An Analysis of the Higher Order Thinking Requirements of a Grade 8 Online-Based English Language Arts Skills Program

Paige D. Sydoruk
paige.sydoruk@student.shu.edu

Follow this and additional works at: https://scholarship.shu.edu/dissertations

Part of the Curriculum and Instruction Commons, Educational Assessment, Evaluation, and Research Commons, and the Educational Leadership Commons

Recommended Citation
https://scholarship.shu.edu/dissertations/2495
An Analysis of the Higher Order Thinking Requirements of a Grade 8 Online-Based English Language Arts Skills Program

Paige D. Sydoruk

Dissertation Committee

Christopher Tienken, EdD
Anthony Colella, PhD
Dario Sforza, EdD

Submitted in partial fulfillment of the requirements for the degree of Doctor of Education
Department of Educational Leadership, Management, and Policy

Seton Hall University
2018
© 2018 Paige D. Sydoruk

All rights reserved
SETON HALL UNIVERSITY
COLLEGE OF EDUCATION AND HUMAN SERVICES
OFFICE OF GRADUATE STUDIES

APPROVAL FOR SUCCESSFUL DEFENSE

Paige D. Sydoruk, has successfully defended and made the required modifications to the

Dissertation Committee
(please sign and date beside your name)

Mentor:
Dr. Christopher Tienken

[Signature] 3-10-18

Committee Member:
Dr. Anthony Colella

[Signature] 3-10-18

Committee Member:
Dr. Dario Sforza

[Signature] 3/11/18

The mentor and any other committee members who wish to review revisions will sign
and date this document only when revisions have been completed. Please return this
form to the Office of Graduate Studies, where it will be placed in the candidate’s file and
submit a copy with your final dissertation to be bound as page number two.
ABSTRACT

Higher order thinking skills have been embedded into state teaching standards, including Standard 9 of the New Jersey Core Curriculum Content Standards (NJCCCS) for 21st Century Life and Careers. These standards aim to encourage problem solving, critical thinking, reasoning, and real-world application in order to prepare students for the workplace and are expected to be embedded consistently in classroom practice and learning. With the promotion of Standard 9 in New Jersey schools, technology has become a paramount tool because of its multitude of capabilities. Over the years, private companies have begun developing online-based programs catered to building content area skills as well as higher order thinking skills.

Although these online-based programs have gained popularity in recent years, there is little research conducted on the effectiveness of these programs, the validity of the claims made by these private companies, or the types and frequency of tasks that promote higher order thinking skill set development embedded in such programs. The objective of this study was to describe the level and distribution of cognitive complexity within an online-based program using a qualitative content analysis. This program, given the pseudonym of HOT Learning, markets itself as promoting higher order thinking skillset development among students Grades K–8. Two coders utilized Hess’ Cognitive Rigor Matrix to examine 231 questions from the HOT Learning program following the double-rater read-behind consensus model. These questions aligned with NJCCCS for Grade 8 English language arts. The findings in this study showed that the majority of questions did not place into higher order thinking cells within Hess’ Cognitive Rigor Matrix.

This study serves as an examination of online-based programs that market the development of higher order thinking skills, raising a need for critique of these programs from
school administrators and stakeholders before the purchase and implementation of such programs. There is a need for school personnel to examine these programs in order to decide on one that best meets students’ needs and the intended goal of how the program would be used. It is suggested that adequate supports in the form of professional development and training be put in place in order to facilitate teacher use of these programs. Furthermore, there is a demand for the New Jersey Department of Education (NJDOE) to assess and monitor the validity of these programs compared to the marketing and provide state-approved professional development to teachers not only in the use of these programs but in the understanding and practice of encouraging higher order thinking skills.

Keywords: higher order thinking, educational technology, 21st century skills, cognitive complexity, critical thinking
DEDICATION AND ACKNOWLEDGEMENTS

Throughout my educational journey, I have been blessed to have the love and support of my family with me through every turn. For that, I want to give a special thanks to my parents, who have instilled in me a love for learning stretching back as far as I can remember. There are no words to express how much I have always admired my parents and as I have grown, I have learned by their example; they were and continue to be the best role models, and I try my best to make them proud everyday. They have ignited my curiosity for learning about and experiencing new things, as well as taught me that there is no end to the possibilities if I am determined. I also want to thank my mother and father for proving countless times that they are always there for me, and for that I am beyond grateful.

I also cannot reflect on my upbringing without noting the affection I have for my grandparents. I have countless memories of how they’ve inspired me in so many aspects of my life, and even though three of my grandparents will not see me receive my doctorate, their love and teachings have guided me throughout my journey. I am blessed to still have the guidance and support of my grandmother, whose advice I cherish most deeply. For the endless love I was so fortunate to receive throughout my life, I dedicate this dissertation to my family: my mother, father, grandmother, and my grandparents who are looking after me from Heaven.

I would also like to acknowledge my mentors throughout the dissertation process: Dr. Tienken, Dr. Colella, and Dr. Sforza. I was extremely lucky to be given the opportunity to work with such intelligent professionals in the education field. They opened my mind to new ideas in education and treated me not only as a mentee but also as a colleague. I greatly valued their insight and support at every step of the way, and I have learned so much throughout my time working with them. Their guidance and dedication to my study has helped me to develop a
passion for my topic of interest, and I thank them greatly for the ways in which they have encouraged me to produce my best work to make this dissertation something of which I am proud. To say that I would be lost without them would be an understatement, and I cannot be more appreciative of their efforts.
# TABLE OF CONTENTS

LIST OF TABLES ............................................................................................................... ix

LIST OF FIGURES ........................................................................................................... x

Chapter I: Introduction ........................................................................................................ 1

- Background ................................................................................................................. 1
- Higher order Thinking ................................................................................................. 2
- Frameworks of Higher order Thinking ...................................................................... 3
- Statement of the Problem .......................................................................................... 4
- Purpose of the Study .................................................................................................. 6
- Research Question ..................................................................................................... 7
- Methodology Overview ............................................................................................ 7
- Conceptual Framework ............................................................................................. 8
- Significance of the Study .......................................................................................... 9
- Limitations ................................................................................................................ 11
- Delimitations ............................................................................................................ 12
- Definitions of Terms ............................................................................................... 13
- Organization of the Study ....................................................................................... 14

Chapter II: Review of the Literature ............................................................................. 15

- Literature Search Procedures ............................................................................... 15
- Criteria for Inclusion of Literature ........................................................................ 16
- Methodological Issues in Studies of Higher order Thinking ................................... 17
- Review of Literature Topics .................................................................................... 19
<table>
<thead>
<tr>
<th>Chapter III: Methodology</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter IV: Results</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>Chapter V: Conclusion</td>
<td>Description</td>
<td></td>
</tr>
</tbody>
</table>

Higher Order Thinking and Cognitive Complexity ........................................ 19
Studies of Higher Order Thinking in Schools ........................................... 27
Online-Based Programs ................................................................. 49

Theoretical Framework ................................................................. 62

Consultant Coder ................................................................. 71

Data Collection ................................................................. 71

Coding Scheme ................................................................. 72

Reliability ................................................................. 77

Data Analysis ................................................................. 80

Chapter Summary ................................................................. 87

Introduction ................................................................. 89

Findings for Sub-Question 1 ............................................................. 90

Findings for Sub-Question 2 ............................................................. 98

Conclusion ................................................................. 102

Methodology Summary ............................................................. 104

Summary and Discussion of Findings .................................................. 106
Conclusion .................................................................................................................. 107
Recommendations for Practice ................................................................................ 109
Recommendation for Policy ...................................................................................... 113
Recommendations for Further Research ................................................................. 116
References .................................................................................................................. 118
Appendix ..................................................................................................................... 127
  Appendix A: Hess’ Cognitive Rigor Matrix .............................................................. 128
  Appendix B: Hess’ CRM with Calibration Comments ............................................... 129
  Appendix C: Coding Table ...................................................................................... 130
LIST OF TABLES

Table 1. Bloom's Taxonomy Frequency of Action Verbs .................................................. 36
Table 2. Bloom's and Revised Bloom's Taxonomy Comparisons .................................. 38
Table 3. Webb's Depth of Knowledge ............................................................................. 43
LIST OF FIGURES

Figure 1. Step model for deductive category application, adapted from Mayring (2000). 70
Figure 2. Abridged coding template ......................................................................................... 83
Figure 3. Distribution of questions in each cell of Hess’ Cognitive Rigor Matrix.............. 91
Figure 4. Percentage of questions in each cell of Hess’ Cognitive Rigor Matrix.......... 97
Figure 5. Comparison of total number of questions placed in lower level and higher level cells
within Hess’ Cognitive Rigor Matrix. ......................................................................................... 98
Figure 6. Comparison of percentage of questions placed in lower level and higher level cells
within Hess’ Cognitive Rigor Matrix. ......................................................................................... 100
CHAPTER I

INTRODUCTION

Background

With the turn of the century, education reform began to change the way teachers taught and students learned. This came, in many ways, through the implementation of technology into the classroom. State and nationwide standards changed in order to stress the use of technology and, more important, the concept of 21st century skills. Specifically, the New Jersey Department of Education (NJDOE) listed the skills related to the broad topics of: career ready practices; personal financial literacy; career awareness, exploration, and preparation; and career and technical education as 21st century skills that make up Standard 9 of the New Jersey Student Learning Standards (New Jersey Department of Education, 2014). These standards derived from the previous Cross-Content Workplace Readiness standards from 1996, which emphasized the “need for students to learn problem-solving and critical thinking skills” (New Jersey Department of Education, 1996, para. 1). Officials at the NJDOE claim that the skills provided in Standard 9 focus on informed decision-making and higher order thinking in order to build problem-solving and reasoning abilities.

According to the NJDOE website, Standard 9 of the New Jersey Student Learning Standards “integrate 21st Century life and career skills across the K–12 curriculum” to promote self-reflection, communication and collaboration skill development, and respond to societal and economic change, to name a few (New Jersey Department of Education, 2017, para. 3). Embedded into each component of these standards is the need to develop higher order thinking skills, particularly in critical thinking, problem solving, and reasoning. To strengthen the skills
that coincide with the New Jersey Department of Education’s standards for 21st century skills, classroom practices changed to focus more on the process of learning rather than the end product and to encourage students to tackle problems that may not have a specific solution.

**Higher Order Thinking**

Higher order thinking that includes incorporation of reasoning, judgment, and critical thinking to solve a problem or task, governs many teaching practices in classrooms (Schulz & FitzPatrick, 2016). Various definitions of higher order thinking exist that alter the types of tasks and problems presented to students in order to improve upon these skills. For example, critics of Webb’s Depth of Knowledge argued that alone, this framework was flawed in that it did not mirror many other frameworks in how knowledge should be applied to solve a task. Likewise, Bloom’s Revised Taxonomy, the other scientific framework used to create Hess’ Cognitive Rigor Matrix, received criticism for its reliance on verbs and action terms, which were restrictive to teachers and could overlap between levels (Hess, Jones, Carlock, & Walkup, 2009a). The framework of Hess’ Cognitive Rigor Matrix sought to solve many problems between both Webb’s Depth of Knowledge and Bloom’s Revised Taxonomy by highlighting commonalities in terms of performance tasks and keywords.

The demand for complex thinking does not always refer to the difficulty of solving a problem or completing a task. Cognitive complexity, in fact, refers to the type and level of thinking that a problem or task requires, apart from the effort it takes to complete the task. The level of difficulty can change based on a student’s learning style, prior knowledge, and personal comfort level with the problem or task because it is related to effort (Bieri & Blacker, 1956).

Difficulty refers mainly to the amount of effort, cognitive or physical, that a student needs to exert to complete a task but does not account for the ways that a student must think
about the task or problem in order to solve it. In some ways, cognitively complex tasks may be labeled as difficult because they require students to demonstrate more abstract thinking. These ways of thinking, however, are not necessarily difficult for all students and can be improved upon through strategies taught in the classroom (Cinedu, Olabiyi, & Kamin, 2015).

**Frameworks of Higher Order Thinking**

One framework from which to identify higher order thinking and create activities that facilitate higher order thinking in students is Webb’s Depth of Knowledge (Webb et al., 2005). Webb’s Depth of Knowledge (DOK) consists of four levels of thinking that range from basic recall to strategic and creative thinking. Each level also provides a list of keywords that teachers could use in the classroom in order to create questions and problems with more depth and rigor. Level 1, the lowest level focuses on recalling facts and contains keywords such as *tell, recognize,* and *quote*. By Level 3, students are asked to think strategically through *developing a logical argument* and *drawing conclusions*. The fourth and highest level focuses on extended thinking and asks students to *critique, synthesize,* and *analyze* (Hess et al., 2009a).

Another framework is Bloom’s Revised Taxonomy (Bloom et al., 1956). The taxonomy organizes levels of complexity based on actions and contains six levels of complexity, ranging from the most basic task of remembering information to the highest level of creating. Similar to Webb’s Depth of Knowledge, the lowest level of Bloom’s Revised Taxonomy focuses around *recall, memorizing,* and *repeating* facts that had been taught. The next level, concentrates on understanding, contains actions including *classify, describe,* and *recognize*. The third level shows more abstract concepts through *applying* information and *solving* problems (Hess et al., 2009a). Further along on the taxonomy are tasks that contain more cognitive complexity, such as analyzing, evaluating, and creating. These performance tasks require students to use
information taught in class and develop their own ideas, draw conclusions, and expand upon the content in a unique way. Because these levels focus on performances, rather than the vocabulary used, there is less overlap than in Webb’s Depth of Knowledge. Bloom’s Revised Taxonomy also aimed to create a list of action words for each level that students could identify in order to understand the level of a problem or performance task (Cinedu et al., 2015).

**Statement of the Problem**

In order to keep up with the demands of engaging and empowering students inside and outside of the classroom, school personnel increased the use of technology. The growing educational technology industry has provided tools to school districts like computer based studying programs and personal computing devices to enable one-to-one technology initiatives in schools. Technology has not only influenced some of the ways teachers teach but also how students learn and the resources used for teaching and learning. In recent years, the NJDOE implemented a set of standards, described as 21st Century Life and Careers, with the intention to “enable students to make informed decisions in preparing them to engage as active citizens in a dynamic global society and to successfully meet the challenges and opportunities of the 21st century global workplace” (New Jersey Department of Education, 2017, para. 2).

The standards require students to demonstrate proficiency in topics of career ready practices; personal financial literacy; career awareness, exploration, and preparation; and career and technical education. According to the NJDOE Standards for 21st century skills, students should be able to “readily access and use the knowledge and skills acquired through experience and education to be more productive,” as well as be able to “make connections between abstract concepts with real-world applications,” as well as apply their skills in appropriate situations (New Jersey Department of Education, 2014, p. 1). Importantly, these standards are designed to
encourage higher order thinking among students through real-world applications and critical thinking opportunities provided with technology use (Cinedu et al., 2015; MacKnight, 2000; Zhao, Zhang, Lei, & Qiu, 2016). As policymakers continue to require students to enhance their higher order thinking skills, technology companies and education resource companies continue to create educational technology products that cater to developing such skills. Many of these programs are formatted as a game, in which students play as they learn and earn points as they increase in levels of content and complexity. Some of the various companies make claims about their programs that consistent use of such programs will increase higher order thinking skills in students.

Much of the literature that exists regarding technology use supports the notion that the presence of technology can lead to academic success (Aktümen & Kacar, 2003 as cited in Ozerbas & Erdogan, 2016; Doran & Herold, 2016; Harper & Milman, 2016; Silvernail & Gritter, 2007 as cited in Sauers & McLeod, 2012). Furthermore, the use of technology in the classroom has provided students with more opportunities for making real-world connections with the content as well as using problem-solving strategies in more meaningful assignments (Cinedu et al., 2015; MacKnight, 2000; Zhao, Zhang, Lei, & Qiu, 2016). Although the literature stresses the importance of higher order thinking skills in preparing students for future careers, there appears to be a disconnect in the types of activities provided to students to strengthen these skills. To date, there are no studies that explore online-based programs offered as a means of enriching higher order thinking skills in elementary and middle school-aged children. Similarly, no empirical evidence exists that focuses on the frequency of tasks that rely on higher order thinking provided by these online-based programs or ways in which these tasks are categorized based on the type of thinking required of students to complete the tasks contained in the products. Some educators, parents, and students rely on educational technology programs as
teaching and learning tools and trust the advertising that the programs provide activities and questions that will teach content and higher order problem-solving techniques that can be transferred into the classroom and ultimately increase student achievement.

In order for school leaders to advocate for the use of these programs as one tool in improving upon higher order thinking skills in students, research must be conducted to classify the types of tasks that are asked of students and the frequency at which each category of tasks is presented. Analyzing these two factors of online-based programs can shed light onto the effectiveness of these programs as a means for strengthening and building higher order thinking skills among students. Additionally, research conducted on the cognitive complexity of the selected online-based program can serve to raise awareness of the strengths and weaknesses of the program as a tool for enrichment and reinforcement.

**Purpose of the Study**

The purpose for this qualitative content analysis study was to describe the level and distribution of cognitive complexity within an online-based program that markets itself as increasing higher order thinking skills among students grades K–8. One such online-based program, HOT Learning, a pseudonym, markets that it helps students to generate deeper understanding of content and enrich their knowledge by making connections that require higher order thinking. According to the marketing literature offered by the company, HOT Learning’s “high-impact, high-value K–12 learning programs provide proven academic support through practice, immediate feedback, and built-in remediation to improve students’ performance in core skill areas.” The program also designs activities around specific state standards, such as New Jersey’s Core Curriculum Content Standards (NJCCCS) and the Common Core State Standards (CCSS). Testimonials on the program’s webpage from school leaders boast that the learning
process and acquisition of skills becomes interactive and fun, while also allowing teachers to differentiate instruction using the program’s adaptive abilities to deliver content to meet different levels of abilities.

I chose to focus on this program’s Grade 8 level of content and evaluated the level of cognitive complexity, according to Hess’ Cognitive Rigor Matrix, for 231 activities provided in English language arts. The level of complexities identified was then compared to the marketing for the online product to assess the validity of the product to its intended goal.

**Research Question**

The study was guided by the following overarching question:

1. Using Hess’ Cognitive Rigor Matrix, what are the characteristics of higher order thinking in the Grade 8 English language arts questions presented to students in an online-based program?

Two subquestions guided the specific inquiry of the study, as follows:

a. What is the frequency and percentage of questions categorized in each specific cell within Hess’ Cognitive Rigor Matrix?

b. What is the frequency and percentage of higher order thinking, as described by Hess’ Cognitive Rigor Matrix, embedded in Grade 8 English language arts questions presented to students in a particular online-based program?

**Methodology Overview**

For the current study, 231 reading-based questions were chosen from the Grade 8 English language arts section of the online-based program, which had been aligned with the New Jersey Core Curriculum Content Standards (NJCCCS). In total, the program contained 660 questions among 21 reading-based sections. Every third question from these sections was collected, as
well as the first question of each section, providing a sample size of 35% of the total number of questions offered by the program. Two coders collected data by reviewing each selected question and aligning it with Hess’ Cognitive Rigor Matrix. Once all questions were aligned, the two coders compared the frequency and distribution of the selected questions within Hess’ Cognitive Rigor Matrix, noting the frequency of questions that were considered higher level. Similarly, the two coders used the data collected to identify the frequency of questions that placed into each cell of Hess’ Cognitive Rigor Matrix. Further explanation of the coding scheme and procedure are provided in Chapter III.

**Conceptual Framework**

Hess’ Cognitive Rigor Matrix was employed as the conceptual framework for the present study. This model creates a parallel between Webb’s Depth of Knowledge and Bloom’s Taxonomy in which the different levels identified in each are merged to give a more well-rounded focus for educators when providing higher order thinking and problem-solving activities and questions for students. At the lowest level of Hess’ Cognitive Rigor Matrix is the connection between Bloom’s *remember* and Webb’s Level 1: *recall and reproduction*. At both of these levels, the objective is to recognize the most basic information and identify facts through rote memorization. The next level of Bloom’s taxonomy is *understand*, which can be transferred into each of Webb’s Depth of Knowledge levels. Here, Bloom’s Taxonomy is more vague in that verbs, such as *clarify* and *paraphrase* can be applied to both basic and complex thinking skills. For example, at Webb’s recall and reproduction level, students can explain the *how* or *why* of a concept, while still meeting Bloom’s second level of the taxonomy. In addition, Bloom’s *understand* level would encourage students to develop generalizations and relate themes between content areas, satisfying Webb’s highest level of Level 4: *extended thinking*. 

8
Even at Bloom’s highest level create, students could be required to merely brainstorm an idea, fitting into Bloom’s recall and reproduction level. Similarly, the highest level of Bloom’s taxonomy can also be extended into Webb’s Level 4 if real-world examples were generated and multiple sources were used (Hess, 2009b). Hess’ Cognitive Rigor Matrix successfully represents the overlap and the ambiguity within each level of both models.

Because higher order thinking is regarded as being a crucial component of 21st century learning, there is a necessity to analyze the learning tools provide for students (Schulz & FitzPatrick, 2016). By doing this, educators can ensure that the materials they offer to students as a means of enrichment or enhancement allow them the opportunities to learn content, as aligned with their state’s standards or the Common Core, and strengthen skills in more advanced levels of understanding. By using Hess’ Cognitive Rigor Matrix instead of solely Bloom’s or Webb’s models, a more accurate assessment of students’ higher order thinking can be made. For this study, the Cognitive Rigor Matrix provides a deeper investigation of the types of activities and assessments being offered to students through an online-based program.

**Significance of the Study**

With new standards embedded into the Common Core State Standards, New Jersey Core Curriculum Content Standards, and Next Generation Science Standards, educators are faced with a push to enhance and develop higher order thinking skills among students in order to prepare them for 21st century demands. Private companies have capitalized on the 21st century skills craze by developing programs and learning tools to sell to schools and children in order to further develop these skill sets. Existing literature, however, does not focus on these programs as a means of developing higher order thinking skills. Additionally, no current research questions the types of activities, problems, or tasks specifically focusing on the level of cognitive
complexity that these programs present to students. Because of this lack of research, schools, teachers, and parents who purchase these products cannot fully know the extent to which these products can help students to build higher order thinking skills and cannot assess whether these products are the best fit to meet students’ needs.

Throughout the reviewed literature, there are discrepancies between definitions of higher order thinking. In some research, critical thinking was used synonymously with higher order thinking, but there are still noteworthy differences in the method of delivery and the execution of problems, which require one of these methods or the other (Butler, 2012; Halpern as cited in Liu, Frankel, & Roohr, 2014). For this study, higher order thinking is used as a broader term that encompasses critical thinking skills, as well as reasoning, judgment, and problem solving. In order to understand the level of higher order thinking skills required to answer a particular question or problem, cognitive complexity of the question or problem must be examined. Cognitive complexity, for purpose of this study, referred to the level of higher order thinking skills required to accurately complete the task or solve the problem (Bieri & Blacker, 1956). Furthermore, cognitive complexity encompasses the use and integration of language, reasoning, and understanding of ideas as they relate to both prior and current knowledge (Holland as cited in Sforza, 2014).

Hess’ Cognitive Rigor Matrix was used to assess the cognitive complexity of the questions provided in the online-based program used in this study. This model was used because it referred to both Bloom’s Revised Taxonomy and Webb’s Depth of Knowledge, two renowned scientific frameworks, and provides a more detailed description of keywords and tasks that could be asked for each level of cognitive complexity. The Cognitive Rigor Matrix offers a more thorough analysis of each question that is assessed from the online-based program, resulting in a better understanding of the types and levels of cognitive complexity provided to students.
This study aimed to analyze the cognitive complexity of 231 problems and tasks presented to students through one online-based program that advertises to promote higher order thinking skill development. As stated previously, the purpose of this qualitative content analysis study was to describe the level and distribution of cognitive complexity within an online-based program that markets itself as increasing higher order thinking skills among students Grades K–8. This will give further research a better understanding of the types of higher order thinking skill development that can be reached through these products, as well as a means of understanding the variety of levels of cognitive complexity offered in order to scaffold the presentation of material to meet various learning needs.

