. No longer did the students have to wait until they were in school to record their ideas.

Kumpulainen et al. (2014) provide insight to the digital lives of upper elementary students and how 24/7 access to computer programs mediates students' actions on school assignments and projects. Studies reviewed earlier did not describe this type of tool mediation. Thompson (2012), Purcell-Gates et al. (2007), Jacobs (2006), and Karlström et al. (2007) focused their research solely on tool mediation in the classroom. Similar to Jacobs, Kumpulainen et al. had a delay time built in for responses via a chat room, which

mediated the students to think and respond more effectively. Kumpulainen et al.'s contribution of 24/7 tool use and mediation added another dimension to Vygotsky's (1987) theory of tool mediation in today's global society. In the current study, I examine how student tool use and presentational tool features of *PowerPoint* and *Prezi* mediate middle school students' actions in their Earth Science class assignments and projects.

The studies reviewed in this section reflect additional different ways tools mediate student actions and behaviors. All with the exception of Kumpulainen et al. (2014) examine tool use in a classroom setting. Each study emphasized Vygotsky's (1987) advocacy for authentic, hands-on application of tools in a specific learning environment. However, Kumpulainen et al. also took into account how tool mediation on class assignments extended beyond the schoolhouse door into a 24/7 virtual environment. Karlström et al. (2007) explored how a second language develops when mediated by a grammar correcting program and oral language. They discovered that Vygotsky's (1987) most important tool, oral language, mediated second language development far beyond any computer program. In their study, Karlström et al. stumbled upon examples of tools not appropriated by students, leaving the door open for future studies that examine why students do not use certain tools. Thompson (2012) and Jacobs (2006) described how specific features such as font size and special symbols mediate how students express emotion in their writing. Purcell-Gates et al. (2007), Kumpulainen et al., and Jacobs all demonstrated the power student collaboration has on writing and creation of meaningful text for others to read. The examples described demonstrate why Vygotsky denotes writing as the most complex tool of all. Purcell-Gates et al. briefly discusses students' previous experiences and understandings from the field trip. Beyond this, the authors

mention very little in regards to how previous experiences and tool use mediate student actions. The studies provided a foundation for future studies. As I laid out, I conducted a qualitative study to explore how student tool use and presentational programs such as *PowerPoint* and *Prezi* mediate student actions when researching for Earth Science class assignments.

Tool Mediation in School Libraries

Vygotsky (1987) argued that tools mediate conceptual development. However, according to Vygotsky not all concepts are the same. He made a distinction between everyday concepts, those developed or through lived experiences, and scientific concepts, or those developed through direct instruction. Myers et al.'s (2009) study is an example of Vygotsky's notion of everyday concept development in tweens. Smagorinsky (2011) pointed out that Vygotsky believed that the formal classroom was an ideal location for studying scientific concept development. Smagorinsky argued that an individual's higher order thinking develops in specific situations using tools. He defined this as an arena, a physical location that has certain cultural and historical features that make it what it is. Smagorinsky continued by explaining that a setting is an individual's preconceived understandings of an arena based on their personal, emotional, societal, cultural, and historical knowledge and background. Two individuals may work in the same arena but construct a different setting based on their own prior experiences and knowledge. A classroom is an example of an arena where students can construct their individual settings. Thus far, I have reviewed several studies with classroom arenas with what most neo-Vygotskian scholars would agree demonstrate tool mediation. Next, I will step out of the classroom arena and examine other physical locations overlooked in the literature.

One physical location not discussed in the existing literature but would also meet Smagorinsky's (2011) definition of an arena is a school library. The library arena affords a variety of learning experiences particularly the types that Kuhlthau (2004) advocates for students. Kuhlthau argues that a library arena offers a comprehensive view on how tools such as an ISP, information literacy skills, and library resources mediate student behaviors. Up until this point, I have reviewed studies that examined tool mediation in everyday life and in the classroom but very little in the way of tool mediation in school libraries. The following studies reviewed next vary in the nature of tool mediation but focus on libraries as an arena. The tools that Vygotsky (1987) outlined are not implements used to repair but rather the means by which individuals act and respond to their environment. McDonald et al.'s (2005) easel and chair that mediated students' action is one type of tool. Purcell-Gates et al. (2007) and several other studies focused on speech as a tool that mediates student behavior. Next, I will examine research studies that explore how tools mediate student actions in a school library arena.

Limberg and Alexandersson's (2003) study reflects Smagorinsky's (2011) definition of an arena. Limberg and Alexandersson examined how 260 students, ages 8 to 19 perceive a library as a tool for locating information for class assignments. In a two-year qualitative study, the authors interviewed and observed students as they used a school library and the types of tools that directed the students' actions. What the findings revealed was that the library functioned in such a way that the physical space, services, and artifacts such as print, electronic, and human resources mediated student action. For example, the physical furniture arrangement such as large or small tables mediated the students' decision-making on whether to work in small groups or independently. One

student remarked while working in the library that the nearby proximity of the print collection to her workspace made her realize that she should explore what the print resources had to offer in addition to what she had from electronic resources. The nearness of the print collection mediated the student's decision to locate and browse books that she had not previously considered. The nature of the assignments mediated the ways students employed the resources available in the library arena.

Limberg and Alexandersson (2003) highlight that human resources or librarians available in the library were another tool that encouraged students to use the library. Students noted on questionnaires that they went to the library for two reasons: first, the librarian's expertise in the use of print and electronic resources and second, the technical services that the librarians can offer. The librarians' knowledge of the assignments and resources supported student actions by assisting them in using library resources or making recommendations on where to look or search on the student's topic. Limberg and Alexandersson continue by reporting that technical services such as photocopying or help with computer problems offered in the library caused students to go there for help. For example, one student reflected that he had difficulty accessing the library databases from home. He talked to the librarian to double-check if the passwords and procedures were correct. The home access issue prompted him to seek a librarian's help to solve the problem.

Limberg and Alexandersson (2003) uncovered that a library arena mediates a range of emotions particularly in the Information Problem Solving (ISP) process. Students remarked that library services from previous experiences and understandings provoked them to have certain emotional responses to their assignments. For example, a

student commented that he was relaxed when he went to the library because he knew that he could get help to complete his assignments. Another student said she was always thrilled with what she found in the library. A third student noted that she and her classmates would meet to work, discuss, and seek help from a librarian if necessary. The availability of a librarian to talk, interact, and collaborate with on finding sources, ideas, and assignment details positively supported the students' emotional perceptions of the library arena.

In their study, Limberg and Alexandersson (2003) investigated the library as an arena instead of specific portions or items that are located in it. Other studies, such as Purcell-Gates et al. (2007) primarily focused on specific resources available in a library. Limberg and Alexandersson did include middle school students in their study, but they did not separate the various age levels in their findings. In my study, I address how specific resources and features of presentation tools such as *Prezi* and *PowerPoint* mediate student actions. However, also I take into consideration how the library arena guides students' actions when using these computer programs. Vygotsky (1987) reminds us that human development does not happen in a vacuum but rather in specific context and the context of the library arena can play an important part in tool mediation.

On a smaller scale, van Aalst, Hing, May, and Yan (2007) investigated in a case study how 18 twelfth-grade students working in small groups gather information on relevant topics. The study's objectives addressed the types of resources used, student cognitive and emotional experiences, and factors that directed students' collaborative work. Through questionnaires, interviews, search logs, and diaries, van Aalst et al. discovered that despite the direct information literacy instruction on print and electronic

resources, students predominately used web-based resources. During the interviews, students remarked that web-based resources were easier to use and less time consuming. The web-based resources' 24/7 availability also encouraged students' actions by being accessible anytime and anywhere. Additionally, the databases' special features of Boolean searching prompted the students to consider and select specific search terms. Students believed that database content was more current and this perception influenced the students to use them over print materials. The amount of information provoked emotional responses in students. They were frustrated and overwhelmed. The information overload and their frustration pushed students to seek help from their peers, instructors, or librarians. Van Aalst et al. highlighted that all the students experienced the six levels of Kuhlthau's (2004) ISP during the project. To address the emotional needs, students used several methods of communication with their group mates. Van Aalst et al. noted that face-to-face discussions and telephone calls were the predominate types of communication that the students used. For example, the amount of information the students uncovered encouraged them to call a group mate to discuss what they had discovered. One student complained that when using email or instant messaging they had to keep the messages short. The assignment requirements, as well as email and instant messaging constraints motivated students to meet face-to-face or call on the telephone for lengthy discussions.

Van Aalst et al. (2007) had similar findings as Kuhlthau (2004) where both sets of participants transversed through the six stages of the ISP. For example, both groups of students experienced anxiety due to information overload, forcing them to seek help. Other studies also noted similar anxiety. The student participants in van Aalst et al. and

in Kuhlthau's studies as well as Darvin (2008), Jacobs (2006), McDonald et al. (2005), Smagorinsky (2011), and Thompson (2012) were high school aged. I followed the path of Meyers et al. (2009) and Grisham and Wolsey (2006) by using middle school students for my study. Van Aalst et al. mentioned briefly that some database special features such as Boolean searching directed student behavior. However, they did not go into detail as did McDonald et al. and Thompson did in their studies. I expand on McDonald et al. and Thompson's ideas and examine more than just one or two special features of the *Prezi* and *PowerPoint* computer programs that guide students' actions.

Focusing on the same target age group as my study, Newell (2009) explores in a qualitative study how two types of ISP processes prompted 27, seventh and eighth-grade middle school students' actions over a four-week time period. Two classes used a library computer simulation and its resources while the other two classes used a face-to-face, authentic, real-life research project within a library arena and its resources. Observations, interviews, field notes, and students' guided portfolios captured the students' ISP behaviors during the study. Newell discovered both groups had similar conflicts with the research assignment: they did not know what to do. Kuhlthau (2004) and van Aalst et al. (2007) report similar student anxiety and conflict. In Newell's study, students had not experienced an ill-structured problem before. He defines an ill-structured problem as a real world, complex information problem with multiple solutions. The term ill-structured, therefore, does not imply the problem or assignment is poorly designed but rather that it is designed as a student-centered, inquire based task. However, for the sake of clarity, I will use the descriptor "less structured" to refer to problems that Newell would have termed ill-structure. Their previous research project experiences were linear

and left very little room for creative thinking. The less structured problem prompted negative student reactions, which in turn, caused them to seek help from the cybrarian, an online librarian, and the school librarian. This unexpected student action forced both librarians to provide more direct ISP instruction than anticipated.

Newell (2009) continues by noting the direct ISP instruction guided student actions. For example, without any encouragement, the students formed small groups within their classes to work together. The computer simulation classes did not follow the suggested ISP but instead created short cuts by sharing what they had found and brainstorming to find better approaches. This was unexpected, whereas the problem based classes worked separately and then came together to share what they had discovered. The information and search problem encouraged student discussions in both groups. From these discussions, the students made joint decisions on what was the best information and the next step in the process. Newell concluded by stating that the students did follow an ISP but the group discussions, information needed, and problem scenario directed the students' actions. For example, one student reflected on the needed information, stating the group discovered that information was not available in the middle school library. After some discussion and additional research, the students had to go to the high school library to get the resources they needed.

Newell's (2009) study addressed the ISP process in a way that most other studies have not. Similarly, to Kuhlthau's (2004) study, Newell explored how emotional thinking mediated student action. Meyers et al. (2009) did describe how emotions motivated tweens and their everyday information gathering but not in the classroom setting. Newell did not focus in detail how the each specific level of the ISP guided

student actions. He only highlighted the first level of the ISP, anxiety and frustration, as an example. However, Newell did describe how these emotions and the unexpected actions and previous experiences prompted unexpected student actions that the librarians addressed, whereas other studies did not report any unexpected student actions. In addition, Newell's study focused on middle school students, an under-researched age group in the literature. Kuhlthau readily admitted that this age group needed some definite studies. Using her suggestion, I recruited middle school students for my study. I compared instructional methodologies as Newell did, but with the intent of exploring the special features of computer programs that mediate student actions in two Earth Science research assignments.

Continuing with middle school students as participants, Foo and Majid (2007) investigated how information literacy (IL) skills instruction mediated 179 13-year old students' actions in a five-week, project-based assignment. In a quasi-experimental study, 109 students received personalized IL guidance or coaching and 70 students did not. The assignment required groups of five students to compose an essay with supporting artifacts for an oral presentation. The scoring rubric design assessed the essay, artifacts, and oral presentation. Foo and Majid reported that the experimental group performed better than the control group. The students in the experimental group stated that the IL guidance from the instructor was very helpful. The IL guidance and assisted them in understanding the assignment better. The IL coaching mediated the students' understanding of the assignment details better, helping them to move forward on the project. The authors both noted within both groups that teamwork was highly valued. The opportunity to discuss the topic and relevant information encouraged

students to evaluate and compare information to determine the best results for their project. The students remarked that discussion helped them to weed out or eliminate information that did not meet the project's criteria. In addition, the experimental group had the opportunity to ask the coach questions. The coach's answers and guidance positively mediated the students' actions. Because of their experiences with the coach the experimental group advocated for additional projects similar to the one used in the study. Kuhlthau (2004) supported the idea of varied learning experiences that allow students time to master the ISP process and other tools needed for success. Vygotsky (1998) argues that tool appropriation is not accomplished overnight: "The transition to higher forms of synthesis of practical and verbal thinking is not instantly achieved. It begins in early childhood...achieved specifically in the transitional age" (p. 116). He advocates that practice and tool application in real life learning experiences over time leads to tool appropriation and mastery.

Foo and Majid (2007) demonstrated in their study the value of Vygotsky's (1987) theory of collaboration and oral discussion and their positive mediating effects on student behavior. Foo and Majid's study has several similarities to my study. I worked with eighth-grade students in two project-based assignments. Students used previously learned IL skills while working on the assignments. What differs from Foo and Majid's study is that the current study does not have a control group. All student participants will receive IL skill instruction and guidance during the Earth Science class projects. Foo and Majid recommended in their implications to integrate IL skills into content areas and provide further guidance in IL skills over a time period for students to practice and gain mastery.

Similar to studies reviewed earlier, Foo and Majid (2007) did not examine what or how special features of IL skills or library resources mediated the students' actions. Foo and Majid were unclear on the project requirements and IL skills because their primary intent was to examine the mediating effects of coaching on student behavior. Data gathering in my study was similar to other studies such as van Aalst et al. (2007) and Newell (2009). I included interviews, artifacts, observations, and field notes that provided rich details of my students' actions. Instead of exploring the IL skills, I explored student tool use and the special features of *Prezi* and *PowerPoint*. I documented that previously taught IL skills mediated students' actions during my study.

The following studies continue the discussion of tool mediation by focusing how a library arena, IL skills, and ISP mediate student behaviors. Foo and Majid (2007) and Newell (2009) did focus on the same target group of middle school students as I did in my study. Limberg and Alexandersson (2003) included middle school students as a part of their study but did not separate their responses from the overall findings. Limberg and Alexandersson examined tool mediation on a larger scale than other studies. They investigated how a library as an arena directed student actions, whereas other studies only focused specific areas or library resources. Newell noted how previous experiences and understandings prompted unexpected student reactions. However, he missed an opportunity to explore more in-depth how those previous experiences prompted the students to react the way they did. Only a few studies, such as Grisham and Wolsey (2006), Smagorinsky (2011), and Spires et al. (2012), addressed prior experiences as part of their studies. However, they too did not take advantage of the opportunity to examine their mediating impact on student actions.

Vygotsky (1998) points out that adolescents or middle school students are in a transitional stage. Significant emotional, social, physical, and cognitive changes are happening during this time. Keeping this in mind, I anticipated possible unexpected student reactions during my study. Van Aalst et al. (2007) did note emotional experiences similar to Newell and Foo and Majid but on the high school level. Van Aalst et al.'s objectives did include how library resources mediated action. However, only Boolean searching was mentioned – not any specific command. The other studies reviewed here did not mention any tools' specific features. In all cases, opportunities were lost to examine in detail tool mediation in a library arena. For the current study, I went further and investigated specific features of the computer programs *Prezi* and *PowerPoint* in more detail.

Tools located in a library, such as books, databases, e-books, and computer software, have the potential of mediating students' actions in many ways. Previously, I reviewed four neo-Vygotskian studies that took place in the context of a library arena and how library resources overall mediated student perceptions. For example, van Aalst et al. (2007) discussed the mediating impact of Boolean searching on students but fail to address how the located information mediated student action. I argue that specific tools need more examination on how they mediate mental growth and development. The following three studies explore in further detail how specific library resources such as encyclopedia articles or websites, mediate student action. The examination of how library resources and their special features mediate student behavior is the intent of my study. The studies are still within the library arena, but focus more upon how specific library resources and tools mediate student learning.

In a recent study, Rojas-Drummond, Mazón, Littleton, and Vélez (2014) demonstrated how library resources mediate student behaviors. In a quasi-experimental study, the authors explored how tools such as reading and writing strategies, oral discussion, and library resources mediate a higher quality of writing in 120 sixth-grade students in a public school in Mexico City. Rojas-Drummond et al. discovered that the “Learning Together” (LT) programs mediated a higher quality of writing in the finished product. The LT program was an instructional unit that introduced specific oral discussion, reading, and writing strategies that guided students’ verbal and written communication. Groups of three students were required to read three types of library resources: a newspaper article, an encyclopedia entry, and a magazine interview, and then write a summary of all three resources and create an original title for the essay. The triads discussed topic ideas and settled on an interesting topic. The students read each article separately and then wrote the summary together. Rojas-Drummond et al. highlighted that the LT discussion strategies mediated the students’ reading and writing strategies. For example, the LT writing strategies prompted student use of a higher-level writing strategy such as linguistic markers to link ideas in their essays. The LT reading strategies directed students to integrate the main ideas with supporting details in an organized manner from each library text into their summaries, whereas the control group did not show these types of actions in their essays.

Rojas-Drummond et al. (2014) along with van Aalst et al. (2007), Jacobs (2006), Meyers et al. (2009), and Newell (2009) support Vygotsky’s theory of oral language as one of the most important tool in human development. Similar to earlier studies, Rojas-Drummond et al. did not mention resource delivery or its mediating impact on student

action. My intent is to examine how resource use directs students' actions. Students who participated in my study had access to a larger variety of resources and the delivery format was electronic. However, Rojas-Drummond et al. did mention two writing strategies that the experimental group used in their written summaries: linguistic connectors and level of expression. The age group that Rojas-Drummond et al. focused on in their study used is at the lower end of Vygotsky's (1998) transitional age range. I used a slightly older population for my study: the eighth-grade students who participated in my study brought the age group closer to the center of Vygotsky's age range of 12-16.

In a similar age group as Rojas-Drummond et al.'s (2014) participants, Ho, Nelson, and Müller-Wittig (2011) focused on 12-13 year old students, exploring in a research study intervention in Singapore on how a virtual museum gallery assignment mediates students' behaviors. Student questionnaires allowed for insight into students' prior experiences with museums, technology, and various resources. Bases on the questionnaire responses, Ho et al. found that students received direct instruction where needed concerning museums, technology, and library resources. Student teams of 4-5 grouped by general topic interest and used only web-based resources: databases, resources on the World Wide Web, electronic books, and virtual museum technology for the assignment. Using interviews, observations, and questionnaires, Ho et al. found that the assignment and topic mediated student actions. The research topic mediated how the students selected images that best reflected the message they wanted to convey. The museum program's special features mediated the student's awareness of the constraints that text had on conveying a message. For example during the Ho et al.'s (2011) interviews, a student stated that an essay could not convey the same "sense" (p. 1090)

that images can. The selected images encouraged students to discuss and compose captions that further enhanced the images' meaning.

Ho et al. (2011) also noted that the small group arrangement mediated the students' actions. Students reported that they learned more about their topic through brainstorming and discussions that broadened their perspectives and helped create a better museum gallery. Interpersonal group dynamics also mediated student behavior: students described the group social behavior such as who the natural leader was or who the technology expert that helped them to produce a quality product was. One student reported how they emotionally bonded to when helping each other when working so everyone stayed together in during the project.

Ho et al. (2011) was different from many of the earlier reviewed studies. Firstly, the authors focused on 12-13 year old students, my target age group, whereas most of the literature has other studies targeted elementary or high school students. Ho et al. also built on students' prior understandings of museums, technology, and various resources. I understood and noted prior IL instruction and resources that mediated student actions. The museum gallery assignment required the use of electronic resources with no mention of print resources nor was any specific resource type mentioned. Ho et al. focused on the museum gallery program and the image types used as well as the collaborative actions that mediated students' behavior. Students who participated in my study were not limited as to the types of resources they could use. Similar to Foo and Majid (2007), I note previous IL instruction and resource use that mediate student behavior. Ho et al. mention text boxes as a special feature that mediated students' writing strategies for the still images. The text box features including size and font, mediated how the students

succinctly composed their message to fit in the text box space. I investigated how text boxes mediate student actions as well when using *Prezi* or *PowerPoint*, but I also considered other features of the programs.

In a prior study, Grant and Branch (2005) investigated how resources mediated five eighth-grade students' actions in a private school in Southeast United States. Students in a 10-week unit study researched a country noted for human rights violations and created an essay with a visual display. The students used a variety of resources such as a teacher-created WebQuest, the government website *CIA World Factbook*, and country newspapers. Student also used note-taking templates, graphic organizers, bibliographic templates, essential questions, and peer and adult evaluation throughout the four-unit study. Grant and Branch conducted interviews with students before, during, and after the project, as well as used observations, field notes, and artifacts to gain an understanding of how the resources mediated learning. The methodology that Grant and Branch used was very similar to that of my study.

Grant and Branch (2005) continued by noting after initial instruction on human rights and violations, students selected a county of interest. They studied and researched their country's political, physical, cultural, and economic geography. As the students learned about their selected countries' human rights violations, they focused on one example to delve into further. The assignment details, student interests, and the resources mediated the students' actions. For example, the government website *CIA World Factbook* provides current information about the political, economic, and cultural status of each country. It does not provide human rights examples but it does identify countries having issues in that area. The *CIA World Factbook's* lack of specific human rights

violations and the assignments requirements encouraged students to explore newspapers and websites to pursue specific details and examples for their essays.

Grant and Branch (2005) reported that the note-taking and bibliographic templates, as well as graphic organizers mediated the students' actions and behaviors throughout each stage of the project. For example, the note-taking templates had the capability of arranging the students' work into a linear organization. Students designated the organization and arrangement by the subheadings and the information. The organization motivated how the students arranged the slides in their presentations. The organized subtopic arrangement mediated the students' use of the computer program's navigating links of "next" and "previous" arrows to direct his audience to their summaries and photos. The research paper contents guided the students to edit the captions on the images they selected.

A common theme appeared in Grant and Branch's (2005) study for all five students. The authors discovered that the computer programs mediated the students' decision-making when they were designing their exhibits. For example, one student realized that the trifold board was not going to work for what he had in mind. The computer program he used had special features that hyperlinked his photo gallery to his essay summaries. He had specific ideas on how he wanted to present his information to his audience and used this to his advantage with the computer program. All the students created their exhibits with the intended audience in mind. The potential audience therefore mediated how they summarized their research papers, selected images and graphics, and linked everything together into print/electronic presentations.

Smagorinsky (2011) advocated for an expanded look beyond the spoken or written word when examining how tools mediate student learning. The studies in this section demonstrated how one specific group of tools, in this case, various library resources, mediated student learning. Each study documented at least one specific feature of a resource or computer program that mediated student actions. A good example of this is Ho et al.'s (2011) description of how the museum gallery still image feature mediated students' awareness of the constraint using text only to convey their intended meaning to an audience. Ho et al. used the students' previous experiences as a starting point for instruction in their study, whereas other studies only allude to student's previous experiences. In the current study, I explore students' previous experiences. Rojas-Drummond et al. (2014) and Grant and Branch's (2005) examples of tool mediation is similar to what I examined during my study. However, the students who participated in my study had access to a larger variety of resources than the students did in these studies. In Rojas-Drummond et al. (2014), Ho et al. (2011), and Grant and Branch, the participants were close to or in the age group that I recruited for my study. Many of the earlier studies focused on high school or adult learners. Vygotsky (1987) reminds us that observing the journey that the student takes during their mental growth and how tools mediate that growth is far more important than examining the mature product. My intent during my study was to examine a small portion of that journey.

Tool Mediation and Presentation Tools

Within a school library arena, many tools can mediate student actions. In addition, presentational tools, like *PowerPoint* for example, are readily available in a school library and the *PowerPoint*'s special features mediate student actions. Several

studies such as Ho et al. (2011), and Grant and Branch (2005) have alluded to presentational tools but failed to examine how those tools mediate student action and thought in detail. My argument is that all types of tools need investigation so that librarians and teachers can have a better understanding of their mediating influence on student actions. Vygotsky primarily investigated oral and written language. Smagorinsky (2011) advocates for a broader view, explaining, “More expanded notion of cultural tools that looks beyond Vygotsky’s focus on linguistic expression and takes into account other means of mediating human thought” (p. 189). Thus, I chose to include in my study electronic resources such as *PowerPoint* and *Prezi*. Similar to studies on libraries and library resources, there is very little in the literature examining presentational tools through a Vygotskian lens. The following studies will take a critical look at how presentational tools and programs mediate student action.

Goos, Galbraith, Renshaw, and Geiger (2003) explored how tools such as graphing calculators and widescreen projection devices mediate student actions. Using an ethnographic study with taped interviews and observations, field notes, and surveys Goos et al. investigated how these technological tools mediated the student behavior in high school calculus classes over a three-year period in Australia. For example, the widescreen projection display prompted small and large group discussions where the students took control of their actions by attempting different calculator commands as suggested by their classmates. One student said, “By displaying things in different ways [technology] can help you understand things more easily” (Goos et al., 2003, p. 79). The authors also found that the mobility and screens of the students’ hand-held graphing calculator encouraged discussion by allowing students to share and compare their work to

emphasize a point or alternative calculation. Calculator error messages prompted student action by encouraging further exploration and discussion. One student noted that the calculator display provoked them to verbalize their thinking and to visualize the math problem more easily. Another student described the features of the graphing calculator as an exploration tool. The calculator functions motivated the students to expand their ideas, test alternative methods of solving problems, and the freedom to explore outside the conventional thinking.

Goos et al. (2003) approached tool mediation in a slightly different manner than previously reviewed studies. The researchers focused on how graphing calculators and widescreen projectors mediated student action in a calculus class. On the other hand, other studies, such as McDonald et al. (2005), focused on non-electronic tools. Similarly, to Goos et al., the current study examines how electronic tools' special features mediate student actions. Goos et al. noted both types of devices promoted oral discussion in large and small groups. Special features such as error messages and small display screens encouraged students to act beyond the usual ways to find the correct answer. In line with Smagorinsky (2011), Jacobs (2006), van Aalst et al. (2007), and Thompson's (2012) studies, Goos et al. selected student participants who were high school age, whereas in my study, I sought out eighth graders.

In a later study, Neo and Neo (2009) investigated how a multimedia constructive-learning project on a "Malaysian Culture" (p. 256) topic guided college students' actions over a 14-week semester. The assignment requirements prompted the students to form small groups, identify a problem or topic in Malaysian culture to create a multimedia project with a presentation of the final product to the class. Students reflected on the

project via surveys and interviews. Neo and Neo discovered that similar to other studies, high topic interest, and the assignment influenced students to work and complete the project. For example, one student commented that the subject his group selected was fun and he had the opportunity to use his creative ideas in the project. Another student stated that she was motivated because she learned new skills that she could not get from her instructors.

Neo and Neo (2009) uncovered that assignment requirements such as hands-on, multimedia programs mediated students' increased understanding of interactive multimedia in a real-world application. One student reflected that working with the multimedia program improved their understanding of how to use the program in the future. Neo and Neo's findings, in regards to how collaboration and teamwork mediate student behaviors, reflect Vygotsky's (1987) theory of collaborative interaction and discussion. Students reported the teamwork discussion and problem-solving was far more in-depth, and that they learned from one another. Similar to McDonald et al. (2005), Neo and Neo highlighted that teamwork and interaction encouraged increased student thinking with discussion, brainstorming, and feedback. One student noted that they shared all of their ideas, discussed each one, and then voted on the best idea.

Similar to the studies by Jacobs (2006), and Grisham and Wolsey (2006), the studies, students who participated in the current study had access to special communication programs that allowed them to respond to each other. Various electronic formats enhanced communication between students: chats, emails, and listservs guided student communication when scheduling conflicts prevented meeting face-to-face. One aspect of teamwork and collaboration that Neo and Neo (2009) highlighted, which other

studies did not report, was how student interaction directed their behavior when dealing with negative collaborative activities and group management. Neo and Neo reported that one of the biggest challenges to the student groups was the conflict in ideas and workload. Student discussion positively guided the resolution of the issues by writing down each problem and working together to solve each one.

Wang and Turner (2006) examined the mediating effects of a slightly different type of presentational tool. In their qualitative study, Wang and Turner used interviews, observations, and document analysis to investigate how electronic portfolios, or e-portfolios, mediated seven graduate students' actions at a university located in the United States Midwest. The students compiled an e-portfolio required for graduation with artifacts that demonstrated their learning during the graduate program. Similar to Grant and Branch (2005) and Neo and Neo (2009), the assignment was a real-life application of skills and learning. The eighth-grade Earth Science instructional units that the current study investigated were student-centered, learning experiences – similar to what Vygotsky and other neo-Vygotskian scholars suggest.

In Wang and Turner's (2006) study, the University's e-portfolio graduation requirement directed the students' motivation and interest in assembling a product that met the University's standards. Previously learned skills and newly learned skills prompted students to reflect on their learning by selecting artifacts that demonstrated their growth over time. Collaboration with instructors and peer reviews also led students to reconsider ways that they could improve their portfolio contents. Wang and Turner's student commented that the discussions they had about computer problems not only helped fix technical glitches but also created new learning opportunities to solve

problems. The e-portfolio software program mediated students' problem-solving skills by forcing them to discover what worked and what did not when converting files.

Selecting artifacts also forced students to analyze and determine whether the artifacts truly reflected their academic growth. Several students commented that this analysis encouraged them to identify how to improve the artifact.

Wang and Turner (2006), like earlier research did not provide specific details on how the portfolio programs mediated student action. They did provide an overview, but not much more. *PowerPoint* and *Prezi* are presentation tools very similar to e-portfolios. All have the capability to encourage students to reflect, decide, and select information or artifacts that demonstrate student learning. I investigated how *PowerPoint* and *Prezi*'s special features mediate student actions. Like McDonald et al. (2005), I delved further into what these programs and their special features can offer in the way of tool mediation as outlined by Vygotsky (1987).

Goos et al. (2003), Neo and Neo (2009), and Wang and Turner (2006) examined tools that previous studies only allude to or highlight. Goos et al. explored how graphing calculators mediate student action and behaviors in a classroom arena. Earlier studies only overview presentational programs on a large scale. For example, earlier studies did not mention handheld calculators' mobility feature. While Goos et al. focused on these handheld devices as presenting the students' thoughts and actions, the authors did not expand beyond the mobility feature – for instance, how specific features mediated student behavior.

The current study investigated devices with similar mobility features as handheld calculators. Students had access to laptops and iPads as part of the study. Neo and Neo

(2009) examined several electronic interactive media programs that guided student actions. Like many of the earlier reviewed studies, Neo and Neo only alluded to presentational software programs. They did however highlight communication advantages of emails and chats, as did Jacob (2006) and Grisham and Wolsey (2006). These authors argued that electronic communication formats mediate students in a positive way but did not go into detail on how the formats' special features encouraged specific student action. Wang and Turner (2006) explored a different presentational tool, an e-portfolio. Again, like others, Wang and Turner did not examine the specific features of the tool but rather only areas that directed student actions such as the new learning that students experienced when converting files for the portfolio. They touched briefly on how students' previous experiences guided student actions when creating their e-portfolios. Ho et al. (2011) also mentioned students' previous experiences but only as a starting point for student direct instruction.

Several studies, such as Grant and Branch (2005), have briefly noted the challenges students face when using tools and how tools, such as the trifold board, mediate students' actions. Wang and Turner (2006) also highlighted challenges and how new learning resulted. Each of the studies reviewed had a variety of opportunities to explore in-depth how tools mediated student behaviors, but the researchers did not take the opportunity to act further. Hoping to take advantage of these lost opportunities, I explored how electronic tools such as *PowerPoint* and *Prezi* and their special features, plus mobile devices such as iPads, mediate student actions in an eighth grade Earth Science research assignments in the school library arena.

Tool Mediation with PowerPoint and Prezi Presentations

In the following section, I explore several studies that examine some of the special features of *PowerPoint* and *Prezi* and how these features mediate student action. As I noted earlier, studies investigating how presentational tools mediate student actions are not abundant in the literature. Goos et al. (2003) and Neo and Neo (2009) discussed presentational devices and software, but not how the special features mediated student action. The explosion of electronic communication and delivery devices provides many opportunities to investigate how Vygotsky's (1987) tool mediation theory influences student behavior. The following two studies examine how *PowerPoint* and *Prezi* features mediate student action in a classroom arena. Both studies move closer to my study. Each study examines one or two special features of *PowerPoint* or *Prezi* and documents how they mediated student behavior. However, I expanded the number of special features examined and added a different perspective to the conversation on Vygotsky's tool mediation theory.

