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# Program Implementation and Upper Elementary Writing Achievement

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This is to certify that the doctoral study by

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Walden University
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Abstract

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Project Study Submitted in Partial Fulfillment

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Abstract

According to the National Assessment of Educational Progress, a significant percent of 4th grade students write well below the basic level. In one elementary school, teachers implemented a new writing program for all students at the school. The purpose of this quasi-experimental quantitative study was to determine the effects of this writing program *A Language for Learning* and *Write from the Beginning…and Beyond*. Bruner's theory of constructivism formed the theoretical foundation of this study. The study included 172 students in 3rd, 4th, and 5th grades.  The research questions examined pre- and post-paragraph writing scores, extended writing scores, grammar and usage scores, and scores in mechanics. A single-factor ANOVA indicated a significant difference among the 3 grade levels in paragraph writing, extended writing, and grammar and usage. A significant difference was also found and among 2grade levels and mechanics. Writing achievement improved after implementation of the program. The results of this study could prompt change in writing programs used at the urban public school.

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# Dedication

To my family of educators who never stop learning. Thank you for teaching me the same. To my family, Ron, Brandy, and Ronnie. Your patience, support, and sense of humor kept me going on day after day. To my colleagues who never failed to listen and provide encouragement.

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# Section 1: The Problem

## The Local Problem

Writing proficiency scores on the 1998 National Assessment of Educational Progress (NAEP) indicate that 23% of United States fourth grade students are proficient or above in writing (National Center for Education Statistics, 2014). The most recent fourth grade NAEP writing scores, for the year 2002, show that 28% of the nation's fourth grade students are proficient or above in writing. The local state's 1998 NAEP writing scores reveal that 27% of fourth grade students are proficient or above in writing. Although the local state's scores are near the average of other students in the United States, they are still lower than the expected score based on the 2001 No Child Left Behind Act (NCLB). According to the local state's Department of Education, the percentage of students at or above proficiency on state writing achievement tests for the following years are: 54% in 2012, 55% in 2013, and 42% in 2014. The local school's writing scores are well below that of the state: 47% in 2012, 36% in 2013, and 27% in 2014.

The local school district has recently implemented a plan for improvement. Part of the plan states that 80% of third grade students will be at or above proficiency on the state's writing achievement test by the year 2020. The local school district will need to nearly double its writing achievement scores. Scores for third grade students from the local school under study need to improve by approximately two-thirds. Third grade students writing at or above proficiency at the local school for the following three years are: 21% in 2012, 16% in 2013, and 33% in 2014.

As the data indicates, the local school is in need of a strong writing program for its students. After evaluating several writing programs and curricula, staff at the local school chose to implement *Write from the Beginning…and Beyond*. The purpose of this study is to examine the effectiveness of this program on writing achievement scores at the local school. It is expected that this study will add to the understanding of writing instruction.

## Rationale

No single writing program or curriculum is used at this school. Instead, the principal purchased several programs for teachers.. These included *Step Up to Writing*, *Lucy Calkin's Units of Study for Teaching Writing*, *6-Trait Writing*, and the district's writing curriculum. The trend of declining writing scores on state assessments prompted teachers to request a single writing program for each grade, kindergarten through fifth. The selected program, *Write from the Beginning…and Beyond*, was implemented in August 2013. Teachers received extensive training on this program during day-long workshops and via professional learning communities (PLCs).

Students are expected to demonstrate proficiency on all district and state assessments. Low test scores suggest a need for a school-wide focus on writing achievement. Trends of the state writing assessment at the local school show a decline in proficiency for the school years 2009-2010, 2010-2011, 2011-2012, and 2012-2013.

Percentages in order of school year are: 41%, 40%, 37%, and 27%. Proficiency for the 2013-2014 is the same as 2012-2013.

Table 1 compares the state writing test scores for all school districts in the state for the 2011-2012, 2012-2013, and 2013-2014 school years, for third, fourth, and fifth grade. The trends in the state writing assessment for all districts in the state have remained steady.

Table 1

*Assessment Writing Results for all Districts in the State*

| State writing scores | 2011-2012 | 2012-2013 | 2013-2014 |
|---|---|---|---|
| %Unsatisfactory | 9.25 | 5.83 | 6.33 |
| %Partially proficient | 41.17 | 39.87 | 40.67 |
| %Proficient | 45.00 | 45.50 | 44.67 |
| %Advanced | 7.50 | 8.23 | 8.00 |
| %Proficient and advanced | 53.40 | 53.77 | 52.67 |

Table 2 compares all schools in the local school district for writing achievement scores on the state assessment for grades three through five for the 2011-2012, 2012-2013, and 2013-2014 school years. The data suggests that there has been no change over the past three years in writing scores for all schools in the local district.

Table 2

*Writing Scores for All Schools in the Local School District*

| All Schools in the District | 2011-2012 | 2012-2013 | 2013-2014 |
|---|---|---|---|
| % Unsatisfactory | 11.33 | 10.40 | 10.39 |
| % Partially Proficient | 47.47 | 46.37 | 46.39 |
| % Proficient | 35.03 | 35.70 | 35.72 |
| % Advanced | 5.63 | 6.43 | 6.41 |
| % Proficient and Advanced | 40.70 | 42.10 | 42.13 |

Table 3 shows the local school's writing scores on the state assessment for third, fourth, and fifth grade. Students scoring unsatisfactory and partially proficient increase from 2011 to 2014, while the number of students who scored proficient decrease 10% these same school years.

Table 3

*Local School State Writing Scores*

| Local School State Writing Scores | 2011-2012 | 2012-2013 | 2013-2014 |
|---|---|---|---|
| % Unsatisfactory | 23.63 | 7.4 | 11.68 |
| % Partially Proficient | 29.73 | 56.23 | 61.34 |
| % Proficient | 44.00 | 34.43 | 24.05 |
| % Advanced | 2.63 | 1.90 | 2.92 |
| % Proficient and Advanced | 46.63 | 36.33 | 26.97 |

The number of students who scoring proficient or advanced on the state writing assessment id higher statewide and at the local school district. Writing achievement scores rise slightly in the state and the local district from the 2011-2012 to the 2012-2013 school year and remain steady from 2012-2013 to 2013-2014. The local school shows approximately a 10% decline in proficiency for these same years.

Teachers and administrators at the local school acknowledge that current writing practices are not working. Collaboration among staff, administration, and district leaders agree that a new model be implemented with fidelity and accountability. The writing program chosen, *A Language for Learning and Write from the Beginning…and Beyond* has been used in all elementary classrooms at the local school since 2013. The purpose of this study is to determine if the new writing program improved state writing assessment scores at the local school.

## Definition of Terms

Achievement level describes the success a student has achieved on the Model Content Standards. There are four levels of achievement identified by the Colorado Department of Education (2014).

Limited Command: Performance consistently fails to meet objectives of standards and criteria (Colorado Department of Education, 2014).

Moderate Command: Performance partially meets standards and criteria (Colorado Department of Education, 2014).

Strong Command: Performance consistently meets standards and criteria (Colorado Department of Education, 2014).

Distinguished: Standards and criteria are clearly exceeded (Colorado Department of Education, 2014).

> "Academic Growth is the change in student achievement against Academic Standards for an individual student between two or more points in time, which shall be determined using multiple measures. One of these measures shall be the results of the statewide summative assessment and may include other standards-based measures that are rigorous and comparable across classrooms of similar content areas and levels" (Colorado Department of Education, 2014, para. 1).

Accredited on Watch defines schools that are performing below the district's expectations in either academic growth, academic achievement, or both. Schools in this category receive intensive instructional support. (Colorado Department of Education, 2014, para. 1).

School Performance Framework (SPF) is the local state's procedure for evaluating schools. The system takes into consideration "a wide range of factors to give ratings on how well each school supports student growth and achievement and how well each school serves its students and families" (Colorado Department of Education, 2014, para. 1).

Thinking Maps® are visual tools developed by Dr. David Hyerle that correspond to eight thinking processes (Hyerle, 2012). These along with programs *A Language for*

*Learning* and *Write from the Beginning… and Beyond* was developed to increase student performance in writing from kindergarten through grade eight.

**Significance of the Study**

The trends identified from the local school's state writing assessment scores, the School Performance Framework, and the school's demographics support a change in current teaching practice. The SPF for this school is currently Accredited on Watch. Progress in student academic achievement is stagnant and does not meet the district standard. The student achievement level for writing during the 2009-2010 school year was labeled as Meets; then changed to Approaching for the school years 2010-2011, 2011-2012, 2012-2013, and 2013-2014.

The local school district developed a long-range plan called the 2020 Plan (Denver Public Schools, 2010). The second of its five goals calls for 80% of third grade students to be at or above proficiency in writing by the year 2020. It is vital that the local school find a way to improve writing scores. A school that does not show progress may have all of its staff replaced or be required to change its programming.

Examining the effects of *A Language for Learning* and *Write from the Beginning…and Beyond* will help determine if this school is on the right path to improvement. This new method of instruction focuses on a common language for learning that the whole school can use. The tools used in this writing program focus on learning that is consistent, flexible, developmental, integrative, and reflective (Hyerle, 2004). Thinking Maps, which are included in *A Language for Learning* may be used as an assessment tool. The developer of Thinking Maps states they provide equal access to learning for students of various cultures, who speak different languages, and who differ in socioeconomic status (Hyerle, 2004).

**Research Questions and Hypotheses**

Based on the literature reviewed for this study and the theory that writing improvement increases when visual representations are used to show cognitive processes, the following research questions and hypotheses were used:

1. Is there a difference between student writing scores prior to implementation of the writing program *A Language for Learning* and *Write from the Beginning…and Beyond* and after program implementation?

   $H_{1o}$: There is no difference between *A Language for Learning* and *Write from the Beginning…and Beyond* in terms of state writing achievement scores for students in grades three through five at the local school.

   $H_{1a}$: There is a difference between *A Language for Learning* and *Write from the Beginning…and Beyond* in terms of state writing achievement scores for students in grades three through five at the local school.

2. Is there a difference in paragraph writing scores for third grade students prior to implementation of the writing program *A Language for Learning* and *Write from the Beginning…and Beyond* and after program implementation?

   $H_{2o}$: There is no difference between *A Language for Learning* and *Write from the Beginning…and Beyond* and paragraph writing scores for third grade students at the local school.

$H_{2a}$: There is a difference between *A Language for Learning* and *Write from the Beginning…and Beyond* and paragraph writing scores for third grade students at the local school.

3. Is there a difference in extended writing scores for third, fourth, and fifth grade students prior to implementation of the writing program *A Language for Learning* and *Write from the Beginning…and Beyond* and after program implementation?