**Limitations**

Few studies analyzed the cognitive complexity of course materials offered to students. There were no studies found, however, that specifically analyzed particular tools or products and their ability to develop higher order thinking skills among students. Most of the research, as further explained in Chapter II, focused on higher order skill development from a perspective of teaching styles or individual student learning styles. A limitation of this study is that individual students’ learning styles will not be examined, nor will teaching styles of individual teachers or how the chosen online-based program is used in a classroom.

This study reviewed only one online-based program, although there are many others available. Another limitation of this study is that since only one online-based program was analyzed, generalizations could not be made about online-based programs as a learning tool and the ability to enhance higher order thinking skills among students. The product was chosen for its popularity and its marketing of developing higher order thinking skills through the questions and games it offers.
For this study, 231 questions were analyzed from the eighth grade English language arts level of this product, which were aligned with NJCCCS. This sample size was composed of every third question offered in each of the 21 reading sections of the program, as well as the first question of every section, equating to 35% of the program’s questions. In addition, only reading-based questions were analyzed. The two coders agreed that the other sections offered by the program, which focused on writing and language conventions, were restricted in their ability to encourage higher order thinking because of the multiple-choice format. Other subject areas and grade levels were not analyzed. Furthermore, this study was developed between 2017 and 2018 and focused on the questions and tasks offered by the product at that time.

**Delimitations**

Delimitations of this study include the grade level and subject matter selected. For this study, I chose to focus specifically on the Grade 8 level of this program due to my own personal comfort level with the content as a middle-school educator. In addition, I chose to examine questions in the subject of English language arts, specifically in reading. Other content areas were not studied from this program due to the multiple-choice format of the program; the two coders in the data collection process agreed that the writing sections of the program had limitations in the program’s multiple-choice format. Another delimitation was the number of questions analyzed. For this study, I evaluated 231 questions from the selected program in order to provide a variety of questions that range in level of complexity as well as type of delivery. Although there were 660 questions provided for reading in accordance with the New Jersey Core Curriculum Content Standards (NJCCCS) and 646 questions for reading in accordance with CCSS, the coders’ sampling strategy maintains validity because there is no evidence to suggest that one or more unexamined sections included more higher level questions than other sections.
In addition, only questions that aligned with NJCCCS were selected. The two coders used in this study agreed that the questions provided under the NJCCCS section of the program were similar to those aligning with CCSS, indicating that the New Jersey based standards were the new, Common Core-aligned standards approved by the state.

**Definitions of Terms**

*Cognitive complexity* is the differences of responses, including the type and level of thinking and reasoning, that is given to particular stimuli, such as a question or problem (Bieri & Blacker, 1956).

*Higher order thinking* is the incorporation of reasoning and judgment, as well as intellectual empathy, fair-mindedness, and persistence, to complete tasks and solve problems (Schulz & FitzPatrick, 2016).

*Online-based program* is a term used in this paper to refer to an educational program that focuses on reinforcement and enrichment of standards-based curricula and advertises that it can improve higher order thinking skills in students. This program can be purchased by a school district or by parents to use as a tutoring or study tool and is accessed through the Internet.

*Student achievement* is the development of subject-matter knowledge, skills, and deeper understanding. Oftentimes, student achievement is also used to refer to standardized test scores (Student Learning, Student Achievement: How do Teachers Measure Up?, n.d.)

*Students with disabilities* are students who have been classified with a disability that qualifies the student for an Individualized Education Plan (IEP). Some disabilities include, but are not limited to, speech delays, cognitive delays, and autism. (NJDOE)

*Technology*, in this study, refers to laptops or computers that have access to the Internet. Other examples of technology include iPads, iPods, and tablets.
Organization of the Study

Chapter I was arranged to develop an overview of the problem related to the relationship between an online-based program and its ability to enhance cognitive complexity in accordance with Hess’ Cognitive Rigor Matrix. Because many of these online-based programs advertise that students can increase their higher order thinking skills through continuous practice and use of these products, it appears necessary for studies to validate these claims so that schools, parents, and students are more educated consumers of these products and their capabilities.

Chapter II included a literature review on the history of technology in schools, studies conducted on how technology impacts education, theories regarding cognitive complexity, and how cognitive complexity has been aided through the use of technology in schools.

Chapter III expanded on the overview provided in Chapter I and explained the design methods and procedure for the study. Data collected from the online-based program were retrieved from a product whose name shall be kept anonymous and paralleled with Hess’ Cognitive Rigor Matrix.

Chapter IV presented the data and findings of the study.

Chapter V summarized the statistical findings and analyzed the data further through the development of implications for schools, parents, and students who use or are looking to use an online-based program for the development of higher order thinking skills. Recommendations and conclusions are also presented along with suggestions for future research that could further investigate this topic.
CHAPTER II

REVIEW OF THE LITERATURE

The literature review had three purposes. First, it served to identify empirical studies about higher order thinking and cognitive complexity of classroom learning tasks. Second, the review attempted to identify any significance regarding technology and its ability to enhance higher order thinking and cognitive complexity in order to provide more sound reasoning behind online-based programs, such as the one being studied in the continuing chapters. Third, it provided a review of relevant theories of higher order thinking and theories of how technology-based programs can be used to develop higher order thinking in K–12 grade level students.

Literature Search Procedures

In accordance with Boote and Beile’s (2005) guidelines for scholarly literature reviews, I focused my review on articles published through peer-reviewed journals and uploaded onto online databases, including ERIC, JSTOR, and Academic Search Premiere, to name a few. In order to identify empirical evidence about higher order thinking and cognitive complexity, articles were found by searching keywords such as higher order thinking and critical thinking, as well as theories including Webb’s Depth of Knowledge, Bloom’s Taxonomy, and Hess’ Cognitive Rigor Matrix. The selected literature included quantitative studies that were experimental, quasi-experimental, correlational, and meta-analyses. Definitions were also extracted from the literature found in these searches, along with textbooks designed to be given to those taking education courses at a collegiate level. In addition, articles designed for practicing teachers as a means of professional development were also reviewed in order to compare any definitions provided to educators. Much of the mainstream education literature, however, is written with the
assumption that the audience has an understanding of higher order thinking and, therefore, the literature does not provide a definition.

When searching for literature about the significance of technology on its enhancement of higher order thinking skills and cognitive complexity, keywords were used including technology in education, technology and middle school and technology and higher order thinking, to name a few. Much of the literature resulted in studies that focused on student achievement scores or centered around perceptions of technology use in schools. Many of the studies found in these searches were of small case studies, which either focused on one school district or a few schools in a specific area. Some of the studies were also comparative between two districts or between two schools of differing demographics.

The third purpose, which aimed to provide relevant theories of higher order thinking in specific technology products, involved a search that was conducted using specific technology product names. The technology product that yielded the most results was Achieve3000, although these articles focused solely on Lexile levels for reading comprehension. In addition, search results for Study Island, another online-based program, yielded reports produced by the company itself. These reports examined Study Island’s alignment with best practice, intervention, and differentiated instruction strategies.

**Criteria for Inclusion of Literature**

- Peer-reviewed research, including dissertations
- Theoretical literature
- Publications intended for educators, such as textbooks and mainstream professional development books
• Empirical studies that focused on higher order thinking skills in regards to teaching practices or student activities
• Studies that focused on K–12 public school districts and their students
• Seminal works
• Quantitative and qualitative studies, including case studies and comparative studies
• Studies conducted after 2000
• Works published by theorists regarding taxonomies, frameworks, and/or models for higher order thinking

**Methodological Issues in Studies of Higher Order Thinking**

There were various issues regarding higher order thinking, particularly in the lack of a formal definition of higher order thinking. Much of the literature provided examples of higher order thinking, including specific tasks students can perform in the classroom that use higher order thinking. Similarly, many of these articles referred to critical thinking and problem solving as synonyms with higher order thinking, failing to distinguish differences between each of these terms. The authors of these articles, having written for an audience in the education field, assumed such terms are understood and, therefore, do not need to be explicitly defined. No common definition existed among educational literature, such as textbooks designed for future and current educators. These texts also provided examples and related higher order thinking to critical thinking and problem solving as essential components of higher order thinking skill set development.

In addition, the term *cognitive complexity* yielded very few results in the search engines that were applicable to the study. Much of the literature for cognitive complexity and higher order thinking focused on undergraduate, graduate, or specific higher education fields (nursing)
students; the cognitive complexity and higher order thinking skills being researched in these studies differ greatly from those at a middle-school level and, in many ways, are not applicable to my study. Similarly, many of the studies found took place outside of the United States, in which different standards govern over teaching practices and student learning. Much of the literature also focused on small case studies, limiting generalizations that could be made regarding practices and higher order thinking development.

Very little literature exists on the connection between technology and higher order thinking among school-age children. Much of the existing literature examined students in collegiate levels of education, including undergraduate programs and graduate studies in specific fields. Literature regarding technology use in the classroom predominantly focused on student achievement in the form of test scores. These studies were typically case studies of a particular school district or used a small sample size of the number of schools. Studies that contained larger sample sizes examined statewide initiatives for technology, such as one-to-one technology programs.

The design of much of the literature surrounding online-based programs focused on promoting the product. Studies on Achieve 3000’s ability to improve Lexile reading levels resulted in many inconsistencies between studies, although researchers in these studies maintain that the program is successful. Similarly in studies of Study Island, another online-based program, the results of the studies are published on the program’s website. This can indicate bias in the methodologies of the studies, as well as in the results. Although the studies differed in when and how these programs were used, with some replacing the reading curriculum and some serving as an extension that students completed independently, the results of these studies failed to show significant improvement on student achievement. Regardless, the results for all studies supported the use of these programs.
**Review of Literature Topics**

**Higher Order Thinking and Cognitive Complexity**

The current push for 21st century learning in the classroom stresses the importance of higher order thinking, a skill that students are expected to develop throughout elementary school and their entire educational experience. Although there is ample information for educators on ways in which to promote higher order thinking in the classroom, there is one crucial piece of information missing: a common definition of higher order thinking in K–12 classroom settings.

Newmann (1988), in his work titled *Higher-Order Thinking in the High School Curriculum*, provided a simple definition that higher order thinking “signifies the challenge and expanded use of the mind” (p. 59). This definition, although true, is extremely vague and does not incorporate the many components of higher order thinking. In order to better explain and define higher order thinking, much of the existing literature provides examples of cases in which higher order thinking can be identified. Brookhart’s *How to Assess Higher-Order Thinking Skills in Your Classroom* (2010) describes higher order thinking as students “being able to relate their learning to other elements beyond those they were taught to associate with it,” such as relating the content to prior knowledge or making connections outside of the curriculum. This example, however, indicates that there is much subjectivity into the degree to which a student can master this skill (p. 5).

Similarly, Keefe et al. (1992) defined higher order thinking as an “objective that drives many programs in [the current cognitive educational] movement” and provided a list of indicators of which higher order thinking consists, including “processes or operations that are emergent over the long haul and require active, repeated interactions among the learner, the content, and the various learning experiences in school” (p. 3). By this definition, one key aspect
of higher order thinking is the time it takes a student to develop these skills. Although the variable of time is represented as the ongoing development of higher order thinking skills throughout a child’s schooling, it coincides with the child’s development. As the child’s brain develops in order to process and hold more complex knowledge, the higher order thinking skills a child can perform become deeper and more complex in turn.

Similarly, one of Brookhart’s (2010) definitions of higher order thinking used a situation in which a student may encounter in the learning process. This definition states:

A student incurs a problem when the student wants to reach a specific outcome or goal but does not automatically recognize the proper path or solution to use to reach it… because a student cannot automatically recognize the proper way to reach the desired goal, she must use one or more higher-order thinking processes. (Nitko & Brookhart, 2007, p. 215, as cited in Brookhart, 2010, p. 4)

This explanation of higher order thinking differs from others in that Brookhart related higher order thinking to the idea of original thought, in that a student must create his/her own solutions to problems if no solution already exists. By doing this, a student must use higher order thinking skills that have been developed.

Higher order thinking has been presented to schools in many different forms and has been interchangeable with terms including “critical thinking, good thinking, metacognitive thinking, productive thinking, creative thinking, thoughtful thinking, complex thinking, deep thinking, and logical thinking” (Giancarlo-Gittens, 2009; Moon, 2008; Moseley et al. as cited in Schulz & FitzPatrick, 2016, p. 62). According to Brookhart (2010), higher order thinking includes critical thinking as an essential component of skill set development. Critical thinking, which encompasses skills of reflection and reasoning, builds higher order thinking skills and the ability to make decisions in order to solve problems and complete tasks. In addition, the incorporation
of critical thinking into higher order thinking skill set development allows students to develop beliefs and ideas on situations and proper approaches to these situations (Norris & Ennis as cited in Brookhart, 2010). Brookhart argues that higher order thinking cannot function without critical thinking occurring concurrently. In many ways, this merger of critical thinking and higher order thinking supports why many researchers use these terms synonymously.

Although critical thinking is the most commonly used term to substitute higher order thinking, it is only one of many components that are essential to higher order thinking skillset development. In addition to critical thinking, Brookhart’s (2010) definition of higher order thinking also includes two other main components: problem solving and transfer (also cited in Paige, Sizemore, & Neace, 2013). The definition of higher order thinking, in terms of problem solving, overlaps in many ways with the definition of critical thinking in that it includes critical evaluation and choosing the proper approach to solving a problem, a skill that requires reasoning (Bransford & Stein as cited in Brookhart, 2010). In fact, Brookhart regards problem solving as a necessary element for critical thinking, implying that the two intertwine when higher order thinking is being utilized. Higher order thinking, in terms of transfer, however, is noticeable when students can recall and understand what they have learned but also apply their knowledge to other situations (Anderson & Krathwohl as cited in Brookhart, 2010).

Again, this definition encompasses many components of the other facets of higher order thinking in that much of the ability to apply reasoning and knowledge from one situation to another cannot occur without evaluation and reflection. Likewise, problem solving and transfer serve as only two aspects of higher order thinking that work in unison to allow for higher order thinking to be performed, as well as developed over time. The varying definitions of higher order thinking make it apparent that no single definition can exist. Within the term of *higher order thinking* exists components, such as critical thinking and problem solving, which need to be built
upon in order to develop higher order thinking skills as a whole. It is possible to strengthen aspects of higher order thinking while neglecting others, such as focusing on logical reasoning and neglecting creativity altogether.

With the push for complex thought in American schools, critical thinking replaced higher order thinking in many reforms to curriculum. This is due in part to the rapid evolution of schools throughout the 20th and 21st centuries, which consistently changed how higher order thinking was taught and evaluated (Nitko & Brookhart as cited in Brookhart, 2010, p. 4). Sforza, Tienken, and Kim (2016) claimed that much of the literature on standards-based education reform regarding higher order thinking groups the skills of creativity, innovation, entrepreneurship, and strategic and critical thinking together (p. 8). Because there is no universal definition of higher order thinking, much of the literature contains overlap with these terms, particularly by alternating between higher order thinking and critical thinking (Brookhart, 2010; Keefe et al., 1992; Liu, Frankel, & Roohr, 2014; Paul et al. 2006; Shaughnessy, 2012). One common overlap occurs between the definitions of higher order thinking and critical thinking. Some researchers of higher order thinking use the terms higher order thinking and critical thinking synonymously, arguing that critical thinking is a crucial component of a larger, broader umbrella term of higher order thinking.

In fact, much of the literature replaces higher order thinking with critical thinking. Although Paul and Elder (2006) argued that critical thinking is considered to be more of an art, whereas higher order thinking is done more through evaluation and analysis of a problem, many works of literature in the education field group critical thinking and higher order thinking together, assuming that one cannot be accomplished without the other (as cited in Paige et al., 2013). Shaughnessy (2012), in a book titled Critical Thinking and Higher-Order Thinking: A Current Perspective, argued that the term critical thinking has become increasingly vague over
the past half century due to the increasing number of examples and elements it encompasses. This has led to many misleading descriptions of critical thinking and, ultimately, allowed for its overlap with higher order thinking because it shares many common components. A collection of articles designed to help educators understand critical thinking education provided definitions that strongly mirrored existing definitions of higher order thinking. Although there were multiple definitions for critical thinking provided in the text, common themes appeared in terms, such as judgment, logical inquiry, problem solving, and evaluative decision making, to name a few (Critical Thinking, 1991). These aspects of critical thinking appear in definitions of higher order thinking as well, such as in overlapping examples between critical thinking and higher order thinking. The facets of critical thinking are essential components of higher order thinking skill set development due to their focus on the development of a belief in order to support a chosen action or thought. In many ways, this idea of critical thinking as a means of developing an opinion reflects on Brookhart’s (2010) argument that higher order thinking skills lead to students being able to develop their own ideas and opinions on problems and proper solutions.

Because higher order thinking is complex and contains numerous components, many researchers argue that creativity is essential in developing higher order thinking skills. In fact, creativity was one of the first aspects of higher order thinking to be recognized. Higher order thinking is not a 21st century skill at all but a skill that has appeared throughout American education since the 1800s and in the work of Dewey in the early parts of the 1900s. Dewey (1902) in his notable book, The Child and the Curriculum, explained that students learn best by being active in their learning and can develop advanced thinking skills through examination and inquiry. Although Dewey never mentioned higher order thinking explicitly, he described the progression of higher order thinking skill set development from infancy and throughout a child’s educational experience. As reported by Tanner (2016), the most elementary stages of higher
order thinking appear in the form of curiosity and creativity, which allow a child to learn about the world through interactions and exploration. By building up these experiences, a child is able to develop emotions to experiences and make connections between one experience and another, creating knowledge that is intellectual and instrumental (Dewey as cited by Tanner, 2016). Once a child enters school, Dewey claimed that the child would develop the ability to reflect and to actively investigate solutions to problems.

Padget (2013) expanded on Dewey’s belief in the relationship between creativity and critical thinking by claiming that these two facets of higher order thinking allow students to develop multiple ways of understanding and approaching a situation (p. 23). Both creativity and critical thinking, according to Padget, should be used interchangeably since one cannot occur without the other. Along with creativity, Dewey emphasized the importance of interest. In many ways, interest and creativity coincide in that students who have an interest in a subject are more willing to think creatively about it. Through Dewey’s explanation of curiosity, he believed that a child develops an interest in a particular subject, which leads to a desire to expand further on learning that subject (Tanner, 2016).

One complication that has arisen in encouraging creativity in the classroom is the concept of functional fixedness, defined by Dunker as the phenomenon of one perceiving an object as having only one function (as cited in Anderson & Johnson, 1966). Runco and Chand (1995) also explained the concept of functional fixedness as the “rigidity or mental ‘set’ which locks thinking so that an individual cannot see alternatives” (p. 247). This concept is prevalent in the ways in which students are taught to think about critical thinking and creative thinking problems. In schools, students learn specific methods and strategies to approach a problem. It becomes difficult for students, however, to think of other possible solutions or ways to approach a problem when they have become fixed in the idea that there is one correct way. Similarly,
Anderson and Johnson expanded on functional fixedness in a student’s way of thinking to include the concept of *Einstellung*, which is the difficulty in utilizing other strategies to solve a problem after mastery of one strategy (p. 852).

In an experiment designed in 1992, Runco and Chand (1995) examined the way in which students utilize their ability to think creatively based on the way in which tasks were presented to them. There was a significant influence among tasks and activities that explicitly asked students to develop multiple solutions or to think creatively, but no significant influence was found in tasks that asked students to generate a problem. In addition, Runco and Chand found that environmental cues, in which students are able to develop answers by looking around them or remembering past experiences, also limited their ability to develop answers that expanded beyond functional fixedness. The results of the study indicated that educators should expand beyond problems and tasks that have a clearly defined solution and, instead, encourage students to utilize their problem solving skills to address real-world situations that have multiple solutions.

Tienken and Orlich (2013), in *The School Reform Landscape: Fraud, Myth, and Lies*, examined the work of Dewey, Taba, Tanner and Tanner, and Tyler and supported the idea of student interest in the subject matter by arguing the following:

There must be a fusion of subject matter with the student, and the student must be viewed as an active constructor of meaning who brings prior knowledge and experience to the learning environment; that prior knowledge and experience must be used as a springboard and connection to new material (Tienken & Orlich, 2013, p. 156).

In order for a student to be an active constructor of meaning, he/she must be willing and interested in finding an answer to the problems presented in school. In turn, by discovering these
solutions, the student could develop a further interest and understanding of the surrounding world.

Dewey’s work, although regarded as groundbreaking in understanding child development, was in many ways outshined by the developmental-stage theory proposed by Piaget (Tanner, 2016). Both theories agree on the development of reflective skills, questioning, and making connections as a crucial indicator of cognitive development among school-age children. Dewey and Piaget differed in their belief of the role of the school in assisting students in their cognitive development, leading to a development in higher order thinking skills. As cited in Tanner (2016), Dewey believed that schools must play a role of a community in which students learn through consistent social interactions (p. 17). Likewise, he stressed that schools should be democratic in that they were designed to promote original thought, problem solving, and critical thinking (Tienken & Orlich, 2013). Learning was to be naturally occurring and continuous. Piaget, however, who tested his theory in a more structured setting, failed to give schools responsibility for aiding in the development of such skills.

In modern schools, higher order thinking has often taken on another synonym: difficulty. According to Sforza et al. (2016), difficulty “simply refers to the amount of work or effort a student must use to complete a task” and does not necessarily correlate to the complexity of the task or the level of higher order thinking required (p. 9). Higher order thinking, instead, can be categorized based on its cognitive complexity. According to Sousa (2006), cognitive complexity is regarded as “the thought processes required to address a task,” which can range from simple recall tasks to more advanced skills of creating and designing (as cited in Sforza et al. 2016, p. 9). By this definition, “remembering facts and imitating procedures are less cognitively complex than developing an original conclusion, product, or process” (Sforza et al., 2016, p. 9).
To some, cognitive complexity is seen more as the amount of time or the degree of time that it takes a student to complete a task, particularly a task that requires a higher level of higher order thinking (Bogess as cited in Paige et al., 2013). A study published in 2013 regarding cognitive complexity, referred to as cognitive rigor, compared the level of critical thinking and higher order thinking tasks offered to students with the students’ overall engagement level (Paige et al., 2013). In this study, 362 students in ninth grade were observed from an urban school in a low socioeconomic area. Paige et al. created a Student Engagement and Rigor Scale for the Classroom (SER-C) to cross-reference the behaviors of engagement expressed by students and the cognitive complexity of tasks or problems presented to students. The results of the study showed that student engagement increased as the amount of higher order thinking activities increased in the classroom, but engagement began to decrease from the beginning of the class period to the end, with the end of the class period having the lowest engagement. Regardless of the decrease as class time progressed, the results of the study indicated that exposing students to higher order thinking tasks can increase overall engagement and, in turn, could promote greater academic achievement.

**Studies of Higher Order Thinking in Schools**

Schulz and FitzPatrick (2016) aimed to compare teachers’ understandings of higher order thinking and how it is incorporated into the classroom. This qualitative study consisted of interviewing 38 teachers, whose experience ranged from teaching kindergarten through ninth grade, in 14 schools located in Newfoundland and Labrador, Canada. Schulz and FitzPatrick (2016) identified five themes through the interviews with the chosen teachers. All teachers agreed that it is important for their students to learn thinking skills, such as critical thinking and problem solving. Some teachers, though, felt that not all students could grasp higher order
thinking if they were not developmentally ready, such as students in younger grades. Many K–3 teachers admitted that they did not incorporate problems that assess higher order thinking on assessments in science and social studies, and focused more on higher order thinking when conducting oral assessments. Generally, teachers for Grades 4–9 avoided assessments that included higher order thinking tasks if they felt as though their students would not solve the problem correctly and, instead, included an extension to a lower level question by asking students to make a connection to something not learned in class. Some teachers expressed that giving lower level questions on assessments guaranteed that students performed better, thus raising their self-esteem. Lastly, the teachers interviewed had different ideas of the components of higher order thinking and developed different definitions for how they view and assess higher order thinking in the classroom.