In the first study, Kinchin and Cabot (2007) explored how a *PowerPoint* presentation and a concept map mediated 37 third-year undergraduate dental students' actions in the United Kingdom. During clinical instruction classes, students received an introduction to a removable partial denture design in a *PowerPoint* presentation, as well as a concept map. At the conclusion of the instruction, students completed a questionnaire. The following class period, focus groups of six to nine students reflected on their questionnaire responses more in-depth. Kinchin and Cabot uncovered that *PowerPoint* presentations prompted the students' behavior by presenting quick, bulleted facts in order to study for a professional exam. One student commented it was an easy

way to memorize for upcoming exams. However, the students agreed that the concept map provided more explicit and better-understood connections in the partial denture construction process. They mentioned that the concept map format aided their in-depth understanding of the denture design process. Students also noted that the concept map encouraged discussions among themselves as well as with the instructor. All agreed that the concept map provoked their long-term application of the construction process and encouraged them to think beyond the linear bullet points of the *PowerPoint*. The concept map design is a visual of creating a partial denture with connecting link, giving the students a complete conceptual model – whereas the *PowerPoint* presentation does not demonstrate variable connectors that are a part of the design process. The concept map acts as a mediating guide for students when practicing and creating partial denture, while *PowerPoint* bullet points do not have that affordance. The concept map also aided the instructors' understanding of the students' procedure in denture making by allowing them to compare whether the students' denture making procedure was correct or not.

Kinchin and Cabot (2007) uncovered two types of mediating factors in *PowerPoint* presentations and concept maps. Both are useful tools in promoting understanding but on different levels. The authors report that *PowerPoint* presentations aided with simple, quick recall for an exam. The program however does not necessarily encourage long-term appropriation. On the other hand, Kinchin and Cabot highlight how concept maps provided a detailed, visual example of the content knowledge. Each level of the concept map provided significant detail for long-term understanding particularly in a hands-on application. Kinchin and Cabot compared two *PowerPoint* presentation features – the linear design, bullet point feature, and how they mediated student behavior.

However, student created *PowerPoint* presentations were not part of Kinchin and Cabot's study. In the current study, students created a *PowerPoint* or *Prezi* presentations instead of viewing one for information. I investigate how special features such as the bullet point application in *PowerPoint* and *Prezi* mediate middle school students' actions, a significantly younger population than Kinchin and Cabot's. Similarly, to Grant and Branch (2005), my exploration will be during real life, hands-on research units with the application of information literacy and resource use in an Earth Science class.

In a more recent study, Ball (2012) explored how digital design tools such as a *Prezi* mediated one graduate student's writing and presentation of an academic manuscript in a multimedia format worthy of publication in an online scholarly journal. The semester long project allowed the student to apply her writing skills in what Ball described as "webtext" (2012, p. 62). The student selected a topic of her choice and using various scaffolded assignments, ultimately produced a completed webtext. Ball pointed out that webtexts have the same strong writing and research components as a conventional written product, but the goal is to have part of the student's argument that in an interactive format and not the written word. Ball explains that a visual multimedia component must enact the student's argument as part of the webtext. Assignment tools such as rubrics, digital design tools, storyboards, instructor conversations, rough drafts, and peer reviews at each stage of project mediated the student's actions throughout the semester.

Ball (2012) discovered that the student's topic and argument guided what type of design tool the student used to make the webtext. The present study had similar options for students to select a presentation tool. However, it was on a more limited scale.

Students had the choice of *PowerPoint* or *Prezi*. In Ball's study, a graduate student wanted to use a *Prezi* to present her creative piece on her struggle and diagnosis of fibromyalgia. Her goal was to demonstrate how her progress with the disease diagnosis and her trigger points were different from the most commonly identified triggers in the medical field. *Prezi*'s unique features mediated her selection of the program as her presentational tool for the assignment. For example, *Prezi* allows users to create on-screen paths or frames that are not linear but rather present information as straight, curved, or jutting as needed. Ball's student could therefore custom design visuals appropriately. In this case, the student used an outline of the front of a woman's body to display her creative writing sections. The visual representation of the student's unique trigger point links demonstrated her pain and also explained her argument in further detail using nonfiction information about the disease. Ball's study reflects Vygotsky's position that writing is the most complex tool. In this case, the webtext takes the writing complexity to a higher level with an interactive visual that conveys the author's intent.

Ball (2012) highlights how suggestions from a peer review encouraged the student to add a second outline of a woman's back to her storyboard to display her trigger points as compared to the medical fields' norms. *Prezi* features allowed the student to have the freedom to create what she needed to reinforce her argument that there is very little that is normal about fibromyalgia and how it affects individuals. The student also used the assessment's rubrics to guide her writing, as well as her visual display to refine her webtext. Ball noted that the student was able to submit successfully her webtext for publication in a scholarly online journal.

The prior two studies demonstrate the nuanced differences that tools have to offer in motivating student actions. Ball's (2012) student used the special features of the *Prezi*'s nonlinear frames that directed her to create a webtext that reflected her struggle with fibromyalgia. Her storyboard promoted her argument in a print format, but the *Prezi* features supported her argument further in a nonlinear, interactive way. The peer feedback received by the student also encouraged her actions further. Earlier studies have also reflected on the importance of oral discussion that Vygotsky (1987) advocates for. Kinchin and Cabot (2007) compared two types of electronic tools that directed student actions in different ways. The *PowerPoint*'s special bullet features aided with short-term recall, whereas concept map's special features encouraged long-term appropriation. Both are useful in mediating different student behaviors. The current study moves beyond this, exploring how *PowerPoint*'s special features mediate more than simple recall. Studies such as Jacobs (2006), Ho et al. (2011), and Grant and Branch (2005) did not delve into the specific features of the technological tools that could mediate student behavior. However, these two studies provide me with a solid foundation to continue Smagorinsky's (2011) position on an expanded examination of Vygotsky's theory of tool mediation.

Prezi has several special features that afford individuals the opportunity to create interactive and effective presentations. Chou, Chang, and Pe (2015) and Yee and Hargis (2010) suggest that the ability to organize relational concepts, such as what the student in Ball's (2012) study is one of the strongest special features that the program has to offer. Strasser (2014) describes the opening frame as a "canvas" (p. 9) that allows the audience to view and analyze the presentation's big picture. He explains that the interactive

transition and zoom feature provides the opportunity to delve deeper into the subject matter in a nonlinear and graphic fashion by directing the audiences' attention to a specific content and connections that the presenter deems vitally important. The option to create a frame within a frame is a special feature not found in other presentational software such as *PowerPoint*. Strasser also notes that the free, cloud-based access promotes 24/7 use by individuals with the option for several individuals to collaborate on the same presentation. *Prezi* offers a variety of backgrounds, color options, fonts, and bullet text features that permits creativity and flexibility when designing a presentation. Yee and Hargis also note that *Prezi* frames have the function to embed hyperlinks for video presentation.

However, Berkun (2012) and Strasser (2014) outline several features that limit an individual's ability to design an interesting presentation when using *Prezi*. Berkun believes that the transition and zoom features distract and confuse the audience. The program attempts to force a spatial relationship where none may exist. Strasser suggests that if the presentation content is not relational using *Prezi's* zoom feature is unnecessary and adds to the audiences' confusion. Chou et al. (2015) and Jensen and Tunon (2012) have noted similar negative reactions to the motion from their audience. Berkun states that the motion sickness caused by the *Prezi's* transition and zoom feature is a limitation of the program. Other limitations that Berkun report include poor selection of backgrounds and colors that hinders an individual's creativity and flexibility. Berkun and Strasser both note that the default settings limit and encourage poor presentation design.

Similar to *Prezi*, the *PowerPoint* program has special features that aid individuals in creating an informative presentation. Hill, Arford, Lubitow, and Smollin (2012)

suggest the slide arrangement allows individuals to create an organized presentation. The slide order in part creates an outline with visuals for the audience to follow during the presentation. *PowerPoint* has print options for creating handouts for the audience to record additional notes from the speakers' presentation. *PowerPoint* users have access to a large selection of background templates, colors, and fonts. Program features also include a variety of slide motions and timing transitions for moving from one slide to the next. Jensen and Tunon (2012) also note the program's ability to embed photos and hyperlinks into each slide. They further suggest that the bullet point features encourages individuals to distill their message to the main ideas for the audience to view while the presenter expands with additional detail. *PowerPoint* provides a 24/7 collaborative feature for several individuals to work on single presentation. Chou et al. (2015) mentions that the collaborative format eliminates the need to email files and maintains the latest version for everyone involved.

PowerPoint has many benefits but the program also has some limitations. Hill et al. (2012) depict the linear organization as an affordance, whereas Jensen and Tunon (2012) view it as a limitation. Jensen and Tunon explain that the linear slide design hinders an individual's creativity and critical thinking when producing a slide show. Additionally, the linear design hampers connecting relational concepts. Chou et al. (2015) also believes the bullet point feature and slide size encourages poor practices by forcing individuals to diminish the content and depth of the presentation's message. Similarly, the outline format reduces the opportunity for audience participation. Jensen and Tunon point out that a free version of *PowerPoint* is not available as with some other cloud-based presentational programs.

The overall objective of my study is to examine and describe how cultural tools mediate student actions. Specifically, my goal was to examine how *PowerPoint* and *Prezi* mediate eighth-grade students' behaviors. Though prior research has investigated the tool mediation on various level researchers have often overlook adolescent students, despite that this is an important population in the eyes of Vygotsky (1998). According to Vygotsky, this is the age of transition where mature critical thinking begins to develop in earnest. Taking the ideas, suggestions, and missed opportunities from the reviewed studies, I explore how student tool use and presentational tools mediate action in eighth-grade students. My study's design exposed how these tools mediate action in a small group of students. I examine the nuances of the special features of *PowerPoint* and *Prezi* and how they mediate eighth-grade students' behaviors when creating presentations for two Earth Science class assignments. Building on Vygotsky's work by using a qualitative study design, I uncover some rich detailed experiences that will add to the conversation on tool mediation in the transitional stage and its impact student development.

CHAPTER 3: METHODOLOGY

Students today face a large array of electronic devices and ever-increasingly complex software programs. For students to be effective users of information and contributing members of the global community, they must master these electronic tools. Though I have noticed over the years that students are eager to use these tools, I still wonder how these tools mediate the students' actions. Vygotsky's (1987) theory of tool mediation provides a foundation for exploring the impact that today's devices and programs have on students. Surprisingly, the education and library fields have few studies that have examined this idea. I uncovered that some studies touch on how non-electronic tools, such as easels or textbooks, mediate student action and some studies address how computer program features such as fonts or use of capital letters mediate student action. However, no studies have looked in depth at how electronic tools mediate student action. My study examines how student tool use and the special features of the presentational tools *Prezi* and *PowerPoint* mediate eighth-grade students' actions when researching in a school library during two Earth Science class assignments. The following chapter outlines and explains how I captured and analyzed the participating eighth-grade students' actions. I prefaced this with my reasoning for selecting a qualitative research study design, which set the stage for a detailed description of the research site and participants, my techniques for gathering data, and a description of the procedures for data collecting, coding, and analysis. The section concludes with a discussion of my role as a researcher, as well as the trustworthiness and limitations of the study.

Rationale for a Qualitative Study

Vygotsky's (1987) work was a foundational element that informed my decision on to select a qualitative study design. Vygotsky argued that an individual constructs an understanding of the social and cultural world with their personal experiences, tool use, and interactions with others while thinking about those experiences. An individual's personal experiences are constructed in a social and historical environment when appropriating tools that mediate their actions. As noted by Smagorinsky (2011), "The appropriate unit of analysis for the study of development of human consciousness is volitional, goal-directed, tool-mediated action in a social context" (p. 250). Creswell (2007) states that qualitative research study designs afford researchers the opportunity to tease out any patterns in participants' beliefs and actions. The intent of my study was to discover if any patterns emerged when eighth-grade students use a variety of tools including *Prezi* and *PowerPoint* for a class assignment.

My research inquiry was to gain an understanding of what Creswell (2007) defines as a, "cultural-sharing group" (p. 14), which in this case, was a group of eighth-grade Earth Science students in a particular school setting. Kuhlthau (2004) encourages additional research with more diverse library groups, such as middle school students. My study offers another dimension to the literature by focusing on middle school students, who have been sorely overlooked. I focused on how the special features of the presentational tools *Prezi* and *PowerPoint* mediate student actions. Creswell argues that a qualitative study design is appropriate for gathering rich, thick data for a study such as this. He continues by suggesting that this type of data collecting requires the use of detailed field notes and memoing, interview transcripts, observations, and the collection

of artifacts throughout the study. Understandably, the study's findings cannot be generalized because of the situated environment and the participants. However, the findings will be of interest to the library field by adding to the ongoing discussion of how tools mediate student actions in a school library arena.

Research site. The Knoxville Area School District (KASD) is a suburban community located in south central Pennsylvania (all names and locations are pseudonyms). KASD covers 43 square miles that includes Bussey and Chariton Townships and the boroughs of Knoxville and Newton. The student population of 4,243 is 85% White, 8% Hispanic, 4% African American, 3% Asian, and .2% mixed heritage, reflecting the diversity of the area. Of the overall district population, 8% is below the poverty level, and 38% percent of the student population receives free or reduced lunches. KASD has four K-4 elementary buildings, one middle school (KMS), and one high school. KMS is the facility for grades 5 to 8 and has a student population of 1,268 as well as 87 faculty and numerous support staff. Students with an IEP make up 8% of KMS building population.

KMS met their Adequate Yearly Progress (AYP) goals for 2012. The building has consistently met their AYP goals for the last ten years. The attendance rate for the building was 96%. The *Pennsylvania System of School Assessment* (PSSA) scores for 2012 show that 82% of the KMS student body was proficient or advanced in math. Additionally, 75% of the student body was proficient or advanced in reading. The eighth grade's 2012 PSSA math scores placed 90% at proficient or advanced, 89% at proficient or advanced in reading and 72% at proficient or advanced in science. KASD community and faculty have a long history of stability. Many of the community members are

graduates of KASD. The district has a long record of employing graduates as teachers and support staff. Currently, six KMS teachers are former students of mine. Nine district faculty members have children attending KMS. KMS is an ideal site for the current study because of its consistent academic achievement that reflects best instructional practices, as well as the District's motto, "Providing Opportunities to Achieving Success One Student at a Time."

Participants and sampling. To conduct this study, I obtained permission from KASD Superintendent Dr. William Wyler and KMS building principal, Mrs. Mary Norton. The cooperating Earth Science teacher is Mrs. Ruth Cavender. The participants were eighth-grade Earth Science students from Mrs. Cavender's classes. The rationale for my decision to select eighth-grade Earth Science students was threefold. First, the classes were in my building and located near the library. Therefore, these students had been exposed to me as their librarian for four years and were used to me. Many of the students saw me weekly, if not more. If I asked them to be part of a study, they would not be concerned or surprised. In fact, the students were very excited to be involved. I also believed our existing relationship meant these students would give me genuine answers and responses and not what they think I wanted to hear. Second, Mrs. Cavender and I have a good personal and working relationship. In the past, we have created several integrated instructional research units for Earth Science and Language Arts Enrichment classes. Mrs. Cavender and I have also collaborated when working with students on Science Fair projects in the past. Lastly, the Earth Science curriculum has at least four research assignments in place that would work well for my study. Mrs. Cavender and I felt that the Hydrology and the Science final research assignments would be the best fit of

the four assignments. Both assignments have a technology component where the use of *Prezi* or *PowerPoint* was required. The assignment requirements or assessment rubrics need very little modification for the current study. Both assignments included a student oral presentation as the final assignment requirement. The study procedures did not interfere with the delivery of the Earth Science curriculum to all eighth-grade students, as was required by the KASD district.

Instructional context. My aim was to gain an understanding of how student tool use, including presentational programs *Prezi* and *PowerPoint*, mediate student actions when completing an Earth Science assignment. The participants were six 12-14 year old eighth-grade middle school students. Research studies examining tool mediation have largely overlooked this age group. Vygotsky (1987) argues for more studies with students in the transitional age range of 12-16 years old. He reminds us that the journey of human development needs to be explored and not just the mature product. Kuhlthau (2004) recommended investigating this age group, as well. Eighth graders are approximately in the middle of Vygotsky's age range that he describes. I selected *Prezi* and *PowerPoint* presentational programs as the tools to examine in the context of Vygotsky's (1987) theory of tool mediation. KASD is moving towards a paperless environment with the purchase of more computer hardware and software for enhanced community communication, electronic delivery of educational resources, class materials, assignments, and assessments. Electronic and technological tools such as *Prezi* and *PowerPoint* use will only be increasingly prevalent in the students' lives. Thus, by having students use the electronic devices and programs in the classroom, educators are preparing students for life beyond graduation.

As a part of this transition towards a paperless environment, KASD teachers and librarians have instructed students on how to use graphic organizers, *Word*, *Publisher*, *NoodleTools*, *Prezi* and *PowerPoint* programs for their class assignments. Instruction in the elementary classrooms and libraries, and computer classes on how to use graphic organizers, *Word*, *Publisher*, *NoodleTools*, and *PowerPoint* occurred in fourth through seventh grades. Teachers introduced *Prezi* to students during their eighth grade Language Arts and Earth Science classes. A brief review of both *Prezi* and *PowerPoint* is part of each research unit's introduction. Handouts and instruction guides on how to use the two programs are also available for the students at all times. As I noted earlier, there are very few studies examine how *Prezi* or *PowerPoint* mediate student actions. By doing so in this study, teachers and librarians will gain further insight into how electronic tools could possibly mediate student actions in the classroom and library. These newly gained insights add to the teachers and librarians' instructional toolkit for future planning and curriculum delivery.

I approached twelve eighth-grade students to ask if they would be interested in being part of the study. I based the student selection on the previous experiences Mrs. Cavender and I had with these students when they were in seventh grade. The students were eager participant in a project in seventh grade. I hoped that they would be just as willing to be part of this study. The individual student selection criterion was who returned their completed consent forms first. The quick form return was an indicator to me that the students wanted to be part of the study. My goal was to recruit three boys and three girls because Smith and Wilhelm (2009) highlight studies that identified achievement differences between males and females brains.

I scheduled the study for the second semester of the 2014-15 academic school year. The Hydrology unit is normally the first unit in February and the Science Final is the last unit in the school year, usually in the end of April, or the beginning of May. Each research assignment allowed for five days in the library to work and complete the project. Students presented their projects to the class over the three days directly following the library workdays. Both research assignments allowed the students to choose either *Prezi*, or *PowerPoint* as the presentational tool for their project. However, students who were participating in the study were required to use *Prezi* for one assignment and *PowerPoint* for the other. The students self-selected one of the six computers where the IT department had installed *Screencast-O-Matic* (SOM) an online screen-recording program that the students used to record their screencasts and dialogue. To teach students how to use SOM, I demonstrated SOM with the example of how to locate a book on the OPAC. The student participants used the same computers for both assignments. Figure 1 outlines the timeline for gathering, transcribing, and analyzing data during the study.

Figure 1
Study Data Gathering and Work Timeline

February	March/April	May	June
Chesapeake Bay Critters Assignment Data Gathering	Transcribing and Analyzing	Science Final Assignment Data Gathering	Transcribing and Analyzing

Earth science assignment descriptions. The first research project assignment was on Chesapeake Bay Critters. Students selected an organism that lives in the Chesapeake Bay estuary. Students received very detailed instructions and subtopics for their research focus. At the conclusion of the project, students were expected to be knowledgeable about their topic. The final product was an oral presentation to their

class. The directions gave students a choice of a *Prezi*, *PowerPoint*, or website for their oral presentation. The assignment details, grading rubric, and graphic organizer for this assignment are located in Appendix A. As noted earlier, the participating students limited their selection to either a *Prezi* or *PowerPoint*.

The second research project assignment was the last Earth Science project of the school year, titled, Science Final. The students had the option of the taking a multiple-choice test or creating presentation on an earth science topic of their choice. Unlike the Chesapeake Bay Critters project where the assignment instructions provided the research topics, for the Science Final assignment the students created their own research questions or topics to guide their work. The Science Final assignment had four requirements: a student self-selected Earth Science topic, a five minute, or longer oral presentation, a multimedia element such as video clip, and minimum of five sources in the works consulted. Other than the four requirements, there were no limitations on what the students could present. The student-directed topic and research was the foundation for the assignment. During the interview with Mrs. Cavender, the science teacher stated that the assignment design's intent was to allow for student choice and decision-making. Similar to the Chesapeake Bay Critters project, students may use a *Prezi* or *PowerPoint* as the presentation component for their class presentation. However, the participating students were required to select the presentation tool that they did not use in the Chesapeake Bay Critters assignment. Assignment details and grading rubric for the Science Final assignment are located in Appendix B.

Informants. The intent of the study was to document the students' actions during two Earth Science instructional research units. My research question was how the use of

presentational software tools mediates adolescents' approaches to conducting research to answer an informational need for an Earth Science class. In terms of the participants, my goal was to have a sampling of three boys and three girls as key informants in the class. I recruited from a group of students that Mr. Cavender and I had worked with when the students were in seventh grade. The students who expressed a willingness to be part of the study I used their first semester Earth Science grades and their seventh grade PSSA Science Scores to make a final selection. Using the students' scores made sure I have a range of student academic abilities with no special requirements that I was seeking for the study. All six students participated in the study for Assignment 1. However, one student opted to take the multiple-choice test and therefore did not participate in Assignment 2.

Data Sources

I collected interview and observational data from each student as well as relevant artifacts throughout the study. The following are the data sources that I used for data collecting.

Semi-structured interviews. Prior to the first Earth Science instructional unit, I interviewed participant about their technology use and prior experiences. At this point, participants completed a short survey on their technology use. The student technology survey is located in Appendix C. I wanted to establish a benchmark of each student's technological abilities and understandings. The survey was not intended to gather quantitative data but rather act as an interview and conversation starter or icebreaker for the students and myself. Hesse-Biber and Leavy (2011) described interviews as a conversation between the researcher and the participant that focuses on a particular topic but allows for latitude in the discussion for change. Keeping in mind Vygotsky's (1987)

transitional stage that the students were in, I expected that some of the students needed to be challenged to think beyond what they have experienced in the past. I gently nudged student participants for their answers and thoughts, by using age appropriate, open-ended questions such as, “what made you think that?” or “tell me more about that comment.” The vocabulary used in the interviews did not have any jargon or unfamiliar language and were appropriate for middle school students. My experience with this age group has been that they are willing to share thoughts and ideas, as well as answer questions thoughtfully and honestly. I followed the path the students wished to take during the discussions while keeping the interview on track. At the conclusion of the second Earth Science instructional unit, the participants took the survey same once again. The goal was to have additional data on the student’s technology use and actions that may have appeared during the course of the instructional units. Suggested questions for the interview protocols are located in Appendix D.

Stimulated recall interviews. In order to obtain the data that describes possible tool mediation I used stimulated recall interviews to collect varied responses from the students. DiPardo (1994) describes stimulated recall interviews as a flexible process that allows participants to read, review, and reflect in more detail on a lived experience. Student reflection on their thinking and actions allows them to evaluate, with the hope of revealing more details on what they did and thought. To obtain the transcripts for the stimulated recall interviews, the students recorded their computer screen moves and their dialogue using SOM as they worked on the two class assignments. At the conclusion of each SOM recording, I transcribed the students’ SOM dialogues. Later, the students read the transcripts and we watched and discussed the SOM recordings together during the

stimulated recall interviews. I interviewed each student twice. The first interview was at the conclusion of the Chesapeake Bay Critters assignment and the second interview at the conclusion of the Science Final. During the stimulated recall interviews, I used the suggested questions documented in Appendix D. I had the students respond and reflect on what they said and did while working on the class assignments. I audiotaped both student interviews. Each interview took about 20-25 minutes. The audiotaping gave me an accurate and complete recording of the student's dialogue, meaning I did not have to rely on my memory for details. Audiotaping and speaking into a recorder was a new experience for the participating students and they were a bit nervous. To compensate for any nervousness, I started each interview with a practice question: "what is your favorite part of being in eighth grade as compared to seventh grade?" The exercise gave each student an example of how the interviews would work and how they sounded on a tape recorder before starting the actual interview.

Field notes of observations. During the student's five-day research period in the library, I observed and recorded field notes on three specific areas: student interactions and movements, technology and resource use, and students' interactions with the teacher or librarian. Purcell-Gates (2011) and Creswell and Miller (2000) note that field notes are thick, rich, and detailed accounts that are part of the foundation of a qualitative study because they document participants' behaviors as they are happening. No one reading a successful field note account should have any difficulty in creating a mental picture of the events. Observing and taking field notes add another dimension to the student dialogues. The student dialogue allowed me to hear what the students were saying whereas the observation and field notes documented their physical actions, such body language,

conversations, and resources used, that might not appear in the audiotapes. Capturing these elements complemented and created a complete picture of the students' actions. In addition, this type of data provided additional documentation and support for what the students may say in their dialogues. I reviewed and reflected on my descriptions with analytic memos and I conferred with Mrs. Cavender to gain another perspective for accuracy on what I have documented.

The library facility has an area that is a natural location for the participating students to work. There is small side wing of the computer lab area where students can work undisturbed. Along with Mrs. Cavender, I reviewed the library-computer lab area and felt this was the best location for the students as they would not be isolated from the rest of the class or the library, but they would have minimal noise disruptions from the rest of the library. I chose this particular area because the students could work, and record their dialogue while I could observe and not disturb the rest of the class. I was able to place myself in a location where I could observe, take notes, and still assist all students during the project. Because the students are used to me being in close proximity, my presence did not distract them.

In the three areas where I observed and took notes, I had specific criteria for each area. When I was watching student interactions, I looked for whom the student spoke to, what the topic was, and details of the conversation related to any possible assistance with technology. For example, a participating student may ask for clarification about the assignment or how their classmates tackled the assignment. I also included the number of times the students interacted with their classmates and where they sat to work.

Vygotsky (1987) argues that oral language and collaboration is an important mediator of

human actions. It is as he says, “The word serves as means of interaction and mutual understanding between the child and the adult” (p. 145).

The student’s technology and resources used was a critical piece of data that needed to be collected for analysis. How technology, in particular, *Prezi* and *PowerPoint*, mediates student action is the study’s foundation. I paid close attention to how the student’s used *Prezi* and *PowerPoint*’s special features as they worked to complete the class assignment. However, I noted in detail all types of technology and resource use. Vygotsky (1987) argues that all types of tools: psychological, material, and human mediate individual’s behavior in a specific social context. Vygotsky (1987) explains, “The subject uses the sign as a means of directing his intellectual operations. Depending on how the word is used, depending on its functional application, we are able to study how the process of concept formation proceeds and develops” (p. 128). By documenting all types of technology, I added further detail to the picture of my students’ actions. The resources and the information the students selected influence how they used the technology.

The final area where I concentrated my observations and field notes was the student’s access of and interaction with the teacher and librarian. Vygotsky (1987) reminds us that language and discussion is society’s ultimate tool. What teachers and librarians say and discuss with students in the course of their research may possibly mediate student actions. Therefore, I wanted to capture the discussions that transpired between the students and the teacher or librarian. I followed the students when they went to speak to a teacher as to record what their actions were as result of those conversations. This data was another source to analyze for possible examples of tool mediation.

Artifacts. Purcell-Gates (2011) defines artifacts as physical evidence of students' learning and literacy practices. In this study, the student artifacts were electronic, but they still had the capability of demonstrating students' actions. I included students' final products as supporting documentation of the observations and student interviews. I examined, in collaboration with Mrs. Cavender, the students' final products and class presentations. I looked for evidence of how the students effectively used the *Prezi* and *PowerPoint* features to present what they learned about their topic and how the students used the program's features to their advantage. I also examined whether the students met the assignment requirements. Thus, the grading rubrics and class presentations were another component of data relevant to the student's actions.

Class presentations gave additional data on student use of the technology. How does the student maneuvered through the programs as they presented to their classmates was one element that demonstrated technology use and how the technology mediated their actions. Class presentations also gave insights into whether the students were comfortable with the program and if they expanded on the displayed information in the oral presentation. These types of data held possible indicators of how the information from the resources mediated the students' actions. I sifted through this data for information on how does *Prezi* and *PowerPoint* mediate student actions when conducting research for an Earth Science class assignment.

Teacher interviews. At the conclusion of each instructional unit, I interviewed Mrs. Cavender. My objective was to gain another perspective and interpretation from the teacher regarding the students' actions during the research units. Her interviews included her analysis of the students' final products and class presentations. Mrs. Cavender's

comments and reflections served as additional documented support for my observations and the students' interviews. I transcribed the interviews for easy use later as when analyzing the students' interviews and work.

Collection Techniques

I obtained permission from Temple University's Institutional Review Board (IRB) prior to start of the study. The potential participants were under the age of 18, and a vulnerable population according to the IRB regulations. Once the IRB Committee granted permission, I verbally presented the study to the potential participants along with a letter to their parents explaining the study. Students who were interested in participating received a permission and informed consent packet. I additionally offered to parents a follow-up contact, by email or by phone, to answer any questions they may have had, review the paperwork, or discuss the study further. I recruited three girls and three boys for the study.

I received a verbal assent from Mrs. Cavender to be a part of the study. Upon IRB approval, I conducted a face-to-face discussion, and explanation of the study with Mrs. Cavender who then signed the consent forms. The teacher's assent was necessary to plan and design the methodology for the study for the dissertation proposal defense and ultimately submittal to the IRB Committee. The Earth Science instructional unit requirements and assessments were also an important part of the study's methodology. Mrs. Cavender and the participating students selected pseudonyms to protect their confidentiality. I created a bank of pseudonyms for the students to select from to prevent any small connection to the students' identities that could occur with student-created

pseudonyms. I compiled the list of suggested pseudonyms, located in Appendix E with character names from *Tomi dePaola's Mother Goose* (1985).

I transported the audio-files from the school and stored the audio-files on a password-protected computer located outside the KMS building. I transcribed the interviews at my home. The transcribed interviews are stored on the same password-protected computer. The transcribed data and all the paperwork connected to this study are stored in a secure location and destroyed three years after the study.

Data Analysis

Vygotsky (1978) defines the research process as an analysis that reveals dynamic relations and identifies the points that foster and advance human action. It is not neat and tidy, but a glorious muddle that fosters exploration and interpretation. It was my job to find those dynamic relations and give meaning to them. As outlined earlier, I used student stimulated recall interviews, field notes of observations, teacher semi-structured interviews, and student artifacts as my data sources. I examined each data source for instances of tool mediation on student actions. I kept analytic memos throughout the study that will help guide and challenge to me as I attempted to make sense of the data and bring some type of order to this muddle.

I analyzed student work to isolate tool use and actions over two Earth Science instructional units. I divided the analysis by each student, each assignment, and finally across both assignments. The student stimulated recall interviews and screencasts were audiotaped, transcribed, and divided into what Smagorinsky (2011) calls segments or content units. Smith and Strickland (2001) define a content unit or move as “a segment

of discourse designed to make a single point” (p. 150). After reading and segmenting the students’ transcripts, I coded the data according to the tools that mediated students’ thinking and decision-making as they worked on the class assignments. Saldaña (2013) defines codes as terms, phrases, or descriptive sections that capture a salient attribute or action. He notes that codes can summarize data as well as condense it. At the beginning of the study, I compiled a list of possible tools that could mediate student actions. Based on my research questions, I established the four themes that I used to begin my reading and segmenting: content knowledge, previous tool use, resource use, and tool use. As the study progressed, I added or removed themes depending on the students’ actions while working on the class assignments. Within the four initial coding moves, I formulated twenty additional coding moves that segmented the students’ actions even further. The content moves that appear for each subcategory in Table 12 demonstrate the number of times that the move was identified during the analysis. I recognize that my coding only suggests the magnitude of the impact of the use particular on the students’ subsequent actions; however, frequency counts were only readily observable measure I had available. I used the following themes to code the student transcripts.

Stimulated Recall Interviews and Computer Screencasts

Content knowledge. Content knowledge mediates student action as they work to meet an instructional problem. For example, Kinchin and Cabot (2007) explored how dental students’ content knowledge mediated their construction of partial dentures. The content knowledge mediated how the students used that information when making dentures. In the current study, I am seeking to locate similar data. Specifically, how and why students’ content knowledge mediated their actions during their research. Life

experiences and interests included students' outside-of-school experiences or personal interests that prompted their actions when working. For example, "I have been to the Smithsonian. I know they have a remarkable group of fossils." Previous instructional units directed student actions when working on the class assignments, such as "The largest source of runoff is agricultural runoff. Isn't what we talked about before in class?" Topic information both image and text, that encouraged students to explore further their topic. For example, "Because of their dense bone they [common loon] need a long runway. What I am going to do is find a video of a loon taking off."

Previous tool use. Previous tool use mediates students as they work to appropriate new tools. Ho et al. (2011) examined how middle school students' previous tool use mediated their actions as they designed a museum gallery. Their previous use of the museum gallery program mediated their design, captions, and images selected for the project. My aim was to identify the tools that mediated student action and discover how and why this occurred. Students' poor handwriting or spelling motivated them to use spellcheck or electronic note taking. For example, "How do you spell circumstance?" Students use of computer login procedures to access *Destiny*, or *Chrome* that guided their actions when researching. For example, "I'm logging in on the network and going to *Destiny*." Student actions that provoked decisions while conducting research and taking notes on their topic such as, "I decided not to do the three different types of coral reefs. I read in a book there is not much difference." Web evaluation strategies students use to decide on appropriate websites. For example, "I knew it was okay."

Resource use. Students participating in the current study were required to use a variety of resources for their Earth Science class assignments. Rojas-Drummond et al.