$H_{3o}$: There is no difference between *A Language for Learning* and *Write from the Beginning…and Beyond* extended writing scores for third, fourth, and fifth grade students at the local school.

$H_{3a}$: There is a difference between *A Language for Learning* and *Write from the Beginning…and Beyond* extended writing scores for third, fourth, and fifth grade students at the local school.

4. Is there a difference in grammar and usage scores for third, fourth, and fifth grade students prior to implementation of the writing program *A Language for Learning* and *Write from the Beginning…and Beyond* and after program implementation?

$H_{4o}$: There is no difference between *A Language for Learning* and *Write from the Beginning…and Beyond* grammar and usage scores for third, fourth, and fifth grade students at the local school.

$H_{4a}$: There is a difference between *A Language for Learning* and *Write from the Beginning…and Beyond* grammar and usage scores for third, fourth, and fifth grade students at the local school.

5. Is there a difference in mechanics scores for fourth and fifth grade students prior to implementation of the writing program *A Language for Learning* and *Write from the Beginning…and Beyond* and after program implementation?

$H_{5o}$: There is no difference between *A Language for Learning* and *Write from the Beginning…and Beyond* mechanics scores for fourth and fifth grade students at the local school.

$H_{5a}$: There is a difference between *A Language for Learning* and *Write from the Beginning…and Beyond* mechanics scores for fourth and fifth grade students at the local school.

## Review of the Literature

### Introduction

The purpose of this study was to learn whether implementation of a new writing program, *A Language for Learning* and *Write from the Beginning…and Beyond* improved state writing scores at the local school. The purpose of this section is to discuss the literature related to the study. This section begins with the theoretical framework related to the problem and moves to a review of the literature on explicit writing instruction, teacher and principal accountability in teaching of writing, and *A Language for Learning*. The review offers insight into the direct and explicit teaching and their characteristics. The literature review highlights accountability with respect to student achievement, accountability to teaching, and accountability to school principals. The last section of the review discusses the visual tools, called Thinking Maps, and research and case studies of their use.

To identify prospective, peer-reviewed articles and books, the following databases: Eric, Education Research Complete, and Teacher Reference Center were searched for the years 2012–2017 using the following keywords: writing, education, elementary education, Thinking Maps, *A Language for Learning, Write from the Beginning…and* Beyond, concept maps, constructivist theory, Bruner, David Hyerle, science, academic vocabulary, critical questions, and earth science. I used the Boolean operators, AND and OR to optimize the results. Abstracts were used to judge an article's relevancy to the research questions.

The literature review begins with the theoretic framework of the constructivist theorist Jerome Bruner. His views of child development and learning constructs are explained here. Explicit writing instruction is discussed next. Bruner's views link to explicit writing instruction in that curriculum is presented to students and they then construct their own meaning from this.

## Theoretical Framework

The constructivist theory of Jerome Bruner provides the foundation for this study. Bruner's theory links to child development research. This theory suggests learners construct knowledge for themselves (Hewing, 1991). The teacher provides problem-solving and inquiry-based learning activities. The students then draw conclusions and inferences, test their ideas, and communicate their understanding collaboratively.

The constructivist believes that instruction is based on four features. The first is that students possess a predisposition towards learning. Second, knowledge must be structured so that the learner grasps it. Third, the material must be presented effectively and in sequence. Last, consideration of the nature and pacing of rewards and punishments is necessary.

Walker (2013) states that the constructivist approach to learning first starts with a large or general concept. This broad topic is then broken down into manageable themes. Hewing (1991) states that constructivist theorists believe that learners construct knowledge for themselves, learning is about engaging the mind, learning involves language, and learning is social and uses conversation. Steiner (2014) states that “learners construct meanings in their minds and integrate new knowledge into their mental constructs” (p. 319) and affirms that students hold possession of their learning.

Learning is based on mental processes in which the learner organizes experiences to gain meaning (“Bruner’s Theory on Constructivism,” 2014). This article also states that students take past knowledge and experiences and organize them to make sense of what they know. Teachers, in turn, must be explicit in how to organize these experiences.

As with constructivism, students who use Thinking Maps are actively involved in creating meaning through visual representations. Students interact with ideas rather than memorize facts and figures. Thinking Maps provide concrete images for abstract thought, organize information from whole to part, and allow students to show and own their thinking.

## Explicit Writing Instruction

According to the National Center for Educational Statistics (2014) and the National Center for Educational Progress (2007), four of five American students are not proficient writers. Writing scores on the most recent NAEP for children in the United

States show that a mere one-third of students accomplished proficient or advanced. These results illustrate the need for a change in current writing practices. The Alliance for Excellent Education proposes three successful instructional practices: (a) explicit teaching of writing strategies, (b) explicit and systematic instruction of summary writing, and (c) students jointly planning, drafting, revising, and editing their writing.

Graham et al. (2012) provided four recommendations for writing improvement: (a) devote a minimum of one hour per day to writing, (b) instruct students on the writing process and the various types of writing, (c) help students to develop fluency in sentence construction, keyboarding, and spelling, and (d) build a classroom of engaged of writers. The second recommendation, teaching students the processes of writing and to write for a range of audiences, includes the idea that individual steps of the writing process: planning, drafting, revising and editing, and publishing be explicitly taught, followed by a gradual release of accountability to the student. The authors recommend 30 minutes should be devoted to direct teacher instruction of writing strategies, techniques, and skills and 30 minutes of writing practice in which the students apply the skills, strategies, and techniques taught. Gilbert and Graham (2010) not only support increasing the amount of time spent on instruction but also on explicitly teaching writing skills and strategies.

Early writing achievement positively correlates with later writing achievement: Writing is a cumulative process. Graham, Harris, and Mason (2005) stated that it is essential to identify effective instructional processes for beginning writers. They also state it is key to single out effective writing practices for children in poor urban locations.

These researchers found explicit writing instruction to have a positive effect on student writing success.

Dunn and Finley (2010) also promote direct instruction of writing through a step by step format to help struggling writers. Correnti, Matsumura, Hamilton and Wang (2012) recommend that students need explicit instruction on specific genres of writing while Brunstein and Glaser (2011) found that strategic planning significantly correlates with the quality of written expression.

A meta-analysis by Graham and Perin (2007) showed that strategy instruction had a large effect size on writing for adolescents. Rogers and Graham (2008) also found that strategy instruction for planning and drafting has a positive impact on student writing. Danoff, Harris and Graham (1993) observed that writing programs which incorporate direct writing instruction and practice result in writing improvement. Regan and Berkeley (2012) found that modeling writing instruction specifically and explicitly had a positive effect on student writing. They state that instruction should focus on why to use a particular writing strategy, and then model how and when to use the strategy.

Sims (2001) suggested that low writing scores by students were the result of inconsistencies by the classroom teacher. These inconsistencies include lack of teacher modeling, the lack integrating writing into daily instruction, and providing insufficient direct writing instruction. This author states that these inconsistencies influence the writing performance by students at the school under study. Pressley, Wharton-McDonald, Mistretta-Hampston, and Echevarria (1998) found that teachers who modeled writing for their students had students who produced better writing.

The emphasis of the writing process makes provides writing quality. Marri, Wharton-McDonald, Mistretta-Hampton and Echevarria (2011) explain that teachers explicitly show students what skilled writers do through the sequence of writing: planning, drafting, revising, and editing. The writing process is taught through teacher explanation, teacher modeling, guided practice, and finally, students practicing independently.

Isaacson (2004) examined writing standards and state assessment results across the United States. He found a link between students' achievement in writing to the following teaching practices: making available frequent occasions to write, emphasis on the process of writing, teachers, clearly stating the specific criteria of successful writing, teaching writing strategies step by step, and modeling each step of the writing process. Wharton-McDonald, Pressley, and Mistretta-Hamptom (1997) examined the teaching practices of first grade teachers in four suburban school districts. Collective practices of teachers whose students were skilled writers included teaching the writing process, daily writing, and explicit instruction in writing strategies.

Graham et al. (2012) measured the beliefs about the role of explicit writing instruction. They found that teachers valued explicit instruction alongside natural learning. White and Bruning (2005) also found similar ideas in their research: Writing beliefs affect writing ability.

## Accountability

Teachers at the local school have had free rein of instructional practices during the 2009-2013 school years. No two classrooms used the same writing program, and in some classrooms, there was no writing instruction at all. Reasons for this include a lack of resources, lack understanding how to teach writing, and most importantly a lack of accountability to administrators of the school.

Administrators must know what constitutes excellent teaching and reinforce the agreed upon vision of what stands as quality teaching. McCann, Jones, and Aronoff (2010) state that administrators “must enter the classrooms to observe instructional truths in their buildings.”(p. 66). Teachers need to teach and teach well for students to reach high levels of achievement, including writing achievement.

The role of principal leadership is to shape internal processes, climate, relationships, and to ensure sufficient and appropriate resources. Principals must monitor student and teacher performance (Finnigan, 2010). Leithwood, Steinbach, and Jantzi (2002) state that school leaders need to provide a sense of direction. A shared vision, trust and respect, and a sense of purpose between staff and principal are required.

Weathers (2011) suggests that principals need to encourage a sense of mutual accountability for improving student achievement. Actions by the principal that have a positive effect are communicating expectations, recognizing teacher efforts, and community building among teachers. Leadership is at the center of accountability. A strong leader has a pervasive physical presence, is accessible, shares leadership duties, promotes conversations about teaching and learning and provides classroom support. Actual behaviors by principals are more important than the defined role of the principal. Leadership activities, in which the principal actively participates with teachers in improving instruction, is necessary.

To guarantee fidelity when implementing new strategies or initiatives, it is critical these strategies or initiative be monitored closely. Evidence of the efficacy of these strategies or initiatives be collected. Evidence should be gathered for every student and teacher, and be aligned vertically and horizontally throughout the grade levels (National High School Center at the American Institutes for Research, 2012). Shared responsibility and accountability among teachers, administrators, and students are crucial according to Sharratt and Fullan (2013).

Effective supervision by principals includes encouraging innovation and experimentation and risk taking. Teachers of classrooms who are not performing should be held accountable through supportive supervisory help and training (U.S. Department of Health, Education, & Welfare, 1966). Teachers state that data and accountability systems support their effectiveness. Standards, assessment, and data go hand in hand with accountability. Coaching, collaboration, and professional judgment also supports this idea (Gallagher, 2012). Professional development and support can help improve teacher effectiveness (Stoelinga, 2011).