At all grade levels, teachers were unsure of the definition of critical thinking and how it could be incorporated into the curriculum. In addition, teachers at the lower grade levels had a different opinion on examples of higher order thinking in their classrooms compared to teachers at the upper grade levels, and teachers who taught different subject areas also showed differences in their examples and ideas. Although the schools were chosen to provide a range of students’ academic achievement, ranging from schools in middle-class districts with high or middle achievement to schools in low socioeconomic areas with low achievement, the sample size was fairly small. In addition, because the schools were only chosen from the Newfoundland and Labrador regions of Canada, larger generalizations or conclusions cannot be made regarding the opinions of teachers in Canada or the opinions of teachers overall.

Much of the literature has agreed that teachers have different opinions on the definition of higher order thinking and ways in which to incorporate it into everyday teaching (Richland & Begolli, 2016; Schulz & FitzPatrick, 2016). A report by Richland and Begolli set out to create
guidelines for teachers on ways to build lessons around higher order thinking development. Higher order thinking was explained synonymously with analogical reasoning, or the “cognitive skill that underpins the conceptual process of recognizing commonalities between systems of relationships” (p.161). Grossen (1991), in an earlier study, explained that analogous reasoning is one crucial aspect of higher order thinking that is learned early in cognitive development and continues to expand as children learn to make further and deeper connections with content. Although used more often when discussing science skill development, analogical reasoning was regarded as a key to understanding how higher order thinking skills develop in children regardless of the subject matter (Richland & Begolli, 2016). Similarly to other studies and research regarding higher order thinking, an explicit definition of higher order thinking was not provided, further highlighting the disconnect between teacher understanding and practice. Strategies were given, however, regarding ways in which educators can promote higher order thinking development in the classroom. First, Richland and Begolli claimed that classrooms must allow students to compare multiple methods for solving the same problem (Rittle-Johnson & Star as cited in Richland & Begolli, 2016). By doing this, students are able to make connections between one subject and another and use their prior knowledge, in accordance with the findings of Dewey. The article also encouraged students to present contrasting cases, such as two sides of a story in which students must formulate an argument or opinion (Schwartz & Martin as cited in Richland & Begolli, 2016). Strengthening opinion and argument development allows students to improve upon their critical thinking skills by developing beliefs and perceptions on problems and situations presented to them. Likewise, Richland and Begolli stressed the importance of comparing a correct and incorrect example of a problem (Durkin & Rittle-Johnson as cited in Richland & Begolli, 2016). Allowing students to think critically and to
make judgment on what they learn are essential components to critical thinking and allow students to continually question and build upon what they know.

Another key component to developing higher order thinking skills in the classroom is student independence. According to Richland and Begolli (2016), teachers should provide multiple solution strategies simultaneously rather than sequentially, allowing students to choose the approach they wish to take in order to solve a task or to create their own solution using the ones suggested to them (Guo & Pang, as cited in Richland & Begolli, 2016; Rittle-Johnson et al., 2009). This independence to choose also transpires into how teachers support students and facilitate learning. Teachers are urged to allow students to solve problems without guidance prior to formal instruction (DeCaro & Rittle-Johnson, 2012; Schwartz et al., 2011; Schwartz & Martin as cited in Richland & Begolli, 2016). Teachers are encouraged to act as the facilitators and to stray away from direct instruction in order to promote original thought. Independence to develop one’s own ideas and solutions allows students to use their existing prior knowledge and experiences to assess the proper approach to a problem, aligning with Nitko & Brookhart (as cited in Brookhart, 2010). Although teachers are to act as guides in the learning process, they must also provide the right supports to allow for learning. This can be done through examples in which teachers supply links between key ideas, problems, or solutions (Alibali & Nathan, 2007; Alibali et al., 2014; Richland as cited in Richland & Begolli, 2016). Likewise, teachers must utilize objects to represent the key elements of the concept being taught (Vamvakoussi & Vosniadou as cited in Richland & Begolli, 2016). Following Brookhart’s description that higher order thinking requires students to “relate their learning to other elements,” providing students with representations and examples gives them the opportunity to expand on their knowledge and understanding of diverse situations (Brookhart, 2010, p. 5). All of these practices in the
classroom build upon various aspects of higher order thinking development, encouraging a variety of cognitive complexity to be used to solve a given problem.

In contrast to Richland and Begolli’s (2016) statements that higher order thinking can be developed in any lesson, Grossen (1991) identified problems students could make in the process of developing higher order thinking skills, hindering its development. Following the concept of analogous reasoning, Grossen conducted a study of literature on the ways in which students make connections between two concepts in order to develop deeper meaning. This study identified problems with students making generalizations or inductions with little to no evidence, as well as difficulty making transfers if two situations appear to be different (Grossen, 1991). Many of the errors identified also affected a student’s ability to apply logic to critical thinking problems in that studies have found that students develop opinions without investigating alternative evidence (Grossen, 1991). Many studies have disregarded these conclusions, referred to as syllogisms, as a component of higher order thinking (Holyoak & Nisbett as cited in Grossen, 1991), but Grossen concluded that the process of developing conclusions based on evidence is important in strengthening analogical reasoning and higher order thinking skillset development overall.

Mandernach (2006) stated that there are two benefits to using online instructional technology in order to increase student critical thinking skills. The first benefit is that it “provides a means of moving lower-level learning tasks outside of class time so that limited student contact time can be devoted to higher-order thinking activities” (p. 43). The second benefit is that it “fosters the use of constructivist teaching philosophies by supplementing traditional face-to-face activities with opportunities for individualized, in-depth interactions with course material” (p. 43). These benefits were observed in a study conducted by Pragaya and Coffey (2008), who observed 21 students in a programming-based summer camp led by the
University of West Florida. These students, ages 10 to 16 and who attended the local public middle school and high schools, were required to create a series of computer games. This camp was an extension of a technology class and provided enrichment to students who were willing to learn programming. Although it did not align with a state curriculum, the camp provided 2 weeks of instruction and the opportunity for students to make their own games. In the first week of the camp, students learned key features of the programming software so that they would have the proper foundation. In the second week, students were given a series of tasks to complete, such as programming an adventure game, puzzle game, and arcade style game (Pragaya & Coffey, 2008, p. 43). Following the class, the students were given a survey on their experiences and the challenges they faced. The results of the survey were compared to Bloom’s perceptions on logical, complex, methodical, and higher order thinking. Pragaya and Coffey defended that “game development and programming promotes the use of higher-order thinking skills by requiring the use of a variety of problem solving skills” (p. 44).

The results of the study showed that higher order thinking tasks required in this summer camp consisted of debugging the computer programs and planning the sequence of the games before designing the code. Students were able to complete many cognitively complex tasks through designing and creating computer games and exceeded the expectations of the summer camp course (p. 47). This study, however, had a small sample size and did not have a curriculum to which higher order thinking benchmarks could be compared. In addition, the perceptions of the participating students were subjective and were not aligned with a framework or model in order to ensure validity. Regardless, this study provided insight into ways in which technology can assist in the development of higher order thinking skills. Although this camp is considered an extracurricular not associated with public education, it provides an example of student-based learning as a means for enhancing higher order thinking and can be transferred into higher order
thinking skill set development in technology classes. One problem with this study, however, is that the small population and environment of a camp setting cannot be generalized to public schools. Despite the positive results on technology and higher order thinking, the results of the study do not indicate that educators would see the same results from using technology in the classroom.

There are very few studies regarding higher order thinking and the use of technology. Many studies conducted on this subject investigate students in higher education or specific graduate programs. These studies, however, are not applicable in research regarding school-age children and their use of technology to improve higher order thinking skills because of cognitive developmental differences that exist between children and adults. Similarly, the types of activities and content presented to students in studies regarding higher order thinking at collegiate and graduate levels are not comparable to those presented to students in a K–12 educational setting.

**Bloom’s Taxonomy and Revised Taxonomy.** In 1956, Dr. Benjamin Bloom created a framework for classifying educational goals, known today as Bloom’s Taxonomy (Armstrong, 2017). This framework “uses a multi-tiered scale to express the level of expertise required to achieve each measurable student outcome” (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956, p. 1). Likewise, according to Hess et al., (2009a), the intent of the taxonomy is to “categorize questions and activities according to their levels of abstraction” (p. 1). Bloom’s Taxonomy focuses around verbs, which are to appear in probing questions in the classroom and dictate the level of complexity of the questions being asked to students. Bloom stated that there were many dimensions involved in building knowledge, a term that has been referred to as the cognitive process dimension. This dimension is considered to be a continuum, in which students are forever on a journey of knowledge to reach higher levels of thinking with the content they are
given in the classroom (Hess, Jones, Carlock, & Walkup, 2009b; Yuan & Le, 2012). Bloom’s Taxonomy was designed so that action verbs used for performance tasks and problems progressively develop as the levels increase, and, in turn, the level of cognitive rigor increases (Stanny, 2016). With this, Bloom’s framework provided scaffolding from the simplest forms of understanding to complex and abstract thought.

But Bloom’s Taxonomy consists of more than just action verbs for students to represent their knowledge of the content. Bloom et al. (1956) identified three separate taxonomies within the framework, each representing a different dynamic of the overall student outcome. The first taxonomy focuses around knowledge-based goals, which focus around the concepts and facts that are learned. At the lowest level is knowledge, which asks a student to recall specific facts. The second level, comprehension, requires students to interpret meanings of the knowledge acquired and understand the facts that have been learned.

The third level, named application, asks students to apply their knowledge to other situations. This level requires students to pick apart information and draw from prior knowledge in order to relate the knowledge learned to other situations. Analysis, the fourth level of the knowledge-based taxonomy, builds upon the previous level by asking students to pick apart information from a complex idea and isolate important information from trivia. As the taxonomy levels increase, students are needed to perform more cognitively complex tasks. The second-to-highest level, synthesis, requires students to employ their creative size by constructing new ideas and drawing from multiple sources to create a new and unique product with the information learned. The highest and final level is evaluation, in which students are able to think critically of the knowledge they have acquired and form judgments or opinions about the concepts learned. Bloom defends that the taxonomy “is a convenient way to describe the degree to which we want our students to understand and use concepts,” making it easier for teachers to
identify the major goals and outcomes of a lesson or unit (pp. 2 & 4).

This knowledge-based taxonomy is the most commonly used and identified taxonomy in education. Stanny (2016) regarded Bloom’s Taxonomy, referring to the knowledge-based taxonomy, to be a focal point for many teachers when designing learning outcomes, classroom activities, and assessments (Adelman, 2015; Fink, 2003). The various levels of Bloom’s highlight the types of activities that students are required to do in regards to higher order thinking. By using commonly used verbs, the tasks become easier to identify among teachers and students, allowing students and teachers to become conscious of the cognitive complexity in each activity. Stanny (2016) tested the action words used in Bloom’s taxonomy and the clarity of the appropriate levels in which each of these action words is placed. She examined 30 websites, which appeared through a Google search, that contained a list of action words for Bloom’s Taxonomy. A spreadsheet categorized each verb alphabetically to emphasize frequency of the verbs provided on each list.

Furthermore, Stanny (2016) analyzed the levels that each verb was placed into, taking note of overlap or discrepancies between the levels assigned by each of the 30 websites. This study revealed that 433 verbs were identified as action verbs in Bloom’s Taxonomy and that 236 (54.5%) of the verbs only appeared in one level. Of the remaining verbs, “108 verbs (24.9%) appeared in two categories, 41 verbs (9.5%) appeared in three categories, 30 verbs (6.9%) appeared in four categories, 15 verbs (3.5%) appeared in five categories, and 3 verbs (choose, relate, select) appeared in all six categories” (p. 4).
Table 1
*Bloom’s Taxonomy Frequency of Action Verbs*

<table>
<thead>
<tr>
<th></th>
<th>$F = 2$</th>
<th>$F = 3$</th>
<th>$F = 4$</th>
<th>$F = 5$</th>
</tr>
</thead>
<tbody>
<tr>
<td>appraise calculate</td>
<td>arrange classify</td>
<td>choose explain</td>
<td>relate select</td>
<td></td>
</tr>
<tr>
<td>categorize cite conclude create criticize defend demonstrate design development differentiate discover discriminate distinguish evaluate experiment illustrate indicate infer interpret invent locate manage match modify order outline rearrange recognize review set up solve summarize synthesize tell test translate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note.* Extracted from 30 published lists (adapted from Stanny, 2016).
Although Stanny (2016) did not publish a complete list of the frequency of repeated action verbs across various Bloom’s levels, the Table 1 represents the frequencies in a smaller sample size of 176 words. The overall study shows the ambiguity that exists within Bloom’s Taxonomy and the action verbs used for each level or skill set. Stanny argued that each verb should only be assigned to one level in order to create more clarity for skill set development and to allow students to be more cognizant of the cognitive complexity of a particular task or problem.

Bloom’s Taxonomy was revised in 2001 by Anderson and Krathwohl to provide subsections to each of the six categories created in the original model (Cinedu et al., 2015). The subsections created action words, which differed from the original verbs in that they provided more specific tasks, which students were asked to perform at each of the levels. The goal of these subsections was to allow students to recognize and distinguish between patterns that connected their prior knowledge to what was presented in front of them, as well as develop an understanding of the overarching problem they needed to solve. According to Hess, Jones, Carlock, and Walkup (2009a), the revised Bloom’s Taxonomy provided an expansion on the cognitive domain of higher order thinking development, intertwining the cognitive processes used in completing a task with the knowledge that is being acquired. With this change to the original model, action verbs shifted to be placed into more intransigent positions (see Table 2).
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Knowledge</strong></td>
<td><strong>Remember</strong></td>
</tr>
<tr>
<td>Define, duplicate, label, list, memorize, name, order, recognize, relate, recall, reproduce, state</td>
<td>Retrieve knowledge from long-term memory, recognize, recall, locate, identify</td>
</tr>
<tr>
<td><strong>Comprehension</strong></td>
<td><strong>Understand</strong></td>
</tr>
<tr>
<td>Classify, describe, discuss, explain, express, identify, indicate, locate, recognize, report, restate, review, select, translate</td>
<td>Construct meaning, clarify, paraphrase, represent, translate, illustrate, provide examples, classify, categorize, summarize, generalize, infer a logical conclusion (such as from examples given), predict, math similar ideas, explain, compare/contrast, construct models (e.g. cause-effect)</td>
</tr>
<tr>
<td><strong>Application</strong></td>
<td><strong>Apply</strong></td>
</tr>
<tr>
<td>Apply, choose, demonstrate, dramatize, employ, illustrate, interpret, practice, schedule, sketch, solve, use, write</td>
<td>Carry out of use a procedure in a given situation; carry out (apply to a familiar task) or use (apply) to an unfamiliar task</td>
</tr>
<tr>
<td><strong>Analysis</strong></td>
<td><strong>Analyze</strong></td>
</tr>
<tr>
<td>Analyze, appraise, calculate, categorize, compare, criticize, discriminate, distinguish, examine, experiment, explain</td>
<td>Break into constituent parts, determine how parts relate, differentiate between relevant and irrelevant, distinguish, focus, select, organize, outline, find coherence, deconstruct (e.g. for bias or point of view)</td>
</tr>
<tr>
<td><strong>Synthesis</strong></td>
<td><strong>Evaluate</strong></td>
</tr>
<tr>
<td>Rearrange, assemble, collect, compose, create, design, develop, formulate, manage, organize, plan, propose, set up, write</td>
<td>Judge based on criteria, check, detect inconsistencies or fallacies, judge, critique</td>
</tr>
<tr>
<td><strong>Evaluation</strong></td>
<td><strong>Create</strong></td>
</tr>
<tr>
<td>Appraise, argue, assess, choose, compare, defend, estimate, explain, judge, predict, rate, core, select, support, value, evaluate</td>
<td>Combine elements to form a coherent whole, reorganize elements into new patterns/structures, generate, hypothesize, design, plan, construct, produce for a specific purpose</td>
</tr>
</tbody>
</table>

*Note.* The table shows the differences between the action words used in original Bloom’s Taxonomy (1956) and the Revised Bloom’s Taxonomy by Anderson and Krathwohl (2001). This table has been adapted from Hess, Jones, Carlock, & Walkup (2009a).
Airasian and Miranda (2002) used Bloom’s Revised Taxonomy to determine how the role of assessments would be altered and, most important, how the role of assessments would be defined following the newer model. They contended that the revised model required assessments that challenged students beyond the knowledge learned in the classroom and called for more complex cognitive processes of focus and thinking. This revised model provided more differentiation in assessments and allowed for better teaching and learning opportunities. Similarly, this study provided guidelines for educators in the action words that should be used to enhance the level of higher order thinking skills being developed and to create unique and appropriate assessments. Airasian and Miranda assessed how ambiguous words such as list focused more on student representation of the knowledge they had acquired rather than the learning process. This study provides more alignment between objectives, cognitive processes, and types of instruction in order to provide educators with a more thorough understanding of ways in which to properly assess higher order thinking skill development in students.

The second taxonomy identified by Bloom et al. (1956) is skills based, which requires that students learn how to complete a task. In this taxonomy, there are seven levels, contrary to the knowledge-based taxonomy that contains six. Perception is the lowest level, in which students are required to use sensory cues to complete actions. This is considered the lowest level because students must be prompted by external stimuli in order to perform an action. Following this is the level of set, in which students are willingly ready to perform an action or task. In this level, they are able to rationalize why they would use a particular approach to solve or complete a task. Next, Bloom identified the guided response as the third level, which requires a student to understand multiple steps that are used in order to complete a task. Multi-step actions demonstrate that a student can utilize higher levels of understanding, since the tasks that require this skill are more cognitively complex.
The following two tasks, named mechanism and complex overt response, contain the same description that students are confident and proficient in their ability to perform the task, while also completing the task in a “habitual manner” (Bloom et al., 1956, p. 2). Although no further explanation was given for these two levels having the same description, the naming of each level indicates that one level requires students to choose a proper procedure in order to complete a task, and the second asks students to incorporate complex thinking and actions to reach the objective. The sixth level, adaptation, requires students to use complex problem solving actions to complete a task while also adapting previously used actions for new tasks. This level shows a student’s flexibility in thinking and actions by presenting them with tasks that they have not been exposed to before. The last and highest level, organization, asks students to create new tasks and objectives from previous ones that have already been learned. This level is cognitively complex in that students must take ownership of their learning and set goals to build upon previously mastered objectives, as well as abilities.

The third category of Bloom’s Taxonomies is known as the affective goal, which focuses on the values, attitudes, and interests students acquire through the learning process. This taxonomy contains five levels, which are also arranged from least to greatest cognitive complexity based on the level of understanding at an emotional level. The lowest level is identified as receiving, in which students show an interest and willingness to participate in the learning process. This, although important for student learning, is considered the lowest level because it focuses more on student engagement in the classroom and on the topic but not on the learning process or acquisition of knowledge. The next level is responding, which is identified by students showing an interest in the content or activity being taught. Although this is more specific than the previous level, students who are interested in a particular subject matter are more likely to meet the requirements of this level than those who do not, placing responsibility
on the teacher to make the lessons engaging and to spark interest in students who do not already enjoy the content. When students develop an appreciation for the content or activity, they have reached the valuing level of the affective goal taxonomy. Students at this level search for additional information outside of class in order to expand on their knowledge and often exceed the expectations of the learning objectives and curriculum. The fourth level, organization, is shown in students who compare and evaluate their values, while also critiquing pre-existing beliefs. Students at this level develop a consistent set of values on the topic and similar topics.

The highest level of this taxonomy, characterization by a value or value complex, is reached when a student develops a long-term system of values on the topic that is pervasive, consistent, and predictable (Bloom et al., 1956, p. 165). The example provided by Bloom et al. (1956) is when a student travels abroad to immerse himself or herself and learn about a culture that had been previously learned in a classroom setting. This is considered the highest level because it shows an interest and appreciation of something taught that exceeds the learning objective and becomes a lifelong value. Many of the affective goals identified in Bloom’s Taxonomy are contingent on the teaching strategies employed and the environment in which the content is learned, putting more ownership on the teacher. Unlike the knowledge-based and skills-based taxonomies, which can be encouraged in the classroom through the types of activities and assignments given to students, the affective goal taxonomy levels must be achieved naturally. That is, a teacher cannot force a student to develop an appreciation for a subject, nor could they assess a student based on their values or appreciation.

In many ways, these three taxonomies work simultaneously. Bloom et al. (1956) defended that it is essential for teachers to understand each of the three taxonomies and to develop assessments based on which taxonomy, or which components from each, ought to be evaluated. Through these taxonomies, teachers can be more cognizant of not only the knowledge
that can be acquired and the actions that can be performed, but also the lifelong lessons that will follow students beyond the classroom. This requires teachers to make content meaningful, which can be difficult given the topic and the student’s personal interest. In addition, it requires that teachers encourage their students to perform more complex tasks, make connections to topics in which they already have an interest, and to create new meanings that can translate outside of the classroom.

**Webb’s Depth of Knowledge.** In 1997, Dr. Norman Webb published the Depth of Knowledge, the use of which shifted perceptions of higher order thinking instruction from actions to the cognitive demands placed on students to complete tasks. Webb defended that “the depth of knowledge or the cognitive demands of what students are expected to be able to do is related to the number and strength of the connections within and between mental networks” (Jirka & Hableton, 2005, pp. 6–7). This model spread throughout schools in the United States because of the way it connected multiple dimensions of thought that extended beyond the capabilities of Bloom’s Taxonomy (Sforza et al., 2016). One significant reason for its growth in classroom use was its alignment between states’ standards and standardized tests, such as the New Jersey Assessment of Skills and Knowledge (NJASK). This alignment provided further clarity for educators by identifying

the level of cognitive complexity of information students should be expected to know, how they should be able to transfer the knowledge to different contexts, how well they should be able to form generalizations, and how much prerequisite knowledge they must have in order to grasp ideas. (Webb, 1997, as cited in Sforza et al., 2016, p. 8)
Table 3  
*Webb’s Depth of Knowledge*

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
</table>
| DOK-1 | *Recall and Reproduction*  
Recall a fact, term, principle, or concept; perform a routine procedure |
| DOK-2 | *Basic Application of Skills/Concepts*  
Use information, conceptual knowledge; select appropriate procedures for a task; perform two or more steps with decision points along the way; solve routine problems; organize or display data; interpret or use simple graphs |
| DOK-3 | *Strategic Thinking*  
Reason or develop a plan to approach a problem; employ some decision-making and justification; solve abstract, complex, or non-routine problems (DOK-3 problems often allow more than one possible answer) |
| DOK-4 | *Extended Thinking*  
Perform investigations or apply concepts and skills to the real world that require time to research, problem solve, and process multiple conditions of the problem or task; perform non-routine manipulations across disciplines, content areas, or multiple sources |

*Note. Source: Webb (1997, 1999) as provided by Hess, Jones, Carlock, & Walkup (2009a).*

Along with its presence in the classroom to aide teachers in creating activities that exercise a student’s cognitive abilities, Webb (2008a) identified four criteria of the framework for properly aligning assessments to state standards. The first is known as categorical concurrence, which assesses the alignment of the same or consistent categories of content in both the assessment and the standards (Webb, 2008a, p. 3). Webb (2008a, 2008b, 2008c) aligned the Wisconsin Alternate Assessment for Students with Disabilities (WAA-SwD), a standardized test, to the state standards for reading, science, and mathematics. In all studies, Webb found that there were issues with categorical concurrence, in that not all items were aligned between the assessment and the supposed corresponding standards. Webb (2008c) proposed that new items
must be developed to fill alignment gaps with ongoing revisions made to remain current with the standards.

The second criteria is the depth of knowledge consistency, which examines the alignment between the assessment’s cognitive demands and what students are expected to know or do at grade level, according to the standards (Webb, 2008a, p. 4). Within the depth of knowledge consistency criteria is a subcategory for students with special needs, known as the extended depth of knowledge stages for special education (EDOK). This subcategory separates the first step of Webb’s Depth of Knowledge level, recall and reproduction, into three stages. At Stage 1, students are asked to respond to basic questions, such as pointing to letters or words or appropriately answer a question in a conversation. Students are then required to demonstrate basic reproduction of the content in Stage 2, such as copying letters and matching words. Stage 3 requires students to recite and recall facts, including identifying details. After these stages, Webb’s Depth of Knowledge resumes with basic application being reassigned to Stage 4, strategic thinking as Stage 5, and extended thinking as Stage 6 (Webb, 2008a, pp. 4–5).