(2014) examined how three different types of library resources mediated sixth-grade student actions. The resource format and content, in this case an encyclopedia and magazine mediated how the students' selected the relevant information needed. In the current study, however students were required to use more resources in their projects. I identified how those resources directed student actions and why the students made the decisions that they did. Databases were the subscription electronic resources that supported student actions during their research. For example, "I went to *SIRSDiscoverer* and picked up some information." Google search provided the possible websites or images that influenced student actions in exploring what was available such as, "Let's go back to my Olber's Paradox list. There it is the University of Oregon." Responses or questions from teachers, classmates, or the librarian directed student action while working. For example, "Mrs. K says I have too much text in my slide. I have to make it shorter." Print library collection that students used that aided their decisions in their research such as, "In one of the books, the chapters were like questions. I used them to guide my research." Website content that motivated student action in understanding and selecting details for their projects. For example, "That website was a big help in helping me understand the area."

Tool use. Newell (2009) explored how students used tools to address a less structured problem. The problem forced the students to use a variety of tools and seek help. I identified segments similar to what Newell uncovered that demonstrate student tool use and why the students did what they did when working on the class assignment. The assignment instructions and supporting handouts that guided student actions throughout each project, "I would read and write down stuff that answers the sections on

the graphic organizer.” *NoodleTools* special features provoked negative student actions. For example, “Websites in *NoodleTools* aren’t easy to do.” *NoodleTools* special features that provoked positive student actions such as, “The [annotation] notes [section] were reminders for me. I didn’t have to try to remember what was best for me and which wasn’t.” *PowerPoint*’s special features prompted negative student actions For example, “Oops...I created 80 or more slides.” *PowerPoint* special features prompted positive student actions such as, “I could get everything to work [in *PowerPoint*]. I used pictures that I cropped to fit.” *Prezi*’s special features that motivated negative student actions. For example, “I couldn’t get everything to work [in *Prezi*] like I wanted it to.” *Prezi* special features motivated positive student actions such as, “The transition from slide [in *Prezi*] is smoother and classier looking.” The websites that students consulted encouraged student actions during their research. For example, “Oh *Biokids* from the *University of Michigan.edu* that’s really good maybe we should look at that.”

Field Notes of Observations

Computer moves. Thompson (2012) and Grant and Branch (2005) highlighted computer moves and features that mediated student actions but focused on only one or two features, such as capital letter usage and font size. I examined for additional special features and captured various computer moves students made during their research. The additional computer moves provided evidence of what types of computer features the students used and how those features mediated the students’ actions.

Interactions. Vygotsky (1987) advocated that human discussion and interactions play an important role in tool mediation. He explained that oral language is one of the most important tools that mediate human action. The type of research assignments that

the students conducted during the current study lends themselves well to interactions and discussions with others. Middle school students are social beings and Myers et al. (2009) reflected this behavior in their studies. Purcell-Gates et al. (2007) also described the importance of oral language in students' actions. I documented my students and their classmates' discussion topics. These interactions added another dimension of how oral language mediated their actions.

Physical moves. The physical location of resources and individuals mediate student actions. McDonald et al. (2005) noted how the physical location of an easel and chair mediates the actions of five-year olds. Limberg and Alexandersson (2003) also noted how a library arena and resource location mediates students' actions when conducting research. A library layout is much different from a classroom and documenting where the students sat and moved to use the various resources shed light on how their physical movement mediated their action.

Resource use. The very center of the two instructional units of this study is research. Students were required to use a variety of print and electronic resources to meet the assignment requirements. Grant and Branch (2005) provided examples of the type of tool mediation that resources had on student actions. When documenting resource use, I aimed to record two important facets: first, the resource type and second, how the student used the resource's information to meet the assignments' requirements.

Artifacts

Content knowledge. Content knowledge mediates what types of tools students use to accomplish a task as noted by Darvin (2008). He stated that text format and content mediates what type of tools students use to negotiate a text. Foos and Majid

(2007) also documented how students' information literacy skills mediated their actions when conducting research. The students' who participated in the current study had newly acquired Earth Science content knowledge that mediated their actions. In my analysis, I captured any segments that revealed how the content knowledge mediated the students' delivery of the final project.

Resource use. Resource use mediating student actions was reoccurring theme. Kumpulainen et al. (2014) demonstrated in their study how resource use mediated their students' writing of a school musical. The electronic resource features, delivery, and communication elements mediated the students use and writing. Neo and Neo (2009) investigated how multimedia programs mediated students' action when creating a presentation. The assignment requirements afforded students several options for types of resources: human, electronic, and print. The students in the present study had similar opportunities and access to electronic resources. In parsing the data, I identified the segments that reflected how the electronic resource features mediated the students' actions when working.

Tool use. Students presented their final projects in an electronic format to their classmates. Both Earth Science projects required students to use a presentational program to deliver their assignment. Participating students used a *Prezi* or *PowerPoint* for their class presentation. Ball (2012) investigated how the presentational tool *Prezi* mediated the delivery of a student's research on fibromyalgia. Jacobs (2006) highlighted how the special features of *Instant Messaging* (IM) mediated high school students' decisions and actions. Each program has features that mediate student action. The participating students' presentational programs mediated their actions in a similar

fashion. By examining the students' presentations, I identified how the students used technology to deliver their assignment.

As I read the interviews, I expected additional themes to appear. I made modifications to the descriptions of themes I initially created. My intent was to have these segments begin to assemble a picture that tells a story of how tools mediated my students' actions. For example, if a student used the outlining features in *NoodleTools* to organize their notes, they then can create their slides and use the visual slide sorter to arrange them into the order they want for their presentation.

Semi-structured Teacher Interviews

I audiotaped Mrs. Cavender's interviews. Her interviews have a twofold purpose. First, I used her comments and reflections for the analysis of my initial themes. I kept in mind my initial themes when reviewing her interviews to determine if she noticed the same student actions as I did. The review helped to clarify and solidify the themes and their definitions. I also used Mrs. Cavender's interviews to corroborate that I had coded the segments correctly. Mrs. Cavender's interviews provided another perspective and additional themes or interpretations that I may not have discovered on my own. In turn, I used the new revelations to reanalyze the students' interviews and artifacts. The second purpose of Mrs. Cavender's interview was to evaluate the students' artifacts. The interviews helped me to determine that I had correctly analyzed the students' artifacts for the themes that I identified.

All the segmenting was completed using *Atlas.ti 6.2*, a qualitative data analysis and research computer program. The program allows for easy parsing, moving, comparing, and adding themes as a study moves forward. I am a visual learner and the

colorful visual computer feature aided in my dividing and interpretation of the data. All together, analyzing the various data sources' content gave me a plethora of possibilities that I read, reviewed, and compared on my journey to identifying Vygotsky's points of advancement. Those pieces that I uncovered helped to form a picture that tells a story of how tools mediate my students' actions when conducting research.

Trustworthiness

Creswell and Miller (2000) argue that one of the challenges of a qualitative study is demonstrating that the study is worthwhile. To address this argument, I used a variety of procedures that will help in establishing validity of my work. As suggested by Creswell and Miller, I triangulated my study by using artifacts, peer reviews, and descriptive field notes. In addition, I took into account how I viewed the data and any resulting themes that appeared. In other words, I considered whether my perceptions, the research topic, and participants' perceptions made sense and clearly showed different avenues to the same conclusion.

I shared transcripts and reviewed students' final projects with Mrs. Cavender in order to obtain an additional perspective from another adult and receive critical feedback throughout the study. Mrs. Cavender confirmed what she saw, read, and heard. These ongoing conversations during the study gave me other viewpoints to consider as I reviewed and evaluated the study's progress. An additional outside group of colleagues who gave critical feedback was my dissertation committee members. Their viewpoints of the ongoing study and wisdom helped guide and challenge me as I progressed through the study.

Role of Researcher

Smagorinsky (2011) argues that Vygotsky's theoretical framework has considerable merit for researchers in today's educational arena. However, he advocates for a more expanded view of Vygotsky's work. Smagorinsky describes the changing landscape of how researchers perceive Vygotsky's work and concludes that researchers need to adapt their thinking on how they conduct research. Specifically, researchers need to accept themselves as part of the study and that they are an additional tool that mediates the learning of the students. The idea of a researcher being a part of a study is critical in a study of middle school students conducting research. Researchers influence students' actions and must not be ignored, but rather embraced as part of the study. The instructional units designed for this study address this important element as the teacher and I were actively involved with the students as they completed the assignments. We play a significant role in these students' academic lives. Thus, it made sense that the teacher and I influenced the students' actions. My role in the research project was, as Guba and Lincoln (1994) call it the "passionate participant" (p. 112). I understood that my values, beliefs, actions, and life experiences would influence the students as well as Mrs. Cavender. I recognized that my perceptions and experiences would play a part in my interpretation of the data. The library arena would also influence the students' actions. All of these influences mediated the student, the teacher's, and my actions throughout the course of the study. The data gathered in this study provided an additional insight into how human, print, and electronic tools mediate middle school students' actions when conducting research. The study provided new data for my colleagues and myself to collaborate and plan. I understood that I may not have made a huge impact on

the research field but if my research in some small way added to the discussion, it has been worth it.

Limitations

The current study investigated how tools mediate middle school students' actions when conducting research. Recent studies on tool mediation neglect the middle school age group as a study population. Vygotsky (1987) argues that this age is when researchers should be taking a close look at how tools mediate the actions of individuals who are beginning to mature in conceptual thinking. He reminds by saying, "Only after the age of 12 that the child begins to develop the processes that lead to the formation of concepts and abstract thinking" (Vygotsky, 1987, p. 123). Kuhlthau (2004) and other researchers have recognized that the new electronic resources mediate student actions but are only starting to explore this area. I focused on only two electronic tools, *Prezi* and *PowerPoint*, and their mediating influence on student actions. The study's implications are not generalizable across all middle school students because of the unique group of individuals that participated in the study. The hope is that my study added to the ongoing discussion about tool mediation, information literacy, and middle school age students.

CHAPTER 4: RESULTS

My research question for this study was how library resources and the presentational software tools *Prezi* and *PowerPoint* mediate adolescents' approaches to conducting research in effort to answer an informational need for an Earth Science class. As seen in Table 1 as well as the results of the stimulated recall interviews, in Assignment 1 the tool that most influenced student actions was the assignment requirements. On the other hand, the content knowledge – topic/visual details mediated student actions the most in Assignment 2. I also discovered that although the students displayed commonalities in their actions different mediating tools uniquely influenced each student's actions. Although not necessarily the presentational tools as I had anticipated. However, what is interesting to note is how the various tools did successfully mediate students' actions to meet their informational needs. Through a discussion of the study's findings, I will attempt to illustrate how and what tools mediated the students' actions as they worked to answer two class assignments for an Earth Science class.

Charlie

Charlie is a 14-year old eighth-grade student at KMS. He is a tall, quiet young man with a wicked sense of humor. His twin sisters remarked that Charlie is a great older brother but he does tease them a bit. Charlie's history teacher, Mrs. Carson, shared that Charlie connects his schoolwork to his personal interests to make insightful contributions in class. For example, Charlie shared his interest in the American Civil War by explaining his participation in a Civil War reenactment group to his class. His classmates hold him in high regard and continually seek him out. Mr. Conine, Charlie's math

teacher, noted that Charlie leads by example and gets along with everyone. Charlie mentioned that he enjoys language arts and has an A- in science. However, math is his least favorite subject.

Table 1
Charlie's Assignment 1 Content Moves

Content Knowledge Life Experiences/ Interests	Content Knowledge Previous Instruction	Content Knowledge Topic/Visual Details	Previous Tool Use Handwriting Spelling	Previous Tool Use Login Destiny/ Chrome	Previous Tool Use Notetaking Research	Previous Tool Use Web Evaluation	Resource Use Databases	Resource Use Google	Resource Use Human/ Verbal
0 -	0 -	25 .18	3 .02	1 .01	1 .01	0 -	2 .01	2 .01	1 .01

Resource Use Print Collection	Resource Use Websites	Tool Use Assignment Requirements	Tool Use NoodleTools Negatives	Tool Use NoodleTools Positives	Tool Use PowerPoint Negatives	Tool Use PowerPoint Positives	Tool Use Prezi Negatives	Tool Use Prezi Positives	Tool Use Websites
0 -	5 .04	32 .23	0 -	6 .04	0 -	9 .06	32 .23	18 .13	3 .02

Assignment 1. As Table 1 revealed, the assignment requirements was the overriding tool that mediated Charlie's actions. Of Charlie's total moves while researching, 23% were from this category. He also had the lowest number of moves made as compared to the other students in the same category. Charlie did use a unique set of tools. For example, 23% of his content moves were in *Prezi* negatives category and 18% were in the topic/visual detail category. In addition, with April, Hector, Jerry, Lucy, and Mary, the assignment requirements also contained their highest number of content moves. However, beyond the assignment requirements category each student had his or her own distinct actions and tool use.

The actions Charlie took to begin the project were very similar to that of the other students. The verbal assignment instructions prompted Charlie to reread the assignment handouts. I noticed he pondered for several minutes before starting to work. He admitted to me that he was brainstorming how he wanted his presentation to go and where he would start looking for information. Charlie explained, "I was thinking about

where I could start and where I could go for information.” The assignment requirements motivated Charlie to read and keep circling back to the handouts. Purcell-Gates et al. (2007) explain that explicit assignment requirements focus and guide student actions – precisely what occurred with Charlie. I observed him on several occasions double-checking the assignment requirements as he worked. The requirements prompted Charlie to reflect on and carefully examine his work as he completed each part of the assignment. His final action before finishing his presentation was to double-check his *Prezi* content against the assignment requirements and scoring rubric.

The assignment requirements encouraged Charlie to take up tools that he had used in the past. After rereading the assignment requirements, Charlie decided how he was going to attack the assignment. He logged onto the network, opened up *Destiny*, and signed on to *NoodleTools*. The assignment directions prompted Charlie to access the *Destiny* homepage for the suggested websites and the *NoodleTools* login screen. His actions eliminated the need for typing or remembering the URLs. Charlie shared with me he believes his organization is better when using *NoodleTools*: “I personally think I am better organized in *NoodleTools* than on paper.” As an example, the assignment required eight subtopics of information related to Charlie’s topic, the common loon. I noticed Charlie using the subtopics from the assignment handouts to label his notes in *NoodleTools*. Each time Charlie created a notecard he typed a subtopic that he decided fit the information he discovered. He used the required eight subtopics as headings in *NoodleTools* to organize his notes. *NoodleTools* has special features that connect assignment subtopic headings to notes and resources. Information about the resources can be used later to create a bibliography or works consulted. A works consulted was

another requirement of the assignment and this requirement provoked Charlie to use *NoodleTools* citation feature. The grading rubric from the assignment requirements on the other hand, encouraged Charlie to evaluate his project by comparing his work to the scoring guidelines. These are examples of what Grant and Branch (2005) describe as computer-driven tools, such as the notetaking fields, that aid students in their work. The program's special features prompted students' decision-making and reflection on how they would approach the assignment.

Charlie disliked his handwriting so much that typing his notes in *NoodleTools* was, in his opinion a better option. His actions support what Thompson (2012) notes in his study that computer programs such as *Word* remove barriers to writing by allowing the individual to focus on the written content instead of their handwriting technique. Typing also eliminated the possibility of Charlie misinterpreting or misplacing his notes. The notetaking fields in *NoodleTools* provide a space for typing the needed information for each of the required eight subtopics. Again, the assignment requirements guided Charlie to reflect and decide to use the special features in *NoodleTools*.

Another special feature of *NoodleTools* is that it is web-based and available 24/7. Charlie remarked, "I can access it from home. So, if I wanted to work from home I could." The 24/7 feature expanded Charlie's options and allowed him to work outside the school day, encouraging him to meet the assignment's due date. Kumpulainen et al. (2014) highlight similar positive student reactions to not being limited to working during the school day.

The assignment requirements provided Charlie with resources as a starting point for his research. Initially, I suggested three websites as a starting place to locate

information. Foo and Majid (2007) describe teacher guidance such as website recommendations as one of the many tools that encourage student actions. During our interview, Charlie stated he started with the first website suggested in the opening directions. He explained, “I went on the *Chesapeake Bay Project*.” As with past assignments, websites hyperlinks for assignments are located on *Destiny*. The teacher and librarian’s verbal directions that Foo and Majid describe as coaching, directed Charlie’s actions to begin with those websites with the understanding the students were not limited to those three. Later on, a verbal recommendation from a classmate of a fourth website, “*All About Birds*” motivated Charlie to explore and evaluate what this website had to offer. There, he discovered new information that was not available on the other three websites. The verbal recommendation prompted Charlie to examine a new website. In addition, the new topic details encouraged Charlie to reevaluate his presentation and include what he had found.

The assignment requirements had one subtopic titled “Interesting Facts.” The “Interesting Facts” subtopic allowed the students to include unique or unusual information that did not fall into the other seven subtopics. The “Interesting Facts” subtopic was included to encourage student to expand their research and add information beyond the basic requirements. Charlie admitted the fourth website provided hyperlinks to the birdcalls, which gave him the idea to add this to his presentation. He explained, “I made sure I could get the “All About Birds” website in for my presentation for the loon calls.” The special birdcall hyperlinks located on the “All About Birds” prompted Charlie to decide to include a recording of the loon’s call as part of his presentation to the class. The requirements did not specifically require examples of birdcalls, but Charlie

believed the birdcall was interesting enough to include it in the “Interesting Facts” subtopic frame. Charlie wanted to broaden his presentation beyond just images and text. In his opinion, the idea of including the birdcalls was an added touch. Charlie’s actions support Neo and Neo’s (2009) description of how ideas and interests motivate individuals to use tools to demonstrate their original thoughts and creativity.

The presentation tool Charlie selected for his assignment was *Prezi*. The assignment requirements offered students a choice of *Prezi* or *PowerPoint*. After much deliberation, the assignment requirements prompted Charlie to evaluate the presentational tools and choose *Prezi* for his presentation. As he said in his screencast, he did not like *Prezi*: “I will be doing a *Prezi* well because I really want to get this over [with].” Of Charlie’s total moves, 23% were in the *Prezi* negatives category. Charlie wanted to get the *Prezi* requirement over with so he could use *PowerPoint* for his later project. The special features of *Prezi*, such as zoom in and out contributed to his negative perception of the tool. Charlie successfully used the zoom feature in his comparison of the cormorant and common loon in his presentation. However, he was not comfortable with it and said so during his interview. Charlie remarked, “Even when I was presenting, I felt like I was all over the place.” Smagorinsky (2011) reminds us that not every individual “takes up and makes use of” (p. 32) tools in the learning process. Charlie used *Prezi* because he was required to.

Charlie felt he was fiddling with *Prezi*’s special features instead of concentrating on the content. Though he tolerated using the *Prezi*, he felt he could not get the program to do what he wanted for his presentation. His struggles are examples of Smagorinsky’s (2011) five levels of tool appropriation that individuals move through as they learn to

master cultural tools. For example, Charlie wanted to include a link to the loon call but his limited experience with *Prezi* rendered him unable to do so. Therefore, his basic *Prezi* tool use prompted him instead to employ tools that he was far more capable of using in order to adapt his presentation. Wang and Turner (2006) remind us that technology is not always foolproof and to expect problems such as what Charlie experienced. The technological barriers encouraged Charlie to reflect and problem-solve to overcome the challenges that he faced. To resolve the problem of having access to the loon call during his presentation Charlie opened a second *Chrome* tab with the loon call hyperlink. He then switched back and forth between the windows during the presentation. Charlie remarked, “I had to go outside the *Prezi* for the loon call.” The problem of accessing the loon call hyperlink encouraged Charlie to problem-solve whereas *NoodleTools* citation fields prompted him to evaluate his website credentials to create his works consulted.

Charlie discovered on “All About Birds” that a common loon needs considerable water space and length to take off. The interesting information encouraged Charlie to reflect and search for a video clip of a loon taking off. Charlie felt the takeoff information was important enough to include as part of his presentation under “Interesting Facts.” However, he was unable to locate such a clip. The inability to locate a video clip provoked Charlie to reevaluate and amend his *Prezi* frame. He commented, “I could not find a way to put in a video of a loon taking off.” Charlie returned to his notes and reread what he had written about loons taking off. The lack of a tool such as a video clip directed Charlie back to his notes, which he then used to describe in detail to the class how a loon takes off. The lack of a video clip prompted Charlie to evaluate and

problem-solve regarding how he would share the takeoff information with his class. His topic details also prompted Charlie to explain to his classmates the length a loon needs to take off whereas the inability to embed the loon call link in his *Prezi* prompted Charlie to problem-solve to overcome the barrier. Wang and Turner (2006) note that problem-solving directs individuals into continually to reflect, review, and amend to demonstrate their new learning.

The assignment requirements, topic/visual details, *Prezi* negative features, and positive special features categories mediated Charlie's actions and behaviors. Of course, Charlie would not have done what he did in his presentation if it were not for the assignment's requirements. However, the assignment requirements also influenced Charlie to use the topic/visual details and explore for new information beyond the assignment's requirements. Topic/visual details category reflected 18% of Charlie's moves. For example, Charlie discovered information about how the cormorant is commonly mistaken for a common loon. He explained, "It [website] said you could possibly mistake a double-crested cormorant for a common loon." Charlie found the identification error interesting and believed it would add another dimension to his *Prezi*. Charlie's interest encouraged him to evaluate and expand his presentation beyond the basic eight requirements by adding a comparison frame. He created a side-by-side frame that displayed both birds. During his presentation, Charlie enlarged the photos to point out the differences to the class. Another interesting idea that prompted Charlie to go beyond the assignment requirements was the birdcall hyperlinks that he discovered. The birdcall link idea encouraged him to include the loon call as part of his presentation. Neo

and Neo (2009) suggest that high interest in a topic, such as what Charlie experienced, encourages students to seek out new information beyond the required elements.

Charlie's negative experiences of *Prezi* tool use motivated him to seek other tools in order to meet the assignment requirements. For example, despite disliking the zoom in and out feature Charlie was able to get it to work for his comparison of the loon and cormorant. On the other hand, Charlie was not able to embed the birdcall hyperlinks in the *Prezi* frames. He said, "I did get pictures in but I never did get the sound to work." The inability to get the birdcall link into the slide provoked Charlie to reevaluate his *Prezi*. He overcame the obstacle by opening up a second *Chrome* tab for the birdcall hyperlinks. Another obstacle Charlie faced was the inability to locate a video clip of a loon taking off. The lack of a video clip motivated him to reread and delve further into his notes. He carefully reviewed how the loon takes off and explained it in detail during his presentation. Charlie remarked, "So I had to explain it [loon taking off] to the class." Wang and Turner (2006) suggest that individuals' evaluation of information promotes decision-making and problem-solving. Charlie's reflection encouraged his thinking and decision-making so that he could clearly articulate to his class how a loon takes off. Charlie's disappointing experiences using *Prezi* confirmed and strengthened his dislike of *Prezi*. However, both the positive and negative *Prezi* tool use encouraged a deeper engagement with other tools such as the topic/visual details that Charlie did use and ultimately fostered his critical thinking. In the next section, a different set of tools mediated Charlie's actions for the second assignment.

Assignment 2. As Table 2 revealed, a different set of tools mediated Charlie's actions in Assignment 2 as compared to Assignment 1. For example, in Assignment 1,

23% of Charlie's actions were attributed to the assignment requirements, whereas in Assignment 2, only 5% were noted in the same category. Instead, in Assignment 2, Charlie's highest number of content moves appeared in the notetaking/research category at 32%. As in Assignment 1, in Assignment 2, Charlie also made use of other tools that mediated his actions. His second highest percentage of moves was in website resource category at 14%, followed by the topic/visual details category and life experiences/interests category.

Table 2
Charlie's Assignment 2 Content Moves

Content Knowledge Life Experiences/Interests	Content Knowledge Previous Instruction	Content Knowledge Topic/Visual Details	Previous Tool Use Handwriting Spelling	Previous Tool Use Login Destiny/Chrome	Previous Tool Use Notetaking Research	Previous Tool Use Web Evaluation	Resource Use Databases	Resource Use Google	Resource Use Human/Verbal
18 .10	1 .01	22 .13	6 .04	2 .01	56 .32	0 -	2 .01	3 .02	1 .01

Resource Use Print Collection	Resource Use Websites	Tool Use Assignment Requirements	Tool Use NoodleTools Negatives	Tool Use NoodleTools Positives	Tool Use PowerPoint Negatives	Tool Use PowerPoint Positives	Tool Use Prezi Negatives	Tool Use Prezi Positives	Tool Use Websites
7 .04	24 .14	9 .05	0 -	5 .03	0 -	0 -	1 .01	0 -	13 .08

I noticed that Charlie followed a similar pattern as the other students when starting the assignment. He listened to the directions, reread the handout, and paused to reflect and decide how he wanted to create his presentation. Charlie did not hesitate on his decision to design a presentation instead of taking a multiple-choice test. Of Charlie's moves, 10% were in the life/experiences category. He had the highest percentage in this category among all five students. Charlie selected fossils as his topic, sharing with me, "I've always been interested in fossils." Charlie's personal interest motivated him in his selection of his topic. Thompson (2012) notes how personal interests and prior life experiences encourage individuals to select research topics. The assignment requirements encouraged Charlie to decide to create a presentation, whereas the Earth

Science topic requirement directed him to evaluate and adapt his topic. I noticed similar actions in Lucy, April, Hector, and Jerry. Charlie's topic did pose a challenge on what he wanted to present to his audience. The topic of fossils relates more closely to biology than to earth science. Charlie said, "I would like to have done prehistoric life but that was considered biology. So I had to go with paleontology." Charlie's personal interest in fossils motivated him to reflect, evaluate, and decide how to investigate his topic and still meet the science final topic requirement.

The parameters of the paleontology field prompted Charlie carefully to evaluate how he would approach his topic. Of Charlie's content moves, 32% were in the notetaking/research category, the highest for Assignment 2. Charlie initially planned to discuss the different types of fossils and their locations in the world. During the interview, he reflected on what he was thinking of presenting to his class, "I would like to tell about the different kinds of fossils." Vygotsky (1987) argues that an individual's interest in a topic is a motivating factor that contributes to their mental growth. He continues by saying an individual's interest encourages increased decision-making and problem-solving. Charlie's interest in fossils prompted him to reflect and decide what he planned to share in his presentation. However, the requirements motivated his decision-making to focus his presentation in paleontology instead of biology.

I noticed that Charlie located several print resources from the library collection. He took notes in *NoodleTools* on some information from the titles that he found. Charlie used *NoodleTools* for notetaking as he did in Assignment 1. He remarked, "The books were helpful. I found the different types and definitions." Charlie's previously held ideas about his topic promoted him to explore the print collection for information.

McDonald et al. (2005) stress that cultural beliefs and practices mediate an individual's actions. Charlie relied on cultural tools such as the print library collection that have served him well in the past to start his research. During the interview Charlie said, "They [books] were very worthwhile. That is where I got my first ten facts." I noticed during class that Charlie did not need any reminders about exploring what was available in the library nonfiction section. He reviewed a cart of books and then went straight to the library collection. The nonfiction section encouraged Charlie to browse, evaluate, and select resources that he believed were useful for his topic. He found what he needed on his own, whereas the other students needed a verbal nudge towards the print library collection.

After Charlie reviewed all of the available print resources on his topic, he moved onto searching the World Wide Web. Of Charlie's moves, 14% were in website use category. The other students' content moves in this category were not as high as Charlie's. I noticed that he started by searching the Smithsonian Institute website. When questioned about his choice he replied, "I have been to the Smithsonian and they have a remarkable collection of fossils." Charlie's life experiences therefore, encouraged him to start with a museum website. Charlie added, "I thought it would be a good place to start." Van Aalst et al. (2007) note that their students prefer web-based resources because they are easy to use. Once Charlie had exhausted all his options with library books, he moved onto web-based resources. Easy access to the Smithsonian website and his positive experiences at the museum influenced Charlie to decide to begin there.

What Charlie discovered on the Smithsonian website challenged his thinking. He did not have the results that he had hoped he would find. Charlie paused and read over

the screen's content. When I asked about this, he said, "The website looks like it has a lot but not what I wanted." Charlie continued by noting, "I kept finding stuff about biology and not the paleontology fossil topic. That is not what I wanted." Finally, in frustration, he paused and reflected for a few minutes, and then amended his search terms. Charlie said during the interview, "There [pointing at the screen] is where I changed to the types of fossils and location." Based on his lack of success, Charlie had decided that his search term "fossils" was too broad. He changed his term to "fossil and location" in hopes of better results. He remarked on the success of this change, "I switched to type and location, and did better." McDonald et al. (2005) and Kuhlthau (2004) document how emotions mediated student actions. Emotions influence how students address the situation they were facing. Charlie's lack of success frustrated him and prompted him to stop and reflect on what terms he was using. In the end, Charlie changed his search terminology.

I observed in the screencast that as Charlie explored different sources, depending on what he discovered, his presentation content evolved. The topic/visual details category influenced 13% of Charlie's moves. Spires et al. (2012) note that student created research questions encourage student reflection by evaluating the newly found content against their research questions and expectations. Newell (2009) adds to the conversation by including that a less structured problem encourages self-reflection and decision-making on the part of the individuals. As an example, Charlie discovered the La Brea Tar Pits when searching. He shared with me that this was unexpected and very interesting. Based on his discovery, Charlie added several slides and a video about the tar pits. The La Brea Tar Pits Museum website provided information that helped Charlie.

He said, “The website was a big help in helping me understand the fossils that were found there.” The website content information prompted Charlie to reflect and amend his ideas for his presentation to include what he discovered about the tar pits. The topic/visual details also encouraged Charlie to reflect and amend his presentation, while his interest in the topic provoked him to evaluate how to use the video to his advantage. Grant and Branch (2005) note similar actions in their study where participants reflected on what they read and amended their presentation content. April, Hector, Jerry, and Lucy displayed similar actions while they were researching their topics. The research results encouraged student to reevaluate their research questions and presentation content. I noticed that the content of each students was ever-changing content throughout this assignment.

Charlie’s presentation content continued to evolve as he encountered new information as he worked. The website-tool use category reflected 8% of Charlie’s moves, the highest of all the students in the study for Assignment 2. The websites that Charlie used motivated how he created and adapted his presentation. Purcell-Gates et al. (2007) reported that limitations can be a motivating factor in an individual’s tool use. In their study, a brochure’s small text space encouraged students to reflect on how they wanted to convey their information to their audience. Instead of the size of text box, Charlie’s limitation was his topic given that he had to keep his presentation content within the paleontology field. The limitation prompted him to explore and analyze a wider variety of websites. Early in the assignment, Charlie started with the Smithsonian Museum website but eventually encountered the British Museum and the British Broadcasting Company (BBC). To his delight, both websites had much to offer. For

example, the BBC website had a hyperlink to a website about the La Brea Tar Pits. The information Charlie discovered encouraged him to reevaluate his content and include a new section that he had not previously considered. When I asked how he discovered the two websites, he replied, “The Smithsonian had a link to the British Museum and the BBC.” The hyperlinks on the Smithsonian website motivated Charlie to explore what those hyperlinks had to offer. Here is an example of how Charlie used the special features of a particular website. I noticed later how other special features of the same website did not encourage Charlies’ tool use.

The websites Charlie used also prompted him to think outside the field of paleontology. I noticed Charlie viewing a movie trailer for the new movie *Jurassic World*. I overheard him explain to a classmate that he was considering a how he could use movie and television clips to compare real fossils to the mass media’s depiction of prehistoric life. During his interview, Charlie confirmed this idea by saying: “I want to include a segment on how movies and television distort sizes of prehistoric creatures.” As in Assignment 1, the outside world influenced Charlie’s actions. Meyers et al. (2009) and Newell (2009) point out how a cultural tool such as the movie trailers can influence actions by promoting creativity and problem-solving. The movie trailers that Charlie stumbled upon motivated him to reflect on how he could use the movie’s size misrepresentation of prehistoric animals via their fossils. The topic/visual details encouraged Charlie to evaluate the movie trailer, whereas the *PowerPoint* special features directed Charlie to embed successfully the hyperlinks in a slide. During his presentation, Charlie used this idea to compare and describe the true size of prehistoric life to what the

mass media portrays. Charlie felt this additional section gave a well-rounded view of fossils and paleontology.

Similar to Assignment 1, Charlie did not use some of the web-based special features to his advantage when working on Assignment 2. In the Chesapeake Bay Critters assignment, Charlie did not use the *Prezi* frame within a frame feature. In the Science Final assignment, Charlie also failed to use some web-based features available to him. For instance, located on the left side of the Smithsonian website is a list of related search terms that may have guided Charlie's search for better results. I observed Charlie scrolling through the Smithsonian website and ignoring the hyperlinks that may have aided his research efforts. He also did not use the special related search terms features that were available on the Smithsonian website. Though these related search terms did not motivate Charlie's tool appropriation, the hyperlinks to the British Museum did encourage Charlie to examine what those websites had to offer. Smagorinsky (2011) points out that individuals like Charlie take up and use tools at different levels and times. However, in some cases, there are individuals who do not take up and use cultural tools. Karlström et al. (2007) highlight examples of their medical students not appropriating a computer program's special features. During his interview, I asked why Charlie did not use these available options. Disgustedly, Charlie replied, "Yeah, I didn't see it. I wish I had." Charlie also noted that if he had seen the hyperlinks and used them, he would not have had so much information to wade through. He said, "I still did not see the filter. I could have really brought my list down. It was too much [information]." Newell (2009) highlights how emotions and a less structured problem can hinder an individual's tool use. The amount of information that Charlie discovered overwhelmed him and interfered

with his progress. I observed Charlie ultimately stepping back to reevaluate his situation and eliminate several websites by using a tool for evaluating websites used previously in Assignment 1. Charlie only selected websites that ended in the domain name of .edu or .org.