Higher performing education systems have professional cultures that encourage behaviors directed toward organizational goals, have strong collective pressure to improve performance and achieve goals, and have supports for teachers to improve skills (Levin, 2012). Effective principals use data to design and implement staff development, offer their support and provide resources, and select programs that will positively affect student achievement (Mott, Moore & Shannon, 2010).

Bright (2011) synthesized the behaviors of top-performing teachers. Teachers recognize the function of a school is not just academic performance but to help students do well in life. They acknowledge that instruction is a performance in which teachers use strategies to improve instructional delivery by preparing for class, moving throughout each lesson (non-stop motion), and use proximity control. Top-performing teachers have personal accountability, rather than placing blame or making excuses. They know that results are valuable, make learning tasks doable and important, and have a continued focus on instructional improvement.

## Thinking Maps

Thinking Maps are a set of eight graphic organizers that document students' thinking abilities. Each map supports a particular thought process: qualifying, sequencing, comparing and contrasting, and classifying. Thinking Maps were developed in 1988 by David Hyerle. Their purpose is to provide a common visual language. They include eight graphic starter patterns, each based on a fundamental thinking skill. The maps may be used separately, or they may be used together. They may also be used across disciplines as well as for specific content tasks. The eight maps are as follows: a Circle Map which is used to generate information about a topic, a Bubble Map which is used to describe characteristics, qualities, and attributes, a Double Bubble Map which is used to compare and contrast, a Tree Map which is used for classification, a Brace Map which is used for spatial reasoning, such as part-to-whole relationships, a Flow Map which is used for ordering and sequencing, a Multi-Flow Map which links causes and effect, and a Bridge Map which shows analogies. Thinking Maps assess how and what students are thinking, they become a graphic of student cognition. The maps allow teachers to gather informal and formal information about students. They are flexible and allow for a broad range of responses (*A Language for Learning*, 2013).

Hyerle (2000), the creator Thinking Maps, suggests that teaching has historically been in a linear format, but that subject matter is nonlinear. This linear format resulted in a mismatch of effectiveness. Linear thinking prevents us from understanding patterns while learning and that patterns must be mapped. Hyerle (2000) states that interdependent relationships and patterns are important in teaching and learning today. Brain-based learning experts state that the brain continuously self-organizes and recreates organizational patterns. In other words, the brain is a pattern detector. As humans, we use our visual modality more than auditory or kinesthetic: Eighty to 90% of the information we receive is through visual means. Information processing occurs in three major stages; paying attention, building meaning, and extending meaning. Understanding is to accumulate and link information in long-term memory. Visual tools help students process and make sense of abstract information. Visual tools show and communicate patterns of thinking.

Hyerle (2000) states there are three types of processing maps for thinking. The first are brainstorming webs. These webs are used for thinking outside the box. They are open-ended and help to move thinking from the generation of ideas to the organization of ideas, to finally, a transformation of ideas and concepts. The second are graphic task specific organizers. These organizers are used to think inside the box. They help students to approach a task, organize ideas, and stay focused. These tools are often sequential. The last type is thinking process mapping for thinking about the box. They focus the learner's attention on their thinking; they are used to compare and contrast information, to classify information, and to show cause and effect. They help to see the overall picture.

Research has shown that nonlinguistic representations are beneficial to teacher instruction and beneficial for student learning. Nonlinguistic representations positively impact writing among all discipline areas (Hyerle and Williams, 2009). Thinking Maps allow students to construct their maps of learning. The developer states there are five qualities of Thinking Maps which transfer theory into practice. They provide visual consistency, the maps are flexible, they are developmental, maps may be used at one time and integrated across the curriculum, and they are reflective in that learners can assess how they are thinking. The maps lead to complex higher order thinking and are displays of metacognition. Thinking Maps will also lead to teacher accountability. Student work will become a visual display and administration can see that teachers are teaching writing.

Brooks (2005) states that pattern finding and relationships among parts of a concept are gaining importance in research. Thinking Maps are used to create awareness of knowledge stored in our brains and for fostering novel ideas. Thinking Maps are founded on the theory that fundamental cognitive skills can be represented through visual mapping. Case studies reveal that content recall, the ability to communicate abstract concepts, and transfer of thinking processes are all improved through the use of visual mapping.

Spiegel (2003) shares that the use of Thinking Maps in her school helped students think at higher levels and they were used to assess student thinking. A school on the east coast who also uses Thinking Maps, state they had an overall improvement in state test scores in writing (Burden & Silver, 2006). Ten students passed and 33 students failed the writing assessment in the fall of 2001. Thinking Maps were introduced in this school during the fall of 2002. At the end of the 2002-2003 school year, 28 students passed the writing assessment, and 13 students failed.

Three case studies of Thinking Maps are presented next. A 2009 case study by Steel (2009) found there was an absence of school focus on thinking and metacognition. Because of this, Thinking Maps were implemented at the local school. Anecdotal evidence shows the quality of essay writing was at least 10% higher for students who used Thinking Maps versus students who did not. The school found that students were provided opportunities to visualize and communicate their thinking at higher levels and that students were developing a common thinking language. Students, in turn, perceived themselves as learners and problem solvers and that problem-solving is the key to their learning progress. The staff stated that Thinking Maps enhanced their effectiveness, produced higher order thinking skills, improved essay writing, and improved student outcomes in writing achievement.

The second case study by Wenke (2009) showed student improvement in writing on a 5-point scale. The average score for students during the 2006-2007 school year were 1.8 on the 5-point scale. After implementing Thinking Maps during the 2007-2008 school year, scores increased to 2.5 on the 5-point scale. Pre-data of instruction suggested that teachers were instructing their students at the knowledge and comprehension levels of Bloom’s Taxonomy. After the implementation of Thinking Maps, data showed that the staff communicated more effectively within and across grade levels and used higher levels of thinking from Bloom’s Taxonomy. Their data also showed that after the first year of implementation, all language arts scores, including writing, increased with the exception of ELLs in second grade. After the second year of implementation, the school’s state test scores improved for all grade levels and on all academic content assessed.

In the third case study, led by Marzano, Gaddy, and Dean (2000), nine strategies are identified for improving instruction. Marzano believes that these strategies are most likely to increase student achievement. “These strategies are identifying similarities and differences, summarizing and note taking, links between effort and achievement, homework and practice, nonlinguistic representation, cooperative learning, objectives and feedback, generating and testing hypotheses, and cues, questions and advanced organizers” (p. 1), all of which can be addressed using Thinking Maps.

At a presentation at the 13th Annual Administrators Conference, Principal Stephanie Holzman spoke about the use of Thinking Maps at her school. She agrees with Marzano’ that Thinking Maps be used for many of his identified effective instructional strategies. At the classroom level, they are easy for students to use, help differentiate instruction, are owned by students, can begin in kindergarten, can be used for assessment, and with any content area or at any grade level. School-wide, they correlate to state standards, provide a common language, and lead to reflective conversations. From an administrator’s view, Holzman (2004) says it is easy to assess student learning, content taught, whether learning is student-centered, if differentiation is occurring, and the kinds and levels of thinking taught.

Other researchers support the positive impact of Thinking Maps on writing achievement. Manning (2011) conducted a study of state writing assessments in the south. Results from 2002 to 2003, after one year of Thinking Maps, showed an increase from level 2.2 to 3.0 on a 4-point scale. From the 2002 school year to the 2003 school year, students receiving a Level 4 increased from two students to 40 students respectively. Mabie-Hicks (2006) confirmed that the use of Thinking Maps for a two-year period improved reading and language achievement. Ritchhart, Turner, and Hadar (2009) propose Thinking Maps as useful tools for capturing students' metacognition. They can also be used to reveal developmental differences and show changes in students' perceptions over time. Research by Long and Carlson (2011) suggests that creating visual representations is the most effective way for students to learn new concepts. In their study, they found that after implementation of Thinking Maps, students were able to associate previous knowledge to the material under current study, put thoughts onto paper, and see improvements in academic progress. Research by Weiss (2011) showed a 14% increase in essay scores after the implementation of Thinking Maps and a 45% growth in compare and contrast writing. Research by Gallagher (2011) indicated that using Thinking Maps improved the organization and clarity of writing. Students stated they had a better understanding of research writing.

## Implications

Little research has been conducted on the effectiveness of *A Language for Learning* and *Write from the Beginning…and Beyond*, additional research is necessary. The author of the program, Hyerle, conducts research and allows others to conduct research through his nonprofit organization The Thinking Foundation. Studies conducted for The Thinking Foundation have shown positive correlations between *A Language for Learning* and *Write from the Beginning…and Beyond* and writing achievement scores (The Thinking Foundation, 2014). Results from this study may contribute to the body of research on *A Language for Learning* and *Write from the Beginning…and Beyond*.

Outcomes of this study may also inform writing practices at the local school. It is possible that a positive correlation between the writing program under study and the effect on student achievement will lead to greater teacher accountability, a focus on explicit instruction, and consistent and sustained growth in writing.

*A Language for Learning* and *Write from the Beginning…and Beyond* were implemented in all elementary grades for the 2013-2014 school year. A positive correlation could also mean that the program is implemented in grades 6, 7, and 8. Students would be exposed to the same academic language, structures, and expectations in writing consistently from kindergarten through eighth grade.

Professional development opportunities could be provided for writing teachers at each of these grade levels. Workshop opportunities are provided for teachers by certified trainers of this writing program throughout the United States. Groups of teacher could attend the workshops and become trainers themselves. They could then come back to the local school and provide school-wide training. Principal partnership and buy-in are needed for training to be effective. Teacher accountability to the program and to administration is also necessary.

A longitudinal study to follow trends, patterns and growth should be conducted at the local school. One year of program implementation is not enough to determine success or failure. A future project study should also include qualitative data. Teacher observations and surveys would add more information to the existing data and increase the study's reliability and validity. Adding accountability structures for school administrators and documenting this data would also enhance the richness of the study. Ongoing monitoring of the program's implementation will be vital in determining its effect on student achievement.

## Summary

The purpose of this quantitative study was to investigate if a new writing program implemented at the local school improved student writing scores. Section 1 presented an introduction to the study that discussed the local problem and the rationale for choosing this problem, both at the local level as well as the national level. This section also presented specific terms associated with the local school and the writing program. The guiding research questions and implications for further practice are provided next. Section 1 ended with a review of the literature: theoretical framework, explicit teaching, and teacher and administrator accountability to writing, and Thinking Maps.

Section 2 includes the following topics:  research design, setting and sample, data collection and inferential analyses,  assumptions, limitations, scope and delimitations.

Section 3 discusses the rationale of the project study, the reviews of the literature and the subsections of the literature review: (a) academic vocabulary, science academic vocabulary, critical questions, and earth science. A description of the project follows.