Webb (2008a) also identified issues with alignments to the depth of knowledge consistency criterion, in that at least one item was not properly met for at least one standard, existing in Grades 3, 5, 6, 7, 8, and 10. In this study, only Grade 4 of the WAA-SwD aligned all items to the Depth of Knowledge levels. In addition, Webb (2008a) observed that one third of the items on the WAA-SwD assessment for Grade 10 would have to be replaced with items that placed into higher Depth of Knowledge levels in order to fulfill the alignment.

The third criteria of Webb’s alignment between assessments and standards is range-of-knowledge correspondence, which compares the range of knowledge students are expected to know to the range of knowledge they need in order to successfully complete the assessment (Webb, 2008a, p. 6). Webb (2008a) found that the range-of-knowledge correspondence was
successfully fulfilled by the WAA-SwD in reading because of the small number of objectives included in each standard assessed across all grade levels. Lastly, Webb identifies a criterion known as balance and representation, which compares the emphasis given to a particular objective on an assessment compared to other objectives, aiming to ensure a balance between each objective being assessed (Webb, 2008a, p. 6). According to Webb (2008a, 2008b, 2008c), the WAA-SwD fulfilled the criteria for balancing the difficulty of tasks across the standards for reading, science, and mathematics.

Webb’s Depth of Knowledge aimed to categorize cognitive complexity, not the level of difficulty of a task or problem. Sforza et al. (2016) conducted a qualitative content analysis case study in order to analyze the percentages of New Jersey Core Curriculum Content Standards (NJCCCS) and Common Core State Standards (CCSS) that utilize strategic and creative thinking in high-school-level English language arts (ELA) and mathematics. Keywords were extracted from these standards and categorized based on Webb’s Depth of Knowledge.

The results of this study revealed that the CCSS contained fewer Levels 3 and 4, the highest two levels of Webb’s Depth of Knowledge model, than the NJCCCS. Sforza et al. (2016) reported that 72% of ELA standards and 90% of mathematics standards in the CCSS were at the lowest two levels of Webb’s model. Comparatively, 62% of ELA standards and 62% of mathematics standards in the NJCCCS were at the lowest two levels, indicating that the New Jersey standards contained more opportunities for higher order thinking skill set development and were more cognitively complex than those of the Common Core. Additionally, Tienken (2016) published these findings separately and expanded upon the study to suggest that the limitations of higher order thinking in the CCSS can hinder not only student thinking and skill set development but also their ability to compete in a global economic environment (Runco & Chang as cited in Tienken, 2016).
In a similar study, which assessed the content of the Smarter Balanced standardized assessment, it was found that 37% of test questions in ELA and 36% of test questions in mathematics were at Levels 3 and 4 (as cited in Herman & Linn, 2014). This study, conducted by Yuan and Le (2012), analyzed the cognitive rigor of standardized test questions used in 17 states across the United States, totaling over 5,100 test questions analyzed. Their findings showed that the overall cognitive rigor of these test questions was low and that open-ended questions had a significantly greater chance of being at a Level 3 or 4 than did multiple-choice questions. Similarly, as reported by Herman and Linn (2014), the publishers of the PARCC assessment claimed that the PARCC was designed to have one third, or 33%, of its test questions place into Levels 3 and 4 (Dogan as cited in Herman & Linn, 2014). Yuan and Le concluded that with the limited number of cognitively complex test questions available in standardized tests, it is probable that less than 10% of American students who take these tests are assessed on deeper learning based on the cutoff scores for multiple-choice test sections.

**Hess’ Cognitive Rigor Matrix.** The Cognitive Rigor Matrix was developed to superimpose Bloom’s action words at each of the six levels of the Revised Taxonomy with Webb’s cognitive complexity at each level in the Depth of Knowledge. Designed by Karin Hess in 2005, this model aimed to connect the two frameworks by making the rigor of tasks more apparent through the task itself and the level of complex thinking it requires on the part of the student (Hess et al., 2009a). Hess et al. (2009b) defended that there are three benefits to educators using the Cognitive Rigor Matrix. First, it helps to identify the similarities and differences between both Bloom’s Taxonomy and Webb’s Depth of Knowledge. Furthermore, it “allows educators to examine the depth of understanding required for different tasks that might seem at first glance to be comparable levels of complexity,” enabling teachers to better understand the level of cognitive complexity of a particular task or action (p. 3). Teachers can
use this information in order to adapt teaching strategies to meet students’ needs, providing differentiation in not only the tasks themselves, but the cognitive rigor students must utilize in order to successfully complete these tasks. Lastly, Hess et al. (2009a) claimed that the Cognitive Rigor Matrix “allows educators to uniquely categorize and examine selected assignments/learning activities that appear prominently in curriculum and instruction” (p. 3). Similar to the other two benefits provided, this allows teachers to better understand the types of activities students are asked to complete in order to meet the expectations of the standards, as well as understand the development of higher order thinking skills through practicing these actions.

Teachers can use this model not only to provide activities for students that require them to use higher order thinking skills, following Bloom’s Taxonomy, but also to adjust those activities to increase cognitive rigor, in accordance with Webb’s Depth of Knowledge, to meet specific students’ needs. Hess et al. (2009b) explained that the Cognitive Rigor Matrix “has significant potential to enhance instructional and assessment practices at the classroom level” because cognitive rigor is multifaceted, including the complexity of content, student cognitive engagement, and the scope of activities (p. 7). Overall, it helps educators to build up students’ higher order thinking skills not only in the actions that they present to students, but also in the level of cognitive complexity of task that students must complete.

The model was tested in 2009 in two large-scale studies that examined the curricula among 200 public schools in Nevada and Oklahoma. In that study, over 200,000 samples of student work were submitted in ELA and mathematics subjects, including assessments, homework, and classwork (The Standards Company as cited in Hess et al., 2009a). Each task or problem on the student work samples was assigned a level on both Bloom’s Revised Taxonomy and Webb’s Depth of Knowledge and later were cross-referenced on Hess’ Cognitive Rigor
Matrix. The results showed that most of the mathematics tasks were at lower levels, with 34% of all samples placing into Level 1 on Bloom’s Revised Taxonomy and Level 1 on Webb’s Depth of Knowledge. The results also revealed that items with lower cognitive complexity, according to Webb’s Depth of Knowledge, could be placed into Levels 3, 4, and 6 on Bloom’s Revised Taxonomy, indicating a discrepancy between the level of cognitive complexity and the level of complexity of the action or task itself (Hess et al., 2009a). This indicates that many of the activities teachers give to their students as higher order thinking tasks might be low in cognitive complexity. Teachers who are unaware of Webb’s model and the connection to cognitive complexity could assign tasks and activities to students, which they claim build higher order thinking skills, but actually contain very little cognitive complexity. This would hinder students in further developing higher order thinking skills if the level of cognitive rigor does not challenge them.

Because Hess’ Cognitive Rigor Matrix is relatively new in education, it has not gained significant popularity, mainly due to schools already using exclusively Bloom’s Taxonomy or Webb’s Depth of Knowledge as a model for encouraging higher order thinking in the classroom. There are little to no studies on the Cognitive Rigor Matrix being used in the classroom, aside from the initial study conducted by Hess et al. (2009a). In order to accurately assess whether Hess’ Cognitive Rigor Matrix can replace Bloom’s or Webb’s in the classroom, teachers would have to be adequately prepared and trained in how to use Hess’s model so that it could be effectively implemented into the classroom. To do this, teachers would have to receive professional development and supports on the change from the previously used model, such as Bloom’s or Webb’s, and the new Cognitive Rigor Matrix. Only then could studies be performed on the types of activities teachers present to students, as well as students’ abilities to improve upon higher order thinking skills. Still, potential future studies would focus primarily on the
alignment of activities and curriculum to Hess’s model or ways in which teaching strategies, subjective to specific teachers’ teaching styles, place on the Cognitive Rigor Matrix.

Furthermore, since Bloom’s Taxonomy and Webb’s Depth of Knowledge are proven to be effective models for encouraging and building higher order thinking skills in students, it can be implied that Hess’ Cognitive Rigor Matrix is also an effective method for properly educating students in higher order thinking skill set development.

**Online-Based Programs**

According to Knezek (as cited in Hill, Lenard, & Page, 2016), technology-based resources are rapidly being implemented into schools as a means of enhancing student achievement. Although there are studies on online-based programs, none investigate these programs and their effectiveness on improving higher order thinking skills. A two-year study on the Achieve3000 program, a CCSS-aligned online-based program designed to improve students’ Lexile reading levels while enhancing critical literacy capabilities (Achieve3000 as cited in Hill et al., 2016), was conducted in 32 public elementary schools in North Carolina. In total, approximately 35,000 students were used in this study, with half of the sample as part of the experimental group that utilized Achieve3000 as an extension of the reading curriculum. The schools were matched based on their end-of-grade reading composite scores, allowing the researchers to divide the schools evenly and placing 16 schools in the control group and 16 in the experimental group. This study focused primarily on Grades 2 through 5 and required students to complete Achieve3000 activities. Students were able to complete these activities at their own pace, with most participants completing between 1 and 39 activities in the time of the study. The participating schools’ goal was to complete 80 activities, but only 7.5% of participants reached this. The students were exposed to Achieve3000 two times a week for 30 minutes. During this
time, students would take an introductory poll, complete the activity, and then complete the closing multiple-choice questions and poll.

The results of this study showed that the online-based program did not show any statistically significant impact or practical significance (effect size) on improving student Lexile reading levels, although the second year of the study revealed that the experimental group outperformed the control group by 0.13 standard deviation units, an effect size that is consistent with empirical averages (Hill et al., 2016, pp. A–4). Likewise, Hill et al. (2016) reported that the number of activities students completed in the second year increased from the first. Still, the study did not report on any correlation between the number of activities completed and an increase in Lexile reading levels; this information could have strengthened the arguments in favor of Achieve3000 in the school district if there was statistically significant improvement in reading levels as students completed more activities. The results of the study, which focused primarily on the effects of Achieve3000 overall on Lexile reading levels, indicate that the use of Achieve3000 is not adequate as a replacement to the reading curriculum and, although it can be used as a reinforcement outside of the classroom, there is no evidence of significant improvement in a student’s Lexile reading levels after use of this program. Much of the failure of this study was credited to the implementation of the Achieve3000 program in the schools studied. Hill et al. (2016) observed that many teachers only allowed students to practice fewer than 40 activities on the program, which may have been deficient in providing enough support to improve a student’s Lexile reading level. Likewise, the second year of the study proved to have better results in improving Lexile reading levels, but much of this was credited to student familiarity with Achieve3000 compared to the first year.

In a similar study of the Achieve3000 program, teachers were required to provide students with a minimum of 90 minutes per week of practice. The results of the study, as
published by Shannon and Grant (2015), revealed that students completed 30.53 program hours in one year and completed on average 50.58 activities. In contrast to the study conducted by Hill et al. (2016), this study found a statistically significant improvement on student Lexile reading levels with the implementation of Achieve3000, as tested by the Gates-MacGinitie Reading Test for Grade 4 (GMRT-4) Vocabulary, Reading Comprehension, and Total Reading tests. The threshold met or exceeded 0.25 with effect sizes of 0.42, 0.47, and 0.48, respectively; the threshold was determined by the What Works Clearninghouse (WWC). Likewise, Achieve3000 was statistically significant on the GMRT-4 Reading Comprehension and Total Reading when being compared to the standard ELA curriculum in the participating schools, but the effect sizes of these results did not meet the needed threshold, with effect sizes of 0.22 and 0.20, respectively. When looking at the GMRT-4 alone, Achieve3000 did not have a statistically significant impact on test scores, with an effect size of 0.12. This indicates that although Achieve3000 may help to improve Lexile reading levels, it may not do enough to show significant improvement in struggling students. Similarly, there was no statistical significance found among a subgroup of English language learners (ELL), indicating that Achieve3000 contains flaws in its design as a means of reinforcing reading skills, especially in students learning English. These results can imply that Achieve3000 is not suitable as a tutoring program for ELL students or students struggling with reading comprehension, as its results are not statistically significant in this subgroup test. The study concluded that the results were, in large part, due to the monotony of the tasks presented to students through Achieve3000 and the time spent away from teacher-led instruction. Achieve3000, although beneficial for improving upon Lexile reading levels overall, must not be used as a supplemental curriculum that replaces teacher instruction in English language arts or reading. Despite any results that claim Achieve3000 is not statistically significant in improving student test scores, the overall report
was designed in order to promote Achieve3000 and, therefore, described the benefits of Achieve3000 as increasing student engagement. Contrary to the results of the study, Shannon and Grant (2015) reported that Achieve3000 is beneficial for students with disabilities, English language learners, and below-level students, despite the fact that the results of the study showed no statistical significance for students in these subgroups.

Urdegar (2014) focused a study on the impact Achieve3000 had on students with learning disabilities, primarily in the differentiation of instruction the program provided. Between 800 and 900 students were tested at each grade level between Grades 6 and 8. The results showed that approximately 78% of students at each grade level completed at least one activity on Achieve3000, but over half of all students completed fewer than 10 activities in an academic school year (Urdegar, 2014, p. 4). In addition, the amount of usage declined as the grade level increased. The results also showed statistical significance in Grades 6 and 7, indicating that as the amount of time using Achieve3000 increases, test scores on the Next Generation Sunshine State Standards-aligned criterion reference tests known as FCAT 2.0 increase; Grade 8 results did not show statistical significance between program usage and test score increase. Even still, there was no statistical significance found between the students in the experimental group and students examined who did not use the Achieve3000 program, showing consistency with other studies that analyzed the results of various subgroups of students (Hill et al., 2016; Shannon & Grant, 2015).

Borman, Park, and Min (2015), in a quasi-experimental study in Chula Vista, California, assessed the impact of Achieve3000 use on scores for the California Standards Test (CST). In this study, 16 schools using Achieve3000 were studied based on implementation of the online-based program, such as professional learning services (PLS) provided to teachers, and on ways in which the 1,957 participating students in Grades 4 through 8 used Achieve3000. Variables in
this study included gender, race/ethnicity, socioeconomically disadvantaged status, ELL status, and grade level. The results of the study showed that the outcomes of Achieve3000 use varied between grade levels, being most effective for students in Grades 4, 7, and 8. Overall, this study determined that the use of Achieve3000 was statistically significant, even when controlling for each of the variables, with an average effect size of 0.04 after adjusting covariates. These results differed from other studies, such as the aforementioned studies in other school districts, suggesting that each of the studies provide only small case studies of individual school districts or regions and cannot be referred to for greater generalizations about the program’s effectiveness.

Another popular online-based program is Study Island. A report published by Magnolia Consulting, released onto the Study Island website, credits Study Island with the Common Core State Standards to allow educators “to remain apprised on student performance toward state expectations” (Styers, 2012, p.6). In this report, Styers addressed research-based instructional practices and their link to Study Island, such as the ability to differentiate instruction by providing a variety of styles and options for learning. In addition, the study suggested that instruction, particularly in mathematics, should be focused, which Study Island achieves through its ability to adapt content and delivery to varying ability levels. In addition, the report gives Study Island credit for enhancing student engagement through a plethora of activities, animations, and lessons. Although the report used evidence from published works to defend claims pertaining to student achievement in mathematics, the report failed to test Study Island on its effectiveness with meeting the instructional practices suggested. For example, despite its claim that “distributed learning over an 8- to 30-day period and having at least one day between learning sessions is beneficial for retention of mathematics skills and increases achievement by 29%,” there is no independent, peer-review study that relates this to Study Island or explains
how the program can help to ensure success (Styers, 2012, p. 2). Likewise, a reference was
given for the previous claim, but this reference solely contained an author’s name and date; with
no title or publisher mentioned, the claim itself loses its validity.

Styers’s (2012) report on Study Island failed to contain any studies that tested the
program. Instead, it related claims about effective mathematics instruction to Study Island’s
capabilities, but failed to defend Study Island’s effectiveness with sound evidence. Watts (2008)
completed a retrospective study, modeling a quasi-experimental framework, which compared
student achievement before and after the implementation of Study Island, as well as student
performance between schools using the program, compared to local and state norms. Watts
(2008) compared Study Island schools in New Jersey to other New Jersey public schools. In this
study, 1,395,602 participated between the 2005 and 2006 school year. The results indicated that
schools using Study Island had higher test scores on the Grade Eight Proficiency Assessment
(GEPA) in mathematics and English language arts, with 75% of students in Study Island schools
placing into proficient or above proficient compared to the 71.7% of students who placed into the
same categories in non-Study Island schools. Demographics of the schools observed were not
included in the study, making it unable to determine whether the Study Island and non-Study
Island schools are comparable. The report did not indicate which schools used Study Island and
did not disclose the socioeconomic statuses in these schools. Also, since the number of schools
in both groups was not provided, it cannot be determined whether or not the sample sizes were
an even distribution. This questions the validity of the study on New Jersey schools and Study
Island’s effectiveness.

Watts (2008) also studied three schools in Florida, which ranged from rural to mid-sized
city demographics, consisting of 100,331 teachers and 2,675,024 students. Of the three
participating schools, 45.8% of students participated in free and reduced lunch. Students in these
schools also identified with ethnicities consisting of 50.5% White, 24.1% Black, and 23% Hispanic. The effects of Study Island were measured by the Grade 3 Florida Comprehensive Assessment Test (FCAT), which showed that students scoring a Level 3 or higher in mathematics increased by 9.54%. These results were three times greater than the state average growth of 2.82%. Similarly, the study observed schools in Illinois, consisting of a total population of 2,111,706 students that also included the Chicago public school system. Consistent with results from schools in other states using Study Island, the results of the Grades 3 and 4 Illinois Standards Achievement Test (ISAT) Study Island schools showed an increase in meeting and exceeding standards in reading by 6.6% and 8.0% in mathematics. Likewise, the results of Grades 5 and 6 grade ISATs showed an increase in meeting or exceeding standards by 13.7% in reading and 8/4% in mathematics. Although these results appear to show that Study Island is an effective method for increasing content knowledge and proficiency, Watts (2008) did not report whether the increases in the New Jersey, Florida, and Illinois schools were statistically significant. Watts (2008) also investigated student achievement in other states, including New York, Ohio, and Pennsylvania. In these tests, findings were consistent that Study Island schools had greater improvement in students meeting the standards than those in non-Study Island schools.

California had the biggest observed improvement on a state standardized test after the implementation of Study Island. The chosen school contained 350 students and had implemented Study Island in the 2006-2007 school year. According to the results, student achievement scores on the Grade 5 California Standards Test (CST) increased in science, reading, and mathematics, although the results were only statistically significant for mathematics. Grade 5 students showed an increase in meeting and exceeding proficient scores from 35% to 66%, as well as an increase in advanced proficient from 10% to 30%. The increase
in test scores were observed after Study Island had been implemented, suggesting the Study Island served as a contributing factor to the increase in mathematics test scores on the CST. These results also were significantly greater than comparative schools across the country in that the participating California school showed 31% gains in mathematics while students across the country showed 2%. The participating California school also had greater improvement in science and reading, with gains triple and five times those of the entire country (Watts, 2008, p. 4). In the same study, students in California scoring below basic and far below basic showed a statistically significant decrease in reading and mathematics ($p < 0.05$) and a decrease in science that approached significance ($p < 0.10$). Watts (2008) expected a decrease in these subgroups, indicating that the number of students in the below basic and far below basic categories decreased as mathematics knowledge increased. Although the participating California school showed the greatest improvement in mathematics proficiency compared to other participating schools in the country, the small population size could indicate that the sample was not an accurate representation of all California schools using Study Island. In addition, other factors, such as the school population’s socioeconomic status, with 30% on free and reduced lunch and 46% of students identifying as Asian Pacific Islander, could influence the results.

The study also included investigations on Study Island use in other states, including Massachusetts, Michigan, New York, North Carolina, Ohio, Pennsylvania, and Texas. In each of these tests, schools using Study Island showed improvement compared to schools that did not use the program. In Massachusetts, Michigan, North Carolina, and Texas, Watts (2008) found that schools using Study Island were more likely to achieve Adequate Yearly Progress (AYP), and were more likely to achieve AYP if they did not do so the year before. Comparing the findings in all states tested, Watts (2008) indicated that Study Island implementation in schools promoted academic achievement at a student level, such as performance on standardized tests,
and also at a school-wide level in attaining AYP. These two conclusions correlate in that schools achieve AYP through student achievement, which suggests that underperforming schools could use Study Island as a tool to improve upon student achievement and to improve the overall ranking of the school.

Watts continued her study in 2009 with a study on the effects of Study Island use on response to intervention (RTI) research. Similar to the study on differentiated instruction, little to no research was used to support claims that Study Island is an effective tool for teachers who use RTI for struggling students. Watts (2009) claimed, however, that Study Island is effective for both a problem-solving approach and a standard treatment protocol model of RTI (p. 6). At the lowest level of RTI, referred to as Tier I or general instruction, Study Island can give a platform for students to practice skills that have previously been taught in the classroom while also giving feedback and targeted remediation for other skills that need improvement. According to Watts (2009), Study Island also provides a variety of ways in which material is presented to students, increasing student engagement and motivating them to perform well by presenting the material in a game-like format. The importance of ongoing assessments is a crucial component of both the problem-solving approach and standard treatment protocol model of RTI, and Study Island accommodates for this by using “a comprehensive system of assessment tools that allow educators to establish an initial performance baseline” and continue to monitor students as they continue to utilize Study Island (p. 8). The program also puts ownership on students by allowing them to choose the tasks they complete and the order in which they complete them. This helps students to set personal goals for learning and regulate their progress in a flexible and comfortable way. Teachers can also access student performance reports in order to monitor student progress and compare students to their classmates, as well as to the state and national averages. Watts (2009) defended that “comparing individual student performance to large
normative sample on an ongoing basis may be one of the most effective ways to determine if a student is responsive to instruction” (Fuchs, 2003, as cited in Watts, 2009). This can be beneficial for teachers by allowing them to assess how their students are performing compared to others in the class. This also can be a means of reflection for teachers, in that he/she can adjust teaching strategies in order to meet the needs of struggling students.

At Tier 2 of the RTI models, known as individualized intervention, teachers are able to assign specific activities to a particular student. Watts (2009) noted that the flexibility of Study Island in its ability to add and change activities that are assigned to each student individually is beneficial for both approaches to RTI. In the problem-solving approach of RTI, Study Island helps to identify specific academic problems based on a student’s performance on each objective and provides information to teachers that allows them to understand the specific skills are content areas that are in need of improvement. In addition, Watts (2009) suggested that teachers can use the diagnostic information to adjust teaching strategies in the classroom in order to meet students’ needs and to assign activities quickly following the results of the reports produced.

Following the treatment protocol model approach to RTI, teachers can set levels for students in order to give them academic and performance goals. In addition, Study Island contains printable worksheets to accommodate for students who do not have access to the program at home or who do not perform well on tasks on the computer. One limitation of Study Island, as inferred by Watts (2009) is that teachers must take responsibility for monitoring student progress and for making necessary changes, such as prescribing activities and changing levels. The program, although beneficial in creating diagnostic reports, does not adapt itself to meet student needs based on the areas of weakness identified.

Watts (2009) also reported that Study Island is beneficial for students in Tier 3 of RTI, intensive intervention. Similar to the benefits Study Island offers for students in Tier 2, its
diagnostic reports can allow for “ongoing process monitoring” that alerts teachers to problems that continue following Tier 2 intervention (p. 12). When used for Tier 3 intervention, Study Island can automatically lower the levels of material presented to students and increase the complexity and wording of activities as students develop their skills. Unlike its use in Tier 2, Study Island shows the ability to use student information to automatically refocus instruction and build upon student needs without placing the responsibility on the teacher to assign tasks at each student’s level. When students complete each level, they receive a ribbon of achievement that allows them to proceed to the next level. Once a ribbon is earned, the student can return to activities in that area that are at grade level, allowing teachers and students to monitor progress.