Charlie faced two vastly different types of assignments: a structured and explicitly detailed assignment and a less structured assignment. Each assignment had its own unique set of tools that mediated Charlie's actions. In Assignment 1, the assignment requirements were the primary mediating force on Charlie, whereas in Assignment 2 it was the notetaking/research tool use. In both assignments, the tools fostered reflection and problem-solving in Charlie. I noticed as Charlie worked his tool appropriation varied. In Assignment 1, the *Prezi* negative special features motivated Charlie to problem-solve and decide how to overcome the barriers that the special features put before him. Charlie employed previously learned tools to solve the challenges he faced as he worked to complete his assignments such as opening a second tab for the needed hyperlinks. In Assignment 2, Charlie's notetaking/research information encouraged him to pause and reflect on how he would use this information. The reflection enabled Charlie to reevaluate and amend what he wanted to share with his audience. I noticed that one tool, the topic/visual details appeared in both assignments. For Charlie the topic/visual detail category was one of the top three most used categories for both assignments. New details that Charlie encountered prompted him to pause and reflect if and how would he use the new information he found. In both assignments, Charlie expanded and amended his content presentation to include what he found. In the end, the

various tools that Charlie used in both assignments motivated his reflection, decision-making, and problem-solving, which in turn fostered his mental growth.

Mary

Mary is a 14-year old eighth-grade student at KMS. She is a pleasant young woman who is an avid reader of mysteries and historical fiction. Mary shared with me once that she loves to try to figure out who committed the crime in her mystery novels before the end of the book. She is a warm and caring individual and her peers constantly seek her out. Mary's language arts teacher, Mrs. Lindell, described Mary as a serious, hardworking student who is not afraid of a challenge. An example is the topic of animal testing that Mary selected for her language arts debate. The topic posed some difficult concepts that she grappled with as Mary persuaded her classmates not to support animal testing. Mary has a B in science and according to her, she is glad for it.

Assignment 1. Similar to Charlie, the assignment requirements primarily prompted Mary's actions in Assignment 1. As Table 3 revealed, all of Mary's content moves 36% were in the assignment requirements category. However, this was below April, Hector, and Lucy's percentages in the same category. Purcell-Gates et al. (2007) notes that explicit directions such as what were in Assignment 1, prompts students by guiding their actions successfully to complete the project. Purcell-Gates et al. also suggest instructions encourage students to focus their writing to meet a specific purpose. Despite the assignment requirements as the primary mediating tool for all students, Mary employed different tools as compared to the others to complete Assignment 1. *NoodleTools* positives, website-tool use, and topic/visual details categories also mediated Mary's actions.

Table 3
Mary's Assignment 1 Content Moves

Content Knowledge Life Experiences/ Interests	Content Knowledge Previous Instruction	Content Knowledge Topic/Visual Details	Previous Tool Use Handwriting Spelling	Previous Tool Use Login Destiny/ Chrome	Previous Tool Use Notetaking Research	Previous Tool Use Web Evaluation	Resource Use Databases	Resource Use Google	Resource Use Human/ Verbal
0 -	2 .01	14 .10	0 -	3 .02	0 -	11 .08	0 -	2 .01	0 -

Resource Use Print Collection	Resource Use Websites	Tool Use Assignment Requirements	Tool Use NoodleTools Negatives	Tool Use NoodleTools Positives	Tool Use PowerPoint Negatives	Tool Use PowerPoint Positives	Tool Use Prezi Negatives	Tool Use Prezi Positives	Tool Use Websites
0 -	10 .07	52 .36	0 -	21 .15	0 -	0 -	4 .03	4 .03	21 .14

Mary started the assignment by listening to the verbal instructions. As she said, “I listened to the teacher and you tell us what the project was about and where to start.” The verbal assignment directions motivated Mary to decide to go straight to the recommended websites and begin to work. Mary admitted she knew what she was doing. She opened up *NoodleTools* and created a new project. As Mary said in the screencast, “Create a new project, we use MLA because that is what we do.” Vygotsky (1987) argue that previous learning experiences aid and enhance an individual’s learning. He suggests that previous educational experiences create an environment where instruction has a mediating influence on an individual’s higher mental processes. Mary created a new project in *NoodleTools* because she knew from the assignment requirements that she would need a works consulted. Mary explained, “I can make my citations for my bibliography. It is easier as I go.” The assignment requirements as well as her previous experiences in creating works consulted provoked her to open *NoodleTools*, the program used to create citations for a works consulted. I observed other students doing a similar process during the project. Smagorinsky (2011) notes that socially accepted practices such as a works consulted play a role in how an individual learns. Individuals learn through interaction with culturally accepted tools that encourage a specific action.

The assignment handouts guided Mary to locate and evaluate the required information that she needed about the black-crested night heron. The graphic organizer, a handout used to take notes, prompted her research by providing the eight required subtopic areas. Mary also used the graphic organizer to record her facts she wanted to use in her presentation. She commented, “The paper was easier because I can read then write. Sometimes going back and forth on the screen I miss stuff.” I noticed that she followed the sequence suggested by the handout. That is, she first located the scientific name of the animal and then moved on the next box labeled “Habitat.” She continued with this procedure throughout her research. The graphic organizer arrangement guided her actions to locate and analyze the required information. In Purcell-Gates et al.’s (2007) study, a procedural guide reflected a similar mediating action, as did the graphic organizer. The graphic organizer sequence also directed Mary to complete each section and use it as a guide. Mary repeated this process with each of the websites. However, she only added new information to her graphic organizer. Mary explained, “I used my class handouts and papers to help me find what I need.” The graphic organizer encouraged Mary systematically to complete each subtopic whereas *NoodleTools* prompted her to create a works consulted.

The assignment requirements motivated Mary when creating her presentation. Throughout her time in the library, Mary repeatedly consulted the assignment requirements. For example, Mary used the subtopics as her headings for each *PowerPoint* slide. She also followed the graphic organizer sequence to put her slides in order. I noticed during the class presentations that many of her classmates did the same thing. Following the graphic organizer sequence encouraged the students not to forget

anything in their presentations. I observed Mary comparing her presentation slides to the rubric. The rubric checklist motivated her to reflect, examine, and compare to make sure that she covered all that was required. After careful evaluation and editing, Mary crossed off each rubric element until she had completely reviewed her presentation and was confident she had addressed all parts of the rubric. Mary mentioned during the interview that she wanted the best grade possible and one way to achieve this was to double-check the rubric. She explained, "I had problems in the past and I wanted to do better. Looking at the rubric helped. I did okay on my presentation." Mary's past presentation experiences encouraged her to use the rubric as a checklist in order to get the best grade possible. Ball (2014) explains that rubrics provide a set of criteria by which the student can gauge their progress and quality of their work. Rubrics act as a guide that encourages student reflection and decision-making. The rubric criteria encouraged Mary to examine each slide's content for the required elements, whereas *NoodleTools* directed Mary to evaluate if she had successfully completed her works consulted.

The assignment requirements directed Mary to use several websites during her research. Of her total moves, 14% were located in the website-tool use category. Mary used the three recommended websites as well as additional websites that she discovered on her own during a Google search. Here is an example of what Smagorinsky (2011) describes as the influence of culturally accepted tools such as Google on a student's behavior. Smagorinsky argues that culturally accepted tools place conditions on an individual's actions that produce an effect on their mental development. Mary browsed, evaluated, and explored many of the websites that the Google search returned. She selected websites, carefully read their content, and double-checked her information

against what she was reading as she searched for new facts. Based on what Mary had recorded in her notes, she eliminated several websites. Mary's notes guided her to evaluate and decide when selecting websites. For example, I observed Mary spending considerable amount of time reading one website. She compared her notes to what she was reading. In the end, she did not use that source, noting in her interview, "I saw the same stuff." Mary skipped facts that she had already previously recorded on her graphic organizer. The topic/visual details motivated Mary to analyze and decide what facts she wanted to include in her notes. The content that Mary recorded in each of the subtopic boxes guided her selection of new facts to add. As noted by Darvin (2008) reading strategies differ depending on the reading need. Mary needed and wanted more information but only new facts. Mary commented, "I needed to find information about the environment. I looked at other websites."

Mary made 10% of her moves in the topic/visual details category, especially to use unexpected and interesting information in her presentation. For example, when searching for the environmental impact on herons, Mary came across information that was not what she was looking for. She discovered how heron fledglings protect themselves by regurgitating on intruders. What she encountered prompted her to read, review, and analyze this new bit of information. Her first thought was how pleased she was with this new fact but upon further reflection, Mary was dismayed. Her initial comment on the screencast was, "Oh wait here is another fact...As I'm writing this, wait that is just gross." Later in her interview, Mary said, "I thought it was gross but then it was good. That it drives the intruders away." The new information that she stumbled upon provoked her to reflect and consider whether to include it as part of her

presentation. The new facts also encouraged Mary to pause and reflect more deeply about what she read previously about the heron's defense. Darvin (2008) explains that reading for information encourages individuals to use reading strategies to locate bits and pieces to meet an informational need. The deeper engagement influenced Mary to include this information in her presentation. She reflected, "Later on, I liked the description and thought it would be useful."

The assignment requirements prompted Mary to use some special features of *NoodleTools* to her advantage as she worked and 15% of her moves were in the *NoodleTools* positive category. Mary had the highest percentage in this category of all the students. As noted earlier, Mary planned to create her citations for her work consulted using *NoodleTools*. I observed that she had little trouble completing the required fields for each citation. She admitted during the interview that she did not have much trouble: "Not really, it depended on what I was looking through and had to cite it. It is getting easier." The citation requirements in *NoodleTools* motivated Mary to use a split screen format and the copy-paste functions to obtain the correct pieces for the citations. Mary carefully examined each citation field and located the appropriate piece of text in the website. She then copied and pasted the text into the correct field. The copy and paste feature removed the chances of misspelling names and URLs, improving Mary's accuracy and ultimately improving her grade on her works consulted. Karlström et al. (2007) has also noted how students used computer program special features to their advantage by identifying and eliminating errors. The special features encouraged students to reflect and revise their writing. Using *NoodleTools* eliminated the need for Mary to remember citation punctuation, a troublesome issue for most students. Mary

remarked, “I like that it puts in the punctuation. I can never remember that.” The topic/visual details motivated Mary to analyze and compare her notes with any new facts she discovered, whereas, the copy and paste feature promoted Mary to examine and reflect on the correct text for the citations.

Mary used a *NoodleTools* special feature that no one else did for Assignment 1. When Mary created her works consulted citations, she made additional notes about each source in an annotation box that is available in *NoodleTools*. The annotation box feature is a field for students to create an annotated works consulted. Mary however adapted that space to hold personal reminders for her about each source that she used in her research. She explained during the interview, “Just if I needed more information, I can remember what the website [source] had and I can go back for more.” She continued by clarifying, “I did not have to remember which [source] was the best and which was not for me.” The special feature availability provoked Mary to adapt and use the space for her own unique need for the project. Similarly, to Karlström et al.’s (2007) findings in which students creatively used the special computer features for their own personalized use. During my observations, I noticed Mary consulting her reminders on at least one occasion while she was working. Her notes prompted her to return to a website for additional research.

The assignment requirements encouraged Mary to use web evaluation tools that she had learned about in previous classes and 8% of her moves were in the web evaluation category. Mary had the highest number of moves in this category of all her classmates for Assignment 1. In previous classes, students had learned how to evaluate website content using a six-item checklist. Mary and her classmates had learned to

examine authority and accuracy, website domains, purpose and content, contact information, revision dates, and ease of use. The most commonly used item from the checklist is the website domain. It is easy for the students to look at the website domain and select websites that have a good chance of having accurate and current information. During the study, I observed many students looking at and commenting to each other on the website domains as they looked over a list of possibilities. Vygotsky (1987) explains that oral discussion is one of the more effective tools available to individuals. Collaborative discussions allow new ideas to emerge and in turn encourage deeper engagement and ultimately mental growth. This was also the case for Mary. I noticed that she listened to the discussions, looked carefully at the domains, and decided to limit her selection to .edu and .org websites. Mary commented, "I knew I was okay with, .edu and .org on this project. I was double-checking as I researched." Spires et al. (2012) noted similar web evaluation techniques in their study. The web evaluation strategies prompt students to reflect and decide as they located information.

Previous instruction also prompted Mary to skip websites that did not have an .edu or .org domain and exploring those that did. The previous instruction on evaluating websites influenced her to skip Wikipedia as a source as well. Vygotsky (1987) argues that individuals need opportunities to practice using cultural tools. Practical application encourages individuals to apply tools in specific learning experiences such as what Mary did with her web evaluations strategies. In her interview, Mary noted how it was not a good idea to rely on the information found on Wikipedia, "Wikipedia stuff can be changed by anyone. I do not want to use stuff that maybe wrong. It is better to skip it." I observed students ignoring Wikipedia and selecting websites that they believed offered

better information. Prior web evaluation instruction guided Mary to evaluate and ignore less reliable websites and select ones that were more promising.

Above all else, the assignment requirements mediated Mary's actions above all. The Chesapeake Bay Critter assignment directions left very little room for student creativity. Only one subtopic, "Interesting Facts" allowed students to be creative about their critter. Mary's classmates demonstrated similar outcomes. The assignment requirements mediated their actions. However, I discovered that Mary used her unique set of tools to develop a presentation with her own personal stamp on it. For example, the *NoodleTools* special features motivated Mary to reflect and decide on how to adapt annotation text boxes for her own personal use. Her creative use allowed Mary to document her website use so that she could return to and reflect on what she had written about each website. The other students did not do this. While working on her project, Mary returned to her notes in *NoodleTools* and discovered facts that were interesting and different enough to include in her presentation. Unusual topic/visual details such as the baby heron's defense mechanisms prompted Mary to reflect and review on how to use them in her presentation, whereas Mary's previous web evaluation instruction encouraged her to be selective in her website use. I noticed the other students did not explore much beyond the recommended websites. Only Lucy and Hector evaluated websites that they found on the World Wide Web. Similarly, to Charlie, Mary's unique tool use fostered her critical thinking, creativity, and mental growth. The Chesapeake Bay Critters assignment was a structured project and therefore it stands to reason why the assignment requirements mediated student actions. However, later in the second assignment Mary's classmates employed a slightly different set of mediating tools. One

of the options in the second assignment for students was the choice of taking a multiple-choice science test or creating a presentation. Mary opted to take the multiple-choice test and withdraw from the study. Therefore, there are no findings to report on Assignment 2 for Mary.

Jerry

Jerry is a 14-old year eighth-grade student at KMS. He is a creative and emerging artist. He shared with his art teacher, Mr. Sederal, that he has an interest in combining his love of art with computer technology. For example, Jerry designed motif of sketches of his classmates using a computer art program. Jerry is not necessarily an outgoing individual but he has a group of friends with similar interests. His other teachers remarked that Jerry contributes in class during discussions but is very content to let someone else speak first. Schoolwork is not a problem for Jerry. He has an A in science and all his other classes as well.

Assignment 1. As Table 4 revealed, Jerry's moves in Assignment 1 mirrored the actions of the other participating students. The assignment requirements category was the most used by Jerry at 27%. Nonetheless, Jerry's moves in this category were the second lowest of the group. Only Charlie's moves in the assignment requirements category was lower. Jerry did use different tools than his classmates while working. Of Jerry's total moves, 21% were in the *Prezi* positives category, the highest of all his classmates. Other categories showing in which Jerry made his moves were *Prezi* negatives, topic/visual details, *NoodleTools* positives, and human/verbal responses. Jerry's tool use motivated him in ways that were uniquely different from his classmates.

Table 4
Jerry's Assignment 1 Content Moves

Content Knowledge Life Experiences/ Interests	Content Knowledge Previous Instruction	Content Knowledge Topic/Visual Details	Previous Tool Use Handwriting Spelling	Previous Tool Use Login Destiny/ Chrome	Previous Tool Use Notetaking Research	Previous Tool Use Web Evaluation	Resource Use Databases	Resource Use Google	Resource Use Human/ Verbal
0 -	3 .03	9 .08	0 -	7 .06	2 .01	0 -	0 -	1 .01	7 .06

Resource Use Print Collection	Resource Use Websites	Tool Use Assignment Requirements	Tool Use NoodleTools Negatives	Tool Use NoodleTools Positives	Tool Use PowerPoint Negatives	Tool Use PowerPoint Positives	Tool Use Prezi Negatives	Tool Use Prezi Positives	Tool Use Websites
0 -	5 .04	32 .27	0 -	8 .07	5 .04	1 .01	12 .10	26 21	2 .01

The assignment requirements motivated Jerry's actions in such that he did not hear the opening directions. I observed that he was so intent on reading the handouts that the teacher had to prod him to begin working. He followed a similar pattern as the other students did in beginning the work. Jerry logged in, and created a split screen – one for *Destiny* and one for *NoodleTools*. I noticed Jerry pausing and glancing at his neighbor's screen before selecting a website from the recommended three. He selected the same website as his neighbor. Jerry's action made sense, given that he was not listening at the beginning of class. Meyers et al. (2009) argue that "tweens" (p. 301) are social in nature and rely on their peers for help. The social interaction with ones' peers aid in developing their social identities. The assignment requirements prompted Jerry to examine closely what his neighbor had on his screen since he did not listen to the opening directions. The classmate's selection provoked Jerry to decide to select the same source.

After opening up the website, I noticed that Jerry referred back to the graphic organizer and studied it for some time. When I questioned him about this, he replied, "I was thinking about the subtopic descriptions. I wanted some ideas before I started to read." Similar to what Ball (2102) suggests subtopic requirements guided Jerry's reading and research. The handouts also acted as an outline that directs to the student's reflection

and decision-making. I observed that Jerry stayed with the suggested websites and did not do any outside searching. He confirmed this during the interview: “I pretty much went to the three websites.” I also noticed that his works slide consulted supported his statement. Jerry did use Google image search for his visuals but he did not use Google to look for any additional information. The assignment requirements did not motivate Jerry to expand his research. However, the requirements did prompted Jerry systematically to follow the instructions. Assignment 1’s requirements were a detailed, point-by-point project that prompted Jerry to reflect and follow the checklist. The type of direction given did not encourage Jerry to expand his research, but rather to do exactly what was required. Another student in the study, Hector followed the same path. Both students followed the basic requirements and went no further. Grant and Branch (2005) noted similar findings in their study. The research paper requirements and contents directed their student actions in creating their human rights displays without adding or expanding the content beyond what was required. On the other hand, Assignment 1 requirements motivated Charlie, April, Lucy, and Mary to explore beyond the basic requirements and include additional facts in their presentations.

Jerry’s reliance on classmates and teachers was apparent throughout Assignment 1. His questions and classmate’s responses directed Jerry’s actions while he worked. His content moves for human/verbal response category of 6% were one of the highest among the six students for Assignment 1. Vygotsky (1987) argues that oral language and discussion is one of the most important tools that society has to offer. Discussion encourages the exchange of thoughts and ideas that promote deeper reflection and engagement on the part of both individuals. Only one other student, Lucy, had a higher

percentage of human/verbal response content moves for the Chesapeake Bay Critters assignment. Lucy and Jerry were in the same class and I noticed that Jerry and Lucy sat near each other while working. While Jerry worked, he turned to Lucy if he had a question. I noticed a related comment from Jerry on the screencast: “I am going to dictionary.com because I do not know how to spell ‘circumstance’ and neither does Lucy.” Lucy’s proximity encouraged Jerry to ask questions and Jerry’s reliance on others kept him on task during the assignment. However, unlike Jerry and Lucy, Hector, Charlie, and Mary did not converse with others during the Chesapeake Bay Critters assignment. Oral discussion motivated Jerry to reflect and ask for help when he needed it, whereas the graphic organizer directed him to reflect and locate just what he needed for the assignment.

Like Charlie, Jerry took notes in *NoodleTools* instead of using the graphic organizer. However, the other four students in the study utilized the graphic organizer for their notetaking. During the interview, Jerry said, “I used *NoodleTools* to create my notes and my bibliography. It is easier.” *NoodleTools* encouraged Jerry to decide to use the program while he worked on the assignment. Kumpulainen et al. (2014) suggests that easy program usage motivates individuals to employ the special features when problem-solving. Jerry appreciated that he could use *NoodleTools* anywhere and not lose his work. He explained, “I do not lose my work. I have had that happen in the past. It was a mess.” Jerry’s negative past experiences positively guided him to utilize the *NoodleTools* notetaking features instead the paper graphic organizers. He did not want to lose his notes and have to start over. Conversely, April was not of the same opinion. She was concerned about losing her notes as well, but wanted them on paper. In a prior

assignment, April recorded her notes in *NoodleTools*, but due to a technology glitch, she lost all of her work. I overheard April say that she was not going to lose her work again. April's and Jerry's negative experiences directed them to reflect and problem-solve on how to record and safeguard their notes. *NoodleTools* notetaking features provoked different actions, emotions, and opinions among different students.

In addition, *NoodleTools*' citation features positively influenced Jerry, as well as the other students. Of Jerry's total moves, 7% occurred in *NoodleTools* positives category, the second highest category for, Assignment 1. Jerry utilized the citation feature to create his works consulted. I noticed Jerry employed the split screen format to locate and evaluate the required items needed for each citation field. He created a citation when he finished taking notes from each website. Jerry remarked, "I can find the parts I need to complete the citation." I observed Jerry using the copy and paste feature, as well, when he made his works consulted. The copy and paste feature prompted Jerry to analyze and select the correct pieces of information from the websites he needed to complete the citation. For example, Jerry reviewed and located the author or responsible organization that produced the website. He copied the name and pasted it into *NoodleTools* filed titled "contributor." The dropdown window prompted Jerry to decide if the name he located was a single author or an editor. Jerry continued this process until he had completed each of the required fields to create the citation. The *NoodleTools* features encouraged Jerry to be accurate with his works consulted because of the expectation for exact information, whereas the assignment requirements only motivated him to complete the project by providing a specific outline. He shared with me, "I do not have to worry about punctuation, what is underlined, and what is not." The other

students had the same opinion. Jerry had very little difficulties with the *NoodleTools* features as compared to the others. Thompson (2012) and Karlström et al. (2007) report similar reactions about special computer features in their studies. Lucy and April admitted that *NoodleTools* was helpful but the websites citations were difficult to complete. Overall, the positive *NoodleTools* content moves reflect that Jerry and his classmates were glad they had access to *NoodleTools* and the special features the program had to offer.

Jerry decided to do a *Prezi* for Assignment 1. The *Prezi* presentation program influenced Jerry positively as compared to the other students and Jerry had the most *Prezi* positive content moves than any other student in the study. Jerry selected the *Prezi* tool it because he believed, the Chesapeake Bay Critters assignment would work better in a *Prezi* than *PowerPoint*. The assignment requirements therefore prompted Jerry to evaluate the subtopics and select *Prezi* for the project. In his opinion, the subtopics lent themselves well to *Prezi*'s special features such as the zoom in and out feature or the frame within frame feature. The student from Ball's (2012) study made a similar decision. *Prezi* had the special features that would meet her expectations for the webtext than other programs. The zoom feature motivated Jerry to reflect and decide clearly on the precise details that he wanted to share with his classmates. He believed that the slide within a slide feature gives more options for adding detail. He commented in the screencast, "I think we need to move to *Prezi* because it gives me more options." When I asked Jerry to expand on this statement, he remarked, "*Prezi* looks better. The transition from one frame to another is smoother and classier looking." Jerry also felt *Prezi*'s availability was greater. The program is free and available on the World Wide Web,

whereas *PowerPoint* is not. Jerry explained, “*PowerPoint* you have to purchase the program.” The 24/7 feature and that it was free motivated Jerry to decide when and where to work on his *Prezi*.

The assignment subtopics prompted Jerry to use the *Prezi* special features when creating his slides. Jerry felt the available options allowed him present his information in far more detail. For example, Jerry created a slide on the American eel’s habitat, a required subtopic. The opening habitat frame had the basic facts about the eel’s ecosystem, but Jerry also included a frame within the main frame that showed more detail, such as the negative impact dams have on the eels’ migration. He said, “I like the way it [frames] looks and how it presents the information.” I observed during Jerry’s presentation that he utilized the frame within the frame feature to narrow the exact amount of detail he provided about the dams. Ball (2102) noted similar results in a student’s webtext. The freedom to place frames within frames encourages students’ deeper engagement with the information, as students have to think about how to display the information. Special features such as frame within a frame, as Grant and Branch (2005) suggest, encourages individuals to reflect on how the audience will perceive the information. Individual reflection prompts problem-solving to decide how to communicate the message. I noticed that other students only employed simple frames with the transitions feature when presenting. Charlie mentioned earlier that because of the movement and transition features, he felt he was all over the place when he was presenting. The *Prezi* transition special feature provoked Charlie and Jerry in different ways. Jerry embraced and used it in his presentation to clarify special information on his topic, whereas Charlie successfully, but begrudgingly used the transition feature.

Jerry shared with me that the *Prezi* frame size guided him into keeping his information concise. The bullet feature prompted Jerry to limit his facts to what he determined to be the most important. He referred to his notes as he created his frames. I asked why he did not use the copy and paste feature. Jerry said, “I took some pretty long notes to use in my *Prezi*. It [typing] keeps me from copying word for word.” Similar to the images, the slide size limitation and bullet features directed Jerry to consider carefully and decide what particular information he wanted to present to his class. On the other hand, the human/verbal response encouraged Jerry to stay on task and complete the project on time. I observed in the class presentations that most students displayed their information using the bullet feature. Kinchin and Cabot (2007) report that special features such as the bullet feature provoke student learning. The limited space encourages students to pause, evaluate, and decide exactly what information they wanted to include.

The Assignment 1 requirements directed Jerry to use the subtopic sequence from the graphic organizer for his frame order. All of the students in the study, as well as the rest of the class, followed the sequence order. Jerry used the zoom in and out feature to make points about certain pieces of information within an image. For example, on his frame about the dams, he zoomed into show the eel ladders explaining, “I have some interesting information about eels that I want to share with my class.” The zoom in and out feature motivated Jerry to reflect on his images and information and decide what was the most important to share with his class. The zoom feature also directed Jerry to analyze and decide what part of the image he wanted to highlight in each particular frame.

Jerry's content topic guided him to review and consider the styles and colors available in the *Prezi* program. Jerry said, "The color I picked thought looked about the color of the eel." Thus, the American eel topic influenced Jerry to evaluate and select the best color and style for his presentation. The assignment requirements provoked Jerry successfully to use the *Prezi* special features to complete his presentation, whereas the websites Jerry used directed him to analyze images that best enhanced his facts on the eel. His reflection on the available colors and styles guided his decision-making. The transition and frame within a frame features encouraged Jerry to problem-solve and plan how he wanted the subtopic information displayed. Finally, the bullet feature prompted him to review and reflect on what was the most important information to include in his presentation. The bullet feature also encouraged Jerry to reflect on his facts in order to compose the text in short but understandable phrases. The tools that Jerry employed for the Chesapeake Bay Critters assignment encouraged him to reflect on what he discovered on the American eel and this deeper engagement fostered mental growth. In the next section, I examined how Jerry used different types of tools in the second assignment.

Assignment 2. As Table 5 revealed Jerry's moves for Assignment 2, I noticed that he had similar tool use to other students in several categories. For example, in Assignment 2, topic/visual details or notetaking/research categories contained either the highest or the second highest number of moves for all five students. Similarly, to April and Hector, Jerry had a high percentage moves – 22% in the topic/visual details category. In the notetaking/research category, Jerry made 16% of his moves. However, after these top two categories, Jerry's remaining tool use categories were distinctly unique from the other students. His other categories were assignment requirements, *PowerPoint*

positives, and resource use-websites. The *PowerPoint* positives and previous instruction categories were individual only to Jerry for this assignment as compared to his classmates.

Table 5
Jerry's Assignment 2 Content Moves

Content Knowledge Life Experiences/ Interests	Content Knowledge Previous Instruction	Content Knowledge Topic/Visual Details	Previous Tool Use Handwriting Spelling	Previous Tool Use Login Destiny/ Chrome	Previous Tool Use Notetaking Research	Previous Tool Use Web Evaluation	Resource Use Databases	Resource Use Google	Resource Use Human/ Verbal
4 .02	9 .06	36 .22	0 -	2 .01	26 .16	3 .02	0 -	4 .03	2 .01
Resource Use Print Collection	Resource Use Websites	Tool Use Assignment Requirements	Tool Use NoodleTools Negatives	Tool Use NoodleTools Positives	Tool Use PowerPoint Negatives	Tool Use PowerPoint Positives	Tool Use Prezi Negatives	Tool Use Prezi Positives	Tool Use Websites
0 -	12 .07	17 .11	0 -	0 -	0 -	13 .08	0 -	0 -	34 .04

Surprisingly, as compared to Assignment 1 Jerry did listen to the opening directions for Assignment 2. For this assignment, Jerry listened and then reviewed the assignment handouts. Jerry had to decide what he was going to do for the science final, whether to take the test or create a presentation. I noticed Jerry reviewing the suggested topic ideas. He approached Mrs. Cavender and he had a short conversation with her. Later on during our interview, Jerry shared with me that he had an idea but needed the okay from Mrs. Cavender. He explained, "I was going to do paradoxes but she [Mrs. Cavender] said it [the topic] only can be something that we learned this year." Mrs. Cavender's comments encouraged Jerry to reflect on their discussion, explore further options, and problem-solve before choosing his topic. Jerry continued, "I searched space and this [Olber's Paradox] came up." I asked what made him settle on his topic. He replied, "I thought it [Olber's Paradox] was pretty interesting so I selected it." Personal interests, as Thompson (2012) suggests encourages individuals to evaluate and explore topics that otherwise have not been considered. Jerry's personal interest in outer space

guided him to reflect and evaluate topics that he believed in his opinion were interesting, whereas Jerry's experiences and interests did not influence his actions in Assignment 1. Further investigation and reflection convinced Jerry that he had found his topic for his science final.

During our interview, I asked Jerry what he was going to share with his audience. I noticed that with Assignment 2 the lack of structure challenged the students' decision-making. All, including Jerry had to evaluate and decide exactly what they were going to tell their audience. The openness of the assignment requirements encouraged the students to reflect and decide on their presentation content. Newell (2009) proposed that a less structured problem promotes problem-solving and decision-making in individuals. For example, some students, like April struggled in selecting a topic and the subsequent subtopics for her presentation. April and Lucy took me up on my offer of a presearch handout that aided their brainstorming efforts, whereas Jerry, Hector, and Charlie did not. However, when explaining the presearch handout to the class, I noticed that though he chose not to use the handout, Jerry had paid attention to what I stated were the foundational questions on the handout: who, what, where, when, why, and how. During our interview, Jerry explained, "I started off with what it is, who created it, when it was first developed, and why." My opening directions about the optional presearch handout guided Jerry's decision-making on what he wanted to present to his audience. The suggested subtopic ideas of who, what, when, where, and why encouraged Jerry to reflect and decide on his individual subtopics. Jerry's screencast remarks also reflected this action. Jerry had commented "Hmm, someone said to make who, what, why questions. I like that." Vygotsky (1987) describes the importance of speech and its mediating

influence on mental growth. Oral discussion promotes individuals to explore and consider new ideas and thoughts.

Jerry spent a considerable amount of time searching the World Wide Web. I noticed he did not use any of the print collection. When I asked why, Jerry replied, “I did not think there would be any books on the topic.” Smagorinsky (2011) suggest that depending on the context individuals do not always appropriate available cultural tools. Individuals may consider using certain tools but in the end decide not to. Jerry did not appropriate the print collection based on his assumption that there would not be any print information on his topic. However, when searching on the web, one website’s images provided a detailed description of Olber’s Paradox theory. The image motivated Jerry to analyze and decide what information from the image’s explanation was appropriate for his project. Another website’s definition directed Jerry to evaluate and decide to use a direct quote rather than risk writing a poor definition.

I observed Jerry evaluating his website options in the screencasts. I heard him mention, “I am looking for definitions...do not want Wikipedia.” During his interview Jerry explained, “I mostly used sites that ended in .edu or .org. I did find one or two .com websites that were useful.” Jerry’s works consulted supported his statement. Jerry reviewed each website in two ways. First, he examined the website domain for .edu, .org, and .com, skipping websites he determined were suspect. Second, he read the website summaries for further information. Only after this evaluation, did Jerry explore and analyze the website’s content in more detail. Previous web evaluation instruction on website domains guided Jerry to analyze and select appropriate websites for his topic,

whereas images prompted Jerry to evaluate and decide on the best image that demonstrated Olber's Paradox.