Section 2: The Methodology

## Research Design and Approach

The purpose of this study was to see if there is a difference in writing achievement scores after implementation of *A Language for Learning* and *Write from the Beginning…and Beyond*. To determine if there is a difference in writing achievement scores, a between-groups, quasi-experimental design was used for the following five research questions:

1. Is there a difference between student writing scores prior to implementation of the writing program *A Language for Learning* and *Write from the Beginning…and Beyond* and after program implementation?

   $H_{1o}$: There is no difference between *A Language for Learning* and *Write from the Beginning…and Beyond* in terms of state writing achievement scores for students in grades three through five at the local school.

   $H_{1a}$: There is a difference between *A Language for Learning* and *Write from the Beginning…and Beyond* in terms of state writing achievement scores for students in grades three through five at the local school.

2. Is there is a difference in paragraph writing scores for third grade students prior to implementation of the writing program *A Language for Learning* and *Write from the Beginning…and Beyond* and after program implementation?

   $H_{2o}$: There is no difference between *A Language for Learning* and *Write from the Beginning…and Beyond* and paragraph writing scores for third grade students at the local school.

$H_{2a}$: There is a difference between *A Language for Learning* and *Write from the Beginning…and Beyond* and paragraph writing scores for third grade students at the local school.

3. Is there a difference in extended writing scores for third, fourth, and fifth grade students prior to implementation of the writing program *A Language for Learning* and *Write from the Beginning…and Beyond* and after program implementation?

$H_{3o}$: There is no difference between *A Language for Learning* and *Write from the Beginning…and Beyond* extended writing scores for third, fourth, and fifth grade students at the local school.

$H_{3a}$: There is a difference between *A Language for Learning* and *Write from the Beginning…and Beyond* extended writing scores for third, fourth, and fifth grade students at the local school.

4. Is there a difference in grammar and usage scores for third, fourth, and fifth grade students prior to implementation of the writing program *A Language for Learning* and *Write from the Beginning…and Beyond* and after program implementation?

$H_{4a}$: There is a difference between *A Language for Learning* and *Write from the Beginning…and Beyond* grammar and usage scores for third, fourth, and fifth grade students at the local school.

$H_{4o}$: There is no difference between *A Language for Learning* and *Write from the Beginning…and Beyond* grammar and usage scores for third, fourth, and fifth grade students at the local school

5. Is there a difference in mechanics scores for fourth and fifth grade students prior to implementation of the writing program *A Language for Learning* and *Write from the Beginning…and Beyond* and after program implementation?

$H_{5o}$: There is no difference between *A Language for Learning* and *Write from the Beginning…and Beyond* mechanics scores for fourth and fifth grade students at the local school.

$H_{5a}$: There is a difference between *A Language for Learning* and *Write from the Beginning…and Beyond* mechanics scores for fourth and fifth grade students at the local school.

Creswell (2012) states that a pre-test and posttest approach be applied to a quasi-experimental design. Creswell (2009) also states that quasi-experimental designs be used when participants are not randomly assigned to groups. The participants are usually entire groups which are available to the researcher. Lodico, Spaulding, and Voegtle (2010) also support the use of an experimental research design to determine whether one way of doing something is better than the previous way, using treatment conditions and treatment groups. According to Cohen, Manion, and Morrison (2003), quasi-experimental designs are often used in educational research where random selection of participants is not practical.

The research design derived from a review of current literature on *A Language for Learning* and *Write from the Beginning…and Beyond*. The literature, from research and case studies, show a positive difference between this writing program and writing achievement from pre to post assessment. Based on the literature review the independent variable was the writing program, *A Language for Learning* and *Write from the Beginning…and Beyond*. The dependent variable was writing assessment scores from the local state's writing assessment.

**Setting and Sample**

This study was led in a large urban school district in the southwest. This district has over 14,000 employees, of which over 5,000 are teachers. Enrollment in the district is approximately 84,400 students: 1% American Indian, 3% Asian, 15% Black, 58% Hispanic, 20% White, and 3% other. Seventy-two percent of all students in the district qualify for free or reduced lunch. One elementary school from this district was the focus of this study.

Nonrandom convenience sampling was used for this study. Creswell (2012) states that nonrandom convenience sampling is best used when a researcher selects participants because they are willing and available to be studied. Nonrandom convenience sampling is difficult to generalize to the entire population. It is not necessary for this researcher to generalize to the entire population. This study's results will only be generalized back to the teachers, administrators, and other interested staff at the local school. The intent is to determine if the new writing program has a positive effect on the local school's writing achievement scores. According to Lodico et al. (2010), generalizability is not usually an issue if results are used for individual schools or districts. This sampling method was selected for this reason: availability of assessment scores for one particular school building. Participants were students from the local school in grades three through five.

Though this type of sampling limited my study's generalizability, this sampling method answers my research questions and hypotheses.

The sample size was 172 students from grades three, four, and five. To determine if the sample size was adequate this researcher used Lipsey's (1990) power analysis table. The statistical level of significance used for this study was set at $p = .05$. This significance level is typical and rigorous according to Creswell (2012). A significance level of .05 shows that five out of 100 times the sample score is due to chance. A power of .80 was used. Cohen (1988) suggests using a power of .80 or greater to detect a medium effect size with an alpha level of .05. The effect size was set at .5, which is typical for educational research (Murphy & Moyers, 1998).

This study included students in third, fourth, and fifth grade from one school in a large urban school district in the southwest. These grade levels were selected for two reasons: These grade levels take the state writing assessment, and these grade levels implemented the new writing program, *A Language for Learning* and *Write from the Beginning…and Beyond*. All students in these grades and at the local school were eligible to participate in the study.

The characteristics of the students from the local school are different than those of the local school district. Student demographics for this school are 77% Hispanic, 13% White, 3% Black, 2% Asian, 1% American Indian, and 4% other. Eighty-one percent of the students from the local school receive free or reduced lunch. The percentage of students who qualified for free and reduced lunch was 83.5% during the 2013-2014 school year. The number of ELL students for the same year was 46%. The percentage of minority students was 81.5%, and the number Special Education students were 8.9%. The population for this study includes 59 third grade students, 54 fourth grade students, and 59 fifth grade students.

**Instrumentation and Materials**

Data collection came from one source: Transitional Colorado Assessment Program (TCAP). This pre-established instrument measures achievement in four content areas: reading, writing, math, and science. The Transitional Colorado Assessment Program is standards-based. This assessment was designed to show student performance and level in which they meet the Colorado Academic Standards. A collaborative effort by the Colorado Department of Education, Colorado educators, and CTB/McGraw-Hill were coordinated to develop TCAP and built around the knowledge that students should possess and perform at each level of their education. Student performance on TCAP is reported in four proficiency levels: Distinguished Command, Strong Command, Moderate Command, and Limited Command. Reliability and validity criteria of this assessment are discussed in a later section.

Student proficiency results from TCAP was obtained for each of the students in grades three, four, and five. This statewide assessment is standardized and requires students to use paper and pencil to determine achievement. This annual test measures performance of students as compared to the state’s content standards: Colorado Model Content Standards (CMCS). To ensure reliability and validity, these tests are timed and administrated under standardized conditions. Two writing sections are administered to students in grade three, and three sections of writing are administered to students in grades four and five.

An item response theory and item pattern scoring procedure are used to score students in three areas: total test score, content standard score, and sub-content area score. This process produces scale scores based on student response patterns. “Pattern scoring based on time response theory produces more accurate scores, better test information, and less measurement error, and greater reliability than number correct scoring” (CTB/McGraw-Hill, 2013, p. 18). For purposes of this study, total test scores were used to compute an analysis of variance (ANOVA).

CTB/McGraw-Hill conducted validity and reliability measures for TCAP. Constructed response items from 300 to 1000 written responses were reviewed by CTB/McGraw-Hill’s hand scoring supervisors. Proficient responses were selected by the scoring supervisors. The responses selected were typical of the varying levels of proficiencies and ideas that were being measured.

Scorers were given instruction and were supervised to develop hand scoring accuracy and reliability. Rater reliability indices were produced and analyzed. Reliability for constructed responses was examined by calculating indices of interrater agreement. Inter-rater reliability was assured by a blind double read. A second reader, not aware this was the second read, was selected at random to read about 5% of students writing. Results of interrater reliability were high: Agreement ranged from 90.8% to 100%.

Rater severity and leniency have been conducted across years by CTB/McGraw Hill (2013). Rater severity and leniency have been done to determine scores assigned by raters that are consistently higher or lower than those ideal, objective, and unbiased raters. Items from a random sample of approximately 1000 students were selected and distributed blindly to the 2013 raters. The weighted Kappa ranged between 0.07 and 0.80. The median value was 0.70.

Students took the state assessment, TCAP, in their homeroom classroom. Teachers administered the assessment in a standardized environment. The assessment required students to answer multiple choice items, perform an editing task, write a short constructed response, and write an extended essay. Third grade students took two 60 minute sessions of the writing assessment, while fourth and fifth grade students had three 60 minute sessions.

The purpose of this study was to see if there is a difference in writing achievement scores after implementation of *A Language for Learning* and *Write from the Beginning…and Beyond*. To determine if there is a difference in writing achievement scores it is appropriate to use quantitative research methods. Specifically, a between-groups, quasi-experimental design was appropriate for the research questions:

Creswell (2012) states that a pre and posttest approach can be applied to a quasi-experimental design. Creswell (2009) also states that quasi-experimental designs are used to when participants are not randomly assigned to groups. The participants are usually whole groups which are available to the researcher. Lodico et al. (2006), also support the use of an experimental research design to determine whether one way of doing something is better than the previous way using treatment conditions and treatment groups.

According to Cohen et al. (2003), quasi-experimental designs are often used in educational research where random selection of participants is not practical.

The research design derived from a review of current literature on *A Language for Learning* and *Write from the Beginning…and Beyond*. The literature, from research and case studies, show a positive difference between this writing program and writing achievement from pre to post assessment. Based on the literature review the independent variable was the writing program, *A Language for Learning* and *Write from the Beginning…and Beyond*. The dependent variable was writing assessment scores from the local state's writing assessment.

**Data Analysis Results**

Data from 50 third grade students, 57 fourth grade students and 57 fifth grade students were gathered for the 2012-2013 school year. Table 4 shows the frequencies and percentages of students by grade level and writing sub-category. Number and percentage are relatively equal among the three grade levels for the 2012-2013 school year. Note that third grade data is missing for mechanics. Students in third grade are not assessed on this skill.