Watts (2009) argued that “research demonstrates that the application of multi-tiered RTI models within instructional settings has been effective regardless of the approach,” indicating that Study Island is inherently successful because it is one of many approaches teachers can use (p. 13). This anything is better than nothing belief allows researchers to view Study Island as an effective method for RTI without conducting studies to analyze its effectiveness at improving upon student achievement. Although the study includes no research using actual data, it is published on Study Island’s website, claiming that “RTI procedures and the Study Island program provide effective solutions” to meet the needs of struggling students (p. 15).

In 2010, Watts (2010) published another study on the alignment of Study Island with differentiated instruction under the belief that this program that “functions as a diagnostic and progress monitoring tool” by using multiple means of delivery to cater to a variety of learning styles (p. 9). This study used the Tomlinson model for differentiation, which encourages teachers to differentiate the content, process, and product based on the student’s readiness, interest, and learning profile (p. 3). In addition, teachers are instructed to provide respectful tasks that respond to a student’s needs, flexible grouping, and ongoing assessments or
adjustments. Watts (2010) explained that Study Island could accomplish these guidelines because of the way it uses real-time feedback on student progress and observed that Study Island helped teachers to differentiate instruction by providing “customized and personalized learning” that also kept students engaged (p. 10). By catering to students’ individual learning needs, Watts observed that Study Island promoted student motivation and confidence. There was no research, however, that proved whether or not motivation actually increased in students who participated in Study Island. Still, the Study Island website published Watts’s (2010) report as evidence in promotion of the program.

In the same study, Watts (2010) observed that Study Island provides a comfort to struggling students because it can be used at school or at home, allowing students to complete the tasks in a comfortable setting. Study Island can also be used in a small-group or whole-group setting, allowing students to work collaboratively. Watts reported that teachers can use Study Island to regularly monitor student progress with up-to-date achievement data, allowing teachers to identify struggling students and to provide higher levels of instruction to students who excel or exceed grade-level requirements (p. 14). The Study Island program also differentiates how content is presented to students and the way in which teachers can use the program to aid in or supplement instruction, catering to multiple learning styles and needs. Study Island also adjusts to students’ readiness levels by adjusting the complexity of tasks that align with each student’s zone of proximal development (p. 19). According to Watts (2010), “technological-based programs such as Study Island inherently peak student interest and promote differentiation based on student interest,” suggesting that students will naturally be interested in learning from Study Island because it is an online-based activity (p. 20). This suggests that when students are interested, they are more likely to succeed at the activities they perform on Study Island, and the
program encourages this idea by awarding blue and white ribbons when they successfully complete each activity of the program.

As previously stated, Watts’s (2010) study on differentiation does not contain any research or scientific evidence to support these claims. The Study Island website, however, categorizes this report as research towards the success and achievement of the Study Island program. This report, however, served to show the alignment between the various features of the Study Island program and a differentiation framework. Further research is still needed to determine whether the program successfully promotes differentiated instruction in the classroom. In addition, further research could also investigate how students use Study Island to cater to individual learning styles, how teachers use Study Island, and the effectiveness of the program on student achievement as a result of a Study Island based learning environment.

Despite numerous studies concluding that online-based programs can enhance student achievement, no research exists on these products and their ability to increase higher order thinking in K–12 students. Paige et al. (2013) suggested that higher cognitive rigor correlates with greater academic achievement, further strengthening the need for research on the ability for online-based programs to improve higher order thinking skills through the activities and tasks presented to students. Studies regarding higher order thinking in these programs can indicate methods for reinforcement for struggling students, as well as struggling schools. Similarly, studies on higher order thinking can evaluate claims made by companies that offer these online-based programs, which claim to enhance critical thinking and problem solving skill set development on their websites.
Theoretical Framework

Although numerous models for encouraging higher order thinking skill set development exist in schools throughout the United States, none have as much popularity as Bloom’s Taxonomy and Webb’s Depth of Knowledge. These two frameworks, although similar in many of the terms and descriptions used at each level, differ greatly in the area of focus regarding higher order thinking. Bloom’s Taxonomy, referring specifically to the knowledge-based taxonomy, concentrates on actions students perform in order to demonstrate an understanding of a particular concept. Webb’s Depth of Knowledge, on the other hand, focuses on a task’s level of cognitive complexity, which encompasses the number of connections a student makes, the level of reasoning, and reflective and self-monitoring processes utilized in order to effectively complete a task (Jirka & Hableton, 2005, p. 7).

Newer and less popular, Hess’ Cognitive Rigor Matrix superimposes these two frameworks in a model that unifies the actions of Bloom’s with the cognitive complexity of Webb’s. This unification of the two frameworks provides a means for educators to be more cognizant of the ways in which classroom instruction can cultivate higher order thinking skill set development while also increasing in cognitive complexity, furthering the levels of differentiated instruction that can occur in the classroom. Furthermore, Hess’ Cognitive Rigor Matrix serves as a model that can help educators understand the complexity of the tasks and questions they assign to their students, allowing them to choose tasks that are developmentally appropriate in fostering higher order thinking skills in each student. Overall, Hess’ Cognitive Rigor Matrix blends the actions with the cognitive complexity of tasks and activities being asked of students in order to create a holistic model that can encourage higher order thinking (Hess et al., 2009).

A major obstacle when assessing higher order thinking skill set development lies in the definition of higher order thinking, or lack thereof. Despite a plethora of research/studies that
highlight the actions and tasks that contribute to higher order thinking, such as critical thinking and problem solving, there is no unified definition of higher order thinking to which educators and researchers can refer. Higher order thinking contains a diverse, complex network of critical learning skills that can either be enhanced separately or together through consistent practice in the classroom. Due to the multiple components needed to reach a level of higher order thinking, it is essential that educators utilize a variety of strategies. A diverse set of strategies and procedures will enable a teacher to enhance these deep learning skills, which will help the teacher and learner focus both on the task itself and the level of complexity of the task. The researched literature reveals that higher order thinking is developed utilizing various learning activities within critical thinking, problem solving, reasoning, and judgment (Brookhart, 2010). As schools move towards 21st century learning, these skills should become the focal point of many standards and educational reforms. With the increase in technology use in schools, companies created online-based programs to aid in a student’s educational experience, serving as a means to provide tutoring and reinforcement in a format that is engaging to students. Many of these companies excessively market their products to schools, claiming their product can enhance higher order thinking skills through differentiation of tasks and through adaptive technology that increases complexity levels as students show success in completing each activity. Although published in reports on the programs’ websites, there is little to no empirical evidence to support the claims that some of these online-based programs effectively promote higher order thinking skill set development. Although many of these online-based programs claim to enhance higher order thinking skillset development through the activities that are presented to students, no studies to date have analyzed the types of activities or the level of cognitive complexity of these activities.
The theoretical framework of this study uses Hess’ Cognitive Rigor Matrix to compare 231 activities from the Grade 8 English language arts section of the HOT Learning program, in order to describe the level and distribution of cognitive complexity. Hess’ Cognitive Rigor Matrix provides an examination of the “depth of understanding required for different tasks that might seem at first glance to be comparable levels of complexity,” allowing for a more in-depth analysis of the types of questions presented in online-based programs (Hess et al., 2009b, p. 3). Similarly, it helps to “uniquely categorize and examine selected assignments/learning activities that appear prominently in curriculum and instruction” (p. 3). Using the Cognitive Rigor Matrix can provide a more comprehensive analysis of the types, frequencies, and categories of questions and activities presented to students in online-based tutoring programs that aim to improve upon higher order thinking skills.

Because Hess’ Cognitive Rigor Matrix utilizes both Bloom’s Taxonomy and Webb’s Depth of Knowledge, it provides a complex look at the tasks students are given in an educational setting. Bloom’s knowledge-based taxonomy helps educators to realize the variety of higher order thinking tasks that should be offered to students. These action verbs, which progressively develop from lower order thinking to higher order thinking as they increase in level, allow students to build upon higher order thinking skills in different ways. This indicates that the types of activities given to students in online-based programs should not only vary overall, but should also increase in Bloom’s levels as students demonstrate proficiency in lower order tasks.

The current study utilizes Bloom’s Revised Taxonomy and the following levels (Hess et al., 2009a):

1. **Remember**: retrieve knowledge from long-term memory, recognize, recall, locate, identify
2. **Understand**: construct meaning, clarify, paraphrase, represent, translate, illustrate, give examples, classify, categorize, summarize, generalize, infer a logical conclusion (such as from examples given), predict, compare/contrast, match like ideas, explain, construct models

3. **Apply**: carry out or use a procedure in a given situation, carry out (apply to a familiar task), or use (apply) to an unfamiliar task

4. **Analyze**: break into constituent parts, determine how parts relate, differentiate between relevant-irrelevant, distinguish, focus, select, organize, outline, find coherence, deconstruct (e.g., for bias or point of view)

5. **Evaluate**: make judgments based on criteria, check, detect inconsistencies or fallacies, judge, critique

6. **Create**: reorganize elements into new patterns/structures, generate, hypothesize, design, plan, construct, produce

One flaw with Bloom’s taxonomy is that many of the action words place into multiple levels, causing confusion as to the level of higher order thinking. Hess’ Cognitive Rigor Matrix reduces some of the confusion when solely using Bloom’s taxonomy by superimposing Webb’s Depth of Knowledge into the Cognitive Rigor Matrix. Webb’s Depth of Knowledge helps educators analyze the level of cognitive complexity within an activity or task, as well as assists educators or curriculum writers in organizing tasks based on what students are expected to know at grade level be able to transfer between contexts and prior knowledge, and make generalizations (Webb, 1997 as cited in Sforza et al., 2016, p. 8). The following categories of complexity make up Webb’s Depth of Knowledge framework: (Webb as cited in Hess et al., 2009a):
1. **Recall and Reproduction**: recall a fact, term, principle, or concept; perform a routine procedure

2. **Basic Application of Skills/Concepts**: use information, conceptual knowledge; select appropriate procedures for a task; perform two or more steps with decision points along the way; solve routine problems; organize or display data’ interpret or use simple graphs

3. **Strategic Thinking**: reason or develop a plan to approach a problem; employ some decision-making and justification; solve abstract, complex, or non-routine problems (DOK-3 problems often allow more than one possible answer)

4. **Extended Thinking**: perform investigations or apply concepts and skills to the real world that require time to research, problem solve, and process multiple conditions of the problem or task; perform non-routine manipulations across disciplines, content areas, or multiple sources

Hess’ Cognitive Rigor Matrix provides a uniquely blended and aligned matrix between Bloom’s six levels of the knowledge-based taxonomy and Webb’s Depth of Knowledge. Hess’ model has been used to categorize the frequency and level of cognitive complexity of various questions presented to students in the selected online-based program, exposing the degree to which this program can aid in the development in higher order thinking skills. Similarly, Hess’ Cognitive Rigor Matrix can serve as an effective tool in providing an evaluation of the types of tasks and activities presented to students in these programs.

Chapter III will include an in-depth analysis of the methodology for this study, including an introduction to the study, research questions governing the study, and a description of the design and purpose of the study. Furthermore, Chapter III contains a description of the coding scheme utilized, a description of the qualifications for trained consultant coders, the method for
ensuring credibility used, training in coding offered prior to the study, and a description of the method for analyzing the selected questions based on Hess’ Cognitive Rigor Matrix.
CHAPTER III

METHODOLOGY

Introduction

The purpose of this study focused on describing and categorizing the distribution of cognitive complexity, as defined by Hess’ Cognitive Rigor Matrix, in the HOT Learning program. Due to the lack of existing literature on online-based programs and the level of cognitive complexity, as compared to the marketing of the program, I explored the topic by analyzing Grade 8 English language arts questions from one program using Hess’ Cognitive Rigor Matrix as an analytical framework to categorize the distribution of higher order thinking of a question. The following chapter describes the methodology, in detail, used for this study.

Research Question

1. Using Hess’ Cognitive Rigor Matrix, what are the characteristics of higher order thinking in the Grade 8 English language arts questions presented to students in an online-based program?
   a. What is the frequency and percentage of questions categorized in each specific cell within Hess’ Cognitive Rigor Matrix?
   b. What is the frequency and percentage of higher order thinking, as described by Hess’ Cognitive Rigor Matrix, embedded in Grade 8 English language arts questions presented to students in a particular online-based program?

Research Design

This study used qualitative content analysis methods to describe and categorize the distribution of replicable and valid inferences using higher order thinking in Grade level 8 English language arts questions from an online-based program, based on Hess’ Cognitive Rigor
Matrix. A qualitative content analysis is “a research method for the subjective interpretation of the content of text data through the systematic classification process of coding and identifying themes or patterns” (Hsieh & Shannon, 2005, p. 1278). Berelson (1952) regarded content analysis as “a research technique for the objective, systematic, and quantitative description of the manifest content of communication” (p. 18, as cited in Bengtsson, 2016, p. 9), although this definition was expanded upon by Krippendorff (2004) to include that content analysis must make “replicable and valid inferences” from the text itself and its use (p. 18, as cited in Bengtsson, 2016, p. 9). Because qualitative content analysis serves to identify the link between the context of a text and the nature by which the text was produced, this method was the best fit for the study (Downe-Wambolt, 1992, as cited in Bengtsson, 2016, p. 9). Thus, this study aimed to identify the relationship between the questions provided in the HOT Learning program and its purpose to enhance higher order thinking skills.

**Methods**

Deductive category application is used to link Hess’ Cognitive Rigor Matrix to the 231 English language arts questions extracted from the HOT Learning program. Deductive category application is the process in which text is analyzed based on pre-existing categories following a coding protocol (Mayring, 2000). The pre-existing categories for this study were the categorization of thinking as represented in Hess’ Cognitive Rigor Matrix. The figure below highlights the step model of deductive category application, adapted from Mayring, for the current study to describe the coding and analysis process.
Figure 1. Step model for deductive category application, adapted from Mayring (2000).

Hess’ Cognitive Rigor Matrix was best suited for this study because its framework is useful in categorizing the types of higher order thinking in the questions presented to students. According to Hess et al. (2009a), this model “vividly connects, yet clearly distinguishes, the two
schemata, allowing educators to examine the rigor associated with tasks that might seem at first glance comparable in complexity” (p. 5). In addition, Hess’ Cognitive Rigor Matrix links both the cognitive complexity of Webb’s Depth of Knowledge and the actions of tasks categorized in Bloom’s Taxonomy. This allows for each question to be analyzed not only for the type of task being asked of students, but also the level of cognition students are required to utilize, allowing each question to be examined from multiple perspectives. Although Hess’ Cognitive Rigor Matrix has yet to gain popularity, it is a reliable and valid framework because it utilizes two frameworks that have already been deemed credible. Since Bloom’s Taxonomy and Webb’s Depth of Knowledge are proven to be both valid and reliable in identifying the level of difficulty or cognitive complexity, respectively, of an action or task, Hess’ Cognitive Rigor Matrix can be considered valid and reliable as well. By using this matrix, the 231 selected questions from the chosen online-based program were categorized.

**Consultant Coder**

A fully trained and qualified second coder was asked to code and reach consensus on the placement of each question on Hess’ Cognitive Rigor Matrix for this study. The second coder for this study is a graduate school professor with an expertise in curriculum and assessment. He is the author of peer-reviewed studies that utilized Webb’s Depth of Knowledge to categorize the cognitive complexity of the New Jersey Core Curriculum Content Standards, Common Core State Standards, and California curriculum standards.

**Data Collection**

The data consisted of publicly available question prompts from an online reading comprehension practice program designed for use with students in Grade 8. In total, the program contained 660 questions for the Grade 8 English language arts portion in reading. The questions
were created by the vendor of the product, which states that they are aligned with NJCCCS. The questions were divided into two reading sections within the program: (a) Reading Literature and (b) Reading Information Text. For this study, I only focused on reading standards and did not include sections on writing or language conventions. Every third question was sampled in this study, as well as the first question of every category, providing a sample size of 35% of the total number of questions. The sampling was justified by the fact that the question types are grouped into threes with similarity in content and rigor for each group. For example, Questions 1, 2, and 3 in the Reading Information Text section all represent the same type of question. Sampling every third question ensured a representative cross section of the entire product. In addition, the first question of every section was also examined to identify any trends in the level of cognitive complexity first presented to students in each section and any trends throughout each section, such as increasing in cognitive complexity from the first question to the last.

**Coding Scheme**

Hess’ Cognitive Rigor Matrix contained sample performance tasks and example activities students are asked to do in each of the cells of the matrix, superimposing Bloom’s Taxonomy and Webb’s Depth of Knowledge. The examples of performance tasks and activities provided a comprehensive list, which reduced the possibility of a question being coded incorrectly and increased the reliability among coders. Because Hess’ Cognitive Rigor Matrix is designed as a grid, with Webb’s Depth of Knowledge as the columns and Bloom’s Taxonomy as the rows, a specific matrix was assigned to each cell to provide a more accurate and comprehensive coding scheme. The first number in the matrix described Webb’s Depth of Knowledge level and the second number described Bloom’s Taxonomy level for each cell. An example of Hess’ Cognitive
Rigor Matrix is provided in Appendix B, including the following categories and explanations (adapted from Hess, 2009b):

- **[1,1]: Webb’s Level 1, Bloom’s Level 1.** Recall, recognize, or locate basic facts, ideas, principles. Recall or identify conversions between representations, numbers, or units of measure. Identify facts/details in texts.

- **[1,2]: Webb’s Level 1, Bloom’s Level 2.** Compose and decompose numbers. Evaluate an expression. Locate points (grid, number line). Represent math relationships in words, pictures, or symbols. Write simple sentences. Select appropriate word for intended meaning. Describe/explain how or why. The two coders agreed that performance tasks asking students to ‘describe how or why’ must use literal comprehension and verbatim responses.

- **[1,3]: Webb’s Level 1, Bloom’s Level 3.** Follow simple/routine procedure (recipe-type directions). Solve a one-step problem. Calculate, measure, apply a rule. Apply an algorithm or formula (area, perimeter, etc.). Represent in words or diagrams a concept or relationship. Apply rules or use resources to edit spelling, grammar, punctuation, conventions.

- **[1,4]: Webb’s Level 1, Bloom’s Level 4.** Retrieve information from a table or graph to answer a question. Identify or locate specific information contained in maps, charts, tables, graphs, or diagrams.

- **[1,6]: Webb’s Level 1, Bloom’s Level 6.** Brainstorm ideas, concepts, or perspectives related to a topic or concept. The two coders agreed that brainstorming in this category requires the recall of prior knowledge and does not include original thought.
[2,2]: Webb’s Level 2, Bloom’s Level 2. Specify and explain relationships. Give non-examples/examples. Make and record observations. Take notes, organize ideas/data. Make basic inferences or logical predictions from data or texts. Identify main ideas or accurate generalizations. The two coders agreed that additional thought is not required in developing predictions but relies on prior knowledge. In addition, inferences and predictions in this category have one clear correct answer.

[2,3]: Webb’s Level 2, Bloom’s Level 3. Select a procedure according to task needed and perform it. Solve routine problem applying multiple concepts or decision points. Retrieve information from a table, graph, or figure and use it to solve a problem requiring multiple steps. Use models to represent concepts. Write paragraph using appropriate organization, text structure, and signal words. The two coders agreed that paragraphs written in this category are done in a procedural sense based on the writing process.


[2,6]: Webb’s Level 2, Bloom’s Level 6. Generate conjectures or hypotheses based on observations or prior knowledge. The two coders agreed that this category is not yet considered higher level thinking, so there is an emphasis on prior knowledge for the performance tasks.

[3,2]: Webb’s Level 3, Bloom’s Level 2. Explain, generalize, or connect ideas using supporting evidence. Explain thinking when more than one response is possible. Explain phenomena in terms of concepts. Write full composition to meet specific purpose.
Identify themes. The two coders agreed that this category is considered higher level, so performance tasks in this category do not have obvious answers and, instead, require students to pull from other sources and develop original ideas.

- **[3,3]: Webb’s Level 3, Bloom’s Level 3.** Use concepts to solve non-routine problems. Design investigation for a specific purpose or research question. Conduct a designed investigation. Apply concepts to solve non-routine problems. Use reasoning, planning, and evidence. Revise final draft for meaning or progression of ideas.

- **[3,4]: Webb’s Level 3, Bloom’s Level 4.** Compare information within or across data sets or texts. Analyze and draw conclusions from more complex data. Generalize a pattern. Organize/interpret data, complex graph. Analyze author’s craft, viewpoint, or potential bias. The two coders agreed that performance tasks in this category require students to draw conclusions from more complex data and/or from multiple sources. In addition, in the performance task of ‘analyzing author’s craft’ students must understand how it affects the interpretation of the reading selection.

- **[3,5]: Webb’s Level 3, Bloom’s Level 5.** Cite evidence and develop a logical argument for concepts. Describe, compare, and contrast solution methods. Verify reasonableness of results. Justify conclusions made. The two coders agreed that the emphasis on justification and explaining is an important component of this category.

- **[3,6]: Webb’s Level 3, Bloom’s Level 6.** Synthesize information within one source or text. Formulate an original problem, given a situation. Develop a complex model for a given situation. The two coders agreed that students must develop an original idea through the practice of synthesis.
• [4,2]: Webb’s Level 4, Bloom’s Level 2. Explain how concepts or ideas specifically relate to other content domains or concepts. Develop generalizations of the results obtained or strategies used and apply them to new problem situations.

• [4,3]: Webb’s Level 4, Bloom’s Level 3. Select or devise an approach among many alternatives to solve a novel problem. Conduct a project that specifies a problem, identifies solution paths, solves the problem, and reports results. Illustrate how multiple themes (historical, geographic, social) may be interrelated. *The two coders agreed that this level may appear in the questions asked in the online-based program, but this may be the highest level that the program can provide.*

• [4,4]: Webb’s Level 4, Bloom’s Level 4. Analyze multiple sources of evidence or multiple works by the same author, or across genres, or time periods. Analyze complex/abstract themes. Gather, analyze, and organize information. Analyze discourse styles.

• [4,5]: Webb’s Level 4, Bloom’s Level 5. Gather, analyze, and evaluate relevancy and accuracy. Draw and justify conclusions. Apply understanding in a novel way, provide argument or justification for the application.

• [4,6]: Webb’s Level 4, Bloom’s Level 6. Synthesize information across multiple sources or texts. Design a model to inform and solve a real-world, complex, or abstract situation.

As per the first coding session, which also involved coder calibration, the two coders agreed that any question placed into Categories 3 and 4 of Webb’s levels would be considered higher level, following the guidelines of the Webb Alignment Tool training manual (Webb, Alt, Ely, & Vesperman, 2005). These categories demonstrate more cognitive complexity in the types of tasks and questions that are asked of students. The two coders also discussed potential
difficulties in the online-based program’s ability to use higher order thinking questions due to the nature of a multiple-choice based format. Likewise, any questions placed into Categories 1 and 2 of Webb’s levels, according to Hess’ Cognitive Rigor Matrix, would be considered lower level due to the simplicity of the questions being asked.

Reliability

To increase reliability among coders, Webb’s and Bloom’s models were aligned to English language arts performance tasks. The Webb Alignment Tool training manual provided detailed descriptions of ways in which English language arts tasks are organized based on cognitive complexity (Webb, Alt, Ely, & Vesperman, 2005). The alignment tool provided the following descriptions of each level in order to provide further clarity and to reduce discrepancies between each level when coding.

- **Reading Level 1**: Simple skills or abilities are used, including recitation. Basic comprehension and understanding are assessed in the form of paraphrasing and repeating specific details from the text.

- **Reading Level 2**: Some mental processing is used that goes beyond recollection and reproduction of a response. Comprehension and subsequent processing of a text is assessed, including inter-sentence analysis of inference. Words such as summarize, interpret, infer, classify, organize, collect, display, compare, and determine (fact or opinion) may be used.

- **Reading Level 3**: Deeper knowledge is assessed by students being encouraged to think beyond the text and to explain, generalize, or connect ideas. Students are also required to demonstrate understanding, but more abstract themes such as engaging prior knowledge, reasoning, planning, and constructing an inference are also involved.
• **Reading Level 4:** The central focus is higher level thinking, which can be identified by extension activities, which oftentimes require time outside of the classroom. Students utilizing this level will take information from the text and apply it to a new task, develop a hypothesis, and perform complex analyses of connections.