I also noticed in the screencast, Jerry analyzed the website domain before examining the website's images. For example, Jerry shared during his interview, "I had pictures to support the theory." The topic/visual details directed Jerry to evaluate and select the images that best explained his topic. I observed Jerry using one particular image a guide for his presentation. The image that Jerry discovered highlighted each principle of the paradox. He explained, "It [hyperphysics.com website] had pictures that helped show the theory." Ho et al. (2011) suggest that images impart meaning beyond the written or spoken text. Jerry wanted additional support for his presentation and the images aided in that support. His notes that appeared on the screencast reflected his use of the image's content but also included additional facts that Jerry had located from other websites. Jerry explained during his interview that he located additional detail to expand his facts for each slide. He commented, "I added details to the slides after I had the basics." The images directed Jerry to locate and evaluate additional content for his notes that he later used in his slides, and his oral commentary about the web evaluation strategies guided Jerry to reflect and review the websites' domains. I also observed during his presentation that Jerry's slide sequence mirrored the image content from the University of Oregon that Jerry decided was the best image he had during his research. The topic/visual details, such as the four possible explanations for Olber's Paradox that Jerry discovered in his research prompted him to analyze and decide what facts and images best served him for his presentation.

The assignment requirements also mediated Jerry's actions in Assignment 2. However, the impact of the requirements in Assignment 2 was not as high as compared to in Assignment 1. Jerry made 27% of his moves in the assignment requirements category for Assignment 1 but only 11% of his moves in this category for Assignment 2. I noticed that Jerry and his classmates made sure they covered the requirements needed for an A in Assignment 2: five minute or longer multimedia presentation, five sources, class participation handout, and a literary device such as video clip or poem. The assignment requirements motivated Jerry to review and reflect on his presentation to make sure he covered all of the required elements. However, Jerry used images in a manner that went beyond the usual action of inserting an image into the slide. For example, Jerry selected one image and made it the background for two of his slides. When I asked about his action Jerry explained, "I really liked that one [pointing at the screencast] and it helped explain the paradox." He was the only student to use an image as background. Ball (2102) proposes that special features of presentational programs allow the individual freedom to display creatively their information. Jerry created a unique background that added detail to his slide content. The image and the meaning that it represented influenced Jerry to examine his facts and decide how to use it as a background in his presentation.

I noticed that Jerry as well as the other students added content beyond the basic requirements for Assignment 2. Jerry included a direct quote in his presentation. When explaining this decision, Jerry said, "I wanted the exact definition of Olber's Paradox, not my explanation." I also observed Jerry evaluating and comparing his presentation slides to the grading rubric. The other students did the same. The science final was very

important to Jerry as it was his last science grade for the school year and he wanted to cover all the requirements. The assignment requirements as well as his dislike for taking the science final test motivated Jerry to carefully evaluate and review his work using the grading rubric. Wang and Turner (2006) suggest that grading rubrics encourage individuals to work beyond meeting the assignments required elements. The rubric criteria prompt individuals to reflect and evaluate their work process and product quality. Jerry explained, “I wanted to make sure I had all that Mrs. Cavender was looking for. I do not want to take the science final.”

Jerry selected *PowerPoint* as his presentational tool for his science final. Out of all of his content moves, 8% appeared in *PowerPoint* Positives. I observed Jerry using several special *PowerPoint* special features that his classmates also used. However, Jerry did use some tools that his classmates did not. For example, Jerry cropped his images to focus on the important point that he wanted to highlight. Cropping an image encouraged Jerry to examine and pinpoint exactly in his image in this case the grain of sand, what he wanted to emphasis about the size of the galaxy. Ho et al. (2011) state that individuals employ a program’s special features to make a point or focus the audience’s attention during a presentation. Jerry used the cropping feature to limit the image’s size but also as directional tool to focus his classmates’ attention during his presentation. During his presentation, Jerry pointed to the exact area on the image that he wanted to highlight as he spoke. In his interview, Jerry said, “I want only to use the part that helps my presentation.” The visuals that Jerry selected directed him to examine and crop the image to meet his presentation focus for each slide.

Jerry used two popular *PowerPoint* special features, as did his classmates: font size and bullet point feature. Similarly, to Lucy, Jerry maintained a consistent font type and size throughout his presentation. During his screencast, Jerry remarked, “New slide – what was the font? 44? 54? Make the title and content larger. I want everyone in the class to see it.” Jerry wanted the size large enough for his audience to see. Purcell-Gates et al. (2007) suggest that an individual’s informational writing serves a purpose to communicate about a particular topic. Individuals need to keep their audience in mind as they compose. Jerry kept his audience in the forefront of his mind as he created his slideshow. Jerry’s purpose for writing and his audience motivated him to reflect and revise the slides’ content as well as the font size. On the other hand, in Assignment 2 previous instruction provoked Jerry to carefully reflect and employ the strategies on how to cite a direct quote for the definition of Olber’s Paradox.

Jerry also used the bullet point feature in *PowerPoint* to limit the amount of information on each slide. The bullet point feature was the most commonly used *PowerPoint* feature among all the students and one of the easier features to use. I observed Jerry using the bullet feature to organize his content in each slide and to keep his information short. He said in the screencast, “All right keep this [content] bulleted. Not copying this word for word ... that is plagiarism.” The bullet point feature motivated Jerry to reflect and evaluate on the type and amount of text he typed in his slides. Jerry also used the bullet point feature to focus on new information and limit previously learned information. For example, Jerry remarked in the screencast, “Distant light of the stars has not reached us yet. I will not have to say too much on this. We spent a whole day on this.” Kinchin and Cabot (2007) note that *PowerPoint* special features, such as

the bullet point feature support certain types of learning. The bullet point feature aids in focusing on the content that the presenter wants to address with the audience. In Jerry's case, this was new information about Olber's Paradox not previously learned in class that he wanted to share with his audience.

Jerry's tool use in both assignments was in many ways was similar to his classmates. For example, assignment requirements mediated his actions in Assignment 1, but in Assignment 2, it was the topic/visual details. Both categories mediated Jerry's action as well as his classmates. The topic/visual details directed Jerry to problem-solve on how to use the information. The newly discovered information prompted him to pause and review his notes. Based on his review, Jerry added a subtopic and ultimately a slide in his presentation. Yet, in Assignment 1, the assignment requirements prompted Jerry to reflect on what steps he needed to accomplish for the project. However, I discovered that *Prezi* positives and *Prezi* negatives, *PowerPoint* positives and *NoodleTools* positives had a far more mediating influence on Jerry's actions than on his classmates.

I noticed that Jerry's special feature tool use in these four categories varied. Several special features, such as the bullet point feature motivated all students – including Jerry to reflect and make decisions about content throughout both assignments. The bullet points also encouraged Jerry to review and decide on the exact phrasing and text for each slide. However, Jerry employed more special features than his classmates did. An example of this is Jerry's use of the cropping tool in *PowerPoint*. The cropping tool prompted Jerry to evaluate what images to use and decide where and how to crop the images that would best enhance his presentation content. I noticed Jerry examining each

image carefully, even to the point of touching the computer screen as he employed the cropping tool to get the precise area he wanted. The cropping tool encouraged Jerry to analyze his images and locate the exact image area he desired for his slide. His classmates did not employ the cropping tool.

Jerry's tool use was unique in other categories, as well. For both assignments, previous instructional unit content encouraged Jerry to pause and reflect on what he discovered. His reflection aided Jerry in adapting his presentation content. Due to the limitations of Assignment 1, Jerry did not expand his presentation content beyond the required elements. On the other hand, the design of Assignment 2 encouraged Jerry to problem-solve and create a presentation of his own interest and design, not a laundry list of items such as what Assignment 1 mandated. The information encouraged Jerry to reflect and consider the information and the potential possibilities that it afforded. The topic/visual details prompted Jerry to problem-solve and decide exactly what information he wanted as part of his *PowerPoint*. Overall, Jerry's tool use in both assignments motivated his problem solving and decision-making promoting critical thinking and growth. The next student, Lucy demonstrated how a slightly different set of tools mediated her actions.

Lucy

Lucy is a 14-year-old eighth-grade student at KMS. Lucy is interested in and active in social issues facing today's society. For example, Lucy chairs the KMS Recycling club and is active in the no-kill animal shelters. The recycling club's faculty sponsor, Mr. DeYoung, described Lucy as a mature young woman. According to Mr. DeYoung, Lucy has the capability of interpreting situations with a mature perspective.

Lucy's peers appreciate her friendship and look up to her in school and out. She enjoys her science and language arts classes. History, Lucy admits, is okay. She likes current events but not necessarily the past American history. Lucy has an A in science.

Assignment 1. Thus far, the assignment requirements have been the driving force behind student actions in Assignment 1. Lucy was no exception. The assignment requirements category comprised of 42% of her moves. I also noticed Lucy had the highest or the second highest percentage of moves in the assignment requirements, *PowerPoint* positives, previous instruction, and human/verbal categories as compared to her classmates. For example, Lucy had 13% of her moves in the *PowerPoint* positives – the highest among the other students. She had the highest percentage of moves in previous instruction with 10%. However, she did have her own routine that differed from the others.

Table 6
Lucy's Assignment 1 Content Moves

Content Knowledge Life Experiences/ Interests	Content Knowledge Previous Instruction	Content Knowledge Topic/Visual Details	Previous Tool Use Handwriting Spelling	Previous Tool Use Login Destiny/ Chrome	Previous Tool Use Notetaking Research	Previous Tool Use Web Evaluation	Resource Use Databases	Resource Use Google	Resource Use Human/ Verbal
0 -	14 .10	10 .07	1 .01	1 .01	0 -	4 .03	0 -	4 .03	11 .09

Resource Use Print Collection	Resource Use Websites	Tool Use Assignment Requirements	Tool Use NoodleTools Negatives	Tool Use NoodleTools Positives	Tool Use PowerPoint Negatives	Tool Use PowerPoint Positives	Tool Use Prezi Negatives	Tool Use Prezi Positives	Tool Use Websites
0 -	5 .03	56 .42	2 .01	1 .01	2 .01	17 .13	0 -	0 -	6 .04

In the beginning of Assignment 1, Lucy followed the same procedure as her classmates. She listened to the instructions, logged on, and opened up *Destiny*. I observed Lucy following the directions and regularly referring to the handout as she worked. When I questioned her actions, she replied, “I was making sure I had all I wanted to put in my slides.” The handout content mediated Lucy's actions by

encouraging her to reflect and double-check the assignment requirements to make sure she had all that she needed. Lucy continued by saying, “The directions in the handouts pretty much told me what to do.” Grant and Branch (2005) highlight similar findings, stating that assignment directions act as a guide and a baseline for student actions. The assignment requirements prompted Lucy to evaluate and follow the handout contents for completing the project.

Lucy recorded her notes on the graphic organizer. When I asked her about *NoodleTools*, she replied, “I forgot we could use *NoodleTools* to take notes.” Smagorinsky (2011) reminds us that individuals appropriate tools at different times and in different learning experiences. The situated learning experience encourages individuals to take up and use tools appropriate to the context. However, in this case, Lucy did not appropriate the notetaking feature of the *NoodleTools* program. Instead, she used the graphic organizer a tool that she had successfully used in the past. Lucy continued by remarking, “It [graphic organizer] was easy and I could see what I had to get done.” Ball (2012) notes that rubrics and assignment requirements act as a prompt for students to evaluate their progress as well as the product. The graphic organizer sections encouraged and reminded Lucy to complete each section.

I also noticed that Lucy followed the graphic organizer sequence order to locate information about her content topic, the northern puffer. Lucy’s presentation slides also followed the graphic organizer sequence order. Other students had a similar arrangement. In the interview, Lucy did clarify that she used *NoodleTools* to create her works consulted. The citation fields directed her to examine and locate the required information for each field. The assignment requirements provoked Lucy to create her

works consulted with *NoodleTools*. Using *NoodleTools* was not new to Lucy, as she had used it in previous research moves. She said to me, “It [*NoodleTools*] is easier now than it was in the fall ... then it was really hard.” Vygotsky (1987) suggests that previous tool instruction facilitates an individual’s action as they practice using a tool. Practical hands-on tool application over several learning experiences, such as what Lucy experienced, promotes tool appropriation by the individual. Previous *NoodleTools* instruction and application guided Lucy to complete her works consulted, whereas the graphic organizer directed Lucy to reflect on the slide order for her presentation.

Similarly, to the other students, Lucy collected her information from the three suggested websites. However, Lucy did look elsewhere for images. She explained, “I researched my topic using websites you recommended. I used Google ...I needed to find pictures.” I noticed the other students also used Google images – in line with Smagorinsky’s (2011) contention on as a socially accepted use. Smagorinsky suggests that culturally accepted tools such as Google image search encourage individuals take up and use certain tools to meet an informational need. Google images aided Lucy and her classmates to locate and select the images that they believed were the best for their presentations. Lucy noted that recommended website images were okay, but she wanted more. She stated, “I wanted different pictures.” I noticed in the screencast that Lucy said she wanted two particular fish images. She discovered in her research that the northern puffer expands its body as a defense mechanism and floats upside down feigning death to escape its predators. Lucy believed that this was interesting and important enough to share with her classmates. The topic/visual details motivated Lucy to analyze and select images that demonstrate the northern puffer’s defense system.

Lucy decided she wanted two specific images to include in her presentation. While Vygotsky (1987) focused on language as the ultimate tool that mediates human development, Smagorinsky (2011) argues that nonverbal signs and symbols such as images also mediate an individual's action. During our interview Lucy said, "I wanted a picture of a puffed-up puffer." She was successful in locating an image of a puffed-up puffer but not one of the fish floating upside down. Ho et al. (2011) also reported how students used images to convey a message beyond the written word. Symbols or images have the capability of adding meaning or sense to the written or spoken text. When it came to the information on puffers floating upside down, Lucy did not have such a tool. She was not able to locate the image she wanted. To compensate for not having an image, Lucy reread her notes and decided to expand her explanation to the class by carefully describing how the fish plays dead to get away from its enemies. During her presentation, Lucy was explicit in her description to make sure her classmates understood this fish's special defense technique. The lack of images directed Lucy back to reread her notes on how the puffer defends itself. Her explicit explanation deepened her engagement with the content knowledge so she could clearly convey the message she intended. Similarly, to Charlie, Mary, Jerry, and April, new and interesting content knowledge nudged Lucy to go beyond the assignment's basic requirements by engaging and adding new information. On the other hand, the images influenced Lucy to examine carefully and select the best one for her presentation.

Up to this point, Lucy's behavior mirrored her classmates', and the assignment requirements directed her actions. However, Lucy's unique tool use began to play an important role in encouraging her actions. Of Lucy's total content moves, 10% were in

the previous instruction category – more than all of her classmates. Previously learned strategies, content knowledge, and class discussions motivated Lucy’s thinking and decision-making as she worked. For example, in the screencast, Lucy mentioned she did not understand what a pectoral fin was. Purcell-Gates et al. (2007) suggests that specialized vocabulary is a motivating factor in an individual’s learning. Specialized vocabulary encourages individuals to investigate and acquire information that meets a specific need. Lucy went to dictionary.com to get a description. She typed in “pectoral fin,” read the definition, and examined the illustration that appeared with the definition. When I questioned her about where she learned about this website, Lucy said, “We used dictionary.com in LA class.” Therefore, she knew from previous instructional units that this particular website was useful and accurate. Lucy’s prior instructional units prompted her to use tools that were successful for her in the past, whereas the websites that Lucy used encouraged her to examine images that aided in explaining the pectoral fin.

Lucy also connected another previous instructional unit content knowledge with her northern puffer presentation. She shared with me during our interview that she recalled an interesting class discussion about environmental issues that are negatively affecting the Chesapeake Bay. Smagorinsky (2011) suggests that personal interests engage student actions by encouraging them to make connections with both previously learned information and new information. Lucy did just that, recalling, “I remembered someone talking about that runoff from farms is causing harm to the bay.” Lucy’s previous class discussion prompted her to reflect and decide to include the past class discussion as part of her presentation. During her presentation, Lucy connected the Chesapeake Bay environmental issues to the runoff as a threat to the northern puffer’s

survival. Vygotsky (1987) suggests that oral language and discussion motivate thinking and learning. Oral language, in the eyes of Vygotsky, mediates an individual's action by introducing new ideas and concepts that prompts to the individual to reflect on the discussion. Lucy, Mary, and April's previous class discussions influenced what they included and how they connected it in their Chesapeake Bay Critters presentations.

Lucy's previous instructional experiences motivated her to select *PowerPoint* as her presentational tool for Assignment 1. In addition, Lucy deliberated and discussed the merits of both programs with Hector, another student in the study. She said, "Hector said he was using *PowerPoint* this time." Both decided to save the *Prezi* for the next assignment so they could help each other. Kumpulainen et al. (2014) notes how collaboration, be it online or face-to-face, facilitates student behavior and learning. Collaboration prompts individuals to exchange thoughts that, in turn, put new conditions upon their thinking. Lucy and Hector weighed the merits of each program, how much experience they had with each, and the assignment requirements before making a selection. The oral discussion prompted thoughtful reflection and decision-making in both Lucy and Hector. Lucy told me during our interview that she had used *PowerPoint* before and she knew she would be comfortable with it. On the other hand, *Prezi* was still new to her and she wanted more practice before using it for a class grade. As she said, "I have used *PowerPoint* before and *Prezi* only once." Lucy's conversation with her classmate motivated her to reflect, analyze, and decide which program was her best option for Assignment 1.

I noticed that Lucy employed several special features of *PowerPoint*. Lucy strongly preferred *PowerPoint* when creating her presentation, evidenced by her having

the highest number of content moves in *PowerPoint* positives as compared to her classmates. Of her total moves for Assignment 1, 13% were in the *PowerPoint* positives category. Lucy did not hesitate while working with the *PowerPoint*. I noticed in the screencast that she kept careful watch on the slide format. For example, Lucy maintained a consistent size, font, and color in each slide. Thompson (2012) and Kinchin and Cabot (2007) support this design type. They suggest that a clean design will not detract from the slide content and helps highlight points the individual is attempting to make. Lucy explained that she likes her slides to be the same, stating, “It looks better. I think it tells the class I put effort into my presentation.” Lucy also remarked that she recalled which classmates’ past presentations she thought looked good and which ones that did not. She did not want hers to look sloppy and poorly prepared. Her classmates past poorly made presentations encouraged Lucy to reflect, evaluate, and create a more polished slide presentation by using the *PowerPoint* special features to her advantage. Her work was evident in her class presentation. Lucy created a clean, well designed, and interesting *PowerPoint* presentation.

Another *PowerPoint* special feature motivated Lucy’s action when working on her slides was the bullet point feature. In fact, all the students used the bullet point feature in their presentations, whether it was in a *Prezi* or a *PowerPoint*. The bullet point feature prompted students to reflect on how to keep their facts short and concise but still convey the message they intended for their audience. I noticed Lucy kept her facts in short phrases. She also referred repeatedly to the grading rubric. During the interview, she said, “It [short phrase reference] is on the rubric and using the bullet points made me think on how I wanted to show my facts.” Lucy also reminded me of a YouTube video

shown in a past LA class on what not to do in a *PowerPoint*. She continued, “I did not want my slides to look like that.” The assignment requirements provoked Lucy to evaluate carefully past instructional experiences and how to write her facts so that they made sense to her and the audience. The bullet point feature influenced Lucy and her classmates to pause and reflect in a manner similar to the findings of Branch and Grant (2005). On the other hand, the rubric criteria guided Lucy to evaluate her work in order to complete successfully the assignment.

The human/verbal response category was another mediator of Lucy’s actions in Assignment 1 with 9% of her moves in this category. Specifically, Jerry and Lucy relied on each other and their classmates throughout Assignment 1. Vygotsky (1987) repeatedly highlights the importance of social and collaborative interactions in promoting learning in individuals. Collaborative interactions prompt individuals to discuss and influence which in return shapes individuals’ mental development. As I mentioned earlier, Lucy and Hector discussed the pros and cons of *Prezi* or *PowerPoint* for this assignment. Their collaborative discussion aided in their decision-making. Lucy commented during our interview that she also discussed this with April. She said, “I talked to April and saw her *Prezi*.” Lucy also shared that she double-checked with Jerry about using a website for images explaining, “Jerry said it was okay to use it.” Lucy’s personal interactions with her classmates demonstrate what Meyers et al. (2009) describes. Adolescents may embrace technology but face-to-face connections are very important to their human development. Lucy’s verbal interactions did not end there. Throughout the screencasts, I heard Lucy ask or answer questions with her classmates. For example, I noticed Lucy checking with a classmate on the spelling of stomach. Later

on, I observed that Lucy's discussions continued with her classmates after the science classes had ended. Lucy and April reviewed what happened in class and their individual progress on the assignment. They analyzed, compared, and edited their presentations according to the rubric as they talked. In Assignment 1, the structured assignment requirements and *PowerPoint* positives mediated Lucy's action, whereas in Assignment 2, a different set of tools mediated Lucy's actions.

Assignment 2. Lucy's decision-making progress in Assignment 2 was vastly different from Assignment 1. As Table 7 revealed, the category with the highest number of moves for Lucy in Assignment 2 was notetaking/research at 30%. In Assignment 1, notetaking/research did not mediate Lucy's actions at all. Other tools also mediate Lucy's actions in Assignment 2. For example, 17% of her moves appeared in topic/visual details, the second highest of all her classmates. Assignment requirements and life experiences/interests were also mediators at 8% and 7%, respectively. Lucy's moves reflected a slightly different tool use than her classmates.

Table 7
Lucy's Assignment 2 Content Moves

Content Knowledge Life Experiences/Interests	Content Knowledge Previous Instruction	Content Knowledge Topic/Visual Details	Previous Tool Use Handwriting Spelling	Previous Tool Use Login Destiny/Chrome	Previous Tool Use Notetaking Research	Previous Tool Use Web Evaluation	Resource Use Databases	Resource Use Google	Resource Use Human/Verbal
8 .07	2 .02	18 .17	0 -	2 .02	32 .30	2 .02	0 -	8 .07	2 .02

Resource Use Print Collection	Resource Use Websites	Tool Use Assignment Requirements	Tool Use NoodleTools Negatives	Tool Use NoodleTools Positives	Tool Use PowerPoint Negatives	Tool Use PowerPoint Positives	Tool Use Prezi Negatives	Tool Use Prezi Positives	Tool Use Websites
5 .05	1 .01	9 .08	0 -	8 .07	0 -	0 -	2 .02	1 .01	7 .07

Lucy went from a highly structured assignment in Assignment 1 to a less structured assignment in Assignment 2. In Assignment 1, 42% of Lucy's moves were in the assignment requirements category. However, in Assignment 2, only 8% moves were

in this category. Thus, the assignment requirements did not influence Lucy nearly as much in Assignment 1. Instead, Lucy's personal interest influenced her thinking about her topic in Assignment 2. Lucy selected coral reefs for her presentation. When I prompted her about her selection Lucy replied, "I like oceans and stuff. I think coral reefs are pretty and that is why I picked it." Lucy's life experiences and personal interests motivated her to reflect, evaluate, and select coral reefs as her topic.

The openness of the science final topic posed a challenge to Lucy as well as her classmates. Lucy had a topic. What was she going to tell her audience about coral reefs? I noticed a similar challenge with many of her classmates. Students were accustomed to directions telling them what they needed to find. The lack of structure and directions stymied them. Newell (2009) and Kuhlthau (2004) report similar negative emotional reactions in their studies. I noticed Lucy and her classmates discussing what they should do next. The assignment's lack of definition prompted Lucy and her classmates to pause, reflect, and discuss what specific information they needed. Students' topic directed their unique actions to problem-solve and decide how they would create their presentations.

As a suggestion during the opening instructions for the science final, I offered an optional presearch topic handout as a brainstorming tool to help the students to record some ideas or subtopics down on paper as a starting point. Lucy accepted the handout, as did April. During the interview, Lucy said, "I started with the chapter titles they were like questions I found in one of the books. I wrote them the way I wanted them on the paper [presearch handout] you gave us." The chapter titles prompted Lucy to reflect and revise her initial ideas before starting to research. Ball's (2009) findings note how ideas and directions guide an individual to reflect and evaluate their project. Lucy's

brainstorming gave her a starting point with the understanding that she could change her presentation any time. Spires et al. (2012) note that self-selected topic prompts individuals to reflect and create a plan of action. Lucy created a tentative plan with her subtopics on the presearch handout. The handout prompted her to evaluate and record her initial topic ideas. Later on, I observed Lucy rewriting her subtopics on her presearch worksheet as she worked. Lucy explained that she wrote her down her changes so she would not forget what she wanted in her presentation. She said, “I used those questions [on the presearch handout] to organize my *Prezi* frames.” The presearch handout contents guided Lucy to problem-solve and organize her presentation frames, whereas topic/visual details directed her to reread, analyze, and adapt her presentation content.

Lucy developed her initial research topics on the presearch handout. She shared with me that she got a few ideas from one of the nonfiction books in the library collection. Lucy said, “The book titles made me pick them to start.” However, I noticed that as Lucy read she rewrote some of her questions and subtopics. For example, one of her subtopics was the description of the three types of coral reefs. Lucy explained that she discovered in one of the coral reef books that the author stated that there is not much difference between the three types. That piece of information prompted Lucy to pause and reflect on her subtopic ideas. Ultimately, she rewrote one of her questions and its related subtopics. During our interview, Lucy remarked about changing her subtopics, “I decided not to do the three different kinds of reefs. I read in one book that they [coral reefs] were mostly the same.” The new information Lucy discovered prompted her to evaluate and change her presentation content. She said, “It was easier to do what was common about all three instead of the different types.” Newell (2009) suggests that

information discovered while addressing a less structured problem enhances an individual's problem solving by examining alternate solutions such as what Lucy did.

Lucy's life experiences/interests mediated her actions as she gathered information for her coral reef presentation with 7% of her moves appearing in this category. Lucy's personal interests prompted her topic selection. However, her life experiences also influenced Lucy's thinking beyond topic selection. For example, Lucy discovered that some coral reefs are older than redwood forests. On the screencast, I heard Lucy say, "Some coral reefs are older than our old-growth redwoods." Later, Lucy shared that she remembered that redwood trees are very old. She explained, "I heard a couple times [redwoods' age] of times in my life. I cannot remember where I heard it." Lucy compared her previous knowledge to the newly acquired information. The information about the redwoods and coral reefs age prompted Lucy to reflect and evaluate the information. In her presentation, Lucy shared a detailed age comparison of coral reefs and redwoods with her classmates. Lucy's life experiences prompted her to reflect and adapt her presentation, whereas the chapter titles encourages her to problem solve and create a presentation that was uniquely her own.

Topic/visuals details mediated Lucy's actions by provoking her to compare information she learned in the Chesapeake Bay Critters assignment to her coral reefs information. I heard Lucy mutter on the screencast, "More things I can present about the environmental impact ... like we did for the Chesapeake Bay. Cool, I can connect them." I noticed in Lucy's class presentation, she connected and compared the negative impacts on both ecosystems. Grisham and Wolsey (2006) note that previous knowledge provokes an individual to critically evaluate and compare the old and new information. The

previous Chesapeake Bay knowledge encouraged Lucy to reflect and evaluate on whether to include the comparison in her presentation. Ultimately, Lucy did include this information as part of her presentation.

Though Assignment 1 was very detailed in its requirements, Assignment 2 had a less structured design wherein the students controlled the content. Lucy's tool use reflected the design structure in both assignments. For example, the assignment requirements mediated Lucy's actions in Assignment 1 but in Assignment 2, the requirements were not as important. Instead, in Assignment 2 the most influential mediator was the research/notetaking category. However, in both cases, the tools promoted Lucy to problem-solve and decide. The opportunity to self-select her topic and brainstorm some initial ideas encouraged Lucy to reflect, decide, and take control of her learning, which was a goal of the assignment. The topic self-selection guided Lucy to problem-solve, whereas the topic/visual details encouraged her to reflect and adapt her presentation content.

I learned that as Lucy uncovered new information on coral reefs, it encouraged her to reflect, evaluate, and revise her presentation content. Lucy's previous knowledge and past instructional units prompted her problem solving and reflection more in Assignment 2 than in Assignment 1. For example, Lucy drew from her past life experiences and prior instructional units as she gathered information about coral reefs. Her reflection of the newly discovered information in comparison to her previously learned facts deepened her engagement and decision-making. Assignment 1 had only a small opportunity for the same type of reflection. I also discovered that the special features of *Prezi* and *PowerPoint* had little or no mediating impact on Lucy's actions in

Assignment 2. Unlike Charlie, Lucy did not have one tool that stood out in both assignments. Instead, Lucy used several tools for each assignment. Thus, the tools that Lucy did use ultimately encouraged her thinking and decision-making. In the next section, I will examine the tools that mediated Hector's actions.

Hector

Hector is a 14-year-old eighth-grade student at KMS. He is an athlete and plays lacrosse. He is an extremely outgoing, socially-minded student. Hector's math teacher, Mr. Conine, observed that Hector has the potential to be an excellent student if he puts his mind to it. Grades are important to Hector but not as important as his friends are. Hector only keeps his grades up so he can be academically eligible to play sports. However, all of his teachers agreed that they look forward to having him in class. Hector is talkative but respectful with a good sense of humor. He has a B+ in science.

Assignment 1. As Table 8 revealed, in Assignment 1 content moves many of Hector's moves were similar to other students in the study. The assignment requirements were the primary mediator of his actions in Assignment 1, at 63%. However, other categories mediated Hector's actions as well. For example, 9% of his moves occurred in the *PowerPoint* positives category, the second highest of all the students. Two other categories, web evaluation and previous instruction reflected Hector's distinct use of tools as compared to the other students.

Table 8
Hector's Assignment 1 Content Moves

Content Knowledge Life Experiences/ Interests	Content Knowledge Previous Instruction	Content Knowledge Topic/Visual Details	Previous Tool Use Handwriting Spelling	Previous Tool Use Login Destiny/ Chrome	Previous Tool Use Notetaking Research	Previous Tool Use Web Evaluation	Resource Use Databases	Resource Use Google	Resource Use Human/ Verbal
0 -	5 .06	2 .02	0 -	2 .02	0 -	4 .04	0 -	0 -	0 -
Resource Use Print Collection	Resource Use Websites	Tool Use Assignment Requirements	Tool Use NoodleTools Negatives	Tool Use NoodleTools Positives	Tool Use PowerPoint Negatives	Tool Use PowerPoint Positives	Tool Use Prezi Negatives	Tool Use Prezi Positives	Tool Use Websites
0 -	1 .01	59 .63	3 .03	1 .01	2 .02	8 .09	1 .01	2 .02	4 .04

Similarly to his classmates, Hector listened to the opening directions, scanned over the handouts, logged on, and opened up *Destiny* to begin to work on Assignment 1. The directions, as Purcell-Gates et al. (2007) propose, prompted Hector's decision to go to the suggested websites. I observed that he paused, studied the three recommended website options, and selected one. Later, Hector shared that he had some issues deciding where to start. He said, "I remember thinking it [website] should be first on the list, not second. It was confusing." Instead, Hector settled on the website that several classmates recommended. Their recommendations guided Hector to decide and select the same website to begin with. He clarified his selection: "I noticed that's where others started so I figured they had checked this out earlier." Like Jerry, Hector also relied on his classmates for help. Their classmates' actions prompted them to select the same website. As Meyers et al. (2009) and Vygotsky (1987) both suggest, adolescents such as Hector and Jerry, who are in the transitional stage attach importance to relationships and social interactions when making decisions. Hector and Jerry are in a time of their lives where they seek out their peers for collaboration and association instead of adults. It is another step in their social self-development.

Hector's actions continued to reflect behaviors similar to that of the other five students in the study. He used the three recommended websites to locate the information he needed for the assignment. I observed that he used the graphic organizer to take notes. During his interview, Hector mentioned in passing that it was easier: "I answered the questions in the packet. It [graphic organizer] had places for me to write my answers." The graphic organizer functioned as guide for Hector as he worked. Ball (2012) and Grant and Branch (2005) both note similar findings with graphic organizers. They promote a sense of order to the assignment. Hector carefully read the website information, paused, and reviewed his graphic organizer and wrote his notes in the corresponding subtopic. The graphic organizer prompted Hector to read, analyze, and determine the correct facts for each subtopic.

Hector opened up *NoodleTools* and used it to create his works consulted. He said it was easy to make his citations: "I opened up *NoodleTools* and a bunch of windows. I went back and forth copying and pasting the things I needed." The copying and pasting eliminated the possibilities for misspellings. The citation fields in *NoodleTools* prompted Hector to locate and analyze the correct items needed for each field. He examined each website for the proper piece of information, then copied and pasted it into the correct field in *NoodleTools*. Hector admitted that, like Lucy and April said, making website citations was hard but they were getting easier. He noted, "It [*NoodleTools*] is getting easier each time I use it." I noticed on his works consulted slide that his website citations had the fewest errors as compared to other students. Vygotsky (1987) suggests that tool practice over time and in several learning experiences aids an individual's tool appropriation. Hector's previous *NoodleTools* experiences provided the foundation that

he needed to continue to practice and move towards mastery with this program. While the graphic organizer promoted Hector to locate his facts in a systematic order the *NoodleTools* citation fields encouraged Hector to examine and select the correct items he needed for the works consulted.

Another category, web evaluation, had a mediating influence on Hector's actions in Assignment 1. Hector's moves appeared 4% of the time in web evaluation – only Mary had a higher percentage at 8%. Mary focused more on eliminating websites, whereas Hector quickly skimmed and found a website that matched his evaluation criteria. After which he went no further. Mary on the other hand, returned several times to her website list. Hector searched for websites that might provide additional information about his content topic, the red-winged blackbird. With exception of Mary, most of Hector's classmates only searched on Google images. During his searching Hector came across a website titled "All About Birds" from Cornell University. I watched him slowly scroll, read, and click through several links within the website before he recorded anything on his graphic organizer. Hector paused and looked back and forth between his graphic organizer and the screen. During the interview, I questioned him about this action, and he said, "I found more interesting facts than the other sites." The new website content encouraged Hector to read, explore, and evaluate what was available. Darvin (2008) argues that reading motivates the use of different reading strategies for different purposes. Hector quickly reviewed the website's contents for new information that he had not encountered before. Ultimately, Hector added new facts to his graphic organizer. Grisham and Wolsey (2006) highlight that a time lapse or in

Hector's case, pausing allows a student to reflect, evaluate, and decide before committing any facts.