Table 4

*Demographics of a Sample of Third, Fourth, and Fifth Grade Students for the 2012-2013 School Year*

| Characteristic | *N* | % |
|---|---|---|
| Paragraph Writing | | |
| Third grade | 50 | 30.5 |
| Fourth grade | 57 | 34.8 |
| Fifth grade | 57 | 34.8 |
| Extended Writing | | |
| Third grade | 50 | 30.5 |
| Fourth grade | 57 | 34.8 |
| Fifth grade | 57 | 34.8 |
| Grammar and Usage | | |
| Third grade | 50 | 30.5 |
| Fourth grade | 57 | 34.8 |
| Fifth grade | 57 | 34.8 |
| Mechanics | | |
| Third grade | 0 | 0 |
| Fourth grade | 57 | 50 |
| Fifth grade | 57 | 50 |

Data from 56 third grade students, 50 fourth grade students and 53 fifth grade students were also gathered for the 2013-2014 school year. Table 5 shows the frequencies and percentages of students by grade level and writing sub-category. Again, number and percentages are relatively equal for the three grade levels. Note that third grade data is missing for mechanics. Students in third grade are not assessed on this skill.

Table 5

*Demographics of a Sample of Third, Fourth, and Fifth Grade Students for the 2013-2014 School Year*

| Characteristic | *N* | % |
|---|---|---|
| Paragraph Writing | | |
| Third grade | 56 | 35.2 |
| Fourth grade | 50 | 31.4 |
| Fifth grade | 53 | 33.3 |
| Extended Writing | | |
| Third grade | 56 | 35.2 |
| Fourth grade | 50 | 31.4 |
| Fifth grade | 53 | 33.3 |
| Grammar and Usage | | |
| Third grade | 56 | 35.2 |
| Fourth grade | 50 | 31.4 |
| Fifth grade | 53 | 33.3 |
| Mechanics | | |
| Third grade | 0 | 0 |

| | | |
|---|---|---|
| Fourth grade | 50 | 49 |
| Fifth grade | 53 | 51 |

Means, standard deviations, and skewness of the 12 key variables for the 2012-2013 school year are shown in Table 6. Fifth grade achievement test scores vary widely in means in paragraph writing, extended writing, and grammar and usage. Standard deviations also vary between grade levels, with the exception of grammar and usage. Assumptions of normality are assumed for all grades in paragraph writing, for third grade extended writing, and fourth and fifth grade mechanics. The assumption of normality has been violated in all other assessment areas and all other grades. Because ANOVA is robust, it can be used when variance are approximately equal if the number of subjects in each group is approximately equal (Morgan, Leech, Gloeckner, & Barrett, 2011).

Table 6

*Means, Standard Deviations, and Skewness of Third, Fourth, and Fifth Grade Students' Writing Scores for the 2012-2013 School Year*

| Characteristic | *M* | *SD* | Skewness |
|---|---|---|---|
| Paragraph Writing | | | |
| Third grade | 423.22 | 36.03 | 0.74 |
| Fourth grade | 442.09 | 64.50 | -0.69 |
| Fifth grade | 493.79 | 54.66 | 0.08 |
| Extended Writing | | | |
| Third grade | 443.54 | 81.17 | 0.37 |
| Fourth grade | 467.46 | 78.74 | 1.77 |

| | | | |
|---|---|---|---|
| Fifth grade | 541.11 | 130.31 | 1.12 |
| Grammar and Usage | | | |
| Third grade | 420.18 | 75.76 | -1.91 |
| Fourth grade | 466.23 | 73.76 | 1.52 |
| Fifth grade | 495.77 | 86.19 | 1.35 |
| Mechanics | | | |
| Third grade | 0.00 | 0.00 | 0.00 |
| Fourth grade | 470.53 | 100.60 | -0.22 |
| Fifth grade | 488.30 | 47.00 | -0.21 |

Means, standard deviations, and skewness of the12 key variables for the 2013-2014 school year are shown in Table 7. Fifth grade achievement test scores vary widely from third and fourth grade in all achievement tests. Fifth grade standard deviations also vary widely from third and fourth grade in extended writing and mechanics. Assumptions of normality are assumed for third and fifth grade in paragraph writing, for fourth grade extended writing, third grade grammar and usage, and fourth and fifth grade mechanics. The assumption of normality has been violated in all other assessment areas and all other grades. Because ANOVA is robust, it can be used when variance are approximately equal if the number of subjects in each group is approximately equal Morgan et al. (2011).

Table 7

*Means, Standard Deviations, and Skewness of Third, Fourth, and Fifth Grade Students Writing Scores for the 2013-2014 School Year*

| Characteristic | *M* | *SD* | Skewness |
|---|---|---|---|
| Paragraph Writing | | | |
| Third grade | 430.05 | 51.26 | -.51 |
| Fourth grade | 437.16 | 67.63 | -1.02 |
| Fifth grade | 502.32 | 61.69 | -.27 |
| Extended Writing | | | |
| Third grade | 465.27 | 83.00 | 1.71 |
| Fourth grade | 455.14 | 83.62 | .69 |
| Fifth grade | 535.98 | 117.90 | 1.35 |
| Grammar and Usage | | | |
| Third grade | 450.52 | 68.82 | .96 |
| Fourth grade | 444.26 | 59.43 | -1.58 |
| Fifth grade | 498.47 | 62.90 | 1.40 |
| Mechanics | | | |
| Third grade | 0.00 | 0.00 | 0.00 |
| Fourth grade | 441.76 | 77.80 | -.30 |
| Fifth grade | 528.81 | 113.00 | 1.00 |

**Analysis**

Research questions and null and alternative hypotheses are presented in this section. Each is accompanied by a description of the findings, rejection or acceptance of the null hypotheses, and tables that highlight the findings.

To assess whether school year and grade level each seems to have an effect on writing achievement scores after the implementation of *A Language for Learning* and *Write from the Beginning…and Beyond* a single factor ANOVA was computed. Table 8 shows the overall *F* scores and significance levels of grade level and each of the writing achievement subtests. A statistically significant difference was found among the three grade levels and paragraph writing, $F$ (2, 471) = 57.51, $p$ = .000, among the three grade levels and extended writing, $F$ (2, 471) = 34.70, $p$ = .000, among the three grade levels and grammar and usage, $F$ (2, 471) = 30.42, $p$ = .000, and among two grade levels and mechanics, $F$ (1, 317) = 34.93, $p$ = .000, third grade is not tested on mechanics. There was no statistical significance among the school year and sub-tests of the writing achievement test. Based on these results, I can reject the null hypothesis of no difference between *A Language for Learning* and *Write from the Beginning…and Beyond* and writing achievement scores for third, fourth, and fifth grade students at the local school and accept the alternative hypothesis.

Table 8

*One-Way Analysis of Variance Summary Table Comparing Grade Level on Paragraph Writing, Extended Writing, Grammar and Usage, and Mechanics*

| Source | *Df* | SS | *MS* | *F* | *P* |
|---|---|---|---|---|---|
| Paragraph Writing | | | | | |
| Between groups | 2 | 364915.48 | 182457.74 | 57.51 | .000 |
| Within groups | 471 | 1494261.93 | 3172.53 | | |
| Total | 473 | 1859177.41 | | | |
| Grammar and Usage | | | | | |
| Between groups | 2 | 268551.27 | 134275.63 | 30.42 | .000 |
| Within groups | 471 | 2078969.82 | 4413.95 | | |
| Total | 473 | 2347521.08 | | | |

Table 9

*Means and Standard Deviations Comparing Three Grade Levels*

| | *n* | *M* | *SD* | *M* | *SD* | *M,* | *SD* | *n,* | *M,* | *SD* |
|---|---|---|---|---|---|---|---|---|---|---|
| Grade Level | | | | | | | | | | |
| Third grade | 155 | 430.76 | 50.68 | 457.19 | 82.69 | 442.09 | 68.40 | 0 | | |
| Fourth grade | 155 | 447.47 | 60.46 | 462.57 | 70.52 | 458.06 | 60.96 | 155 | 455.86 | 83.87 |
| Fifth grade | 164 | 495.69 | 57.34 | 534.98 | 118.83 | 498.24 | 69.38 | 164 | 514.59 | 94.06 |

## Analysis of Variance and Paragraph Writing

To assess whether school year and grade level each seems to have an effect on paragraph writing achievement, a two-way ANOVA was conducted. Table 10 shows the means and standard deviations for paragraph writing achievement for school year and grade level. Table 11 shows that there was not a significant interaction between the school year and grade level on paragraph writing achievement ($p$ = .167). Also, there was not a significant effect of school year on paragraph writing achievement ($p$ = .154). The main effect of grade level on paragraph writing achievement, $F$ (4, 474) = 57.64, $p$ < .001 was significant as shown in Table 11. Eta for grade level was about .45, which, according to Cohen (1988), is a large effect. Based on these results, I can reject the null hypothesis of no difference between *A Language for Learning* and *Write from the Beginning…and Beyond* and paragraph writing scores for third, fourth, and fifth grade students at the local school and accept the alternative hypothesis.

Table 10

*Means, Standard Deviations, and n for Paragraph Writing Achievement as a Function of Grade Level and School Year*

| | Third Grade | | | Fourth Grade | | | Fifth Grade | | |
|---|---|---|---|---|---|---|---|---|---|
| Year | *n* | *M* | *SD* | *n* | *M* | *SD* | *n* | *M* | *SD* |
| 2012 | 49 | 439.27 | 61.41 | 48 | 464.60 | 42.47 | 54 | 491.19 | 56.14 |
| 2013 | 50 | 423.22 | 36.03 | 57 | 442.09 | 64.49 | 57 | 493.79 | 54.66 |
| 2014 | 56 | 430.05 | 51.26 | 50 | 437.16 | 67.63 | 53 | 502.32 | 61.69 |
| Total | 155 | 430.76 | 50.58 | 155 | 447.47 | 60.46 | 164 | 495.69 | 57.34 |

Table 11

*Analysis of Variance for Paragraph Writing Achievement as a Function of Year and Grade Level*

| Variable and source | *Df* | *MS* | *F* | *P* | $\eta^2$ |
|---|---|---|---|---|---|
| Year | 2 | 5900.50 | 1.88 | .154 | .008 |
| Grade | 2 | 181359.50 | 57.64 | .000 | .199 |
| Year x grade | 4 | 5111.10 | 1.62 | .167 | .014 |

To determine which specific means were different a post hoc Games-Howell was computed. Games-Howell was selected because the assumption of equal variances was violated. There was a significant mean difference on paragraph writing achievement between third and fourth grade, ($p$ = .024, $d$ = .95) and between fourth and fifth grade ($p$ = .000, $d$ = .82).