Although no training manual exists for Bloom’s Taxonomy or the Revised Bloom’s Taxonomy, Anderson and Krathwohl (2001) provided action verbs that correspond with each of the six Revised Taxonomy levels (as cited in Hess et al., 2009a). These action words serve to provide identifiers into the levels in which questions from the HOT Learning program place. Many of these actions can be directly linked to reading and writing practices through ways in which students exhibit their understanding of the material, predominantly in the form of performance tasks. The following action verbs provided a basis for placement into each of the Bloom’s Revised Taxonomy levels:

- **Level 1:** *Remember.* Retrieve knowledge from long-term memory, recognize, recall, locate, identify

- **Level 2:** *Understand.* Construct meaning, clarify, paraphrase, represent, translate, illustrate, provide examples, classify, categorize, summarize, generalize, infer a logical conclusion (such as from examples given), predict, math similar ideas, explain, compare/contrast, construct models (e.g., cause–effect)

- **Level 3:** *Apply.* Carry out use of a procedure in a given situation; carry out (apply to a familiar task) or use (apply) to an unfamiliar task

- **Level 4:** *Analyze.* Break into constituent parts, determine how parts relate, differentiate between relevant and irrelevant, distinguish, focus, select, organize, outline, find coherence, deconstruct (e.g., for bias or point of view)
• **Level 5: Evaluate.** Judge based on criteria, check, detect inconsistencies or fallacies, judge, critique

• **Level 6: Create.** Combine elements to form a coherent whole, reorganize elements into new patterns/structures, generate, hypothesize, design, plan, construct, produce for a specific purpose

To ensure the reliability of coding, a main coder and second coder compared results when aligning each question to Hess’ Cognitive Rigor Matrix following the double-rater read-behind consensus model. Both coders were trained through calibration exercises, conducted by an experienced coder during the first two coding sessions. During these calibration sessions, the two coders were trained in deductive coding. According to Elo and Kyngäs (2008), deductive content analysis relies on a categorization matrix by which data is coded according to the specific categories (p. 111). In this study, the two coders discussed each cell of the Cognitive Rigor Matrix prior to coding individually in order to provide clarity on the types of questions and tasks that would be placed into each category from the HOT Learning program. This clarification aided in the coding process because the coders aligned key words and phrases found in each question from the program to the examples and explanations provided in Hess’ Cognitive Rigor Matrix. In addition, the two coders expanded on the examples and explanations already provided in order to further clarify each cell. The goal of this discussion was to not only familiarize the two coders with the progression of cognitive rigor from lower level to higher level, but also to allow for more objective coding. In order to increase validity and reliability throughout the data collection process, the coders rationalized their choices in placement along the Cognitive Rigor Matrix by inputting the corresponding explanations from the chosen cell for each question. This strategy also aided in the calibration sessions, in which the two coders discussed how each question aligned with specific criteria.
During each calibration session, the two coders discussed each question individually and the reasoning behind assigning a cell to each question. This consistent communication also ensured that both coders agreed upon the placement of each question through the use of comments on a shared data collection document, e-mail, and telephone conversations. The two coders used the double-rater read-behind consensus model to increase inter-rater reliability and offer a means of calculating and monitoring the coders’ agreement (Miles, Huberman, & Saldaña, 2014, p. 84). Through the double-rater read-behind consensus model both coders hold calibration sessions in which they discuss each question specifically in sets of 10 questions. For each question, they rationalize the placement of the question into a specific cell and hold a discussion in order to reach an agreement. After each set of 10, the percent of agreement is calculated and recorded. Questions that the two coders did not originally place into the same category are marked in red to signify that there was a difference of opinion and that a discussion was held. During the calibration sessions, the two coders discussed each question in which there was a disagreement in placement. After a conversation between both coders, an agreement was reached on the appropriate placement. The two coders also agreed that if both coders could not reach consensus on the placement of a question, they would agree to the higher of the two placements that the coders gave, following recommendations provided by the Webb Alignment Tool. Furthermore, practices performed in this study modeled those of similar studies in order to provide a consistent methodology in the topic area (Miles et al., 2014; Sato, Lagunoff, & Worth, 2011; Sforza, 2014).

Data Analysis

The two coders met on September 23, 2017, in order to review the Webb Alignment Tool and to calibrate to the categories found on Hess’ Cognitive Rigor Matrix. The training session
began with both coders reading each level of Webb’s Depth of Knowledge separately, following the Webb Alignment Tool pages 70 and 71. Then the coders read the corresponding categories of Hess’ Cognitive Rigor Matrix to familiarize themselves with how Webb’s DOK intersects with Bloom’s Taxonomy on the Cognitive Rigor Matrix. The coders discussed the specific characteristics of each category of the Cognitive Rigor Matrix and made clarifications in order to reach consensus on the meanings of the examples presented in each cell of the matrix.

Following the discussion, the two coders began the first coding session using 13 questions at random from the HOT Learning program. First, the coders practiced categorizing each question according to Webb’s DOK levels. After they reached consensus on the Webb’s level for a particular question, the two coders discussed the placement of the question in Hess’ Cognitive Rigor Matrix at the appropriate intersection with Bloom’s taxonomy. The two coders completed 13 questions with 100% agreement after utilizing the consensus read-behind method. Once the two coders agreed to use every third question for the study, 4 of the original 13 questions were preserved in the collected data.

Following the first coding session, the two coders completed 100 questions independently. A second coding session was held on October 2, 2017, to review 50 of the 100 questions in sets of 10 and to discuss any disagreements with the codes selected for each question. During this second coding session, the two coders utilized a double-rater read-behind consensus model to ensure credibility and consensus of the placement for each question (Miles et al., 2014, p. 84; Sato, Lagunoff, & Worth, 2011, p. 11). In addition, the two coders discussed each question in sets of 10, focusing on the skill being asked of students and the appropriate cell into which each question should be placed. The two coders read a question and worked toward consensus for the categorization on the Cognitive Rigor Matrix. For example, one coder would present a categorization to the other coder and then would use the double-rater read-behind
consensus model. Furthermore, the second coder would then agree or challenge the first coder by discussing Hess’ Cognitive Rigor Matrix and referencing the Web Alignment Tool. Each coder presented his or her evidence for each categorization, whether the coders had initial agreement or whether there was a disagreement. The two coders followed the suggestion of Webb et al. (2005) to assign the higher DOK level in cases in which the coders were split between two DOK levels for their ratings.

The two coders used the coding table (see Appendix C) to organize each question and to visually represent the category into which each question was placed. The table was also used as a means for checking the alignment between the two coders as part of the read-behind method. Any questions that did not receive the same placement from both coders were flagged so that a discussion could ensue and consensus could be reached. Figure 2 represents an example of the template used for this study for the questions selected from the HOT Learning program. The completed template is located in Appendix C.
Once all data had been collected, the frequency and distribution of questions were assessed. To do this, the total number of questions placed into each cell of the matrix was evaluated in order to calculate a percentage. Questions that placed into cells considered to utilize higher order thinking skills, cells [3,2] to [4,6], were also calculated as a percent in order to better assess the frequency of higher order thinking questions offered in the overall program.

The two coders completed 50 questions with 82% exact agreement and 100% consensus by the end of the session. In Set 1, the two coders agreed on 90% of the questions, moving only one question from [2,2] to [2,3] on Hess’ Cognitive Rigor Matrix. There was 80% agreement in Set 2, with two questions moved from [2,2] to [3,4] due to the complexity of analysis between sets of text. In Set 3, there was 70% exact agreement, in which the two coders discussed wording of questions and wording of the tasks on Hess’ Cognitive Rigor Matrix. For this set, the two coders discussed the concept of theme and the extent to which students were asked to discover the theme of a text rather than identify it through multiple-choice questions. The two
coders agreed to move 2 questions from [3,2] to [2,2] and 2 questions from [3,2] to [2,4]. One question in Set 3 was agreed upon in the first calibration, but revisited and changed in the second calibration to more closely match the placements of similar questions. Set 4 was completed with 90% exact agreement, with the first question being moved. The first question was changed from [1,2] to [2,2] due to the skills students were being asked to perform. In Set 5, the first question was also moved from [1,2] to [2,4] because the coders agreed that students were required to distinguish between relevant and irrelevant information and not solely recall. This resulted in the coders reaching 80% agreement on Set 5. In addition, one question was moved from [1,2] to [2,2] for its use of inferences. Only one of the initial disagreements caused a question to be rated as higher level when it was initially coded as a lower level question by a coder. All other adjustments were changes in Bloom’s category at lower levels, not changes to a higher level of thinking in regards to cognitive complexity. For example, one question was initially categorized as Bloom’s Understand at Level 2 of Webb’s Depth of Knowledge, which is considered low level. It was eventually moved to Bloom’s Analysis and remained at Level 2 of Webb’s Depth of Knowledge after the two coders engaged in the read-behind method and providing evidence and looking at exemplars. In Webb’s Alignment Tool, exemplars are provided for each level of Webb’s Depth of Knowledge and a list of tasks and types of thinking that would be utilized at each level. In addition, Hess’ Cognitive Rigor Matrix provided a list of sample tasks that would classify into each cell. A cross reference between Webb’s Alignment Tool and the examples given in Hess’ Cognitive Rigor Matrix provided the two coders with the resources to reach an agreement on all questions.

A third calibration session was conducted on October 12, 2017. During this session, coders reviewed another group of 50 questions in sets of 10 with 88% total agreement and 100% consensus at the end of the calibration session. The percent of exact agreement was calculated
for each set. In Set 1, the two coders agreed on 100% of the questions and discussed commonalities between the wording and types of questions presented to students in that set. Sets 2 and 3 both had 90% agreement. During these two sets, one question was changed from [1,2] to [1,1] after a discussion on how the wording of a question does not make it more complex. The other question was changed from [2,4] to [2,2] following a discussion that the question did not require students to distinguish between relevant and irrelevant information while choosing the answer in a multiple-choice format. Set 4 also had 100% agreement between the two coders.

The final set of the calibration session had 60% agreement between the two coders. This was in large part due to the wording of questions in this set, in which four codes were changed from [1,2] to [2,2]. This was agreed upon due to the extra step students had to take in these questions, in which they were required to not only identify the meaning of a word or phrase but use it appropriately in a separate sentence. Overall, the five sets for the third calibration session resulted in 88% exact initial agreement and 100% agreement after implementing the read-behind method.

A fourth calibration session was held on November 2, 2017, in which another 50 questions were discussed in sets of 10. Previous to this calibration session, each coder coded the remaining questions individually. The double-rater read-behind consensus model was utilized again to ensure the reliability of the questions coded. In the first set of 10, the coders had 80% total agreement. One question was moved from [2,4] to [2,2] upon discussion of the wording of the question and the task that was being asked of the students. Another question was increased in cognitive complexity from [1,2] to [2,2] after the two coders discussed that due to the answer choices in the multiple-choice format, students would need to use inference skills in order to successfully answer the question. The second set had 80% agreement, with both questions being raised from [1,2] to [2,2] due to the lack of context clues provided in the passage to help students
identify the correct answer. Set 3 of the calibration session had 100% agreement. In Set 4, the coders agreed on 80% of the questions, with two questions being lowered in cognitive complexity from [3,4] to [2,4]. The two coders discussed that even though the passages provided in these questions had two texts that students were required to read, the level of cognitive complexity did not inherently increase due to the format and content of each passage and its relation to the questions being asked of students. The fifth and final set of the calibration session had 90% total agreement, with one question being lowered from [3,4] to [2,4], again due to the format and content of the two texts in relation to the question itself. The two coders had 86% total agreement and 100% consensus in the fourth calibration session.

A fifth and final calibration session was completed on November 20, 2017. During this session, the remaining questions were calibrated from the online-based program in seven sets of 10 questions and one set of 8 questions, in which the coders had 84.06% total agreement. The two coders had 90% total agreement in Set 1, in which one question was lowered from [3,4] to [2,4] following a discussion on the wording of the question and the two passages given to students to interpret. In Set 2, the two coders also reached 90% agreement. In this set, one question was moved from [1,2] to [2,2] because the students had to identify a main idea that was not explicitly stated in the passage. Set 3 had 60% agreement, with all four questions being moved from [3,2] to [2,2] following a discussion on the difference between how the question was worded and the task being asked of students. There was 100% agreement for Sets 4 and 5 and 70% agreement in Set 6. In this set, one question was moved from [2,4] to [1,2] and two questions were moved from [3,2] to [1,2] because the choices for each question were explicitly stated in the text. The two coders agreed that the nature of the multiple-choice format of the questions lessened the cognitive complexity because students were being led to the correct answers. There was 100% agreement in Set 7 and 62.5% agreement in Set 8, which contained 8
questions instead of 10. The three questions that had been changed were lowered from [3,4] to [2,4] because the answers to these questions were explicitly given in the passages and would be easy for students to identify.

Triangulation increases the validity of a content analysis study. According the Merriam (2009), there are four kinds of triangulation methods for qualitative studies, including multiple sources of documents analyzed, multiple methods of observation, multiple investigators in interviews, and multiple theories (p. 215). For this study, a previously conducted study on a similar topic was used as a comparison of methodologies and the double-rater consensus model. Sforza’s (2014) study on the alignment of Common Core State Standards and New Jersey Core Curriculum Content Standards to Webb’s Depth of Knowledge was used as a means of triangulation. Although Sforza’s study differed in the framework used and the content examined, there were many similarities between the methodology of Sforza’s study and this study. I compared Sforza’s method for using a second coder and the setup of calibration sessions in order to ensure that my process for data collection was effective in reaching agreement on the placement of questions into cells within Hess’ Cognitive Rigor Matrix. In addition, Sforza’s data collection used Webb’s Alignment Tool as a means of reaching agreement into the placement of standards into Webb’s Depth of Mnowledge, providing information on ways to utilize the Alignment Tool for my study.

Chapter Summary

This chapter described the coding protocol used to align 231 English language arts questions from an online-based product to Hess’ Cognitive Rigor Matrix. For this study, a qualitative content analysis research methodology was utilized to answer the two research questions. Furthermore, Mayring’s (2000) step model for deductive category application was
used to create a visual representation of the research process, including methods to ensure credibility in the overall study. A combination of the Webb Alignment Tool training manual and research on Bloom’s Revised Taxonomy and Hess’ Cognitive Rigor Matrix aided in the training of both coders in order to reach consensus on the placement of the selected questions from the HOT Learning program. With both coders trained and qualified, an organized coding agenda was used to provide specific definitions, examples, and coding rules, increasing inter-rater reliability. If consensus was not reached, in that each coder chose a different placement for a particular question, the coders agreed to choose the higher of the two levels, in accordance with Webb et al. (2005). In addition, a final coding template that consists of each selected question and its placement along Hess’ Cognitive Rigor Matrix is provided in Appendix C.

Chapter IV presents the findings of the study, focusing on the two subquestions and the overarching question.
CHAPTER IV

RESULTS

Introduction

The following chapter presents the findings of the study on cognitive complexity in the questions provided in an online-based program, HOT Learning. This study aimed to categorize and analyze the frequency and percentage of higher order thinking in Grade 8 English language arts questions. A sample size of 231 questions was used in this study. Two trained coders held five coding sessions in which they utilized the double-rater read-behind consensus model to discuss and categorize each question from the sample. The coding sessions took place between September 23, 2017, and November 20, 2017. During these coding sessions, Hess’ Cognitive Rigor Matrix was used as an alignment tool, which measured higher order thinking. A copy of Hess’ Cognitive Rigor Matrix with annotations from the two coders is located in Appendix B. The two coders agreed in their first calibration session that questions placed into the third and fourth levels of Webb’s Depth of Knowledge, as identified in Hess’ Cognitive Rigor Matrix, would be considered higher order thinking. In the matrix, higher order thinking categories included [3,2], [3,3], [3,4], [3,5], [3,6], [4,2], [4,3], [4,4], [4,5], and [4,6].

The two coders utilized the double-rater read-behind consensus model to reach alignment of each of the questions provided by the HOT Learning program. This model allowed for both coders to discuss the placement of each question along Hess’ Cognitive Rigor Matrix and develop a rationale for their placement. The double-rater read-behind consensus model is regarded as being an effective method for increasing inter-rater reliability (Miles et al., 2014; Sato et al., 2011). During each calibration session, the two coders discussed the placement of each question into a specific category and examined differences in placement until a consensus
was reached. After coding and discussing each question, the total number of questions in each
category of Hess’ Cognitive Rigor Matrix and the percentages were calculated.

The study was guided by the overarching question: *Using Hess’ Cognitive Rigor Matrix, what are the characteristics of higher order thinking in the Grade 8 English language arts questions presented to students in an online-based program?* There were two subquestions that further broke down the overarching question and were used as the main foci in interpreting the collected data from HOT Learning.

**Findings for Subquestion 1**

The first subquestion was: *What is the frequency and percentage of questions categorized in each specific cell within Hess’ Cognitive Rigor Matrix?* According to Hess’ Cognitive Rigor Matrix, the lowest level of cognitive complexity was placed as Level 1 in accordance with Webb’s Depth of Knowledge. The complexity of the tasks itself, however, increased within Level 1 in accordance with Bloom’s Taxonomy. For the lowest level of cognitive complexity, Hess’ Cognitive Rigor Matrix contains cells [1,1], [1,2], [1,3], [1,4], and [1,6].
Figure 3. Distribution of questions in each cell of Hess’ Cognitive Rigor Matrix.

There were 14 questions that placed into cell [1,1] of the matrix, making up 6.1% of the total questions examined. In the Setting category of the HOT Learning program, three questions were placed into this cell. Similarly, 7 questions were placed into this cell from the plot category because each question required students to directly recall facts that had been explicitly stated in the text or passage provided. Questions were also placed into [1,1] from figurative meaning; cultural literature; connections between individuals, ideas, and events; and visual elements. Each of the 14 questions showed similarities in the nature of how information was retrieved in that students were able to find the answer directly in the passage provided. For example, one question from the plot category asked students to identify what happened when one of the characters was not looking, which directly references to a specific moment in the story provided. The answer choices provided in the multiple-choice format also contained two choices that did
not occur in the passage, one answer choice that did not make sense to the question being asked, and the correct answer choice. The two coders discussed that questions and answer choices such as this are leading in that the correct answer is obvious. In another example, the question for the visual elements category required students to understand facts that extended beyond the text, but the question itself was not cognitively complex. This question asked students: “Which media source frequently enables its audience to actively participate in discussions of current events?” with choices of radio, books, newspapers, and magazines. It can be expected that students at a Grade 8 level can successfully answer this question without it being linked to a passage or text.

There were 48 questions that placed into cell [1,2] of the matrix, making up 20.8% of the total questions examined. Cell [1,2] contained the second-highest frequency of questions from the sample examined in the online-based program. The highest frequency of questions placed into [1,2] were from the multiple-meaning words, connotative meaning, and technical meaning categories, which each had 7 questions. These questions were placed into cell [1,2] because they asked students to identify appropriate words or definitions that were explicitly stated or that could be defined through context clues given in the passage provided. For example, one question from the technical meaning category asked students to define blanching. The passage provided contained a sentence stating “…he plunges a metal basket full of the cut vegetables into the boiling water to blanch them, removing the basket after just a few seconds and rinsing them quickly with cold water.” In addition, 6 questions were placed into cell [1,2] from the categories of characters, context clues, and from connections between individuals, ideas, and events. Some of these categories also asked students to select the appropriate word or meaning, but there were also questions that asked students to explain or describe a phenomena or event that happened within the passage provided. In one question provided in the connections between individuals, ideas, and events category, students were required to read a list of six safety rules for using
power tools and then respond to the question “Why is it important to not wear jewelry?”

Although the answer is not explicitly stated in the list, the answer choices imply that there is one apparent correct answer, that jewelry can get caught in the moving parts of power tools, because the list provided as the passage addresses that when operating power tools, one should not wear jewelry or loose clothing if there are moving parts. Of the remaining questions that placed into cell [1,2], 1 question was placed from plot, 3 from figurative meaning, 2 from cultural literature, 1 from compare and contrast, 1 from author point of view, and 1 from visual elements.

One question placed into cell [1,3], which was placed from the category of connections between individuals, ideas, and events. This made up 0.4% of the total number of questions examined. This question provided a passage of a recipe to make coffee with the instructions to “add 1 tbsp. of grounds per cup of water.” The question that followed this recipe asked students to calculate how many tablespoons of grounds would be required if someone wanted to make 4 cups of coffee. In addition, one question was placed into cell [1,4], which also made up 0.4% of the total number of questions. This question was from the visual elements category in which students were asked to interpret the meaning of the table provided. This fulfilled the criteria for cell [1,4] in that it asked students to identify information contained in a table. The last cell in Level 1, cell [1,6] on Hess’ Cognitive Rigor Matrix, did not have any questions from the HOT Learning program place into it.

Level 2 of Hess’ Cognitive Rigor Matrix, which is also aligned with Webb’s Depth of Knowledge Level 2, “includes the engagement of some mental processing beyond recalling or reproducing a response” by encompassing comprehension and basic analysis of text (Webb et al., 2005, p. 70). Uniformly with Level 1, as the complexity of the task itself increased, the level of Bloom’s Taxonomy assigned to each cell increased in complexity as well. Cells within Level 2 include [2,2], [2,3], [2,4], and [2,6].
Of all the questions examined in this study, 97 were placed into section [2,2]. This was the greatest frequency of questions placed into any one cell along Hess’ Cognitive Rigor Matrix, equating to 42% of all questions. Most of the questions that placed into this cell required students to make logical predictions and inferences, identify the main idea of a passage, or explain relationships between the text and the text structure. Many of the questions that fulfilled the criteria for [2,2] asked students questions such as “What is the central idea of the passage?” or “Which sentence in the passage conveys the message that…?” In total, there were 10 questions from the textual evidence category; 9 from making inferences and relevant connections; 7 from theme; 10 from objective summary; 5 from characters; 6 from setting; 2 from plot; 3 from context clues; 4 from multiple-meaning words; 4 from figurative meaning; 4 from connotative meaning; 7 from meaning and tone; 2 from cultural literature; 2 from compare and contrast; 1 from author’s point of view; 11 from central ideas; 2 from connections between individuals, ideas, and events; 2 from text structure, 1 from technical meaning, and 5 from visual elements.

Central ideas had the highest frequency of questions placed into cell [2,2], with every question asking students to identify the main idea. Objective summary and textual evidence had the second highest frequencies, with 10 of the 11 selected questions from each of these categories requiring students to make inferences and generalizations. The evaluating arguments category of the online-based program had the lowest frequency with 0 of the questions placing into cell [2,2]. Author’s point of view and technical meaning had the second-lowest frequency in this cell with only 1 question from each category placing into [2,2]. The low frequency of [2,2] questions in these categories is due, in large part, to the nature of the questions being asked and the skills being assessed.
Cell [2,3] had one question place into it, which came from the textual evidence category of the HOT Learning program. This question asked students to create an inference given a political cartoon; since students had to reference both the passage and the image in order to appropriately answer the question, the question placed into [2,3] for requiring students to make inferences about implicit themes. This question equated to 0.4% of the total number of questions sampled.

A total of 41 questions, or 17.7% of the total sample of questions, placed into cell [2,4]. This was the third-highest frequency of questions placed into a given cell. Many of the questions placed into cell [2,4] required students to identify the use of a literary device, compare and contrast two pieces of information from the text, or to distinguish between relevant and irrelevant information. There were 2 questions from Theme that placed into cell [2,4], 1 from objective summary, 1 from setting, 1 from plot, 2 from context clues, 2 from figurative meaning, 2 from meaning and tone, 5 from cultural literature, 5 from compare and contrast, 2 from author’s point of view, 1 from technical meaning, 3 from visual elements, and 6 from evaluating arguments. The category with the highest frequency of questions placed into cell [2,4] was text structure, which contained 8 questions in this cell. The high frequency of questions from this category placing into cell [2,4] was due to the nature of the category, which required students to identify particular literary devices, such as the organization of the passage, cause and effect, and classification.