Hector shared with me that he knew the "All About Birds" was an acceptable because it was an .edu domain. I asked him to expand on that statement. He said, ".edu is an extension for a university. I remember that from last year." The domain extension prompted Hector to reflect and select that particular website because he knew from prior experiences that it was an acceptable website to use. Hector also made sure that I was aware that he did not use Wikipedia. Mary did the same thing. In fact, overheard Mary and Hector discussing the merits of the websites they discovered and both agreed that Wikipedia was not a site to be trusted because anyone can change the content. Spires et al. (2012) advocate for web evaluation strategies such as the ones that Hector and Mary used. Such strategies encourage individuals to think critically, evaluate, and be selective in their website use. Hector shared the "All About Birds" website with his teacher and classmates. As I noted earlier, Charlie and Mary both had considerable success with the website. Spires et al. also suggests, as did Vygotsky (1987), that collaboration is an important tool in promoting human development. Discussion between individuals allows for the sharing of thoughts and ideas that prompts a deeper reflection by all individuals. The web evaluation strategies motivated Hector to analyze and select promising websites, whereas the topic/visual details of the "All About Birds" influenced Hector to decide to share it with his classmates.

Hector selected *PowerPoint* as a presentational tool for his Chesapeake Bay Critters assignment. One of his higher percentages for Assignment 1 was for the *PowerPoint* positives category at 9%. Hector decided he needed additional time to work

with the *Prezi* and its special features. Hector said, “By the time I do use *Prezi* I will know more about it.” Lucy had the same opinion. As with the others students, Hector used the bullet point feature to organize his facts in each slide. He shared with me that using the bullet point feature prevents him from copying word for word. I noticed in his screencast, he said almost in a chant, “Bullets keep it short.” The bullet point special feature promoted Hector’s thinking by pushing him to reflect and decide how he would effectively convey his facts in short, meaningful phrases on each slide. Jacobs (2006) suggests that special symbols such as bullet points facilitate a deeper engagement with the content in order for the text to make sense to the reader. Another action that Hector did similarly to his classmates was use the graphic organizer as a sequence guide for the slide arrangement. The sequence order guided Hector and his classmates to reflect and decide on content when creating their presentations. The handout sequence order encouraged and provided an outline for the students to follow to make sure they covered all the necessary requirements for the assignment.

Up until this point, I have noted examples of what Hector did that was similar to the other students. Here, I will examine Hector’s unique tool use. When Hector created his presentation, he used several *PowerPoint* special features differently than his classmates. For example, Lucy, Mary, Charlie, April, and Jerry carefully evaluated backgrounds and colors when putting their slides together. Hector, however went in the opposite direction. He used very little color and decided to use a plain white background and red subtopic headings only. He wanted his selected images to be a focal point for the audience. Hector said in the interview, “I want the red titles to stand out and the pictures I used.” Hector also explained that he selected the color red for the font because it

created a direct visual connection to his content topic, the red-winged blackbird.

Thompson (2012) suggests that individuals use special features such as computer font to highlight important points the individual wants to convey to their readers. Hector did this by using a red font color to emphasize certain facts about his bird. Hector thought the key points that he wanted to make would be lost if there were a background color. He used the simplicity of a white background as a guide for his audience, directing them to the images that supported his facts. Thus, the topic/visual details directed Hector to reflect, problem-solve and decide to how to use the *PowerPoint* features to his advantage. Images, as Ho et al. (2011) point out aid in conveying sense or meaning that the printed text cannot communicate to the intended audience. The background color or design did not distract his audience's attention from the message Hector wanted to send. The topic/visual detail of the bird's color patch prompted Hector to reflect and decide to use red for the text headings. On the other hand, the bullet point features encouraged Hector to reflect and analyze his notes to compose meaningful text to complement his images.

During our interview, Hector explained that he used the automatic transition feature in *PowerPoint* to move automatically from one slide to another. I noticed that Hector was the only student in his class to utilize that special feature. During the interview, Hector explained his reasoning. He said, "All the *PowerPoints* I see are boring. I wanted a little action just to break up the presentation." He continued by noting the time lapse between slides was not long, but it was enough for him to gather his thoughts before the next slide. Hector had noticed a time element was part of the grading rubric. The grading rubric motivated Hector to reflect and decide how to use the transition feature between slides. The time-lapse feature also prompted Hector to reflect

and decide what he was going to say for the next slide. He believed the transition movement would keep him within the allotted time. Hector remarked, “I did not want to go over and lose points.” Ball (2012) reported similar actions, in that students utilized grading rubric requirements in order to complete the assignment successfully. The rubric details provide a criteria list for the students to compare and evaluate their work to the expected requirements. I observed that during his presentation, Hector stayed within the designated timeframe – his reasoning paid off.

Hector relied on previous instructional units and content – 6% percent of his moves to create his presentation. One other student, Lucy, had a higher percentage at 10% but for Hector used previously learned strategies to analyze websites, he found when searching for additional information on the red-winged blackbird. Hector selected one of the easier strategies, domain evaluation, but he used the strategy effectively. I noticed Hector skimmed his search results and ignored .net and .com websites. The domain extensions prompted Hector to reflect and decide or not to use the .net or .com websites. Another example was skipping Wikipedia. Mary shared she did the same thing based on what she has learned in the past. During his interview, Hector reflected, “I think I learned about it [web evaluation strategies] in science last year.”

Hector also integrated previously learned information from earlier units into his presentation about the red-winged black bird. He remembered an earlier unit about environmental issues concerning the Chesapeake Bay. Hector said, “That [pollution impact] is what we learned earlier about environmental issues. It was cool to see the connection.” Grisham and Wolsey (2006) noted similar findings in that individuals connecting previously learned information with newly acquired information encourages a

deeper engagement with both new and previously learned information. The previously learned skills and strategies encouraged Hector, Lucy, and April to reflect and make connections about the Chesapeake Bay environmental issues unit and their critter. On the other hand, the grading rubric motivated all three students to evaluate carefully to meet the expected assignment criteria.

The assignment requirements strongly mediated Hector's actions in the Chesapeake Bay Critters assignment. The assignment design encouraged Hector to evaluate and use the directions and handouts to complete the assignment successfully. However, Hector employed the *PowerPoint* special features differently as compared to his classmates. Instead of using a complicated color and layout design, Hector used minimal color with a plain design in his *PowerPoint*. He used the transition feature in *PowerPoint* to time his presentation and allow him to prepare quickly for the next slide. His classmates did not use the transition feature at all. The special transition feature motivated Hector to analyze the time factor of his presentation. Hector's positive tool use motivated a deeper engagement and reflection on the content in order to be ready to present to his class. In the next assignment, I will examine how Hector used a different set of tools to create his science final presentation.

Assignment 2. Hector's tool use for Assignment 2 differed slightly from Assignment 1. As Table 9 revealed, his highest number of moves for Assignment 2 was in the topic/visual details category at 22%. Hector's number of moves in the topic/visual detail category was the second highest of all the students for Assignment 2. In comparison, in Assignment 1, the same two categories had very little influence on Hector's actions. The other students had similar high number of moves in topic/visual

details and notetaking/research categories in Assignment 2. Despite having these categories in common with the other five students, Hector also did displayed unique tool use. For example, Hector had high number of content moves in verbal/human interactions, assignment requirements, and *Prezi* negatives.

Table 9
Hector's Assignment 2 Content Moves

Content Knowledge Life Experiences/Interests	Content Knowledge Previous Instruction	Content Knowledge Topic/Visual Details	Previous Tool Use Handwriting Spelling	Previous Tool Use Login Destiny/Chrome	Previous Tool Use Notetaking Research	Previous Tool Use Web Evaluation	Resource Use Databases	Resource Use Google	Resource Use Human/Verbal
6 .05	0 -	26 .22	0 -	0 -	14 .12	4 .03	0 -	6 .05	14 .12
Resource Use Print Collection	Resource Use Websites	Tool Use Assignment Requirements	Tool Use NoodleTools Negatives	Tool Use NoodleTools Positives	Tool Use PowerPoint Negatives	Tool Use PowerPoint Positives	Tool Use Prezi Negatives	Tool Use Prezi Positives	Tool Use Websites
2 .02	3 .03	14 .12	0 -	3 .03	3 .03	3 .03	15 .12	0 -	4 .03

How Hector began Assignment 2 was very similar to his classmates. He listened to the assignment directions and the two options for the assignment. I noticed Hector carefully studied the handouts and paused to consider what he wanted to do. He briefly discussed his topic choice with Mrs. Cavender and then recorded his topic on the sign-up sheet for presentation dates. During our interview, Hector shared with me how he selected his topic. He said, "I was looking through some topics. So I decided on the evolution of a star." I asked what made him select that topic and he replied, "I was familiar with space from before in another class." His actions were similar to his classmates. Hector selected a known topic that he wanted to know more about. Neo and Neo (2009) suggest that personal interests motivate individuals to select topics that appeal to their interest. Kuhlthau (2004) also suggests that selecting a meaningful topic encourages the individual to moves towards specialized knowledge in a particular subject area. The individual's interest encourages problem-solving and evaluation as the

individual investigates their chosen subject. Hector's personal interest in space motivated him to analyze and select the evolution of stars as his presentation topic.

Hector's personal interest in the life of a star encouraged him to explore information beyond the basic knowledge needed for the assignment. In Assignment 2, many of his classmates selected their topic in a similar manner. I observed Hector browsing some library books on a cart. He selected two books, sat down, and started to read. Similarly to Lucy, April, and Charlie, the availability of print resources motivated Hector to browse, analyze, and select books on his topic. Limberg and Alexandersson (2003) suggest that the location of print resources such as a cart full of books prompts individuals to think about all of their available options. Hector shared with me in the interview, "I used *Space* a book told me the main stages of it [star evolution stages]." McDonald et al. (2005) propose that a historically significant cultural tool such as a library collection mediates individual's actions during the research process. During the interview, I questioned his actions. Hector replied, "I found some good basic information about stars. It was a good start." The basic star information encouraged Hector to reflect, evaluate, and decide on what he wanted to do next.

In the screencast recordings, I noticed Hector reviewed several websites that he discovered during a Google search. I observed him in class looking back and forth comparing his notes with each website summary. In his interview, Hector shared with me what he was doing: "I read the captions for information that related to my topic." Hector continued by saying he selected websites that gave him new information to support what he already had on stars. Hector made a point to say he checked the domain extensions. He stated, "I checked the .org extension to make sure I was not using

someone's personal page." Hector also shared with me that he used other web evaluation strategies when he analyzed commercial websites. He said, "The .com website sold stuff about space like telescopes, but [the website] also had current space articles. The articles were current, had authors, and were helpful." Hector's website evaluation strategies prompted him to evaluate each website beyond looking merely at the domain extension. However, Hector made minimal moves in the website evaluation strategies categories at 3%. Nonetheless, these strategies mediated Hector's action as he worked. Spires et al. (2012) propose that web evaluation strategies such as what Hector and his classmates used prompts them to evaluate and decide the best website for their specific informational need. The domain extensions prompted Hector to evaluate carefully the information before he added anything to his presentation, whereas the library books information encouraged Hector to problem-solve and search further for more details.

In his interview, Hector explained that he used information that he discovered in one of the library books as a foundation or starting point for his research on the evolution of a star. The requirements for Assignment 2 were not as structured as the directions for Assignment 1. Assignment 2 directions were vague in order for individuals to take leadership in their learning. Newell (2009) proposes that a vague or less structured information problem prompts individuals to problem-solve and evaluate more in order to address an informational need. As I did with the other students, I asked Hector what he intended to share with the audience about the life of a star. He replied, "I want to make the audience understand that the evolution of a star is a long process." Assignment 2 requirement's lack of structure motivated Hector to reflect and problem-solve on what he planned to present to his class.

I noticed in the screencast that Hector kept changing his notes by adding and subtracting facts. He also kept rearranging the order of the facts. When I asked about this, Hector explained, “I just went online for details that added to the basic information.” He continued by saying he compared what he found in the book to the online information to make sure it was the same. Hector concluded, “I kept reading my facts and selecting what I wanted.” The new information encouraged Hector to reflect, examine, and revise his notes. Newell (2009) suggests that vague, less structured problem offers more opportunities for individuals to reflect and evaluate to solve the informational need. In this way, Hector did the same actions as Charlie, Lucy, and April. As he discovered new and more interesting information facts, he analyzed his notes and then changed his content and the focus of his presentation. Hector had an initial idea of what he wanted to share, but as he discovered new information, it prompted him to reflect, reconsider, and revise his topic.

The information that Hector located mediated his actions as he was creating his presentation. For example, while Hector searched and explored websites he stumbled on to some images that demonstrated the different stages of a star’s life. I noticed in the screencast that Hector kept returning to the same image. In the interview, Hector shared that the specific image was helpful as he created his slide presentation. I asked why. He added, “I used the image as an outline for the sequence.” The content in the image of the star life sequence prompted Hector to reflect, evaluate, and compare his information to his slide content. The content knowledge Hector acquired for his presentation guided his decision-making. Compared to Charlie who struggled with the content of his presentation, Hector did not have this issue. Hector knew what he wanted to present.

Though he had a clear idea of what he wanted to express, he wanted more detail to expand his presentation. Hector said, “It helped to give them [audience] a visual as I was explaining each step of the star’s life.” The images that Hector selected enhanced the audience’s understanding of his presentation. Grant and Branch (2005) discovered that students often use images to enhance a point in their human rights presentation. The images added an element or as Ho et al. (2011) call it, a “sense” to an oral presentation. The images also motivated Hector to reflect and be explicitly clear in his explanation of each stage in a star’s life as he proceeded through his slideshow, whereas new topic/visual details prompted Hector to evaluate and compare his notes for a clear understanding of the life of a star.

One category in which Hector had a higher number of moves was in the human/verbal category. Twelve percent of his moves appeared in this category. His classmates did not have as many moves in this category. Hector’s screencast dialogue revealed that he had a discussion with Mrs. Cavender about his slide content. In his screencast, he mentions that he had too much in each slide and needs to revise. I observed Hector copying his text out of each slide. He paused, read, and reviewed what he had on the screen. Hector slowly deleted and retyped the wording in the document. Hector explained, “My teacher just said I have too much in my frames. I need to make notecards of my talk and only use some details on the frames.” The oral discussion between Mrs. Cavender and Hector mediated his actions. The discussion prompted Hector to reflect and revise his presentation text. Vygotsky (1987) propose that oral language encourages critical thinking and mental growth. Individuals reflect on and evaluate the discussion content, which in turn prompts critical thinking and decision-

making. Mrs. Cavender's recommendations influenced Hector to review and revise the slide content.

Hector also had a high number of moves in the assignment requirements category at 12%. Only April had a higher percentage in this category. I noticed that Hector carefully reviewed the rubric. He followed the few directions that were required for the assignment. However, during his interview, Hector admitted that he forgot to limit his text on his frames. He was so intent on making sure he adequately covered his topic he overlooked that item on the rubric. Hector said, "I know I looked at it [rubric] from time to time. But most of the time I did not." Mrs. Cavender's suggestions reminded him of that specific assignment requirement. After the conversation with Mrs. Cavender, I noticed that Hector referred to the rubric more often. In the interview, Hector said, "I shortened my text by using bullet points. It kept me from copying. I really worked on that. I knew Mrs. Cavender would be looking for that." Ho et al. (2011) and Ball (2012) propose that rubrics and assignment requirements act as a guide that the students can use to navigate successfully to the conclusion of the assignment. The assignment requirements prompted Hector to use the bullet point features to limit his text content, whereas the websites encouraged Hector to analyze the images for the best representation of a star's evolution.

Hector selected *Prezi* for his presentation tool for Assignment 2. He had opportunities to learn more about the program since the Chesapeake Bay Critters project. Hector believed that a *Prezi* would be a visually appealing method of delivery for each stage of the star's life. I noticed that Hector used the transition with the zoom in and out feature as he was creating his slideshow. In his screencast dialogue, Hector said, "I can

use the zoom in and out to get an outer space effect.” However, as Hector was designing his frames, he had some challenges. The high number of moves in the *Prezi* negatives category demonstrates the challenges that Hector faced, and 12% of Hector’s moves were in this category. As Hector worked, he attempted to copy a frame, which resulted in creating at least 80 or more frames. Hector was very dismayed. His screencast moves and dialogue demonstrated his emotion. Hector said, “Oh! I have 80 slides!” He had difficulty with deleting the unwanted frames while retaining the frames he wanted to keep. Hector’s screencast comments also reflected his anxiety about not wanting to lose all of his work. He said, “Oh, did I delete the slides I wanted to keep?” Hector paused and then said, “Okay, let me think. I know I will NOT save and I will still have my stuff.” Hector’s emotional fear of losing his work prompted him to reflect and problem-solve. Wang and Turner (2006) suggest that technology glitches motivate individuals to evaluate and decide what will work to solve their problem. Hector’s problem-solving worked. He was able to keep the frames that he wanted and deleted the unwanted ones. I overheard Hector comment to a classmate that if he had to do this project over again, he would not use *Prezi*. He would use *PowerPoint* instead. The negative *Prezi* experiences prompted Hector to reevaluate his *Prezi* use for the future. On the other hand, Hector’s conversation with Mrs. Cavender prompted him to reflect and revise the frame text.

Just as his classmates, Hector addressed Assignment 1 and 2 in different ways. The assignment requirements mediated Hector’s actions in Assignment 1. However, in Assignment 2, the topic/visual details mediated his actions. Both categories encouraged Hector to problem-solve. I observed Hector employing a variety of tools. Only the assignment requirements category appeared in Hector’s top five categories for both

projects. However, 63% of Hector's moves were in this category for Assignment 1, whereas just 12% were in this category for Assignment 2. The assignment requirements encouraged Hector to reflect and evaluate on how he would meet the requirements successfully. In both projects, I noticed that the bullet point feature in *PowerPoint* and *Prezi* played an important role. The bullet point feature encouraged Hector to evaluate his notes and decide how he would condense the content and still keep the intended meaning for his audience. Another feature in both programs influenced Hector's actions in his presentations. He used the *PowerPoint* transition and the *Prezi* zoom feature to move from one slide to the next in each presentation. The motion allowed Hector to reflect quickly and decide what he wanted to say for each slide, as well as add a smooth, visually appealing movement to his presentation. In Assignment 2, the human/verbal and *Prezi* negatives categories mediated Hector's actions, whereas the same two categories had a very little mediating impact on his classmates. Hector's discussions directed him to reflect and consider how to adapt his content. The negative *Prezi* experiences prompted Hector to reflect and problem-solve on how he could keep his existing notes and delete the unwanted frames. The variety of tools that Hector made use of during both assignments mediated his actions, which in turn promoted his mental growth. I will now examine the last student in the study.

April

April is a petite, 14-year-old eighth-grade student at KMS. She is a leader and organizer. April kept the "family" as she described her classmates in the study on task when it came to paperwork and meetings. April likes to be involved in school activities and is on the KMS student council. Her classmates enjoy her company and leadership.

Mrs. Lindell, the student council faculty adviser, remarked that April is a gifted speaker. For example, April delivered a well-rounded nominating speech that helped get April elected to student council. Mrs. Lindell expects April to be the high school senior class president in the future. April has an A- in science.

Assignment 1. As Table 10, revealed that April's moves in Assignment 1 were not much different from that of her classmates. As with the others, the assignment requirements heavily influenced her actions and 38% of her moves were in this category. April, however, showed some unique tool use as compared to her classmates. For example, 10% of Aprils' moves occurred in topic/visuals details category, the second highest for Assignment 1. Three other categories, *Prezi* negatives, *NoodleTools* positives, and website tool use demonstrated April's specialized tool use as compared to her classmates.

Table 10
April's Assignment 1 Content Moves

Content Knowledge Life Experiences/ Interests	Content Knowledge Previous Instruction	Content Knowledge Topic/Visual Details	Previous Tool Use Handwriting Spelling	Previous Tool Use Login Destiny/ Chrome	Previous Tool Use Notetaking Research	Previous Tool Use Web Evaluation	Resource Use Databases	Resource Use Google	Resource Use Human/ Verbal
0 -	1 .01	12 .10	0 -	6 .05	4 .03	0 -	0 -	3 .03	5 .04
Resource Use Print Collection	Resource Use Websites	Tool Use Assignment Requirements	Tool Use NoodleTools Negatives	Tool Use NoodleTools Positives	Tool Use PowerPoint Negatives	Tool Use PowerPoint Positives	Tool Use Prezi Negatives	Tool Use Prezi Positives	Tool Use Websites
3 .03	4 .03	44 .38	2 .02	8 .07	0 -	1 .01	11 .09	5 .04	8 .07

April began working on the assignment in a similar manner to the other students in the study. Like her classmates, she listened to the directions, logged on, went to the recommended websites located on *Destiny* while opening up a new window for *NoodleTools*. April created a new project in order to make her works consulted. The verbal instructions encouraged April to evaluate and select a website to begin her

research. April, as well as four of her classmates, used the graphic organizer to record her notes for each of the eight subtopics. During her interview, April admitted, “I would read and write down stuff in each section on the graphic organizer.” She did not refer to the requirements page often but faithfully followed the graphic organizer sequence. The graphic organizer prompted April to complete each subtopic. April carefully read and analyzed the content to select the subtopic and record her facts. She said, “I’m glad I used the graphic organizer because I lost my *Prezi*.” April was visibly upset when her *Prezi* disappeared. April demonstrated what Meyers et al. (2009) and Kuhlthau (2004) describe as emotions and personal experiences directing an individual’s actions. Emotions motivate an individual to pause and reflect prior to attempting to problem-solve. Her negative experience with technology motivated April to record her notes on the graphic organizer instead of in *NoodleTools*. It was only at the end of the assignment that I noticed her carefully checking and comparing the grading rubric against her final project. I observed her making a few changes to her presentation. Ball (2012) suggests that students use rubrics to evaluate their progress and the quality of their work. The grading rubric also guided the girls’ actions to make sure that they reflected and reviewed all the assignment requirements. The assignment requirements provoked April to select a website to begin researching, whereas the negative technology experiences encouraged April to reflect and decide to record her notes on the graphic organizer.

April’s content topic, the lined sea horse, motivated her actions beyond the eight required subtopics. The topic/visual details category reflected 10% of her moves. For example, one piece of information April came across prompted her to delve further on the subject. She discovered that lined sea horses cling to crab pots. April said during our

interview, “I did not know what a crab pot was. I went on Google to find a picture and a description.” Her interest and curiosity, similarly to what Meyers et al. (2009) found, motivated April to look beyond the basic requirements. During April’s presentation, I observed how she used the crab pot image and carefully explained how crab pots play a part in the lined sea horses’ environment. The crab pot information, in April’s opinion was an important addition to her habitat subtopic.

As suggested by Smagorinsky (2011) and Goos et al. (2003) adding new information such as a crab pot image aid a student’s explanation by prompting their thinking to a higher degree. Images add meaning beyond the written or spoken text. April provided a visual reference for her audience while she explicitly explained the role of crab pots in the sea horse’s environment. April expressed during her presentation that she believed manmade products such as crab pots, were an important added component to the lined sea horses’ natural habitat. April also questioned her audience to ensure they knew what a crab pot was prior to her explanation. Vygotsky (1987) advocates the importance of oral discussion such as what April had with her classmates. Oral discussion offers opportunities to shape individual’s mental functions through social, communicative interactions. Purcell-Gates et al. (2007) and Meyers et al. (2009) also uphold that oral language plays a critical role in thinking and learning. The new facts about the crab pot encouraged April to include it as part of her presentation. The crab pot information and her own lack of understanding provoked April to quiz her audience to make sure they clearly understood the definition of a crab pot and its role in the lined sea horses’ habitat.

One aspect of the assignment requirements that evoked negative reactions in April was using *Prezi* for her final project. Out of April's total moves 9% appeared in the *Prezi* negatives category. The assignment requirements allowed the students to choose from a *Prezi*, *PowerPoint*, or a *Weebly*. April chose a *Prezi* and similarly to Charlie, April made this choice with reluctance. She struggled while making her frames. During her interview, April said, "It [*Prezi*] was confusing when I started. I could not get my bibliography into my *Prezi*." Again, the negative emotions that Kuhlthau (2004) highlights and the challenges of *Prezi*'s special features provoked both April and Charlie to state that they do not want to take this tool up in the future. The challenges prompted April and Charlie to reflect and reevaluate their preferences by comparing *Prezi* and *PowerPoint*. Karlström et al. (2007) found similar reactions in their study. April stated in her interview, "If I had to do it over again. I would not use a *Prezi*." When I asked her to expand on that statement, she said, "I did save or publish my *Prezi* but it disappeared. I had to do it over at home the night before it was due." April said earlier that she was glad she had her graphic organizer and notes. The graphic organizer and notes guided and aided her in replicating her lost *Prezi* presentation. She remarked, "I remembered just about everything I did the first time so it was not hard to make the *Prezi* again." I also noticed that April followed the graphic organizer sequence in her frames. All six students in the study did the same process. The subtopic order on the graphic organizer guided her construction of her presentation. On the other hand, following the subtopic sequence also encouraged April to reflect and not omit any required assignment elements.

The assignment requirements also motivated April to employ other sources besides the original recommended websites. She mentioned that she was able to get most

of, if not all of the required information from the recommended websites. However, April also used the print library resources that were available for the project. On the other hand, none of the other students used the print collection for the Chesapeake Bay Critters project. I asked April why she has used additional resources and she replied, “I wanted to check everything I can.” McDonald et al. (2005) and Smagorinsky (2011) describe how using historically accepted tools such as books in the library collection promote meaningful action. Tools such as library books act as a mediator of society’s shared understandings of individuals’ actions. April continued, “I did find a fact or two that the websites did not have.” Similarly to the other students, April only added new facts to her graphic organizer. April also pointed out that the assignment required three sources for the works consulted. A book was her third source. The assignment requirements prompted April to reflect and explore other resources such as the print library collection. She wanted to cover all the options for information but also meet the project requirements.

I noticed as April read, she referred frequently to her graphic organizer notes and compared her notes to the printed text. April’s notes on the lined sea horse directed her to read and select only new facts to add to her graphic organizer. Similarly to Darwin’s (2008) findings April’s reading strategies encouraged her to focus on facts that she had not read before. To her delight, April found some new facts that she added to her graphic organizer. She said, “I was surprised I found something...usually it is the same.” I observed her contemplating her notes for a few minutes. She then asked her teacher to clarify two subtopics, “special circumstances” and “interesting trivia” before she wrote anything down. During her interview, April said, “I wanted to know the difference

between the two [subtopics].” Smagorinsky (2011) states how Vygotsky advocated for collaboration such as this between a novice and expert. The collaborative interactions between a novice and expert encourage the novice to accomplish activities that they may have otherwise not been successful completing. The interaction creates a joint activity that motivates the novice to work towards mastery. April’s conversation with her classroom teacher guided her to reflect and decide which subtopic to record her new information.

Information that April discovered in her research also provoked her to reflect and recall content from previous Earth Science instructional units. April was not alone in recalling previously learned content knowledge. Several other students in the study remembered the environmental issues unit from earlier in the school year. As part of the habitat subtopic, students were required to include information about the environmental impact on their particular critter. April mentioned in her screencast that the fact that the seagrasses are disappearing was important. During the interview, I asked her to expand on that statement. She said, “That pollution in the water was the cause for the grasses dying.” She went on to explain that she remembered from an earlier Earth Science instructional unit that runoff from farms impact the Chesapeake Bay. April commented in the interview, “Lancaster County was one place that impacted the Chesapeake Bay because of the farmlands.” The content knowledge information about the seagrasses encouraged April to reflect and review previously learned knowledge and connect it to the new knowledge. Ho et al. (2011) propose that previously learned knowledge such as what April remembered motivates an individual to construct links between the previously learned information and the new information, encouraging a higher level of thinking.

April believed the information about the runoff being a threat to the lined sea horses' habitat to be such an important connection that she included it in her presentation. The previous instructional unit content prompted April to analyze the subtopics and decide where to record her notes, whereas a previous instructional unit content motivated April to connect the prior unit information to her seahorse presentation.

The assignment requirements motivated April to take up tools such as *NoodleTools* and special electronic features to complete the project. For example, as April read information available on the websites she would highlight sections by clicking and moving the cursor over the text. At the conclusion of reading a section, she reviewed her graphic organizer and decided where the highlighted information belonged. During her interview, I asked about this technique. She replied, "I like to read stuff on the screen, then go back and highlight the important pieces I want to use." April was the only student I noticed that used this highlighting technique. She also commented that she does it because she can see the important information better. April was not sure when she learned the highlighting technique, she stating, "I do not remember anyone saying to do that." April admitted she highlights on paper, and highlighting on the screen would be the same idea. Karlström et al.'s (2007) findings suggest that students appropriate and adapt tools for the individual needs. The previous learned highlighting techniques encouraged April to adapt her highlighting technique from the paper/pen world to the electronic world, just as did Mary with the *NoodleTools* annotation fields. April appropriated the highlighting feature for her own personal use, whereas the other students did not use the highlighting feature.

April had mixed results using *NoodleTools*. However, 7% of her moves were in the *NoodleTools* positive category. Unlike Mary or Charlie, she did not use any *NoodleTools* special features beyond the citation feature. Though she used the program to create her works consulted but she was not happy with some of its features. For example, April did not like citing websites. Websites, in her opinion, were difficult to cite. She admitted, “I can never find all the parts I need for *NoodleTools*.” April’s difficulty citing websites as compared to other sources demonstrates the impact the varying degrees of Smagorinsky’s (2011) tool appropriation continuum has on how an individual uses a cultural tool. Tool appropriation appears on various levels and in specific learning contexts. For example, April did not use *NoodleTools* notetaking feature. Instead, she used the graphic organizer because as she said, “I could lose my notes in *NoodleTools*.” Her tool appropriation of this special feature was not high. However, April did admit that *NoodleTools* helped her keep track of the number of sources she used and reminded her what she needed to meet the assignment requirements. The *NoodleTools* citation features prompted April to reflect and review the assignment requirements criteria. April’s appropriation here was higher. The *NoodleTools* citation features also supported April’s actions by acting as a safety net. After losing her *Prezi* presentation, April was relieved that all she had to do was export her citations from *NoodleTools* and copy them into a *Prezi* frame for her works consulted. The tools that April used for Assignment 1, such as the assignment requirements, motivated her critical thinking and served her well for the Chesapeake Bay Critters project. In the next section, other types of tools will appear that April used and how those tools mediated her actions.

Assignment 2. April followed a similar pattern of tool use as her classmates for Assignment 2. As Table 11 revealed, her top two categories were topic/visual details at 29% and notetaking/research at 17%. These two categories were the highest or second highest for the other students as well. Topic/visual details category was the highest category for April, Hector, and Jerry. However, this category was the second highest for Charlie and Lucy. Similarly, notetaking/research category was the second highest for April, Hector, and Jerry but first for Charlie and Lucy. April's other three highest content moves categories were assignment requirements, print collection, and tool use-websites. These three categories comprise April's unique tool use for Assignment 2.

Table 11
April's Assignment 2 Content Moves

Content Knowledge Life Experiences/Interests	Content Knowledge Previous Instruction	Content Knowledge Topic/Visual Details	Previous Tool Use Handwriting Spelling	Previous Tool Use Login Destiny/Chrome	Previous Tool Use Notetaking Research	Previous Tool Use Web Evaluation	Resource Use Databases	Resource Use Google	Resource Use Human/Verbal
5 .04	7 .06	33 .29	0 -	3 .03	20 .17	3 .03	0 -	2 .02	5 .04
Resource Use Print Collection	Resource Use Websites	Tool Use Assignment Requirements	Tool Use NoodleTools Negatives	Tool Use NoodleTools Positives	Tool Use PowerPoint Negatives	Tool Use PowerPoint Positives	Tool Use Prezi Negatives	Tool Use Prezi Positives	Tool Use Websites
9 .08	1 .01	18 .16	0 -	0 -	0 -	0 -	0 -	0 -	8 .07

April listened to the directions for this assignment at the beginning of class, same as her classmates. However, April took longer to decide on her topic as compared to the other students in the study. April reread the handouts, then sat quietly and pondered her options. I overheard her say earlier that she was not going to take the science final. In her opinion, she was not a good test taker but on the other hand, she did not have any ideas for a topic. After thinking for a few minutes, April approached the book cart and browsed the titles. She selected one book and slowly scanned the contents. April returned to her seat and began a discussion with her classmates. I observed the students

brainstorming possible ideas and topics for a few minutes. One of April's classmates went to the presentation sign-up list and reviewed topics that other students had selected. She returned to the group and reported her findings. April paused and reviewed this information. Vygotsky (1987) suggest that oral discussion aids in mental growth. Discussion among individuals encourages critical thinking and decision-making. April reflected and evaluated the information and ideas that her classmates shared as she attempted to select a topic. It seemed, from my observations that April struggled with selecting a topic and making a decision. She later confirmed this impression during the interview. April said, "Yes, I did not know what to do."