To assess whether school year and grade level each seems to have an effect on extended writing achievement, a two-way ANOVA was conducted. Table 12 shows the means and standard deviations for extended writing achievement for school year and grade level. Table 13 shows that there was not a significant interaction between the school year and grade level on extended writing achievement ($p$ = .618). Also, there was not a significant effect of the school year on extended writing achievement (p = .991). There was, however, a significant main effect of grade level on extended writing achievement, $F$ (4, 474) = 34.51, $p$ < .001 as shown in Table 15. Eta for grade level was about .36, which, according to Cohen (1988), is a large effect. Based on these results, I can reject the null hypothesis of no difference between *A Language for Learning* and

*Write from the Beginning…and Beyond* and extended writing scores for third, fourth, and fifth grade students at the local school and accept the alternative hypothesis.

Table 12

*Means, Standard Deviations, and n for Extended Writing Achievement as a Function of Grade Level and School Year*
*r*

| | Third Grade | | | Fourth Grade | | | Fifth Grade | | |
|---|---|---|---|---|---|---|---|---|---|
| School Year | *n* | *M* | *SD* | *n* | *M* | *SD* | *n* | *M* | *SD* |
| 2012 | 49 | 461.90 | 83.82 | 48 | 464.50 | 39.10 | 54 | 527.52 | 108.38 |
| 2013 | 50 | 443.54 | 81.17 | 57 | 467.46 | 78.74 | 57 | 541.11 | 130.31 |
| 2014 | 56 | 465.27 | 83.00 | 50 | 455.14 | 83.62 | 53 | 535.98 | 117.90 |
| Total | 155 | 445.19 | 82.69 | 155 | 462.57 | 70.52 | 164 | 534.98 | 118.83 |

Table 13

*Analysis of Variance for Extended Writing Achievement as a Function of Year and Grade Level*

| Variable and source | *Df* | *MS* | *F* | *P* | $\eta^2$ |
|---|---|---|---|---|---|
| Year | 2 | 82.71 | .009 | .991 | .000 |
| Grade | 2 | 304072.66 | 34.51 | .000 | .129 |
| Year x grade | 4 | 5845.25 | .663 | .618 | .006 |

To determine which specific means were different a post hoc Games-Howell was computed. Games-Howell was selected because the assumption of equal variances was violated. There was a significant mean difference in extended writing achievement between fourth and fifth grade ($p$ = .000, $d$ = .74)

**Analysis of Variance and Grammar and Usage**

To assess whether school year and grade level each seems to have an effect on grammar and usage writing achievement, a two-way ANOVA was conducted. Table 14 shows the means and standard deviations for grammar and usage achievement for school year and grade level. Table 15 shows that there was not a significant interaction between the school year and grade level on grammar and usage achievement ($p = .055$). Also, there was not a significant effect of the school year on grammar and usage achievement (p = .262). There was, however, a significant main effect of grade level on grammar and usage achievement, $F$ (4, 474) = 31.01, $p < .001$ as shown in Table 9.1. Eta for grade level was about .34, which, according to Cohen (1988), is a large effect. Based on these results, I can reject the null hypothesis of no difference between *A Language for Learning* and *Write from the Beginning…and Beyond* and grammar and usage scores for third, fourth, and fifth grade students at the local school and accept the alternative hypothesis.

Table 14

*Means, Standard Deviations, and n for Grammar and Usage Achievement as a Function of Grade Level and School Year*

| | Third Grade | | | Fourth Grade | | | Fifth Grade | | |
|---|---|---|---|---|---|---|---|---|---|
| School Year | *n* | *M* | *SD* | *n* | *M* | *SD* | *n* | *M* | *SD* |
| 2012 | 49 | 454.82 | 54.87 | 48 | 462.75 | 41.32 | 54 | 500.61 | 55.30 |
| 2013 | 50 | 420.18 | 75.76 | 57 | 466.23 | 73.76 | 57 | 495.77 | 86.19 |
| 2014 | 56 | 450.52 | 68.82 | 50 | 444.26 | 59.43 | 53 | 498.47 | 62.90 |
| Total | 155 | 442.09 | 68.48 | 155 | 458.06 | 60.96 | 164 | 498.24 | 69.38 |

Table 15

*Analysis of Variance for Grammar and Usage Achievement as a Function of Year and Grade Level*

| Variable and source | *Df* | *MS* | *F* | *P* | $\eta^2$ |
|---|---|---|---|---|---|
| Year | 2 | 5866.31 | 1.35 | .262 | .006 |
| Grade | 2 | 135642.81 | 31.10 | .000 | .118 |
| Year x grade | 4 | 10185.02 | 2.34 | .055 | .020 |

To determine which specific means were different a post hoc Games-Howell was computed. Games-Howell was selected because the assumption of equal variances was violated. There was a significant mean difference between grammar and usage achievement between fourth and fifth grade ($p = .000$, $d = .86$).

**Analysis of Variance and Mechanics**

To assess whether school year and grade level each seems to have an effect on mechanics achievement, a two-way ANOVA was conducted. Table 16 shows the means and standard deviations for mechanics achievement for school year and grade level. Please note that third grade is not tested on this skill. Table 17 shows there was not a significant effect of the school year on grammar and usage achievement ($p = .642$). There was, however, a significant interaction between school year and grade level on mechanics achievement, $F$ (2, 319) = 4.83, $p < .001$, as shown in Table 16  Eta for year and grade level was about .17, which, according to Cohen (1988), is a small effect size. There also was a significant main effect of grade level on mechanics achievement, $F$ (2, 319) =

36.67, $p < .001$ as shown in Table 17. Eta for grade level was about .32, which, according to Cohen (1988), is a medium to large effect. Based on these results, I can reject the null hypothesis of no difference between *A Language for Learning* and *Write from the Beginning…and Beyond* and mechanic scores for fourth and fifth grade students at the local school and accept the alternative hypothesis.

Table 16

*Means, Standard Deviations, and n for Mechanics Achievement as a Function of Grade Level and School Year*

| | Fourth Grade | | | Fifth Grade | | |
|---|---|---|---|---|---|---|
| School Year | *n* | *M* | *SD* | *n* | *M* | *SD* |
| 2012 | 48 | 453.15 | 64.78 | 54 | 528.37 | 105.87 |
| 2013 | 57 | 470.53 | 100.61 | 57 | 488.30 | 47.00 |
| 2014 | 50 | 441.76 | 77.80 | 53 | 486.66 | 106.43 |
| Total | 155 | 455.86 | 83.87 | 164 | 514.59 | 94.06 |

Table 17

*Analysis of Variance for Mechanics as a Function of Year and Grade Level*

| Variable and source | *Df* | *MS* | *F* | *P* | $\eta^2$ |
|---|---|---|---|---|---|
| Year | 2 | 3468.20 | .444 | .642 | .003 |
| Grade | 1 | 286099.39 | 36.67 | .000 | .118 |
| Year x grade | 2 | 37678.02 | 4.83 | .009 | .030 |

**Summary of Results**

One hundred and fifty-five students' writing achievement scores comprised the data for this study. I received writing scores for third, fourth, and fifth grade for 2012, 2013, and 2014 school years. I conducted factorial ANOVAs to determine whether the writing program *A Language for Learning* and *Write from the Beginning…and Beyond* had an effect on each of the test areas: paragraph writing, extended writing, grammar and usage, and mechanics. Significant differences were found between grade levels in all of the writing achievement subtests. No significant differences were found between the school year and grade level while one significant difference was found between the function of school year and grade level on mechanics achievement.

Students at the local school in third, fourth, and fifth grade have had declining writing achievement scores as determined by the state's yearly writing assessment. Schools that do not meet the districts' and states' annual yearly progress expectations face restructuring or closure. Restructuring of the school would mean hiring new administrators, and all teaching staff would need to reapply for their job. The closing of the school would be devastating for the neighborhood students who would then need to attend a school much further away. Because of declining test scores in writing and the possibility of restructuring or closure, staff and administrators at the local school saw a need to focus on improving writing achievement. A decision was made to choose a single writing program that would be implemented in grades K-5. The writing program selected was *A Language for Learning* and *Write from the Beginning…and Beyond*.

Section 1 of this study reveals that the local school had declining writing scores from the 2009 school year to the 2013 school year. Collective writing scores for third, fourth, and fifth grade students were 41% during the 2009-2010 school year, 40% during the 2010-2011 school year, 37% during the 2011-2012 school year, 27% during the 2012-2013 school year, and finally, 27% during the 2013-2014 school year. These declining scores prompted the five questions to be answered during this study. Section 1 also includes the literature review related to Jerome Bruner's theoretical framework of constructivism as well as the literature associated with explicit writing instruction, teacher and principal accountability to the teaching of writing, and lastly, the writing program *A Language for Learning* and *Write from the Beginning…and Beyond*.

The research design and methodology are discussed in Section 2. Data was collected from 155 students in third, fourth, and fifth grade. Descriptive statistics were used to examine means, standard deviations, and skewness. The purpose of this quantitative study, using a quasi-experimental design, was to determine whether the new writing program implemented at the local school would increase writing achievement scores for students in the third, fourth, and fifth grade. I conducted an ANOVA of writing scores in four sub-categories: paragraph writing, extended writing, grammar and usage, and mechanics. Third, fourth, and fifth grade students were assessed in each subcategory with the exception of mechanics. Third grade students are not assessed on this skill.

Section 2 also discusses the results of the quantitative analysis using ANOVA. Each research question and hypothesis were examined. The ANOVAs revealed that there were statistically significant findings between the grade levels in all writing sub-categories.

The theoretical framework that guided the five research questions and the associated null and alternative hypotheses are based on constructivist theory, particularly that of Jerome Bruner. The first research question asked if there was a difference between student writing scores prior to implementation of the writing program *A Language for Learning* and *Write from the Beginning…and Beyond* and after program implementation. Constructivists focus on interdisciplinary transfer, continuity and consistency, and student choice (Juvova, Chudy, Neumeister, Plischek, & Kvintova, 2015). While learning, students actively deduce and verify. Learning should be viable (necessary, useful, and functional), provide permanence, be sustainable, and stable: it makes sense Juvova et al. (2015). When Thinking Maps are used in the classroom students choose the map that meets their need for the learning task. They draw the map, organize their thinking by deciding what to put on the map, and build and show their knowledge on the map. Thinking Maps can be used in all content areas of math, science, social studies, reading, and writing. Thinking Maps may also be used in art and music. The constructivist believes that learning requires guided participation of the teacher and active participation by the student (Sheehy, 2002). Tani (2014) agrees that students should be active in their learning. Wattsjohnson (2005) also states that teachers act as a guide and students should be actively "doing." Concepts and knowledge are more likely to be retained if learners create on their own (Jing & Perkins, 2013). Jing and Perkins (2013) also state that basic ideas should frequently be revisited and that students should be able to bridge old knowledge to new knowledge. Walker (2014) also supports the idea of revisiting concepts and exploration of concepts with increasing degrees of sophistication. When introducing Thinking Maps to students, teachers guide the process. The maps are introduced one at a time and sequentially. As the teacher introduces the maps, students interact with them, then construct their meaning and knowledge. Wang (2011) also agrees that learners are not passive receivers but rather active constructors of knowledge and that teachers are not transmitters but organizers of learning activities for students. Tani (2014) agrees that an important aspect of the constructivist theory is students applying their learning while Sheehy (2002) also supports the constructivists' view that learning should be transferred to other situations.