There were no questions that placed into cell [2,6].

The third level of Hess’ Cognitive Rigor Matrix aligns with Webb’s Depth of Knowledge Level 3, which encourages students to extend thinking beyond the text and connect ideas using reasoning or planning (Webb et al., 2005, p. 70). Cells in Level 3 include [3,2], [3,3], [3,4],
[3,5], and [3,6]. At this level of Hess’ Cognitive Rigor Matrix, questions only placed into cells [3,2] and [3,4].

There were 11 questions from the sample that placed into cell [3,2], with 10 of the total questions being placed into this category because they required students to connect ideas using supporting evidence. Many of the questions examined had drag-and-drop features that consisted of multiple components, making the questions more complex than the multiple-choice questions that had been placed into other cells. The other question placed into [3,2] required students to identify a theme that was not explicitly stated in the text. The questions in cell [3,2] accounted for 4.8% of the total questions in the sample. There were 2 questions in this cell from theme, 1 from setting, 1 from cultural literature, 2 from compare and contrast, 1 from text structure, 2 from technical meaning, and 2 from evaluating arguments. During the calibration session, the two coders agreed that many questions that seemed at first glance to place into this category would, instead, be dropped into cell [2,2] because of the nature of the multiple-choice format; having a multiple-choice format provided guidance for students that eliminated the necessity to use abstract or critical thinking concepts.

A total of 17 questions were placed into cell [3,4], equating to 7.4% of the total sample of questions. The highest frequency of questions in this cell was from the author’s point of view category of the online-based program. Questions from this category required students to interpret the author’s craft or viewpoint and how it related to the passage. Likewise, the same style of questions were present in other categories, such as 1 question from making inferences and relevant connections; 1 from figurative meaning; 2 from meaning and tone; 1 from compare and contrast; 1 from evaluating arguments; and 1 from connections between individuals, ideas, and events. There was also 1 question from the category of making inferences and relevant connections that was placed into this category because it required students to analyze
information within sets of text. Although the question asked students to draw an inference from the passage, the content within the passage and multiple-choice answers provided to students required further thinking and analysis than other inference questions found in the program.

The highest level of cognitive complexity in Hess’ Cognitive Rigor Matrix was categorized as Level 4, in correspondence with Webb’s Depth of Knowledge Level 4. In this level, extended activities were encouraged that targeted deep understanding and analysis. Prior to the data collection process, the two coders discussed that Level 4 would be difficult to accomplish in an online-based format that was designed to have one correct response for every question (Webb et al., 2005, p. 71). The cells in Hess’ Cognitive Rigor Matrix for Level 4 include [4,2], [4,3], [4,4], [4,5], and [4,6]. None of the questions examined from HOT Learning placed into Level 4.

![Percentage of Questions in Each Hess Category](image)

*Figure 4. Percentage of questions in each cell of Hess’ Cognitive Rigor Matrix.*

97
Findings for Subquestion 2

The second subquestion was: What is the frequency and percentage of higher order thinking, as described by Hess’ Cognitive Rigor Matrix, embedded in Grade 8 English language arts questions presented to students in a particular online-based program? Prior to data collection, the two coders reached consensus that cells in Levels 3 and 4 of Hess’ Cognitive Rigor Matrix contain higher order thinking tasks. This decision followed the Webb Alignment Tool, which stated that tasks in Levels 3 and 4 required analysis of texts, use of prior knowledge, and abstract or critical thinking (Webb et al., 2005, pp. 70–71). In addition, the cells in Level 4 are the most cognitively complex because they require extended learning beyond the activity or task presented to students. In addition, tasks in Level 4 require students to utilize multiple sources to draw conclusions and make complex connections.

![Figure 5. Comparison of total number of questions placed in lower level and higher level cells within Hess’ Cognitive Rigor Matrix.](image-url)
A total of 231 questions were examined in this study. Of the sampled questions from the online-based program, 28 questions were considered higher level, making up 12.1% of the total questions sampled. As previously stated, 11 of the higher level questions were placed into cell [3,2]; this represents 39.3% of the questions considered higher level. In addition, 17 questions, or 60.7% of the questions considered higher level, were placed into cell [3,4]. Questions at Level 3 were considered to be higher level because they required higher order thinking from students, such as connecting ideas from multiple texts and analysis of concepts that are not explicitly stated.

The higher order skills asked of students in the HOT Learning program include the identification of theme, connection of ideas using supporting evidence, and analysis of the author’s craft or viewpoint. In cell [3,2], 1 question required students to identify a theme that was not explicitly stated in the passage. This task was regarded as higher level because it required students to use critical thinking skills and use key events, ideas, and concepts within the passage to develop an overall theme. There were also 10 questions that placed into cell [3,2] because students were asked to connect ideas using supporting evidence. Many of these questions utilized a drag-and-drop format in which students had to locate specific quotes or pieces of information from the passage and link them to concepts or overall ideas. Other questions, however, contained a multiple-choice format but required students to identify contributing factors that drove a main event or theme in the passage provided.

The questions that placed into cell [3,4] focused primarily on understanding the author’s use of language, writing style, and perspective in relation to the overall meaning or tone of the passage. Although many of these questions remained in the multiple-choice format that was common throughout the HOT Learning program, some questions required students to select the appropriate answer directly from the passage. These questions required students to use reasoning
skills about the author’s choice in how the story provided in the passage was told and how elements incorporated by the author influenced the overall message being conveyed. Some examples of questions asked students to identify a specific sentence that best shows how a sense of mystery was developed in the passage or how the author acknowledged conflicting evidence in an argumentative text. These questions employ higher order thinking skills because students have to analyze specific information in the text. The questions asked of students do not directly lead students to a particular passage or concept in the text, but rather require students to identify the information that is relevant to appropriately answering the overall question.

Figure 6. Comparison of percentage of questions placed in lower level and higher level cells within Hess’ Cognitive Rigor Matrix.

Levels 1 and 2 of Hess’ Cognitive Rigor Matrix were considered lower level because of the limited cognitive complexity that would be present in these types of questions. At Level 1,
the level of cognitive complexity is limited to basic recall of facts and simple explanation of an event or phenomena. Responses to questions at Level 1 can be found explicitly in the text and do not require further analysis or the use of inferences (Webb et al., 2005, p. 70). Although the cognitive complexity increases from Level 1 to Level 2, questions that place into the second level of Hess’ Cognitive Rigor Matrix require the lowest level of thinking that extends beyond the text, particularly by asking students to culminate multiple sentences from the passage in order to formulate a response rather than recall a specific event that was explicitly stated. While some analysis occurs at Level 2, the reliance on the passage provided to students as the source to find the answer limits the cognitive complexity of questions in this level.

There were 203 questions, or 87.9%, from the sample that placed into Levels 1 and 2. A total of 139 questions placed into Level 2, making up 68.5% of the lower level questions. The majority of these questions, which were placed into cell [2,2] required students to choose a main idea that best fit the passage following a multiple-choice format. In addition, many of the questions placed into cell [2,2] asked students to make basic predictions or inferences based on the contents within a passage. Other questions at Level 2 were placed into cell [2,4] because they required students to compare information, identify relevant information, and describe the use of a literary device. Although some analysis was required in these questions, the multiple-choice format of the answers guided the students to the answer, reducing the ability for students to use higher order thinking skills.

There were 64 questions placed into Level 1, which equaled 31.5% of the total number of lower level questions. The majority of Level 1 questions were placed into cell [1,2] because they required students to describe an event that happened in the passage or to define a term from the text. The answers to these questions were oftentimes found directly in the text and did not require students to use context clues since they could reach the appropriate answer through
process of elimination from the multiple-choice answers given. In addition, many of the terms that students were asked to define were explained in the sentence following the use of the term. For example, one question asked students to define the word *complex*. In the passage, the word *complex* was used in the sentence “some paintings may be quite complex, with layers of meaning to them.” Similarly, questions asking students to describe an event or phenomena in the passage contained answer choices that guided students to the correct answer without students having to utilize any reasoning or critical thinking skills. The second highest frequency of Level 1 questions were placed into cell [1,1], which required students to directly recall specific information that had been stated in the passage. These questions required no higher order thinking skills and contained very little cognitive complexity.

**Conclusion**

The purpose of this study was to describe the level and distribution of cognitive complexity within an online-based program that markets itself as increasing higher order thinking skills among students grades K–8. Hess’ Cognitive Rigor Matrix was used to determine the level of cognitive complexity that aligned with Webb’s Depth of Knowledge and the complexity of the task itself that aligned with Bloom’s Taxonomy. Questions that placed into Levels 3 and 4 of Webb’s Depth of Knowledge, along Hess’ Cognitive Rigor Matrix, were considered higher level because the tasks required of students involved higher order thinking skills.

In response to the overarching research question, data analysis revealed the following trends from the sample questions used in the online-based program:

1. The majority of questions presented to students in the online-based program was not higher level and did not require students to utilize higher order thinking skills.
2. The cell with the highest frequency was [2,2]. Questions in this cell asked students to identify the main idea of a passage or to make predictions from key concepts within the text.

3. No questions were placed into Level 4. The most cognitively complex questions in the online-based program placed into cell [3,4].

4. Of the questions sampled, 12.1% of questions were higher level.

Chapter V includes a summary of the study, comments on the findings of the study as they relate to the overarching research question and both subquestions, implications for policy and practice, and future research recommendations.
CHAPTER V

CONCLUSION

This chapter provides a summary of the study, including comments on the findings as they relate to the overarching research question and both subquestions, a conclusion, implications for policy and practice at a district level, and recommendations for future research.

This qualitative content analysis study aimed to describe the level and distribution of cognitive complexity within an online-based program that markets itself as increasing higher order thinking skills among students Grades K–8 (HOT pseudonym, 2017). For this study, a representative sample of 231 questions from the Grade 8 English language arts section of the HOT Learning program was examined using Hess’ Cognitive Rigor Matrix. The questions aligned with the New Jersey Core Curriculum Content Standards (NJCCCS). No empirical evidence exists on the use of online-based programs to improve students’ higher order thinking skills. Similarly, there is no evidence on the categorization of the types of questions provided in these online-based programs in regards to the type of thinking or level of cognitive complexity required of students.

Methodology Summary

The analytical framework used for this study was Hess’ Cognitive Rigor Matrix, which superimposes Webb’s Depth of Knowledge and Bloom’s Taxonomy. Webb’s Depth of Knowledge, which categorizes the level of cognitive complexity of a task, contains four levels. At the lowest level, Level 1, there is very little cognitive complexity. Many of the questions at this level rely on recall and basic operations that do not require an analysis of text (Webb et al.,
2005, p. 70). Questions in Level 2, the second level of Webb’s Depth of Knowledge, are also considered lower level because the level of cognitive complexity does not extend into analysis or in-depth thinking. Levels 3 and 4 of Webb’s Depth of Knowledge are considered higher level because they require more complex thinking to answer questions including reasoning and identifying abstract concepts. Level 4 is the highest level of cognitive complexity according to Webb’s Depth of Knowledge, which requires students to extend their understanding and learning beyond the question or task being asked. Much of the criteria for Level 4 ask students to extend the information from one text to another and to create additional projects or tasks that require additional time (p. 71).

The levels of Bloom’s Taxonomy embedded into Hess’ Cognitive Rigor Matrix include, from lowest to highest level: remember, understand, apply, analyze, evaluate, create. These levels increase in complexity based on the type of tasks that students are asked to complete. The complexity of tasks do not correspond to cognitive complexity in that tasks with lower cognitive complexity in Webb’s Depth of Knowledge could place into a higher level of complexity of the task in Bloom’s Taxonomy. By superimposing both models, questions in an online-based program such as HOT Learning can be assessed based on the depth of understanding required and the complexity of the task itself (Hess et al., 2009a).

This study employed a qualitative content analysis to examine the following overarching question: Using Hess’ Cognitive Rigor Matrix, what are the characteristics of higher order thinking in the Grade 8 English language arts questions presented to students in an online-based program? Two coders used deductive category application, in accordance with Mayring (2000), to categorize each question into the appropriate cell of Hess’ Cognitive Rigor Matrix. Each cell was assigned a matrix based on the level of Webb’s Depth of Knowledge and Bloom’s Taxonomy. An example of a matrix is [2,4], which is Webb’s Level 2 and Bloom’s analyze.
The double-rater read-behind consensus model was utilized in this study to increase inter-rater reliability and to allow the two coders to discuss the placement of each question. The coders held five telephonic conferences in order to calibrate and discuss the questions in sets of 10 questions. To ensure credibility, the data collection procedures, including the double-rater read-behind consensus model and Webb Alignment Tool calibration, were compared to previous studies that had used these same methods.

**Summary and Discussion of Findings**

As discussed in Chapter I, the HOT Learning program advertises that it helps students to acquire a deeper understanding of the content through tasks that require higher order thinking skills. This program, as well as many others, was designed to meet the needs of 21st century skills, which had been incorporated into Standard 9 of the NJCCCS. Tasks that are considered higher level require students to engage in their learning through tasks that allow them to make real-world connections to global issues and issues that would be presented in the workplace (New Jersey Department of Education, 2014). Questions that are higher level will allow students to not only learn the content, but also better understand it through making connections and thinking critically about abstract concepts.

Of the questions examined in the HOT Learning program, 12.1% of questions placed into higher level cells, signifying that the majority of questions provided by the program were not considered cognitively complex. The questions that were considered higher level required students to analyze text structure or elements that were not explicitly stated in the text. In addition, some higher level questions required students to identify an abstract theme, differing from other types of questions that had required students to identify main ideas from the passage that were more apparent.
Conclusion

The HOT Learning program’s website markets that it promotes higher order thinking and inquiry “based on the designs employed by next-generation assessments” that are stated to align with Webb’s Depth of Knowledge. Upon analyzing the selected questions from this program, the HOT Learning program does not hold true to its claim, indicating a discrepancy between the marketing and the tasks presented to students through this program. In fact, the findings suggest that the HOT Learning program does the complete opposite of its claims by providing mainly lower level questions. These findings raise further awareness of the importance of being an educated consumer, in this case school leaders being more knowledgeable of the features offered by a program before purchasing it. It is important that school officials do not get distracted by the catchy marketing tactics used, such as slogans, cartoon mascots, or colorful artistry that makes the product look appealing or fun to use. Instead, these programs must be thoroughly inspected for the quality of the product in relation to the school’s ultimate goal, whether it is to provide remediation for struggling students or to promote higher order thinking skills. School officials need to be more reflective and critical when bringing programs into schools and must thoroughly examine these online-based programs before choosing one over another.

For many schools, there is a push for encouraging higher order thinking skill set development. Standard 9 of the NJCCCS requires teachers to encourage higher order thinking skillset development for students grades K–12 (New Jersey Department of Education, 2014). To meet these demands, private companies, such as the HOT Learning program, developed online-based programs that serve to develop higher order thinking through academic support in the form of practice, immediate feedback, and remediation. In addition, the HOT Learning program is marketed as building skills that encourage a deeper understanding and connections that extend beyond the program. Following the results of this study, it can be concluded that the HOT
Learning program does not provide students with adequate practice in higher order thinking skills, including problem solving, critical thinking, or analysis. The limitations of this program start with the overall multiple-choice format, which leads students to the correct answer or offers the ability for process of elimination. Similarly, the types of questions that were asked of students in the program were repetitive in nature to the other questions in the same category.

Although 12.1% of questions examined in the HOT Learning program are considered higher level, these questions did not encourage students to use problem solving, judgment, reasoning, or critical thinking, skills that are regarded as higher order thinking by Brookhart (2010). Higher order thinking skillset development can be encouraged through creating an engaging and active learning environment in which students take ownership of their learning. Following the writings of Dewey (as cited in Tanner, 2016), inquiry and experience in a problem-based setting promote the development of 21st century skills. The nature of the HOT Learning program, which focuses around drill and continuous practice of the same types of tasks within each category, fails to meet Dewey’s criteria for effective development of these skills. Instead, the HOT Learning program promotes functional fixedness, or a rigidity in thinking that limits an individual from identifying alternatives to a solution, in that students will be able to answer specific tasks based on how the question or task is worded or the category in which the question is located (Dunker as cited in Anderson & Johnson, 1966). The lack of higher level questions that allow students to think critically about topics, as well as the multiple-choice format that contains the correct answer to the question, can lead students to develop a closed mindset to the categories and literacy skills that they practice in the HOT Learning program.

Similarly, if adequate practice in the development of higher order thinking skills is not provided in other aspects of the curriculum, such as classroom lessons to which students are exposed, functional fixedness will be further developed. This will cause further problems when higher
order thinking tasks are introduced in the classroom, on the PARCC test, or outside of a learning environment. Continuous drill practice and exposure to lower level questions can also lead to a convergent thinking mindset, in which students become reliant on identifying the correct answer instead of learning to problem solve and develop a solution that is not the sole correct response. Without exposure to higher level questions, either in an online-based program or in the classroom, students will not develop the necessary skills to problem solve, think critically, or use reasoning and judgment to solve more difficult tasks that extend beyond the classroom and into the real world.

The findings of this study suggest that the HOT Learning program can better serve as a means of remediation and drill practice through its repetitiveness of tasks and the majority of questions placing into lower level cells within Hess’ Cognitive Rigor Matrix. According to Mandernach (2006), online-based programs can assist in transitioning lower level tasks to higher level if these programs are used inside and outside the classroom. This suggests that online-based programs can serve to extend learning beyond the curriculum if they offer individualized and student-driven connections between content and real-world application (p. 43). The HOT Learning program, however, does not meet the capabilities of such online-based programs without further teacher instruction, such as projects or supplemental curriculum, making this program dependent on the way in which classroom teachers utilize the program as a learning tool.

Despite the lack of research on this online-based program and its ability to promote higher order thinking skillset development, private companies are still marketing this program, and other online-based technology programs, to schools. This results in a need for school officials to be more critical of these programs and to investigate these online-based programs before implementing them in schools. Similarly, teachers must be informed as to ways in which
to utilize these programs as a tool and ways to adapt lessons that extend beyond the capabilities of the program to develop students’ higher order thinking skills. Most important, it is crucial that online-based programs are not seen as an instant fix to a problem. Teachers must still be entrusted to know what is best for their students by building higher order thinking skills in the ways material is presented to students and the types of activities that are given in the classroom. Richland and Begolli (2016) stressed the importance of teachers in helping students to develop higher order thinking skills because teachers, not programs, can help show students multiple methods of approaching a task and can provide useful guidance to students that are catered to their individual learning needs. It must be understood among school officials that online-based programs serve as an extension to a teacher-led curriculum and is not suitable as a replacement.

**Recommendations for Practice**

The findings of this study raise awareness of the need for teachers and school administrators to be more proficient in understanding and using Hess’ Cognitive Rigor Matrix, or similar frameworks, to promote higher order thinking skill set development in the classroom. Since there is an apparent disconnect between the marketing of online-based technology programs and their use in schools, the responsibility rests with school personnel to evaluate these programs to decide on the appropriate one before purchase. Furthermore, the responsibility rests with administrators and teachers to be cognizant of ways to promote higher order thinking and to utilize such frameworks as Hess’ Cognitive Rigor Matrix to not only evaluate the questions provided in online-based programs but also the tasks and activities presented to students in the classroom. It is recommended that school personnel design professional development sessions and committees to educate teachers on ways to identify and encourage higher order thinking. By doing this, school personnel can promote a shared vision of the types of learning that occur in
and out of the classroom, as well as establish a unified understanding and practice of skills that further develop higher order thinking.

The findings of this study also have potential to open discussions among school administrators regarding the implementation of online-based programs. Before school officials decide to purchase an online-program, such as HOT Learning, a committee should be formed involving the principal, curriculum supervisor, teachers, and special educators. According to Bennis and Goldsmith (2010), collaboration between professionals can promote outcomes that are creative and effective through an open line of communication between education professionals. A collaborative model between educators and administration can establish a unified vision on how an online-based program can be effectively utilized and implemented in classrooms. To do this, a committee could be created in order to evaluate online-based programs and to help with the implementation process. The responsibility of an evaluation committee is to decide on the intended use for an online-based program, review multiple programs for their alignment to the school’s goal, and choose the appropriate or best-fit program. Once a program is decided upon, the committee must work with teachers to promote a successful implementation, such as facilitating a pilot and providing necessary supports to teachers. An evaluation committee would ensure that the chosen program would be an asset to students and teachers and can promote a successful implementation into the school.

Yukl (2013) identified four requirements of an effective committee. The first requirement is for a committee to identify how to perform a specific task (p. 214). This can be accomplished through review and critique of multiple online-based programs in order to decide on one that best meets the needs of the students and the intended goal, whether it is remediation or promotion of higher order thinking skill set development. This committee can also discuss strengths and weaknesses of various aspects of the school culture, such as teacher comfort level
and technology capabilities within the school, in order to identify potential problems with implementing an online-based program at a school-wide level. Once a program is decided upon, the committee must decide on how to implement the program and to properly train staff through supports and resources. For many online-based programs, trial sessions are offered, which would allow the committee to test these programs by piloting them in classrooms and examining specific questions. This could provide the committee with further understanding of the ways in which teachers in specific subject matters or grade levels can use the program, as well as identify possible infractions that may arise with teacher comfort level and technology capabilities.

Once a program is decided upon, adequate professional development must be provided to teachers in order to prepare them to utilize the online-based program as a teaching tool and a resource. This aligns with Yukl’s (2013) second requirement for an effective committee, which advocates for necessary resources to be offered to staff. Professional development should be provided regularly to teachers in the beginning stages of implementation. In the first few professional development offerings, teachers should be trained on ways in which to identify and foster higher order thinking. This can be done through training in Hess’ Cognitive Rigor Matrix, the model used for this study, or Webb’s Depth of Knowledge and the Webb Alignment Tool. By identifying one framework to incorporate throughout the school, teachers can build cooperative professional development sessions in which they help each other to implement the framework and analyze their practices, lessons, and assessments. These professional development offerings should also help teachers to distinguish between cognitive complexity and difficulty, which can be shown through Hess’ Cognitive Rigor Matrix and the superimposition of Bloom’s Taxonomy and Webb’s Depth of Knowledge.

Once teachers are comfortable with higher order thinking and identifying tasks and activities that promote the development of higher order thinking skills, professional development
offerings should introduce the online-based program. During these training sessions, teachers should be given the opportunities to familiarize themselves with the types of questionings, categories, and any levels that are offered within the program. In addition, teachers should be given the opportunity to practice with the program in order to build their comfort level with how the program is operated and how teachers can use the program to assign tasks, receive reports, and provide feedback to students.

The third requirement of an effective committee is to offer supports to specific individuals (Yukl, 2013). Teachers should be given a trial period to implement the online-based program within their classrooms in order to gain first-hand experience on ways in which the program can be utilized. Members of the committee should offer to help these teachers by observing their classrooms and providing feedback on ways in which to best employ the online-based program. Likewise, members of the committee should meet with teachers in order to allow teachers to express concerns or to ask for more personalized support in successfully implementing the program. This support can be in the form of additional professional development opportunities or through more tailored guidance on ways in which the online-based program can effectively be integrated with classroom curriculum.

The fourth and final requirement for an effective committee is to provide support during the implementation process at a school-wide level (Yukl, 2013). The committee should identify common concerns expressed by teachers using the program and provide school-wide interventions and supports to meet the needs of all teachers. Furthermore, the committee should continue to provide one-on-one help to teachers who require support during the implementation process. The committee should continually check in with teachers in order to identify concerns that arise throughout the implementation process and provide the supports and guidance necessary in order for the online-based program to be successful for the intended goal.
Similarly, the committee should monitor the use of the online-based program’s use in the classroom in regards to the intended goal to judge its overall success in the school.

**Recommendations for Policy**

In order to ensure that teachers are properly trained, the company providing the online-based program should offer professional development with the program’s purchase. This should be mandatory or included in the package that is sold to schools. In this training, members from the company should visit schools prior to the implementation of the program to train teachers in ways to use the program in the classroom, as well as the features that the program provides. Teachers should be given the opportunity to practice with training modules in order to understand how to assign tasks to particular students or groups of students, read diagnostic tests, and modify or adjust the levels or types of lessons assigned to students.