In her struggle to find a topic, April went back to the book cart and selected another book. I noticed that both books were on supernovas and space. She flipped through the book and then approached Mrs. Cavender. They had a brief discussion. After the conversation, April went to the sign-up sheet and recorded her topic. The conversations with April's classmates and teacher encouraged her to reflect and evaluate the conversations in order to make a decision. During the interview, I asked April about how she determined her topic. She replied, "The pictures, I did not know what they [supernovas] were. I liked what I saw." April also mentioned that the visuals were a help to her in understanding the topic. Another point that April mentioned in regards to her topic selection was, "We have not talked about supernovas in class so my classmates will not know much about supernovas." Grant and Branch (2005) suggest that intended audiences mediate an individual's actions by encouraging reflection and evaluations as the individual creates a presentation. April considered her potential audience as she decided on her topic. The supernova images that April liked, as well the notion that her

classmates would know very little about supernovas, motivated her to select this as her topic. The conversation prompted April to reflect on possible topics, whereas the supernova images motivated April to decide and select that topic for her science final.

Like Hector and Jerry, April's highest number of content moves appeared in the topic/visual details category. As previously mentioned, the images that April found encouraged her to choose her topic. The topic/visual details influence did not stop there, however. For example, April used the books she found on the cart as a starting point for her research. I questioned her on what she was going to tell her audience. April replied, "I figured if I have the covered the who, what, and where type of questions I will have covered the topic pretty well." She also shared that she created a list of questions. April explained, "My questions...I have them on that sheet [presearch worksheet] you offered us. It was a big help." The presearch handout directed April to reflect and problem-solve on the subtopics for her presentation. Purcell-Gates et al. (2007) highlight those individuals who have a high interest in their topic have a tendency to enhance their subject matter with further research. In the screencast, I noticed April commented on the amount of information she discovered on supernovas: "Holy cow! Look at all this information." The amount of information that April discovered motivated her to reflect, expand, and add to her presentation. In addition, the images also encouraged April to examine and decide that supernova was her topic choice.

The information April discovered in the library books prompted her to review, reflect, and adapt her subtopics. In fact, 8% of her moves were in regards to using the print collection. I noticed on the screencast that April referred to the print resources. She commented, "I am now looking at another book about super giants." April paused in her

recording and then said, “What is a red giant? I am looking up the definition of a red giant.” During the interview, April explained she found most her of information in library books. However, the facts she discovered encouraged her to pause, reflect, and expand on her subtopic and look for additional information. For example, April when looking up the red giant definition, April discovered another name for a red giant, which she added to her notes. The new red giant name prompted April to go back to the books because she then remembered another red giant name. She recorded both names in her notes. Grisham and Wolsey (2006) highlight how resource content crossover mediates actions. Their findings suggest that the integration of information motivates individuals to reflect and evaluate when researching. In this case, the new information motivated April to reflect and investigate the red giant’s status further. In the screencast, she said, “The book says *Eta Carinae* is the next best candidate to become a supernova. I want to see if it has become one yet.” April’s interest in *Eta Carinae*’s status prompted her to search some websites for further information. The topic/visual details directed April to analyze and decide to research further. On the other hand, the *NoodleTools* citation fields prompted April to analyze carefully for required information.

The screencast demonstrated that April went to a several websites. Her website use category was one of her most used at 7%. To answer her question about the red giant April went to a website that she had used in the past, *NASA*. In her interview comments, she told me, “I used the website in the past. I knew I would be okay with that website.” April’s past successful experiences and evaluation of the *NASA* website prompted her to return to the website. Spire et al. (2012) highlights how web evaluation strategies

prompt individuals to evaluate and select appropriate websites. April's web evaluation strategies supported her decision that the website was safe to use.

April's notetaking/research details in Assignment 2 mediated her actions similarly to the other students. April had only a vague idea of what she wanted to present to her audience. With exception of Hector whose topic had a definite sequence, April, Charlie, Lucy, and Jerry were not committed to any particular sequence. Newell's (2009) suggests less structured problem promotes the student's own unique problem solving and evaluation. The information they found while researching guided them to reflect and decide about their slide order. April kept her options open regarding how she would organize her slide content. In her interview she said, "I think will arrange my slides by my questions. I am still working on it." Later during April's presentation, I noticed that April used a few questions as part of the slides but not all. For example, April's opening slide was the origin of the name supernova, which led to the definition slide. April displayed in extra slides the information she wanted to emphasize to her audience. The sequence was logical and the content connected seamlessly from slide to slide. The notetaking/research details directed April to reflect, problem-solve, and decide on the content and sequence of her presentation.

April used the assignment requirements more than her classmates did for Assignment 2. Sixteen percent of her moves occurred in this category. April was concerned about her grade, as the science final was the last grade of the school year. I overheard her tell a classmate that she wanted an A on the assignment. The others in the study did not voice a similar thought but their actions reflected the same sentiment. In April's case, she referred the assignment rubrics often. April clarified her screencast

actions by saying, “I was shuffling my papers. I was back on my rubrics checking things to make sure I had everything.” I noticed that her classmates in the study engaged in similar behavior but not to the degree that April did. Ball (2012) study exemplifies how assignment requirements and grading rubrics mediate action in individuals. The assignment and rubric criteria provoke individuals to gauge their progress and quality of their work. A similar impact occurred on April. The assignment rubric motivated her to reflect and evaluate her progress and the quality of her presentation, whereas topic/visual details guided April to problem solve and decide on her exact presentation content.

In regards to the assignment requirements, April used *PowerPoint* as her presentational tool. I overheard her tell a classmate that she was glad that she did not have to use a *Prezi*. She did not want to jeopardize her science final grade of the year. Kuhlthau (2004) highlights how emotions influence individuals’ actions. April exhibited a range of emotions when using *Prezi*, mostly negative. The negative *Prezi* experiences from the Chesapeake Bay Critters project influenced April to reflect with some relief that she can use *PowerPoint* for the science final.

April employed the same *PowerPoint* special features, as did her classmates for this assignment. Thompson (2012) suggests that special features, such as bullet point or font size encourage individuals to reflect and evaluate. As an example of this, I noticed in April’s presentation that she used the bullet point feature to organize and keep her text to a minimum. The bullet point feature encouraged her to read, reflect, and analyze her information in order to be concise in her slide text. April discovered quite a bit of information on supernovas. She said in the screencast, “There is a lot of information on supernovas.” The size limitation on the slides, however, prompted April to reflect,

evaluate, and decide on what she wanted to place in her slides while still conveying her complete meaning to her audience.

Other features that April used in her *PowerPoint* were visuals both still photos and video clips, as well as background special effects. April shared in her interview that the visuals helped her to understand supernovas. She wanted to use images and videos to explain the life and death of a star. April clarified this by saying, “They [pictures] helped me to understand my topic. I want the same for my presentation.” I noticed in April’s presentation that she shared an image of the life cycle of a star with her class. She used each stage in the image as her visual cue to explain in further detail. The slide images prompted April to reflect as she carefully explained supernovas with additional facts. Ho et al. (2011) suggest that images engage individuals’ senses beyond the written word. Images such as what April used in her presentation, can add to the message that a student is attempting to share with her audience. April kept her *PowerPoint* backgrounds simple. Similarly, to what Hector did in Assignment 1, April wanted her pictures to stand out. I observed April reviewing the different background types that are available in *PowerPoint*. She finally settled on a simple black background with grey undertones. I questioned her decision and she replied, “I have to select my pictures. I am thinking about how I am going to use them to help explain my facts. I am still working on it.” In her screencast, April said, “That black and grey background reminds me of space.” The images encouraged April to reflect, review, and decide on a background that supported her presentation topic.

Similarly, to the other students, April had her own unique set of tools that mediated her actions in each assignment. In Assignment 1, the assignment requirements

motivated April's decision-making. However, in Assignment 2, the primary category that reflected April's moves was the topic/visual details. These two categories were also high-ranking categories for the other students as well. The different design structures of Assignment 1 and 2 encouraged different tool use for April. I noticed in April's moves, assignment requirements garnered a high number of content moves in both assignments. The assignment requirements were the highest in Assignment 1 but in Assignment 2, it was third highest. In both cases, the assignment requirements directed April to reflect, evaluate, and decide if she had covered all the required elements and to what level, that she wanted to obtain.

Interestingly enough I learned that the topic/visual details category was a high-ranking categories for April in both projects. April's topic/details category was the second highest in Assignment 1 and the highest for Assignment 2. No other student showed a similar pattern. Despite the assignment requirements mediating April's actions, the topic/visual details that April discovered encouraged her to reflect and explore beyond the basics. For example, in Assignment 1 April expanded her presentation to include information about crab pots and their role in the seahorse's habitat. In Assignment 2, the lack of a topic challenged April. She had the most difficulty with this out of all the students. The less structured nature of Assignment 2 provoked April to brainstorm and problem-solve and ultimately select supernovas as her topic. She chose this topic because she liked the pictures. Her decision was not unusual. Her classmates also selected their topic based on personal interests. However, April also selected supernovas because the topic was not part of the class curriculum setting her apart from the other students. April reasoned that she would be introducing a new, attention-

grabbing topic. April considered her audience as she made decisions, whereas her classmates did not.

Once April had her topic, whether it was Assignment 1 or 2, she took control of her learning. As she researched her topics, she did not limit herself to what was required to obtain a passing grade. I noticed similar actions in her classmates. Everyone expanded his or her research to add interesting information. The newly discovered information encouraged April and her classmates, to reflect, evaluate, and revise to create a well-rounded presentation. One example is April's quest for the latest update on the red giant *Eta Carinae* to see if it had exploded.

I noticed that the *Prezi* had a negative impact on April's actions. She did not care for the program and used the program only because it was required. April was pleased that she could use *PowerPoint* for the Assignment 2. Charlie similarly disliked using *Prezi*. However, the *PowerPoint* special features did not influence April's actions in either assignment. Overall, April's tool use was distinct and motivated her reflection, problem-solving, and mental growth.

Table 12
Proportion of Moves by Category

Code Names	April		Charlie		Hector		Jerry		Lucy		Mary		Total												
	Assign 1	Assign 2	Assign 1	Assign 2	Assign 1	Assign 2	Assign 1	Assign 2	Assign 1	Assign 2	Assign 1	Assign 2													
Content Knowledge-Life Experiences/Interests	0	-	5	.04	0	-	18	.10	0	-	6	.05	0	-	4	.02	0	-	8	.07	0	-	-	-	41
Content Knowledge-Previous Instruction	1	.01	7	.06	0	-	1	.01	5	.06	0	-	3	.03	9	.06	14	.10	2	.02	2	.01	-	-	44
Content Knowledge-Topic/Visual Details	12	.10	33	.29	25	.18	22	.13	2	.02	26	.22	9	.08	36	.22	10	.07	18	.17	14	.10	-	-	207
Previous Tool Use-Handwriting/Spelling	0	-	0	-	3	.02	6	.04	0	-	0	-	0	-	0	-	1	.01	0	-	0	-	0	-	10
Previous Tool Use-Login/Destiny/Chrome	6	.05	3	.03	1	.01	2	.01	2	.02	0	-	7	.06	2	.01	1	.01	2	.02	3	.02	-	-	29
Previous Tool Use-Notetaking/Research	4	.03	20	.17	1	.01	56	.32	0	-	14	.12	2	.01	26	.16	0	-	32	.30	0	-	-	-	155
Previous Tool Use-Web Evaluation	0	-	3	.03	0	-	0	-	4	.04	4	.03	0	-	3	.02	4	.03	2	.02	11	.08	-	-	31
Resource Use-Databases	0	-	0	-	2	.01	2	.01	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	4
Resource Use-Google	3	.03	2	.02	2	.01	3	.02	0	-	6	.05	1	.01	4	.03	4	.03	8	.07	2	.01	-	-	35
Resource Use-Human/Verbal	5	.04	5	.04	1	.01	1	.01	0	-	14	.12	7	.06	2	.01	11	.09	2	.02	0	-	-	-	48
Resource Use-Print Collection	3	.03	9	.08	0	-	7	.04	0	-	2	.02	0	-	0	-	0	-	5	.05	0	-	-	-	26
Resource Use-Websites	4	.03	1	.01	5	.04	24	.14	1	.01	3	.03	5	.04	12	.07	5	.03	1	.01	10	.07	-	-	71
Tool Use-Assignment Requirements	44	.38	18	.16	32	.23	9	.05	59	.63	14	.12	32	.27	17	.11	56	.42	9	.08	52	.36	-	-	342
Tool Use-NoodleTools Negatives	2	.02	0	-	0	-	0	-	3	.03	0	-	0	-	0	-	2	.01	0	-	0	-	0	-	7
Tool Use-NoodleTools Positives	8	.07	0	-	6	.04	5	.03	1	.01	3	.03	8	.07	0	-	1	.01	8	.07	21	.15	-	-	61
Tool Use-PowerPoint Negatives	0	-	0	-	0	-	0	-	2	.02	3	.03	5	.04	0	-	2	.01	0	-	0	-	0	-	12
Tool Use-PowerPoint Positives	1	.01	0	-	9	.06	0	-	8	.09	3	.03	1	.01	13	.08	17	.13	0	-	0	-	0	-	52
Tool Use-Prezi Negatives	11	.09	0	-	32	.23	1	.01	1	.01	15	.12	12	.10	0	-	0	-	2	.02	4	.03	-	-	78
Tool Use-Prezi Positives	5	.04	0	-	18	.13	0	-	2	.02	0	-	26	.21	0	-	0	-	1	.01	4	.03	-	-	56
Tool Use-Websites	8	.07	8	.07	3	.02	13	.08	4	.04	4	.03	2	.01	34	.04	6	.04	7	.07	21	.14	-	-	110
Total	117		114		140		170		94		117		120		162		134		107		144		-	-	1419

Differences across students

The tools that the students took up and used when completing Assignments 1 and 2 had different effects on their actions and their mediating impact appeared in a variety of ways. Palfrey and Gasser (2008) suggest that individuals view cultural tools as pliable and adaptable to meet their individual manner. As the students navigated the assignments, the tools they employed mediated their actions. For example, in Assignment 1, Charlie utilized *NoodleTools* notetaking features to record his notes, a conventional use of the program. The notetaking features prompted Charlie to reflect and analyze the facts he located to decide under what subtopic those particular facts belonged. The notetaking features also provoked Charlie to create his citations and connect them to the note fields for each source. On the other hand, Mary adapted the *NoodleTools* citation annotation field to record her evaluation and reflections of each resource that she used for future reference. As Mary remarked, “The notes are reminders.” She used the annotation fields for her own distinct use. The annotation fields prompted Mary to read and carefully evaluate the sources’ content in relationship to her research.

In Assignment 1, Jerry enjoyed using and creating his *Prezi*. He explained, “*Prezi* just looks better.” The special zoom in and out features motivated Jerry to utilize the feature to draw his audience’s attention to an important piece of information during his presentation. For example, Jerry zoomed in on the eel ladders in a photo to demonstrate how eels use ladders to bypass dams on their way up a river to spawn. The zoom feature encouraged Jerry to reflect on what he wanted to explain as he pointed to specific ladder details and explicitly described how the ladder works to his classmates. Branch and Grant (2005) suggest that the use of a program’s special features aids in communicating

the presentation's message to the audience. On the other hand, April and Charlie did not like *Prezi*. Both tolerated and used the program because it was required. Due to a technological mishap, April lost her presentation and had to redo it. The program limitations of imbedding hyperlinks into the frames hindered Charlie as he created his presentation. In both situations, using the tool encouraged April and Charlie to step back, reflect, problem-solve, and decide how to overcome their challenges to complete the assignment.

During her research, April adapted a highlighting strategy recalled from past notetaking experiences to the electronic world. She highlighted important facts in the electronic text that she decided to include in her notes. She would then record the highlighted information on her graphic organizer. April said, "Highlighting on the screen would be the same as on paper but it does not stay." The highlighting strategy directed April to read, evaluate, and select the facts that she wanted to include in her notes. The highlighting technique encouraged April to read and evaluate the text to determine what was important, whereas the negative *Prezi* experience prompted her to record her facts on the graphic organizer. In addition, previous instructional content mediated Lucy's actions in Assignment 1. Her discoveries during her research prompted her to reflect and compare past instructional content to new information. Lucy said, "I saw that [runoff] as a problem for the puffer. I remembered we talked about that earlier." During Lucy's reflection, she connected past instructional content from the environmental issues unit to what she found about the northern puffer and included it as part of her presentation.

In Assignment 2, I continued to see that unique sets of tools mediated each student's action. The students employed a different set of tools as compared to

Assignment 1. The less structured problem design of Assignment 2 motivated the students to problem-solve more as compared to Assignment 1. Newell (2009) proposes that a less structured problem encourages individuals to evaluate and problem-solve to meet an informational need. Problem-solvers may not have considerable knowledge of the topic but they reflect and decide how to use the new information to be successful. For example, Charlie applied his life experiences to his project as he worked. He explained, “It [Smithsonian] is the national archives.” His fossil topic motivated him to pause and reflect on his experiences, which he then applied to his research. April used print resources as a guide for her work on supernovas. The images and the information she found motivated her to reflect, evaluate, delving deeper into her topic.

Jerry had an infinity for technology and employed some *PowerPoint* features that his classmates did not. For example, Jerry cropped his images in order to focus his audience’s attention. The cropping feature guided Jerry to analyze and decide precisely the area of the image that displayed the specific detail that he wanted to emphasize in his presentation. Jerry also selected images that he believed best accentuated the message he wanted to share with his classmates about Olber’s Paradox. He also overlaid an image of the galaxy with a grain of sand image. Jerry shared during his interview, “The perspective of a grain of sand would cover 10,000 galaxies is hard to visualize. I found a picture that measures a grain of sand.” Thus, the topic/visual details guided Jerry to evaluate, select, and decide to create a single image for his audience to consider. In addition, the text box feature prompted Jerry to decide where and how large he wanted the grain of sand image to be in the slide. In both situations, the *PowerPoint* special

features encouraged Jerry to problem-solve and decide how to enhance the message he wanted to convey.

On the other hand, human interactions and responses prompted April to reflect on, evaluate, and adapt her presentation. April relied on her classmates as guides that aided her in putting together her presentation. For example, in the screencast I heard April ask for help. She said, “Sue, what is a light year?” The classmate replied 5.88 trillion miles. April replied, “Wow that is a lot. Mine [red giant] is 750,000 light years away.” Meyers et al. (2009) suggest that middle school students place great importance on oral discussion and face-to-face interaction. Face-to-face discussion prompts middle school students to reflect on and evaluate the discussion’s content. In this situation, the oral discussion directed April to reflect on what she and her classmate discussed about how far the red giant is from Earth. She evaluated and decided how to modify and include the distance of the red giant as part of her presentation.

NoodleTools special features mediated Lucy’s actions. Lucy relied heavily on the citation fields of *NoodleTools*. I noticed on the screencast time clock that Lucy took more time than the other students did as she created her works consulted. All the students created a works consulted, but Lucy had fewer errors than most. Lucy explained during her interview, “I did not have any problems. *NoodleTools* helps.” The citation fields guided Lucy to slow down, carefully examine, and decide what pieces of information she needed to complete each citation field. The assignment requirements prompted Lucy to analyze pieces of text to complete successfully her works consulted, whereas the previous instructional units encouraged her to reflect on how two environmental issues related to the northern puffer. Overall, the students’ unique tool use

mediated their actions across both assignments. The varied tools used during both assignments prompted the students to engage with and reflect on their presentations promoting mental growth and critical thinking. In the next section, I will continue to examine tool use and their mediating influence on student actions.

Patterns across both assignments

As I coded the student dialogues and interviews, patterns started to emerge across both assignments. The students' tool use was distinct but as Table 1 revealed, there were several noticeable patterns. Four categories showed unique tool use that mediated students' actions as they worked on their projects. Assignment requirements, topic/visual details, notetaking/research, and life experiences/interests categories captured 53% of the content moves. Of these four categories, only assignment requirements were in Assignment 1, whereas the remaining three categories were located in Assignment 2. I will examine examples of the unique patterns from the four categories that mediated student actions in both assignments.

Assignment requirements. Grant and Branch (2005) identify in their study the necessary elements that are a part of a project-based learning experience. In their opinion, items such as assignment requirements, graphic organizers, and resources mediate student actions. Both science assignments reflect evidence of such mediation. Assignment requirements mediated the student actions more in Assignment 1 than in Assignment 2. Understandably so, as Assignment 1's requirements were structured and Assignment 2's requirements were less structured, allowing for more student control over content. In Assignment 1, April, Hector, Jerry, and Lucy recorded their notes on a graphic organizer. The close proximity of the graphic organizer encouraged student use.

In addition, the graphic organizer contents directed the students to locate, evaluate, and select the best information for each subtopic. The students did not have to be on or near a computer to work. As Lucy pointed out, “The graphic organizer was part of the handouts, so I used it.” On the other hand, Charlie and Mary used *NoodleTools* to type their notes. Charlie’s poor handwriting motivated him to record his notes in *NoodleTools*. Mary created annotations about her sources for future reference in *NoodleTools*. The handouts did not have that affordance while the annotation field in *NoodleTools* did. However, the criteria documented on the graphic organizer handout directed Charlie and Mary to locate and evaluate information as they worked in *NoodleTools*. This was similar to their classmates’ behaviors. All the students used the graphic organizer to organize the slide order as they designed their presentations. On the other hand, the graphic organizer subtopic contents prompted students to reflect, analyze, and decide on the precise information they needed for their individual critter presentation.

The number of moves made in the assignment requirements category was fewer in Assignment 2. However, the requirements mediated student actions in a similar fashion. I noticed that one of the most important requirements in Assignment 2 that prompted students to reflect and discuss was the option to create a presentation or take a multiple-choice test. I observed and overheard some very thoughtful discussions among all the students, who weighed the pros and cons of creating a presentation versus taking a test. One group of students wrote on a scrap of paper the pluses and minuses of each choice before making a decision. I also overheard April affirm her decision by stating that she was not a good test taker. In response to April’s statement, many of her classmates nodded their heads in agreement. Meyers et al. (2009) propose that middle school

students are social beings and seek information from many sources, one of which is their peers. The social interaction among middle school students promotes developing their social self as well as gaining additional perspectives on which to reflect. Vygotsky (1987) suggests that oral language is the ultimate tool that mediates an individual's actions. The impromptu discussions and brainstorming motivated the students to evaluate their shared ideas and to make their own personal decision. Jerry said during his interview that he did not want to take the science final, because as he reported, "I heard that it [science final] was hard." Ultimately, five of the six participating students decided to create a presentation. The initial specific assignment requirement choice motivated the students to discuss, reflect, and decide what would be the best course of action for them. Similarly, to Assignment 1, after deciding on creating a presentation, Assignment 2's requirements prompted the students to reflect on and evaluate each of the required elements as they planned and worked on their presentation.

An important part of the assignment requirements that mediated student actions was the grading rubrics. Both assignments had grading rubrics, each with two sections. The first section defined the required presentation topic content and the second defined the required class oral presentation. The rubric criteria explained details for each portion of the assignment as well as the point value for each. Students received the rubrics at the beginning of the assignment so that there was no misunderstanding of the requirements. Ball (2012) proposes that rubrics act as more than assessment tool of the final product. Students use rubrics to analyze their progress through the assignment as well as the quality of their ongoing product. In both assignments, I noticed that the students used the rubrics in the manner observed by Ball. In Assignment 1, the students used the rubric to

evaluate and make sure they had included all the required elements. In her interview, Lucy remarked, “I used the rubric as a checklist.” Mary also physically checked off the required items as she worked. I observed Hector frequently referring to the rubric. He said in his interview, “I noticed on the rubric had a time, the number of minutes we had to have.” The individual rubric criteria prompted Hector to analyze the length of his presentation in order to be compliant with the required amount of time.

Similar student rubric use appeared in Assignment 2. The students frequently referred to their rubrics to evaluate their progress and the quality of their presentations as outlined by Ball (2012). April supported this observation by stating, “It [rubric] helped me to keep track of what I had.” The rubric criteria also prompted the students to determine and select elements they wanted to include in their presentations. For example, Assignment 2 requirements offered a choice of different elements described in the rubric as “literary devices” for the students to include in their presentations. Charlie noted in his interview that he used the rubric to make sure he had all the required elements. While working, he outlined each element he had completed. Charlie concluded by saying, “I have covered all that I need for the assignment.” The grading rubrics encouraged the students to reflect and evaluate their progress as well as the quality of their presentations to make sure that they had met all the assignment requirements. The rubric also criteria encouraged students to reflect and decide on the type of literacy element best suited their presentation, whereas the *PowerPoint* special features directed the students to problem-solve and select the font style and size that enhances their presentation.

Topic/visuals details. The topic/visual details category had mediating influence on student actions in both assignments. The topic/visual details content moves were higher in Assignment 2 than in Assignment 1. Ho et al. (2011) proposes that an individual in an inquiry-driven activity wherein the individual is in control of their learning and constructs new knowledge that is personally meaningful to them. The student-centered learning design of Assignment 2 encouraged the students to explore and examine more topic/visual details than Assignment 1. Newly discovered facts or images motivated students to reflect on and evaluate whether to expand their research by digging deeper into their topic. I noticed that the information that the students uncovered prompted them to pause, reflect, and decide how to adapt their presentations in light of what they discovered.

Assignment 1 had a more focused direction because of the structured requirements. However, one subtopic titled “interesting facts” opened the door for the students to go beyond the basics and explore their topic further. For example, Charlie discovered that some birdwatchers mistake a cormorant for a common loon. The topic/visual details that Charlie found about the two birds’ appearance did not fit any the subtopics except interesting facts. The bird misidentification information prompted Charlie to investigate further. He located images, analyzed them, and compared the loon and cormorant. Charlie said, “I could see where they [common loon and cormorant] could be mistaken. I wanted to show this to the class.” Ho et al. also notes the importance of images in conveying meaning to an audience. Visual details expand the options for learning beyond the written or spoken text. The two bird images provoked Charlie to analyze, compare, and decide on how to adapt and expand his presentation to

include the new information and images. On the other hand, Charlie's challenges in embedding hyperlinks *Prezi* motivated Charlie to problem-solve to allow him to share the loon call with his classmates.

Assignment 2 topic/visual details afforded more opportunities for the students to expand their research. Topic self-selection as Ho et al. (2011) suggests, motivates an individual to collect, analyze, and decide what topic/visual details to use in their presentation. In many cases, the facts and details the students located prompted them to pursue further information or revise their thinking based on what they discovered.

April's work on supernovas demonstrates for example demonstrates Ho et al.'s implications of how student-centered learning mediates an individual's actions. April read that scientists have been watching a particular red giant for several years. This information about the red giant prompted April to search further for the latest status on the red giant's condition. I heard her say in the screencast, "Wow, it [red giant] is one of the brightest stars in the galaxy. I am adding that to my notes." The new information about the red giant's brightness motivated April to reflect, evaluate, and include it in her notes. I noticed similar types of activity among the students throughout the project. The topic/visual details encouraged students to explore and revise as they worked. Ho et al. suggests that the interest in and control students have over their learning motivates them to problem-solve and in turn, has a positive influence on the individual's mental growth. As another example, Lucy discovered as she gathered examples of creatures that live in a coral reef that her subtopic was too narrow. In the screencast, I heard Lucy say, "Wait! Many of these [sea creatures] are not mammals. I will change my paper [presearch handout] to say, 'What marine life lives in a coral reef?'" The topic/details motivated

Lucy to reflect and reevaluate the scope of her subtopic. Based on her evaluation Lucy modified and expanded her subtopic to include all sea creatures and not just sea mammals. The topic/visual details encouraged April to reflect and decide to search further, whereas Lucy's details prompted her to reflect, reevaluate, and adapt her presentation content.

Notetaking/research. Previously I examined two categories where there was a pattern of tool use with different amounts of moves across both assignments. Notetaking/research category highlights a contrasting method of how students employed or did not employ tools that were available to them. Table 1 demonstrates how very little notetaking/research category played a role in Assignment 1. Smagorinsky (2011) suggests that tool appropriation occurs in a specific learning experience. Individuals have to see a need or reason to utilize tools in a particular situation. The need for students to utilize notetaking and research did not appear to students in Assignment 1. It is evident there was little opportunity for the students to expand or revise their notetaking and research. Only April, Charlie, and Jerry had content moves in this category though it was negligible. I noticed in the interviews and screencasts all three of the students' remarks in the notetaking/research were in regards to saving their work. For example, Jerry's prior experiences prompted him to reflect and decide how to maintain his information so he would not lose it. Jerry explained, "I lost my notes and had to start over." However, for Assignment 2, the notetaking/research category played a much stronger role.

Assignment 2's requirements offered more opportunities for notetaking and research to mediate the student actions. The less structured design of the assignment

allowed the students the freedom to plan, redesign, and adapt their research as they worked. Newell (2009) proposes that less structured problems are multifaceted and offer multiple solutions. I noticed at the beginning of the project that students struggled with deciding what they wanted to include in their project. However, as they worked I observed the students' subtopics or the facts that they wanted to share with their classmates evolving as they attempted to find information. The student-centered activity encouraged the students to reflect and problem-solve. For example, at the beginning of the project, Charlie directed his research to types of fossils. In his interview, Charlie outlined what his initial plans for his presentation: "I had to go to paleontology...how they [fossils] were made and what they tell us." However, he did not have much success with this plan. In the screencast, I heard Charlie mutter, "It is clear I cannot find anything." The lack of results prompted Charlie to pause, reevaluate, and revise his topic by modifying it from fossil types to fossil locations. Charlie's previous experiences at the Smithsonian directed him to explore and evaluate the museum's website, whereas his search terms prompted him to pause, reflect, and change his search terms for better results.

Charlie decided to change his focus and revisit the websites he had previously explored. Grisham and Wolsey (2006) propose that topics of high interest that are connected to an individual's life motivate them to reflect and problem-solve. Charlie came across a link from *BBC Nature* that led him to the La Brea tar pits of California. I noticed that he spent a considerable amount of time on the tar pit website. What Charlie discovered about the La Brea tar pits had a profound influence on his thinking. He said, "The tar pits helped me to understand how they [prehistoric creatures] got trapped in the

tar and the creatures that lived around the tar pits.” A video Charlie found on the tar pits website prompted him to include it as part of his presentation. I noticed that in his class presentation, Charlie adapted his slide content to include more about the tar pits than he originally intended when beginning to work on the project. The notetaking/research details encouraged Charlie to reflect, reevaluate, and problem-solve to create what he determined to be a well-rounded presentation on fossils.

Life experiences/interests. The final category that displayed a contrasting tool use across both assignments was life experiences/interests. Life experiences/interests had a smaller and more diverse number range in content moves than the notetaking/research category. Table 1 clearly shows that life experiences/interests category had no mediating influence on student actions in Assignment 1. Smagorinsky (2011) proposes that in a situated learning environment students have a reason to take up and utilize tools. In this case, the students did not have a reason for drawing on any life experiences/interests in Assignment 1. However, in Assignment 2, there was a small amount of influence, as shown by the small number of content moves. In comparing the two assignments in my field notes, I noticed during the Chesapeake Bay Critters project, students were not as engaged as they were in the science final. The students followed the assignment requirements to complete the project and they did add some interesting facts outside the basic required elements. However, I could sense they were interested but not as nearly as they were for the science final. For example, I overheard the April and Lucy discussing Assignment 1. They both agreed that their topic was acceptable but they wished they could have selected a more interesting critter. The nature of the Chesapeake Bay Critters project did not provide opportunities for student life experiences and interests to mediate

their actions, whereas the science final assignment encouraged the students to reflect and decide on an interesting topic of their presentation.

For example, all students shared in their interviews that their personal interests or a topic that struck their fancy was the reason behind their topic decision-making. Lucy and April did struggle in their topic selection, but overall, I noticed that the students were excited at the prospect of selecting their own topic. Thompson (2012) proposes that individual's interests encourage decision-making. Individuals attach importance to self-selected topics and are willing to investigate further. Hector said, "I am interested in it and so I know some other stuff about space." Hector's interest in space encouraged him to reflect and select the life of a star. Hector explained in his interview that one of his objectives of his presentation was to get his class to understand the length a star's life. Hector's topic encouraged him to reflect and decide on what exactly he wanted his audience to learn from his presentation. In a similar fashion, Charlie expanded his fossil presentation to include an examination of how the entertainment industry exaggerates prehistoric creatures' size for the sake of artistic creativity. Charlie explained, "I want to show using fossils real size and compare it to what is in the movies." Charlie's interest in fossils prompted him to reflect and analyze exactly how he wanted to compare the true size of fossils to the distorted movie versions.

As I reviewed the data, I expected to find that different *Prezi* and *PowerPoint* special features mediated student actions. However, this was not the case. Table 1 clearly demonstrates the mediating power of the assignment requirements had on student actions. Twenty-four percent of all the students' combined content moves appeared in the assignment requirements category. All six students also had the most number of

moves appear in assignment requirements category for Assignment 1. In Assignment 2, four out of the five students had assignment requirements as their third category with the most moves. Assignment 1's requirements were very specific and detailed, whereas Assignment 2 was more of a student-centered project where the students were in control of their learning. Grant and Branch (2005) suggest that assignment requirements act as a guide that directs individuals through each phase of the assignment. The assignment requirements design influenced how other tools mediated student action. For example, Hector sat and read the assignment handouts before beginning to work. He said, "I read through the packet to see what I had to do." The handouts motivated Hector to reflect and evaluate the assignment criteria and decide how he would complete the project. One student, April described Assignment 1's assignment requirements as a checklist. On further reflection, I had to agree.