The first research question asked if there was a difference between student writing scores prior to implementation of the writing program *A Language for Learning* and *Write from the Beginning…and Beyond* and after program implementation. The null hypothesis stated there would be no difference in state writing achievement scores for students in grades three through five at the local school while the alternative stated there would be a difference in scores. To test this hypothesis, I computed a single factor ANOVA. A statistically significant difference was found among the three grade levels and paragraph writing, $F$ (2, 471) = 57.51, $p$ = .000, among the three grade levels and extended writing, $F$ (2, 471) = 34.70, $p$ = .000, among the three grade levels and grammar and usage, $F$ (2, 471) = 30.42, $p$ = .000, and among two grade levels and mechanics, $F$ (1, 317) = 34.93, $p$ = .000, third grade is not tested on mechanics. Based on these findings I can reject the null hypothesis and accept the alternative: There is a difference between *A*

*Language for Learning* and *Write from the Beginning…and Beyond* in terms of state writing achievement scores for students in grades three through five at the local school.

The second research question asked if there was a difference in paragraph writing scores for third, fourth, and fifth grade students prior to implementation of the writing program *A Language for Learning* and *Write from the Beginning…and Beyond* and after program implementation. The null hypothesis stated there would be no difference in paragraph writing scores for students in grades three through five while the alternative hypothesis stated there would be a difference. To test this hypothesis, I conducted a two-way ANOVA. There was a significant main effect of grade level on paragraph writing achievement, $F$ (4, 474) = 57.64, $p < .001$. Eta for grade level was about .45, which, according to Cohen (1988), is a large effect. Based on these results, I can reject the null hypothesis of no difference between *A Language for Learning* and *Write from the Beginning…and Beyond* and paragraph writing scores for third, fourth, and fifth grade students at the local school and accept the alternative hypothesis.

The third research question asked if there was a difference in extended writing scores for third, fourth, and fifth grade students prior to implementation of the writing program *A Language for Learning* and *Write from the Beginning…and Beyond* and after program implementation. The null hypothesis stated there would be no difference in extended scores for students in grades three, four, and five while the alternative hypothesis stated there would be a difference. To test this hypothesis, I conducted a two-way ANOVA. There was a significant main effect of grade level on extended writing achievement, $F$ (4, 474) = 34.51, $p < .001$. Eta for grade level was about .36, which, according to Cohen (1988), is a large effect. Based on these results, I can reject the null hypothesis of no difference between *A Language for Learning* and *Write from the Beginning…and Beyond* and extended writing scores for third, fourth, and fifth grade students at the local school and accept the alternative hypothesis.

The fourth research question asked if there was a difference in grammar and usage writing scores for third, fourth, and fifth grade students prior to implementation of the writing program *A Language for Learning* and *Write from the Beginning…and Beyond* and after program implementation. The null hypothesis stated there would be no difference in grammar and usage scores for students in grades three through five while the alternative hypothesis stated there would be a difference. To test this hypothesis, I conducted a two-way ANOVA. There was a significant main effect of grade level on grammar and usage achievement, $F$ (4, 474) = 31.01, $p < .001$. Eta for grade level was about .34, which, according to Cohen (1988), is a large effect. Based on these results, I can reject the null hypothesis of no difference between *A Language for Learning* and *Write from the Beginning…and Beyond* and grammar and usage scores for third, fourth, and fifth grade students at the local school and accept the alternative hypothesis.

The fifth research question asked if there was a difference in mechanics writing scores for fourth and fifth grade students prior to implementation of the writing program *A Language for Learning* and *Write from the Beginning…and Beyond* and after program implementation. The null hypothesis stated there would be no difference in mechanics scores for students in grades four and five while the alternative hypothesis stated there would be a difference. Third grade is not tested on this skill. To test this hypothesis, I conducted a two-way ANOVA. There was a significant main effect of grade level on mechanics achievement, $F$ (2, 319) = 36.67, $p < .001$. Eta for grade level was about .32, which, according to Cohen (1988), is a medium to large effect. Based on these results, I can reject the null hypothesis of no difference between Thinking Maps and *Write from the Beginning…and Beyond* and mechanic scores for fourth and fifth grade students at the local school and accept the alternative hypothesis.

## Summary

Descriptive statistics of the sample are described in Section 2. Means, standard deviations, and n are provided. Anovas were used to compute the data collected from local states department of education. Significant differences were found among grades three, four, and five in paragraph writing, extended writing, and grammar and usage. A significant difference was found among fourth and fifth grade students on mechanics. Third grade is not tested on this subsection. F scores and significance levels are provided for each hypothesis. A summary of each hypothesis, along with the accompanying F score and significance level are also provided in in Section 2.

Section 3 describes the project that will be based on the findings of this study. A literature review discusses the research about science instruction to include: vocabulary, questioning, and earth science. Evaluation of student performance and potential barriers are also discussed.

Section 3: The Project

## Introduction

Results from the quantitative data analysis suggested that the writing program *A Language for Learning* and *Write from the Beginning…and Beyond* improved writing achievement scores at the local school. However, *A Language for Learning* and *Write from the Beginning…and Beyond* is not meant only for writing: They are designed to for use in all content areas. With this idea in mind, I present a brief description of the project. The complete projected is found in the Appendix A.

Science is taught through units of study and alternates about every nine weeks with social studies at the local school. I proposed a nine week curriculum plan on earth science for third grade students. Planning involves the use of Thinking Maps. I began by using a Circle Map to define the goals and assessments of the unit, adding skills, concepts, resources, guiding questions, timeline, and essential vocabulary to the map. Next, I classified and task-analyzed the learnings of the Tree Map. Finally, daily lesson planning began using a variety of maps.

Students used a variety of Thinking Maps to organize their thinking and learning throughout the unit of study. For example, when studying rocks and minerals, students might select a Brace Map to show the layers of the earth, the landforms on earth, soil layers, and components of soil. A Flow-Map may show earth processes, and a Tree Map may organize the rock cycle.

The project in Appendix A includes goals, Thinking Map purpose and accompanying map for each lesson, and exemplars. The goals of this project were to use a program that has been successful with writing at the local school and transfer its use to another content area: science. Science is teeming with academic vocabulary and notetaking. Thinking Maps are used deepen students' understanding of academic vocabulary and with notetaking strategies. They are to help students to think like scientists.

## Rationale

This curriculum plan incorporated research on what constitutes effective curriculum development as well as examples of best practice for content and language objectives, end-of-unit assessment, and evaluation plan for the curriculum. The authors of *A Language for Learning* suggest their use in all content areas, including math, reading, science, and social studies. I developed the project based on the idea of cross-curriculum transfer of *A Language for Learning* from writing to the content area of science.

In developing the science curriculum plan, I looked at key terms from the local state and school district's standards and grade-level expectations. Thus, the following keywords were used for the literature review: *curriculum planning, academic vocabulary, science academic vocabulary, critical questions,* and *earth science.* The following databases were used: ERIC, Education Research Complete, Sage Premier, and Teacher Reference Center.

## Review of the Literature

Curriculum planning is a plan for learning, in which the objective determines what learning is important. The three purposes of a curriculum plan are to first produce a curriculum for an identifiable population, second is to implement the curriculum in a specific school, and third is to appraise the effectiveness of the curriculum. Curriculum planning requires two components: subject matter and learning experiences (Lunenburg, 2011). Rusman (2015) believes that successful implementation of a curriculum is its people, programs, and processes. Wallace (2012) also agrees that in the process of curriculum development learning that occurs should be identified. These activities should be open-ended and include student voice and choice. The result of curriculum development is to bring about student change and to assess the extent of these changes (Festus & Seraphina, 2016). Byrne, Downey, and Souza (2013) also support the theory that innovative curriculum should be designed to facilitate change. For teachers to develop quality curricula, they must develop activities to engage students in meaningful ways. The teacher determines the academic standard to present and the instructional strategies to use (Read, 2014). When planning curriculum, teachers should determine what is important in the content area and create learning experiences that augment the learning. After, an appraisal of the effectiveness of the curriculum should be assessed (Lunenburg, 2011).

**Academic Vocabulary**

Nagy and Townsend (2012) define academic vocabulary as a tool for communicating and thinking about content areas. They state that there are four components of vocabulary learning; wide reading, word consciousness, teaching word learning strategies and teaching individual words. A study by Uccelli, Galloway, Kim, and Barr (2015) found that academic language skills and academic vocabulary positively correlate to growth of comprehension. Wessels (2013) agrees that vocabulary knowledge is central to the comprehension of academic texts. Sibold (2011) claims explicit instruction is necessary for academic vocabulary in content areas. To foster vocabulary in content areas teachers should provide visual aids such as graphic organizers and word walls. Making connections between prior knowledge also aids in learning academic words. Relating background knowledge is also supported by Wessels (2013). Wessels (2013) goes further to suggest that students be provided with multiple exposures to text along with meaningfully related activities. While in the classroom setting students should be allowed to explore, evaluate and extend the meaning of words to make a personal connection. Palumbo and Kramer-Vida (2012) feel that to achieve success in school students need to tools for learning in which words play an important part.

**Academic Vocabulary in Science Instruction**

Fazio and Gallagher (2013) state life, earth, and space systems have more academic vocabulary than other science topics. According to Bryce (2011), scientific vocabulary is dry with an abundance of concepts that are complex. The consensus is scientific academic vocabulary be taught explicitly. Science vocabulary may be new to students or never heard of by students (Cohen & Johnson, (2014). Connor et al. (2012) believe science vocabulary be introduced and taught explicitly. Cohen and Johnson (2014) feel that basic science vocabulary is crucial, so students comprehend the basics to move on to more complicated concepts. A study by Cevetti, Hiebert, Pearson, and McClung (2015) showed that new vocabulary should frequently be encountered through reading, writing, speaking, and listening. In other words, students should use these new words orally and in writing. Knowing which words to teach is critical. Students’ background knowledge of the related science topic is considered before selecting which vocabulary to teach.