The online-based program’s company should also provide training during the school year in which the program is being implemented. These training sessions should focus on particular concerns teachers and administrators have with the use of the program in the classroom. In addition, training sessions held during the implementation of the program can allow teachers to learn and become more confident in the capabilities of the online-based program that extend beyond the curriculum, serving as an extension to student learning.

The planning and offering of professional development should not be solely reliant on school administrators, or even on an online-based program company. The New Jersey Department of Education (NJDOE) should also be held accountable to provide professional development sessions to educators on ways to assess student thinking and to promote higher order thinking. These professional development opportunities should not only be offered at the annual New Jersey Education Association’s teacher convention but should also be provided at
schools throughout the school year. Trained professionals hired by the NJDOE should visit schools upon request to provide training in teaching strategies that promote the development of higher order thinking skills, giving teachers additional resources to improve upon both teaching and learning. By doing this, teachers can become more comfortable in planning lessons that utilize higher order thinking skills and incorporating these types of lessons into everyday practice.

Furthermore, private companies that create these online-based programs should be responsible for providing independent research results to validate the claims made in their marketing. The studies conducted should be posted publicly on the company’s or program’s website and should not only identify the positive capabilities of the program but also provide a list of potential negative effects. By doing this, school officials would be better able to choose the best program for the intended goal of the school. In addition, the NJDOE should more carefully monitor private companies that create online-based programs, such as HOT Learning, to make sure these programs meet the requirements of the New Jersey Core Curriculum Content Standards (NJCCCS) standards and the Core Curriculum State Standards (CCSS). The NJDOE must also monitor these companies to ensure that the capabilities and offerings of the programs align with how the program is marketed. Holding private companies to higher standards by assessing the marketing and types of questions as they align with teaching standards can lead to more honesty among these private companies. By doing this, school administrators looking to purchase an online-based program to implement in a school would have more confidence in knowing that the program selected will be a proper fit for the intended student population.
Recommendations for Further Research

To date, there are no studies that examine the frequency and type of higher order thinking skills present in online-based educational technology programs. Further research is needed on other online-based programs aside from HOT Learning in order to gain a better understanding of the capabilities of these programs overall in promoting higher order thinking. The HOT Learning program divided the questions into 21 different categories in which there was a similarity between the types of questions within each category. Since the questions are clustered based on skill, further research can be done on types of programs that use content clustering to expose students to questions of varying skill and topic.

Future studies should also examine questions from the HOT Learning program from other programs used in public school classrooms. These studies may yield different results that could help to further understand the capabilities of online-based programs and can serve as a means of comparison between different online-based programs and their capabilities to promote higher order thinking development. In addition, this study examined questions aligned with Grade 8 standards. Further research can analyze and categorize questions from other grade levels in order to better understand the program overall or its capabilities for students in different grade levels. By examining the questions in other grade levels, similarities and differences can also be identified in the frequency of higher order thinking questions provided to students of different grade levels.

This study focused solely on categorizing and describing the number of questions that were considered higher level in the HOT Learning program. It did not, however, examine the effects of these programs on other aspects, such as student achievement or PARCC (Partnership for Assessment of Readiness for College and Careers) scores. Further studies that explore the use of an online-based program’s impact on student achievement or PARCC scores could
provide useful insight into the programs’ overall effectiveness. Likewise, studies conducted on the effectiveness of HOT Learning in low-income, Abbott, or failing school districts as it relates to student achievement could provide useful implications and could serve as a means for future legislation or policy in struggling schools. There is also a need for research to be conducted on the interactions between the structure of activities or questions presented to students in online-based programs and how the structure addresses various types of learning. This can serve to better understand the connection between student learning styles and the capabilities of these programs to help students develop necessary skills and content knowledge.
REFERENCES


www.studyisland.com/sites/studyisland.com/files/content/research/pdfs
/StudyIslandStatisticalResearchReport12408.pdf

Watts, J. (2009). *A foundational research study connecting response to intervention research to the Study Island program.* Retrieved from


Yuan, K., & Le, V. (2012). *Estimating the percentage of students who were tested on cognitively demanding items through the state achievement tests*. (WR-967-WFHF). Santa Monica, CA: RAND.


APPENDIX

Appendix A: Hess’ Cognitive Rigor Matrix................................................................. 128

Appendix B: Hess’ CRM with Calibration Comments .................................................. 129

Appendix C: Coding Table.......................................................................................... 130
### Appendix A: Hess’ Cognitive Rigor Matrix

<table>
<thead>
<tr>
<th>Bloom’s Revised Taxonomy of Cognitive Process Dimensions</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Remember</strong></td>
<td>Recall &amp; Reproduction</td>
<td>Skills &amp; Concepts</td>
<td>Strategic Thinking/Reasoning</td>
<td>Extended Thinking</td>
</tr>
<tr>
<td>Retrieve knowledge from long-term memory, recall, locate, identify</td>
<td>Recall, recognize, or locate basic facts, ideas, principles</td>
<td>Recall or identify conversions between representations, numbers, or units of measure</td>
<td>Identify facts/details in texts</td>
<td></td>
</tr>
<tr>
<td><strong>Understand</strong></td>
<td>Compose &amp; Decompose numbers</td>
<td>Specify and explain relationships</td>
<td>Explain, generalize, or connect ideas using supporting evidence</td>
<td>Explain how concepts or ideas specifically relate to other content domains or concepts</td>
</tr>
<tr>
<td>Construct meaning, clarify, paraphrase, represent, translate, illustrate, give examples, classify, categorize, summarize, generalize, infer a logical conclusion (such as from examples given), predict, compare/contrast, match the ideas, explain, construct models</td>
<td>Evaluate an expression</td>
<td>Give non-examples/examples</td>
<td>Explain thinking when more than one response is possible</td>
<td></td>
</tr>
<tr>
<td><strong>Apply</strong></td>
<td>Follow simple/routine procedure (recipe-type directions)</td>
<td>Select a procedure according to task needed and perform it</td>
<td>Use concepts to solve non-routine problems</td>
<td>Select or devise an approach among many alternatives to solve a novel problem</td>
</tr>
<tr>
<td>Carry out or use a procedure in a given situation, carry out (apply to a familiar task), or use (apply) to an unfamiliar task</td>
<td>Solve a one-step problem</td>
<td>Solve routine problem applying multiple concepts or decision points</td>
<td>Design investigation for a specific purpose or research question</td>
<td></td>
</tr>
<tr>
<td><strong>Analyze</strong></td>
<td>Retrieve information from a table or graph to answer a question</td>
<td>Categorize, classify materials</td>
<td>Compare information within or across data sets or texts</td>
<td>Analyze multiple sources of evidence or multiple works by the same author, or across genres, or time periods</td>
</tr>
<tr>
<td>Break into constituent parts, determine how parts relate, differentiate between relevant-irrelevant, distinguishing, focus, select, organize, outline, find coherence, deconstruct (e.g., for bias or point of view)</td>
<td>Identify or locate specific information contained in maps, charts, tables, graphs, or diagrams</td>
<td>Compare/contrast figures or data</td>
<td>Analyze and draw conclusions from more complex data</td>
<td></td>
</tr>
<tr>
<td><strong>Evaluate</strong></td>
<td>Make judgments based on criteria, check, detect inconsistencies or fallacies, judge, critique</td>
<td>Select appropriate display data</td>
<td>Generalize a pattern</td>
<td>Gather, analyze, &amp; evaluate relevancy &amp; accuracy</td>
</tr>
<tr>
<td><strong>Create</strong></td>
<td>Reorganize elements into new patterns/structures, generate, hypothesize, design, plan, construct, produce</td>
<td>Identify text structure of paragraph</td>
<td>Organize/interpret data, complex graph</td>
<td>Draw &amp; justify conclusions</td>
</tr>
<tr>
<td>Brainstorm ideas, concepts, or perspectives related to a topic or concept</td>
<td>Distinguish relevant/irrelevant information, fact/opinion</td>
<td>Distinguish relevant/irrelevant information, fact/opinion</td>
<td>Analyze author’s craft, viewpoint, or potential bias</td>
<td></td>
</tr>
<tr>
<td>Generate conjectures or hypotheses based on observations or prior knowledge</td>
<td>Cite evidence and develop a logical argument for concepts</td>
<td>Cite evidence and develop a logical argument for concepts</td>
<td>Gather, analyze, &amp; evaluate relevancy &amp; accuracy</td>
<td></td>
</tr>
<tr>
<td>Synthesize information within one source or text</td>
<td>Describe, compare, and contrast solution methods</td>
<td>Describe, compare, and contrast solution methods</td>
<td>Draw &amp; justify conclusions</td>
<td></td>
</tr>
<tr>
<td>Synthesize information across multiple sources or texts</td>
<td>Verify reasonableness of results</td>
<td>Verify reasonableness of results</td>
<td>Apply understanding in a novel way, provide argument or justification for the application</td>
<td></td>
</tr>
<tr>
<td>Design a model to inform and solve a real-world, complex, or abstract situation</td>
<td>Justify conclusions made</td>
<td>Justify conclusions made</td>
<td>Apply understanding in a novel way, provide argument or justification for the application</td>
<td></td>
</tr>
<tr>
<td>Bloom’s Revised Taxonomy of Cognitive Process Dimensions</td>
<td>Webb’s Depth of Knowledge (DOK) Levels</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------------------------------------------------</td>
<td>---------------------------------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remember</td>
<td>Level 1: Recall &amp; Reproduction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Retrieve knowledge from long-term memory, recognize,</td>
<td>Level 2: Skills &amp; Concepts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>recall, locate, identify</td>
<td>Level 3: Strategic Thinking/Reasoning</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Level 4: Extended Thinking</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Understand</td>
<td>[1.1] Recall, recognize, or locate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construct meaning, clarify, paraphrase, represent,</td>
<td>basic facts, ideas, principles</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>translate, illustrate, give examples, classify,</td>
<td>Recall or identify conversions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>categorize, summarize, generalize, infer a logical</td>
<td>between representations, numbers,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>conclusion (such as from examples given), predict,</td>
<td>or units of measure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>compare/contrast, match the ideas, explain, construct</td>
<td>Identify facts/details in texts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>models</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apply</td>
<td>[1.2] Compose &amp; Decompose numbers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carry out or use a procedure in a given situation,</td>
<td>Evaluate an expression</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>carry out (apply to a familiar task), or use (apply)</td>
<td>Locate points (grid, number line)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>to an unfamiliar task</td>
<td>Represent math relationships in words,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>pictures, or symbols</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Write simple sentences</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Select appropriate word for intended</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>meaning</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Describe/explain how or why using</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>literal or verbatim responses</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apply</td>
<td>[1.3] Follow simple/routine procedure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(recipe-type directions)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Solve a one-step problem</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Calculate, measure, apply a rule</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Apply an algorithm or formula (area,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>perimeter, etc.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Represent in words or diagrams a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>concept or relationship</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Apply rules or use resources to edit</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>spelling, grammar, punctuation,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>conventions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apply</td>
<td>[2.2] Specify and explain relationships</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Give non-examples/examples</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Make and record observations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Take notes, organize ideas/data</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Make basic inferences or logical</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>predictions from data or texts if</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>data that does not require</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>original thought and have a clearly</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>defined answer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Identify main ideas or accurate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>generalizations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apply</td>
<td>[3.2] Explain, generalize, or connect</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ideas using supporting evidence</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Explain thinking when more than one</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>response is possible</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Explain phenomena in terms of concepts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Write full composition to meet</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>specific purpose</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Identify themes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Performance tasks do not have obvious</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>answers and require students to pull</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>from multiple sources and develop</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>original ideas</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apply</td>
<td>[4.2] Select or devise an approach</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>among many alternatives to solve a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>novel problem</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Conduct a project that specifies a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>problem, identifies solution paths,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>solves the problem, and reports</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>results</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Illustrate how multiple themes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(historical, geographic, social) may</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>be interrelated</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>This may be the highest level found</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>on the online-based program</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apply</td>
<td>[4.3] Analyze multiple sources of</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>evidence or multiple works by the</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>same author, or across genres, or</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>time periods</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Analyze complex/abstract themes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gather, analyze, and organize</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>information</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Analyze discourse styles</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apply</td>
<td>[4.4] Synthesize multiple sources of</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>evidence or multiple works by the</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>same author, or across genres, or</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>time periods</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Analyze complex/abstract themes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gather, analyze, &amp; evaluate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>relevancy &amp; accuracy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Draw &amp; justify conclusions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Apply understanding in a novel way,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>provide argument or justification for</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>the application</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apply</td>
<td>[4.5] Generate conjectures or</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>hypotheses based on observations or</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>prior knowledge</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Emphasis is on prior knowledge</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>and not original thought</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Formulate an original problem, given</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>a situation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Develop a complex model for a given</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>situation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apply</td>
<td>[4.6] Synthesize information across</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>multiple sources or texts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Design a model to inform and solve a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>real-world, complex, or abstract</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>situation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apply</td>
<td>[1.4] Retrieve information from a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>table or graph to answer a question</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Identify or locate specific</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>information contained in maps, charts,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>tables, graphs, or diagrams</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analyze</td>
<td>[2.4] Categorize, classify materials</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Compare/contrast figures or data</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Organize or interpret (simple) data</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Extend a pattern</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Identify use of literary devices</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Identify text structure of paragraph</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Distinguish relevant/irrelevant</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>information, fact/opinion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluate</td>
<td>[3.4] Compare information within or</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>across data sets or texts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Analyze and draw conclusions from</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>more complex data and/or multiple</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>sources</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Generalize a pattern</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Organize/interpret data, complex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>graph</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Analyze author’s craft, viewpoint, or</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>potential bias and how it affects the</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>interpretation of the reading</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>selection</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluate</td>
<td>[3.5] Cite evidence and develop a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>logical argument for concepts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Describe, compare, and contrast</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>solution methods</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Verify reasonableness of results</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Justify conclusions made</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Create</td>
<td>[1.5] Brainstorm using prior knowledge</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ideas, concepts, or perspectives</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>related to a topic or concept</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No original thought is utilized</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Create</td>
<td>[2.6] Generate conjectures or</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>hypotheses based on observations or</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>prior knowledge</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Emphasis is on prior knowledge and</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>not original thought</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Create</td>
<td>[3.6] Synthesize information within</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>one source or text with an emphasis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>on original thought</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Formulate an original problem, given</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>a situation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Develop a complex model for a given</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>situation</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Appendix C: Coding Table

<table>
<thead>
<tr>
<th>Question</th>
<th>[1,1]</th>
<th>[1,2]</th>
<th>[1,3]</th>
<th>[1,4]</th>
<th>[1,6]</th>
<th>[2,2]</th>
<th>[2,3]</th>
<th>[2,4]</th>
<th>[2,6]</th>
<th>[3,2]</th>
<th>[3,3]</th>
<th>[3,4]</th>
<th>[3,5]</th>
<th>[3,6]</th>
<th>[4,2]</th>
<th>[4,3]</th>
<th>[4,4]</th>
<th>[4,5]</th>
<th>[4,6]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Textual Evidence- 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Textual Evidence- 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Textual Evidence- 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Textual Evidence- 9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Textual Evidence- 12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Textual Evidence- 15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Textual Evidence- 18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Textual Evidence- 21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Textual Evidence- 24</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Textual Evidence- 27</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Textual Evidence- 30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Making Inferences- 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Making Inferences- 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Making Inferences- 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Making Inferences- 9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Making Inferences- 12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Making Inferences- 15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Making Inferences- 18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Making Inferences- 21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Making Inferences- 24</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Making Inferences- 27</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Making Inferences- 30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Theme- 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Theme- 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Theme- 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Theme- 9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Theme- 12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Theme- 15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Theme- 18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Theme- 21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Theme- 24</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Theme- 27</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Theme- 30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Objective Summary- 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Objective Summary- 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Objective Summary- 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Objective Summary- 9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Appendix C: Coding Table

<table>
<thead>
<tr>
<th>Question</th>
<th>[1,1]</th>
<th>[1,2]</th>
<th>[1,3]</th>
<th>[1,4]</th>
<th>[1,6]</th>
<th>[2,2]</th>
<th>[2,3]</th>
<th>[2,4]</th>
<th>[2,6]</th>
<th>[3,2]</th>
<th>[3,3]</th>
<th>[3,4]</th>
<th>[3,5]</th>
<th>[3,6]</th>
<th>[4,2]</th>
<th>[4,3]</th>
<th>[4,4]</th>
<th>[4,5]</th>
<th>[4,6]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objective Summary- 12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Objective Summary- 15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Objective Summary- 18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Objective Summary- 21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Objective Summary- 24</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Objective Summary- 27</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Objective Summary- 30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Characters- 1</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Characters- 3</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Characters- 6</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Characters- 9</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Characters- 12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Characters- 15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Characters- 18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Characters- 21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Characters- 24</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Characters- 27</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Characters- 30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Setting- 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Setting- 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Setting- 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Setting- 9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Setting- 12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Setting- 15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Setting- 18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Setting- 21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Setting- 24</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Setting- 27</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Setting- 30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Plot- 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Plot- 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Plot- 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Plot- 9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Plot- 12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Plot- 15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Plot- 18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Plot- 21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
### Appendix C: Coding Table

<table>
<thead>
<tr>
<th>Question</th>
<th>[1,1]</th>
<th>[1,2]</th>
<th>[1,3]</th>
<th>[1,4]</th>
<th>[1,6]</th>
<th>[2,2]</th>
<th>[2,3]</th>
<th>[2,4]</th>
<th>[2,6]</th>
<th>[3,2]</th>
<th>[3,3]</th>
<th>[3,4]</th>
<th>[3,5]</th>
<th>[3,6]</th>
<th>[4,2]</th>
<th>[4,3]</th>
<th>[4,4]</th>
<th>[4,5]</th>
<th>[4,6]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plot- 24</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plot- 27</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plot- 30</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Context Clues- 1</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Context Clues- 3</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Context Clues- 6</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Context Clues- 9</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Context Clues- 12</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Context Clues- 15</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Context Clues- 18</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Context Clues- 21</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Context Clues- 24</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Context Clues- 27</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Context Clues- 30</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple Meaning- 1</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple Meaning- 3</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple Meaning- 6</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple Meaning- 9</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple Meaning- 12</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple Meaning- 15</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple Meaning- 18</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple Meaning- 21</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple Meaning- 24</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple Meaning- 27</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple Meaning- 30</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Figurative Meaning- 1</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Figurative Meaning- 3</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Figurative Meaning- 6</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Figurative Meaning- 9</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Figurative Meaning- 12</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Figurative Meaning- 15</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Figurative Meaning- 18</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Figurative Meaning- 21</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Figurative Meaning- 24</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Figurative Meaning- 27</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Figurative Meaning- 30</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connotative Meaning- 1</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Question</td>
<td>[1,1]</td>
<td>[1,2]</td>
<td>[1,3]</td>
<td>[1,4]</td>
<td>[1,6]</td>
<td>[2,2]</td>
<td>[2,3]</td>
<td>[2,4]</td>
<td>[2,6]</td>
<td>[3,2]</td>
<td>[3,3]</td>
<td>[3,4]</td>
<td>[3,5]</td>
<td>[3,6]</td>
<td>[4,2]</td>
<td>[4,3]</td>
<td>[4,4]</td>
<td>[4,5]</td>
<td>[4,6]</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td>Connotative Meaning- 3</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connotative Meaning- 6</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connotative Meaning- 9</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connotative Meaning- 12</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connotative Meaning- 15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connotative Meaning- 18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connotative Meaning- 21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connotative Meaning- 24</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connotative Meaning- 27</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connotative Meaning- 30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meaning and Tone- 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meaning and Tone- 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meaning and Tone- 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meaning and Tone- 9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meaning and Tone- 12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meaning and Tone- 15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meaning and Tone- 18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meaning and Tone- 21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Meaning and Tone- 24</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Meaning and Tone- 27</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meaning and Tone- 30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cultural Literature- 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cultural Literature- 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cultural Literature- 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cultural Literature- 9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cultural Literature- 12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cultural Literature- 15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cultural Literature- 18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cultural Literature- 21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cultural Literature- 24</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cultural Literature- 27</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cultural Literature- 30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compare Contrast- 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compare Contrast- 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compare Contrast- 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compare Contrast- 9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compare Contrast- 12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Appendix C: Coding Table

<table>
<thead>
<tr>
<th>Question</th>
<th>[1,1]</th>
<th>[1,2]</th>
<th>[1,3]</th>
<th>[1,4]</th>
<th>[1,6]</th>
<th>[2,2]</th>
<th>[2,3]</th>
<th>[2,4]</th>
<th>[2,6]</th>
<th>[3,2]</th>
<th>[3,3]</th>
<th>[3,4]</th>
<th>[3,5]</th>
<th>[3,6]</th>
<th>[4,2]</th>
<th>[4,3]</th>
<th>[4,4]</th>
<th>[4,5]</th>
<th>[4,6]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compare Contrast- 15</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compare Contrast- 18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compare Contrast- 21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compare Contrast- 24</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compare Contrast- 27</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Compare Contrast- 30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Author POV- 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Author POV- 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Author POV- 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Author POV- 9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Author POV- 12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Author POV- 15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Author POV- 18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Author POV- 21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Author POV- 24</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Author POV- 27</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Author POV- 30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Central Ideas- 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Central Ideas- 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Central Ideas- 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Central Ideas- 9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Central Ideas- 12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Central Ideas- 15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Central Ideas- 18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Central Ideas- 21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Central Ideas- 24</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Central Ideas- 27</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Central Ideas- 30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Connections- 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Connections- 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Connections- 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Connections- 9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Connections- 12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Connections- 15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Connections- 18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Connections- 21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Connections- 24</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>


## Appendix C: Coding Table

<table>
<thead>
<tr>
<th>Question</th>
<th>[1,1]</th>
<th>[1,2]</th>
<th>[1,3]</th>
<th>[1,4]</th>
<th>[1,6]</th>
<th>[2,2]</th>
<th>[2,3]</th>
<th>[2,4]</th>
<th>[2,6]</th>
<th>[3,2]</th>
<th>[3,3]</th>
<th>[3,4]</th>
<th>[3,5]</th>
<th>[3,6]</th>
<th>[4,2]</th>
<th>[4,3]</th>
<th>[4,4]</th>
<th>[4,5]</th>
<th>[4,6]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connections - 27</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connections - 30</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Text Structure - 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Text Structure - 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Text Structure - 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Text Structure - 9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Text Structure - 12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Text Structure - 15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Text Structure - 18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Text Structure - 21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Text Structure - 24</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Text Structure - 27</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Text Structure - 30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technical Meaning - 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technical Meaning - 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technical Meaning - 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technical Meaning - 9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technical Meaning - 12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technical Meaning - 15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technical Meaning - 18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technical Meaning - 21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technical Meaning - 24</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technical Meaning - 27</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technical Meaning - 30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visual Elements - 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visual Elements - 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visual Elements - 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visual Elements - 9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visual Elements - 12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visual Elements - 15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visual Elements - 18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visual Elements - 21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visual Elements - 24</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visual Elements - 27</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visual Elements - 30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluating Arguments - 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Evaluating Arguments - 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
Appendix C: Coding Table

<table>
<thead>
<tr>
<th>Question</th>
<th>[1,1]</th>
<th>[1,2]</th>
<th>[1,3]</th>
<th>[1,4]</th>
<th>[1,6]</th>
<th>[2,2]</th>
<th>[2,3]</th>
<th>[2,4]</th>
<th>[2,6]</th>
<th>[3,2]</th>
<th>[3,3]</th>
<th>[3,4]</th>
<th>[3,5]</th>
<th>[3,6]</th>
<th>[4,2]</th>
<th>[4,3]</th>
<th>[4,4]</th>
<th>[4,5]</th>
<th>[4,6]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluating Arguments- 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluating Arguments- 9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluating Arguments- 12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluating Arguments- 15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluating Arguments- 18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Evaluating Arguments- 21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Evaluating Arguments- 24</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Evaluating Arguments- 27</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Evaluating Arguments- 30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>