Assignment 2, on the other hand, allowed for more student control of topic selection, content, and design of the presentation. Thus, the topic/visual details and notetaking/research categories were most influential categories for Assignment 2. The assignment criteria in Assignment 2 afforded more student creativity and tool use than Assignment 1. The less structured design prompted students to self-select their topic, determine what they wanted to share with their audience, and decide how to arrange their presentation. Neo and Neo (2009) propose that project based-learning, such as what Assignment 2 offered, encourages problem-solving, reflections, and creativity. As an example, Lucy decided to use *Prezi* for her presentation on coral reefs. I overheard her tell a classmate that she thought the *Prezi* transition feature emulates ocean waves. In the end, the assignment design and criteria requirements motivated the students to problem-

solve, reflect, and make decisions as they worked through each class assignment, which in turn fostered their critical thinking and mental growth.

CHAPTER 5: DISCUSSIONS AND IMPLICATIONS

When I started on this journey, I expected to find that the special features of *Prezi* and *PowerPoint* would have a significant impact on student activities. What I found, however, was entirely different. At first, I was disappointed – but what I did discover was fascinating. My findings indicated that a variety of tools mediate my students' actions, especially assignment requirements. Interestingly, I noticed that the assignments requirements played a part in how the students took up various tools to complete their assignments. In this final chapter, I will construct an explanation of my findings with suggestions for literacy and library educators regarding how tools mediate how adolescents conduct their research.

Findings Summary

The objective of this study was to examine how presentational tools mediate student action. Instead, what I had the pleasure of observing was how the requirements of a highly structured assignment and a less structured assignment worked differently to motivate students to employ various tools to complete each assignment. I recognized that investigating the assignment design was not an objective of this study, but its importance became apparent early on as I closely watched the students work. Both assignments provided a window for me to observe actual tool use in action. As noted in the introduction, I suspected something was occurring with students' thinking and learning but was not sure what it was. However, prior to this study, I had little opportunity to examine what tools mediates the thinking and decision-making of a students. By conducting this study, I was able to do to get a glimpse of what Vygotsky's (1987) theory

of how cultural tools mediate individuals' actions. It was exciting and gratifying to say the least.

I observed several of Vygotsky's (1987) descriptions of adolescents in the transitional stage of growth in the participating students' actions. For example, Vygotsky suggests that individuals learn more effectively in a situated learning experience with authentic, hands-on tool application. Individuals who take up tools during a real life application allows them to draw on prior experiences and knowledge to problem-solve as they work in the new learning experience. A prime example of prior knowledge mediating action in this study was the previously learned web evaluation strategies that they applied during both projects. Vygotsky argues that prior knowledge puts new conditions on the individual's thought process and promotes mental growth. The assignment designs of both the Chesapeake Bay Critters project and the Science Final project promoted student problem-solving and decision-making in line with what Vygotsky suggests occurs during individuals' learning experiences. In other words, the students practice strategies and skills in a real-life application, wherein the teachers and librarians are there to assist and guide them. Witnessing students be in control of their learning was one of the most satisfying aspects of this study. I watched students make their own decisions and not rely on Mrs. Cavender or myself. Students did have the proper instructional supports suggested by Vygotsky to guide their actions, but how they interpreted and used those supports was entirely up to them. The students asked questions, but I noticed that the questions clarified a point or cleared up a misconception.

Assignment 2 provided the students with more opportunities for the kind of learning advocated by AASL (2007): drawing conclusions, making informed decisions,

and becoming productive members of the global community. The less structured assignment design prompted students to use various tools that encouraged problem-solving and reflection, which in turn promoted their critical thinking. Again, the student-centered learning experiences with a self-selected topic reinforced the student inquiry research that AASL encourages. Vygotsky (1998) explains that adolescents in the beginning of the transitional stage merge concrete and abstract thinking. During the study, there were moments that the students' thinking followed a logical order, such as the systematic assignment directions that encouraged them not to think beyond the handout instructions. However, the varied tools the students employed influenced their critical thinking – even if it was very simplistic in nature. For example, Charlie's discovery of the common loon and cormorant images prompted him to evaluate and compare the similarities and differences of the two birds. Based on his reflection and evaluation, Charlie decided he understood how the misidentification could happen and included this as part of his *Prezi*. Here is an example of the beginning of the transition stage that Vygotsky (1997) outlines for this age group. Vygotsky describes that adolescents reach a stage in which they are beginning to think in concepts but only at basic level. The participating students' thinking slowly moved towards the abstract, such as when Lucy reflected on, evaluated the three coral reef types, and then amended how she presented the differences. The students did not rely on adults to make their decisions but rather made their own critical judgments and analyses.

The final positive experience that stood out in my reflection was the student interactions and discussions that occurred during the study. Vygotsky (1987) proposes that oral communication is one the most effective tools that society has to offer. The

student actions during the study demonstrated just how well oral discussion mediates individuals' behavior and mental growth. The students collaborated, brainstormed, supported, and pushed each other every step of the way. Throughout the study, I highlighted examples of student discussion and interaction, demonstrating how language mediates human behavior. I marveled at how the students discussed and problem-solved to address the challenges that they faced. One example was the students' serious discussion in which they weighed the pros and cons of taking a science final test versus creating a presentation. Again, I was awestruck to see a visible example of what Vygotsky described. By watching and listening closely, I was able to witness how culturally designed tools mediated student actions and mental growth. As with any study, along with the positives there are drawbacks. In the next section, I will examine the positives and what I would have changed given what I know now.

Implications for Research

Study Positives. While I was conducting the study, I made mental notes of what I liked and what worked. The age group that I selected for the study was a pleasure to work with. Eighth graders are in the transitional age range displaying the actions and behaviors that Vygotsky (1998) defined. I have always thought that eighth-grade students are interesting and fun to work with. They are willing to try new things, have a sense of humor, and still enjoy activities that some might describe as elementary. On the other hand, eighth graders are beginning to transition in their thinking and actions from concrete to abstract. Thus, they are willing to attempt activities that are more complex and challenging. Vygotsky (1998) describes this as the "middle ground" between a child

and a young adult (p. 27). I like studying this middle ground and would work again with the same age group.

A data collection method I found valuable during the study was the visual observation and casual listening that I describe as eavesdropping on student conversations. The observations provided an expanded view of student actions and physical movements throughout the library that the screencasts might not have captured. All of the students in the school, including those who participated in the study, are accustomed to my presence while they are in the library. My standing nearby, watching, or listening did not inhibit their actions or discussions. However, the conversations added or confirmed earlier students' discussions and actions. The conversations I overheard, similarly to my observations, added another layer of student actions and thoughts that may have not appeared in the student interviews or screencast dialogues.

If given the opportunity to replicate the study, I would definitely use *Screencast-o-Matic* or a similar program again to record the computer screenshots and student dialogue as one method of data collecting. *Screencast-o-Matic* was an easy program to use and it provided clear screenshots and voice recordings. The free version of the program did not pose any challenges to the students recording or myself when replaying. The recordings were especially helpful during the student interviews. They provided visual as well as audio data to discuss. During the interviews, the screencasts prompted students to analyze their actions by pointing something out on the screen to clarify or emphasize a statement. The program thus added another dimension to the interviews. The students enjoyed using the program, and its use did not hinder as the students worked on the assignments.

The most valuable data collection method during the study was the stimulated recall interviews. The interviews, coupled with reading the interview transcripts and viewing the screencasts, provided me with a rich amount of data from my students. The students were also amazed by what they said and did during the screencasts. As mentioned, the screencasts encouraged the students to analyze their actions. Their careful reflection provoked considerable discussion during the interviews evoking more insight into their thinking. The student interviews and discussions were another example of Vygotsky's (1987) belief that oral language is a valuable cultural tool that encourages reflection in individuals. I should point out that the participating students were not shy in sharing their thoughts and opinions. They were thoughtful and serious throughout the interviews and the study.

Study Changes. As with all studies, there are items that I would change if given the opportunity. Upon reflection, I would maintain the foundation of the research questions and I would still investigate how student tool use and the special features of *PowerPoint* and *Prezi* mediate adolescents' approaches to conducting research to answer an informational need. However, instead of the free *Prezi* version that was used in this study, I would invest in the subscription edition. Students had difficulties with the free version and the challenges added to the frustration for some students. Two major issues students faced with their *Prezi* presentations were presentations disappearing and the inability to embed hyperlinks into frames. April, as well as other students, lost their completed *Prezi* presentations. Despite following the publish/save function, their presentations files vanished. April had to recreate her presentation the night before it was due in class. Additionally, none of the students could embed a hyperlink in the *Prezi*

frames, as the function of embedding a hyperlink is not available in the free version. Charlie problem-solved to overcome this obstacle, but having to do so enhanced his dislike of *Prezi*. A subscription account would help eliminate these challenges and offer additional special features for students to use.

Technology aside, there are four aspects of the study I would amend to gain a wider vision of tool meditation in eighth-grade students. For this study, I recruited six students who were advanced readers and writers. Because of this, I was left with the question of how cultural looks mediate the actions of students who are not advanced reader and writers. To examine tool use in students with varied reading and writing abilities, I would increase the number of participants to eight to ten students and have a more diverse representation of basic, proficient, and advanced readers and writers. I would still omit students with Individualized Educational Program (IEP) and Gifted Individualized Educational Program (GIEP). A more academically diverse group of students would provide a larger and more accurate snapshot of tool use in eighth-grade students. Though the results of such a study may end up being similar to the findings of this study, the idea is worth pursuing.

In addition, I would have allowed the students to have more control over selecting the content area instead of limiting them to one subject. I would allow students to self-select two assignments from any of the three core subjects of social studies, language arts, or science. By expanding the student self-selection to a higher degree, deeper student engagement could have been achieved. For example, Charlie and Mary would have preferred the content area of American History instead of Earth Science. Allowing students to select the content area for the study would tap into the students' personal

preferences and interests. Vygotsky (1998) explains that interests begin to change and new ones appear during adolescents' biological and socio-cultural maturation. He suggests that building learning experiences upon students' personal interests provides an avenue for instructional strategies that promote tool use. In addition, I would expand the number of teachers involved in the study. Having more adults involved in the study would bring a wider perspective to the analysis. A higher number of teachers as part of the study would allow for more and different eyes on student actions. This in turn, would provide additional adult perspectives of student actions as well as observations that I may not notice. Each teacher would bring to the study their own teaching style and connection with their students that mediate student action. The teacher and student conversations would, as a result, provide more opportunities to observe the cultural tool that Vygotsky believes was most important in promoting mental growth.

Students also would have had more freedom to create a presentation if they were permitted to use tools of their choice. Adhering to the same student-inquiry research foundation, I would keep the two types of assignments: highly structured, and a less structured research assignment. However, I would also add a third assignment in the middle of the school year. I would space the assignments out within the school year: the first assignment located in early in the first semester, the second assignment in the middle of the year, and the third one located at the end of the school year. The goal of this design would be to gain an understanding of tool development over a period of time. Vygotsky (1987) suggests examining the progress of cognitive development, not the final product, is most useful. Over an eight-month period, I would hope to see tool use slowly develop as well as the mediating influence on students' cognitive growth.

Future Studies. If I had the opportunity to examine tool use in studies, I would employ several of the changes that I mentioned in the previous section. Reflecting back on Vygotsky (1987), the adolescent transitional age is a journey of social, physical, and cognitive development that occurs not overnight but rather over an extended period of time. Designing a study that examines student tool use and their mediating impact on thinking over a two-year period would capture a broader picture of such action.

Beginning with two assignments in eighth grade and concluding with two assignments in ninth grade, researchers would gain insights into how cultural tools mediate adolescents' actions over the transitional period.

One of the foci of my study was the mediating influence of *Prezi* and *PowerPoint's* special features on student actions. In a future study, I would examine the special features of other presentational tools. My study examined presentational tools that were primarily two-dimensional. In today's classrooms and libraries, students are taking up and using a wide variety of tools such as *Weebly*, *Flash*, and *Camtasia* to create presentations for class assignments. The addition of different presentational tools would allow students to step beyond the two-dimensional and use video production programs for their presentations. Additionally, *Office 365* and similar collaborative programs allow students to collaborate on projects and assignments. Vygotsky (1987) proposes that oral discussion and interaction is one of the most valuable tools in promoting cognitive development. Collaborative assignments, in which pairs or triads work together towards a common final product, would offer another opportunity to examine the mediating influence of cultural tools and collaboration on adolescents' cognitive development.

Implications for Practice

Implications when working with teachers. The study's findings have implications and possibilities for literacy educators, especially library professionals. The educational mission of school librarians as described by AASL (2007), is to encourage, promote, and teach students to become lifelong readers, writers, and problem-solvers. Teaching students to be effective users of information is not new to librarians but examining how cultural tools mediate student action may be for some. Gaining a Vygotskian perspective of how students use language, writing, and other cultural tools provides another view of how students learn and grow. For example, during the study, I recognized in greater detail the importance of collaborative discussion. I had always noted what I defined as "constructive discussion" among students. Students talking about their project, sharing ideas, and giving suggestions to their classmates act as they worked as valuable learning tools. The study's results made even clearer to me constructive discussion's vital importance. Therefore, I plan to promote the notion that oral discussion, as Vygotsky (1987) reminds us is a crucially important learning tool in my future work with teachers and students. Smagorinsky (2013) argues that literacy educators need to allow all students the time to discuss and brainstorm as they work their way through an idea. Sometimes in the rush of all that educators must accomplish in a day's schedule, the exploration derived from conversation during a learning situation is lost. Educators need to find an avenue to include that in their plans.

However, educators have to contend squeezing in one more item into an already tight schedule. I noticed during the study that the science final assignment requirements offered students more opportunities to reflect and problem-solve as compared to the

Chesapeake Bay Critters assignment. As a school librarian, I have the opportunity to collaborate with content teachers in the design and implementation of research-based instructional units. Based on the results of this study, in our future planning stages I will promote the concepts that Vygotsky (1987) states is the avenue for meaningful learning experiences: the student centered, hands-on activities that promotes cultural tool use. AASL (2007) standards for the 21st century learning recommend moving from highly structured activities to less structured learning experiences, as described by Newell (2009). This does not mean allowing students free rein, but rather creating inquiry-based projects and activities that promote critical thinking and problem solving.

With that in mind, I plan to suggest to teachers to slow down project timelines and add the inquiry-based research element to the assignment. As an example of this, during my study the students engaged in impromptu brainstorming session when they had to decide whether to take the science final or create a presentation. Teachers will be encouraged to make this small adjustment to the length of the unit and allow extra time for in-depth discussion and decision-making. The additional time would also allow students to employ and practice the cultural tools that are so important. For example, I reviewed the Chesapeake Bay Critters assignment based on what I discovered in the study. Instead of five days for the assignment, I would suggest six days be afforded, and I would modify the assignment to include criteria that addresses student interests, emotions, and social wellbeing and development. In the past, these options were not always part of the instructional plan, but should be in the future.

An example of how I put into practice what I discovered during the study occurred in the semester following the conclusion of the study. The fifth-grade reading

teachers and I designed a research project where the students researched a person described as a highly successful role model or leader. Traditionally, the students worked individually on a self-selected notable individual. However, this year the teachers and I paired students together and they collectively selected a person to research. The students took turns reading aloud to each other from a variety of suggested resources. At the conclusion of each reading session, the students discussed, analyzed, and problem-solved what they had read in relationship to the subtopic or heading on the notetaking graphic organizer. At the end of each discussion, the students completed their own graphic organizer and ultimately a final project. The teacher and I discovered that the students' notes and final projects demonstrated a higher level of student analysis and writing as compared to the past. However, to achieve result, the teacher, and I only needed to add one class period – 40 minutes. Smagorinsky (2013) suggests that extra time allows students to explore, discuss, and write as they develop their thoughts and ideas about a problem.

As a librarian, my goal is to promote students' critical thinking and decision-making. I also want to instill the AASL objectives in students across all content areas. I discovered that less structured assignments, such as the science final, promote problem-solving and critical thinking in students. Based on this discovery, I now encourage and recommend that teachers to adapt curricula to include student-centered, inquiry-based activities in their research units that allow students to take control of their learning. Putting reading and writing aside, I need to keep examining what other cultural tools students use and how they use them in the course of their learning. I also need to continue to promote effective tool use through multiple balanced learning experiences for

students. By balanced, I mean a blend of the traditional tools that Vygotsky (1987) encourages as well as the new tools that are an important part of today's society. I discovered that students used a wide variety of resources during their research. They did not want to overlook any possible information that could help with their project. Students demonstrated this during the Science Final assignment and to a lesser degree in the Chesapeake Bay Critters assignment. Teachers and librarians do not know what resources students may use. I suggest a varied selection of resources be available to be available to meet the individuality of their students. Vygotsky also suggests that tool growth occurs with practice and over time. Having several real life learning experiences motivates students to practice and apply those tools, slowly move towards mastery. I noticed far less problems with tool use in the Science Final as compared to the Chesapeake Bay Critters assignment. Nothing is more gratifying than to watch and help my students as they read, and write on topics that are so engaging they lose track of everything else. When students start to control their tool use and learning, I know I have accomplished what I set out to do.

Implications for working with preservice teachers. As a teacher educator working with preservice elementary teachers and school librarians, I have discovered that they have similar characteristics as veteran classroom teachers in regards to libraries and library resources. Pajares (1993) suggests that preservice teachers come into the education field with preconceived perceptions and experiences from their own K-12 schooling. For some, those perceptions also include those about libraries. In many cases, these experiences are neutral or negative. I have been on the receiving end of those neutral perceptions during my time in education. Preservice teachers rarely have

knowledge of what a librarian has to offer or what information literacy curriculum is.

Asselin and Lee (2002) suggest that many preservice teachers are overwhelmed with all the responsibilities of student teaching, so they have a tendency to overlook libraries and their curriculum. As a teacher educator, I will include library resources and information literacy as part of the coursework.

During the study, I discovered that Mrs. Cavender was not aware of several library resources that are available for students. As a part of the unit planning, I introduced to Mrs. Cavender to these resources and their benefits for students. Throughout the study, I reminded or introduced students to resources that helped with their assignments. I plan to do a similar introduction for preservice teachers and librarians, as well outline how information literacy ties into the Common Core standards. I will also demonstrate how the standards and collaborating with a school librarian has a positive influence on student learning. My primary teaching experiences have been at the secondary level but I will advocate to my preservice students to integrate in the use of varied library resources and information literacy skills, across all content areas, and grade levels in their classrooms and instructional plans. My suggestions reflect what I uncovered during this study but also Vygotsky's (1987) belief that tool application occurs overtime and with practice in many learning experiences.

Asselin and Lee (2002) propose that teacher education coursework include opportunities to collaborate with a school librarian on a small research unit. The authors suggest that working with a school librarian provides preservice teachers with practical experience in creating a student-centered research activity that uses a wide variety of resources. Students' varied resource use was evident throughout this study. I noticed

that students selected different types of resources that, in their opinions best met their informational needs. I will encourage the same with preservice teachers and introduce how a less structured assignment design promotes more effective tool use in students than a highly structured assignment. In the comparison of the two assignment designs, I will stress the importance of student inquiry-based learning experiences have such a positive influence on student actions. In addition, I will emphasize how students need time to discuss, practice, and apply their emerging tool appropriation.

Asselin and Lee (2002) and Roux (2008) suggest that one of the more challenging aspects that school librarians face is getting classroom teachers to collaborate on an integrated instructional unit. I mentioned earlier how important it is for students to engage in collaborative discussions. Preservice teachers need the same. I plan to encourage preservice teachers to collaborate, discuss, and plan with a librarian or another teacher. Just as I discovered that informal discussions that I overheard during the study motivate students to reflect and make decisions, preservice teachers need the same opportunity. The real application of Vygotsky's (1987) theory of tool mediation applies to preservice teachers as much as it does for eighth graders. Both preservice teachers and eighth graders are a work in progress. They need the time to practice and slowly appropriate the cultural tools that they need to be successful in the classroom and in life.

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APPENDIX A

CHESAPEAKE BAY CRITTERS ASSIGNMENT AND GRADING RUBRIC

It's time for research! You will be randomly assigned an organism of the Chesapeake Bay. Through your research, you will become the resident expert on your organism.

Be sure to include information concerning:

- ☞ The organisms common name/ Scientific name (genus and species)
- ☞ Description of habitat
- ☞ How it obtains nourishment (what it eats)
- ☞ Role in the food chain (what level in the food chain/who eats it/predator/ prey/consumer/ producer)
- ☞ Appearance of the organism
- ☞ Life cycle (be VERY specific)
- ☞ Status (this category varies widely by organism. Possible topics include how it is affected by pollution, population size changes, endangered, harvested, etc. An example would be if you were being overharvested to the verge of extinction.)
- ☞ Interesting facts (wonderful or astounding things about your organism)

Project options:

1. Create a presentation using *Prezi* or *PowerPoint* highlighting your organism and its' specific information.
2. Design a website for your organism. The website should be informative, creative, and entertaining. Weebly.com, wix.com, or Google Sites are all great sites to use to complete this option.
3. Create an informational flyer using Microsoft Publisher. This option allows for a wide range of creative ideas.
4. Student choice: If you have a different idea on how to present information about your critter, please discuss your idea with your science teacher and gain approval first.

****All options must include a bibliography with at least 3 resources. Bibliography must use the correct format and include citations for where you obtained your information and pictures for your project (use Noodle Tools).**

****PLEASE REFER TO THE ATTACHED RUBRIC FOR PROJECT GRADING AND EXPECTATIONS!****

<i>Some Chesapeake Bay Organisms</i>				
Red-jointed Fiddler Crab	Canada Goose	Striped Bass	Sea Nettle	Channel Catfish
Copepod	Herring Gull	Mummichog	Sea Squirt	Alewife
Horseshoe Crab	Green-backed Heron	American Eel	Common Sea Star	Bluefish
Dragonfly	Marsh Periwinkle	Blenny	Eastern Oyster	Cattail
Black-fingered Mud Crab	Great blue Heron	Green Goby	Redbeard Sponge	Oyster Toadfish
Banded Hermit Crab	Loon	Lined Seahorse	Moon Jellyfish	Atlantic Silverside
Barnacle	American Widgeon	Summer Flounder	Water Stargrass	Atlantic Menhaden
Bay Anchovy	Mallard	Northern Puffer	Muskrat	Marsh Fiddler Crab
Sand Fiddler Crab	Snowy Egret	Spot	Smooth Cordgrass	Blue Crab
Nine-spined Spider Crab	Sanderling	American Shad	Widgeon Grass	Eelgrass
Macoma Clam	Osprey	Pipefish	Atlantic Ribbed Mussel	Downy Woodpecker
Grass Shrimp	Red-winged blackbird	White Perch	Broad-clawed Hermit Crab	Atlantic Croaker
Canvasback Duck	Belted Kingfisher	Atlantic Needlefish	Black-crowned Night Heron	Pipefish

Category	4	3	2	1
Preparedness	Student is completely prepared and rehearsed. (Did not read frames to the class.)	Student seems pretty prepared but might need a couple more rehearsals. (Some information was read from the frames.)	Student is somewhat prepared, but is clear that rehearsal was lacking. (Presentation was incomplete or student read most of the frames to the class.)	Student does not seem prepared to present.
Presentation	Presentation includes a variety of color, animation(s), or graphics to improve the understanding of what is being presented.	Most of the presentation includes color, animation(s), or graphics to improve the understanding of what is being presented.	Less than half of the presentation includes color, animation(s), or graphics to improve the understanding of what is being presented.	Presentation does not include any color, animation, or graphics to improve the understanding of what is being presented.
Volume	Volume is loud enough to be heard by all of the audience throughout the entire presentation.	Volume loud enough to be heard by the audience 90% of the time.	Volume loud enough to be heard by the audience 80% of the time.	Volume often too soft to be heard by all audience members.
Posture and Eye Contact	Stands up straight, looks relaxed and confident. Establishes eye contact during presentation.	Stands up straight and establishes eye contact during the presentation.	Sometimes stands up straight and some establishes eye contact.	Slouches and/or does not look at the audience.
Comprehension	Student is able to accurately answer almost all the questions posed by classmates or teacher about the topic.	Student is able to accurately answer most questions posed by classmates or teacher about the topic.	Student is able to accurately answer a few questions posed by classmates or teacher about the topic.	Student is unable to accurately answer questions posed by classmates or teacher about the topic.
Topic Content	Shows complete understanding of the topic.	Shows a good understanding of the topic.	Shows a good understanding of parts of the topic.	Does not understand the topic very well.
Information on Frames	Obvious effort was used to limit the amount of information on the frames.	Noticeable effort was used to limit the amount of information on the frames properly.	Some effort was used to limit the amount of information in the frames properly.	Little or no effort was used to limit the amount of information on the frames properly.
Works Consulted	3 or more sources documented in correct MLA format including pictures and graphics.	3 sources but NOT documented in correct MLA format or missing information.	LESS than 3 sources documented in MLA format.	NO sources documented.
Time Limit	Presentation is 2-5 minutes long.	Presentation is 1-2 minutes long.	Presentation is less than 1 minute – 30 seconds long.	Presentation is less than 30 seconds OR more than 5 minutes long.

Note sheet/ Graphic organizer

<p>Common name</p>	
<p>Scientific name Underlined or italicized with only genus capitalized</p>	
<p>Habitat Abundant and accurate details of where your organism lives</p>	
<p>Nourishment Identify consumer vs. producer and explain specific food source</p>	
<p>Role in food chain (who eats it) Details about place in food chain</p>	
<p>Life cycle Abundant and accurate details</p>	
<p>Special circumstance Abundant and accurate details about a special feature or characteristic</p>	
<p>Excellent trivia Intriguing and surprising information not required in another category</p>	

APPENDIX B

SCIENCE FINAL ASSIGNMENT AND GRADING RUBRIC

8th Grade Science Final Project

This major project is to be completed as an option instead of the final exam. This is a major project worth 200 points. Students will investigate a topic from one of the units covered throughout 8th grade science to gain a deeper understanding. In order to receive maximum credit on this project, students will need to create, design, and deliver a professional presentation. Presentations should include an activity for your classmates to complete while viewing your presentation. Be educational, be entertaining. Teach us something new!

<p style="text-align: center;"><u>"A" Additions:</u> <u>Complete at least 2 of the additions listed below.</u></p> <p>Write a reflective essay regarding how this topic relates to the world around you and your everyday life.</p> <p>Interview a qualified scientist/person working in the field of your topic.</p> <p>Include contact information and a copy of your correspondence (letter, email, audio, etc...).</p> <p>Compare your topic to something you have learned in another class this year.</p> <p>Design a website that highlights your topic. Your presentation should be available on your website.</p> <p>Create a video, podcast, or screencast.</p> <p>Make a comparison to a character or literary selection in something that you read either on your own or during a previous school year.</p>	<p style="text-align: center;"><u>Base Requirements ("B" Category):</u></p> <ol style="list-style-type: none"> 1. Develop a multimedia class presentation using a <u>minimum of five cited sources</u>. 2. Deliver a <u>thorough</u> presentation to the class that includes excellent eye contact, posture, volume, and projection. 3. Incorporate the use of a literary device (news or magazine article, commercial, video clip, song, advertisement, etc) into your presentation. 4. Create a way of collecting feedback from your peers (preferably electronic). <p><i>***Students are not guaranteed the letter grade that they agreed to or contracted for.</i></p> <p><i>***Science Fair students are only required to complete #1 and #2 of the base requirements, but can supplement their project with additions per letter grade.</i></p>
<p>Incorporate the use of a <i>SECOND</i> literary device into your presentation. (news or magazine article, commercial, video clip, song, advertisement, etc). Advertisements in the media can sway personal decisions. Find at least TWO ads that try to convince people to think and/or act a certain way about your topic.</p> <p>Find a poem written by an author that shares a similar experience about your topic and discusses the connection between this author's experience and your own.</p> <p>Find a free app that connects to your topic. Evaluate this app and explain how it can be used in science class.</p>	<p style="text-align: center;"><u>"C" Category:</u></p> <p>In order to be considered for a "C" on this final project, the student must complete items #1-3 on the basic requirement list.</p> <p style="text-align: center;"><u>"D" Category:</u></p> <p>In order to be considered for a "D" on this final project, the student must complete items #1-2 of the base requirements above in their entirety.</p> <p>This grade category is also used for students who complete ALL of the base requirements listed above but they decline to give a speech to the class.</p> <p style="text-align: center;"><u>Grade of Zero:</u></p> <p><i>The student did not complete a final project for eighth grade Science</i></p>

Science Final Project Rubric

Base Requirements:

Multimedia Class Presentation _____ / 100 points
(See attached Presentation Rubric for specific point values)

Citation of 5 or more primary sources _____ / 15 points
(Images need to be cited, but do not count towards to the 5 required citations)

Use of literary device _____ / 20 points
(Video, Poem, Article, Song, etc... needs to be included in citations but does not count towards the required 5 citations. Student must reflect and refer on the literary device in their presentation.)

Method of collecting feedback _____ / 20 points
(Quiz, Poll, Handout, or some other approved method)

Presentation mechanics _____ / 15 points
(See attached Presentation Rubric for specific point values)

Base Requirement Total: _____ / 170 points

"A" Additions:

Addition #1 _____ / worth a possible 15 points

Addition #2 _____ / worth a possible 15 points

Final Project Total Score _____ / **200 points**

Science Final Project Presentation Rubric

Category	Scoring Criteria	Total Points	Score
Organization (15 points)	The type of presentation is appropriate for the topic and audience.	5	
	Information is presented in a logical sequence.	5	
	Presentation appropriately cites requisite number of references.	5	
Content (45 points)	Introduction is attention getting, lays out the problem well, and establishes a framework for the rest of the presentation.	5	
	Technical terms are well defined in language appropriate for the target audience.	5	
	Presentation contains accurate information.	10	
	Material included is relevant to the overall message/purpose.	10	
	Appropriate amount of material is prepared, and points made reflect well their relative importance.	10	
	There is an obvious conclusion summarizing the presentation.	5	
Presentation (40 points)	Speaker maintains good eye contact with the audience and is appropriately animated (e.g., gestures, moving around, etc.).	5	
	Speaker uses a clear, audible voice.	5	
	Delivery is poised, controlled, and smooth.	5	
	Good language skills and pronunciation are used.	5	
	Visual aids are well prepared, informative, effective, and not distracting.	5	
	Length of presentation is within the assigned time limits.	5	
	Information was well communicated.	10	
Score	Total Points	100	

Teacher Comments:

APPENDIX C

STUDENT TECHNOLOGY SURVEY

How often do you use a computer to complete the following tasks? Check the response that most accurately describes how often you use each of the following software programs or tools:

	Never	Once or Twice a Year	Monthly	Weekly	Daily
Word process a document					
Perform calculations with spreadsheets					
Create presentations					
Produce multimedia projects					
Use library resources for information					
Search for information on the Internet					
Communicate through email					
Use class management programs					
Work with graphics and pictures					

When using each of the following software programs, check the statement that most accurately describes how much help you need. Skip questions concerning application that you have not used.

	I always need help.	I sometimes need help.	I rarely need help.	I never need help.	I can help other people.
Word processing (e.g. <i>Word</i>)					
Spreadsheet (e.g. <i>Excel</i>)					
Presentation software (e.g. <i>PowerPoint</i>)					
Databases (e.g. <i>SIRSDiscoverer</i>)					
Multimedia (e.g. <i>Weebly</i>)					
Internet (e.g. webpages)					
Email (e.g. <i>Outlook</i>)					
Class Management Systems (e.g. <i>Schoology, Moodle</i>)					
Work with graphics and pictures					

Adapted from Learning and Support Laboratory University of Georgia College of Education

APPENDIX D

SUGGESTED INTERVIEW QUESTIONS

What made you think that?

Tell me more about...

Why did you do that?

I noticed you began the search in this manner. Why did you do this?

What made you think that was useful?

Why did you eliminate that from your consideration?

What made you go in that direction? Why?

Can you expand on that statement?

Is this always the way you approach something like this? If not? What other approaches do you use and why?

What are you thinking about this item?

You haven't said anything for a bit. Tell me what you are thinking.

How does this compare to what you have been taught?

How did you know that this was a good idea or piece of information?

I noticed when you started, the first thing you did was..... Can you tell me why you did that? Did you think about doing anything else? If you did, what made you go this route?

I noticed between the two activities some similarities/differences, Can you explain why?

I noticed when you began the task by doing...Is this the way you always start? Can you tell me how you came to make that part of the way you do research?

What do you have to say concerning this?

What do you think is happening here?

Additional questions may be generated at the time of interviews depending on the responses.

APPENDIX E

SUGGESTED STUDENT PSEUDONYMS

Female Names

Anna

April

Bess

Betty

Caroline

Elsie

Jill

Joan

Kitty

Lucy

Marjorie

Mary

May

Molly

Nancy

Polly

Robin

Ruth

Sally

Sarah

Male Names

Ben

Bobby

Charlie

David

Dunstan

Fred

George

Greg

Hector

Jack

Jerry

Jim

Joe

John

Luke

Mark

Matthew

Simon

Tommy

Will

APPENDIX F
PRESEARCH TOPIC WORKSHEET

Research Topic: _____

Questions

Write 10 questions about your topic. (Who, What, When, Where, How, and Why)

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

8. _____

9. _____

10. _____

Keywords

List possible search terms.

1. _____

2. _____

3. _____

Adapted from Princeton University Humanities Library