Techniques for acquiring science vocabulary are suggested by multiple authors. Bryce (2011) suggests several strategies improve comprehension. First, discussions among students will lead to a synthesis of information. Second, use text features, look at text organization, and set a purpose for the reading. Making real world connections and using videos and the Internet may assist vocabulary development. Cohen and Johnson (2014) recommend using imagery as a way to learn new science terms. Students visualize the content while they read. In turn, these science terms are processed at a deeper level.

Science vocabulary may be new and seem foreign to students. To move to more complicated vocabulary, a good grasp of the basics is necessary. Introduction to and explanation of new content vocabulary essential. Vocabulary development accomplished through visualization and image creating of the reading is called dual coding. Verbal and nonverbal (imagery) lead to deeper level comprehension.

**Critical Questions**

Questioning promotes dialogue among students. Introducing critical questions for students before hands-on science allows for open discussion about the outcomes of the science task. Feedback from the teacher should be provided only after this open discussion (Van Booven, 2015). Portnoy and Rabinowitz (2014) found that as a learning strategy, question asking is a valuable way to increase comprehension after reading multiple science passages. In their study, Portnoy and Rabinowitz (2014) found eight types of questions to promote understanding:

- Verification:  Are floods a natural disaster?
- Request for information:  What are some examples of natural disasters?
- Definition:  What is a hypothesis?
- Casual:  What causes a natural disaster?
- Possibilities: What happens to a city if there is a flood?
- Function:  How do volcanoes erupt?
- Mechanism:  How does erosion occur?
- Comparison:  Are hurricanes like a tropical storm?

Student-generated questions enhance learning, comprehension, communication, and problem-solving. Construction of student knowledge strengthens when students generate and then share relevant questions (Yu & Chen, 2013). Questioning reinforces scientific interest and engagement in what scientists do during the scientific process of observation and questioning (Weiss, 2013). Alamar (2013) agrees with Weiss that questioning also leads to interest and engagement. Ness (2013) also affirms that real-world student generated questions reflecting the child's interests also enriches student learning. With practice, students not only increase their quantity of questions but more importantly the quality of the questions improves.

Open-ended student questions may or may not be answered and are not to be judged as good or bad or right or wrong. These open-ended questions demonstrate high-level inquiry in which students infer and predict. With student generated questions teachers should listen for correct use of vocabulary, transfer of knowledge, and learning through comparisons (Rumohr, 2013). Bennett (2012) also believes that every teacher's goal should be instruction in developing critical thinking, and in turn, new understanding.

**Earth Science**

Pressure from states, as well, as nationally, has fostered a new-found priority by school districts growth for incorporation of science curriculum into the classroom. The reason: obtain high scores on state assessments. When increasing the amount of time spent on science instruction several concepts should be kept in mind. First, science is a part of our everyday lives (Marincola, 2006). The National Science Teachers Association (NSTA) (2002) believes that every grade level needs daily science instruction. The curriculum must provide hands-on, investigative and use inquiry skills for students to develop science understandings. Instruction in science should be taught to include the scientific method, the difference between guessing and actual data, how to develop research questions and accompanying hypotheses, and include hands-on activities for students. Wysession (2013) is of the same opinion that science instruction must include observation, analyzation, and explanation of research questions and hypotheses.

Scientific inquiry helps students understand the ideas of science and provides opportunities for students to seek knowledge to solve everyday life problems. According to Next Generation Science Standards (NGSS) (Pruitt, 2014). Science should include authentic inquiry, logical reasoning and be student generated (Park and Park, 2013). Next Generation Science Standards moves the focus of memorization of facts and concepts to that of understanding and application of ideas. Planning and conducting, observation and data representation in tables and graphical displays is a component of the NGSS (Pruitt, 2014). A deeper understanding of core ideas in science is a focus of NGSS as is scientific literacy (Huff, 2016). Pruitt (2014) supports Huff in that students' science education must include the ability to show a deep level of content knowledge.

The National Science Teachers Association reinforces the ideas and goals of the NGSS. They too believe science curriculum should provide inquiry-based instruction that includes an understanding of the processes of science and include supporting materials which stimulate science learning.

## Project Description

Statistically significant results found in the study using *A Language for Learning* and *Write from Beginning…and Beyond* on writing achievement prompted the development of this curriculum plan. This curriculum was developed to address low science scores based on results from the 2015 measure of academic performance at the local school. This nine week plan offers students hands on, investigative, and inquiry based lessons. The author of *A Language for Learning* and *Write from the Beginning…and Beyond* recommend using this program cross curricular in the content areas. Thinking Maps are described for each weekly lesson.

I created this curriculum plan to address the need to increase test scores in science at the local school. This unit of study is based on the theory that cross curricular transfer of Thinking Maps to other content areas will improve science achievement at the local school. Thus, it is crucial to execute this unit to increase student learning in science which in turn will increase test scores at the local school.

This unit of study is written using third grade state level expectations. It has the capacity to be implemented by third grade teachers at the local school as well as schools throughout the state and universally. For the purposes of immediate use the local school will implement the curriculum in the third grade. This grade is chosen in order for later grade levels to continue to build upon concepts and skills used through Thinking Maps.

Goals for this nine week unit are modeling the use of Thinking Maps for students, gradual release to students to create and show ownership of their maps, and assessment of student success as well as teacher success. The nine week Earth Science unit may begin at any time during the school year. When the nine week period of instruction is selected, planning will begin. Third grade teachers will plan before implementation begins.

## Project Goals and Learning Outcomes

Third grade teachers will work together to implement the nine week Earth Science unit at the local school. Goals for this nine week unit are modeling the use of Thinking Maps for students, a gradual release to students to create and own their maps, and assessment of student success as well as teacher success. The nine week Earth Science unit may begin any time during the school. In the past, Thinking Maps showed significant results in increasing writing achievement. This use of Thinking Maps is transferable across content area, one of which is science.

### Description of Thinking Maps

Each of the eight Thinking Maps are used to organize thinking in different ways. The thinking process used in a Circle Map is defining in context. This map is made up of two concentric circles with key ideas placed in the inner circle and what is known about the key ideas in the outer circle. The Bubble Map looks like a web but is only used with adjectives or adjective phrases. This map is used for describing qualities. The key idea is in the center and the outlying bubbles hold the descriptors. A Double Bubble Map is similar to a Venn diagram. It is used for comparing and contrasting characteristics. Tree Maps are used for classification and organization and is a way to outline the main topic, main ideas, and details. A Brace Map is used to show part to whole. The whole can be broken into parts and subparts. The Flow-Map is used for sequencing events. It may also contain sub-stages of the events. A Multi-Flow Map is used to show cause and effect. The event is placed in the middle and the causes come before the event and the effects after the event. The eighth map is a Bridge Map. This map uses analogies and metaphors. A Bridge Map is used to show a relationship between the concrete and abstract.

The choice of the Thinking Map to use is based on the organizational method which is needed for the lesson. Not all Thinking Maps are necessary for this Earth Science unit. A Bridge Map is not necessary as none of the lessons call for organizing thinking from the concrete to the abstract. The maps chosen below are based on the thinking process students may use for each week's learning.

## Implementation Timeline

Table 18 below provides week by week lessons, the appropriate Thinking Map to use, and the reasoning behind using the map.

Table 18 *Week by Week Guide of Earth Science Unit*

| **Lesson** | **Thinking Map** | **Thinking Process** |
|---|---|---|
| Week 1: Layers of the Earth | Tree Map | A Tree Map is used for this lesson to organize information about each of Earth's layers. The four layers are the main ideas of the lesson and the details provide description of each layer. |
| Week 2: Landforms | Bubble Map | A Bubble Map is used for describing things using adjectives and/or adjective phrases. Each of the landforms studied; plains, plateaus, mountains, oceans, valleys, and continents have distinct adjectives to describe them. |
| Week 3: Types of Rocks | Tree Map | A Tree Map is used for this lesson to organize information about each type of rock. Igneous, sedimentary, and metamorphic rock are the main ideas of this lesson, and the details provide description of each type. |
| Week 4: The Rock Cycle | Multi-Flow Map | A Multi-Flow Map is used for this lesson to show how temperature and pressure effect the rock cycle. |
| Week 5: Minerals | Double Bubble Map | A Double Bubble Map is used for this lesson to compare and contrast the properties of minerals. |
| Week 6: Components of Soil | Brace Map | A Brace Map is used for this lesson to identify the whole, soil, and then break down the whole into the layers of soil. |
| Week 7: Weathering and Erosion | Flow-Map | A Flow Map is used for this lesson to show a |

| | | |
|---|---|---|
| | | sequence of events. This map will show what happens when weathering and erosion occur. |
| Week 8: Natural Disasters | Multi-Flow Map | A Multi-Flow Map is used for this lesson to show a sequence of events. This map will show what happens when a natural disaster occurs. |
| Week 9: Earth's Resources | Circle Map | A Circle Map is used for this lesson to show key ideas, the resources; minerals, rocks, sand, and oil, and show what students know about each. |

The Thinking Maps for this unit of study are; a Circle Map, a Bubble Map, a Double Bubble Map, a Flow-Map, a Multi-Flow Map, and a Brace Map. It is important to model the map used for the week on day one of the week. Students make their maps by replicating each step in their science notebook. You can check student understanding by walking around the room and observing while they work. The Circle Map is the planning tool used for this unit. Topics to teach each week are listed and the order in which to teach each topic is written above.

## Project Evaluation Plan

Third grade teachers will evaluate the nine week science unit using performance-based evaluation. The science unit developed through the use of the local state's common core standards. Each learning experience is aligned to one or more of these standards, and a criterion is set for what every child should know. It is expected that every child will meet science standards. The four levels of performance from highest to lowest are;

Distinguished Command, Strong Command, Moderate Command, and Limited Command. Students performing Distinguished Command are academically well prepared to engage in future studies in the content area of science. Students performing at Strong Command are academically prepared to engage successfully in further studies in the content area, Science. Students performing Moderate Command will likely need academic support to engage successfully in the Science content area. Last, students who demonstrate a Limited Command will likely need extensive academic support to engage successfully in further studies in science. After each of the nine learning experiences, students will be given a performance-based assessment to determine what command level each student is performing. The performance-based assessments include creating and labeling, describing, categorizing, completion of learning stations, identification, and the design of experiments.

A focus at the local school was placed on reading, writing, and math. Because of this, classroom teachers tend to disregard science instruction and fit it into their schedules when they can or wait until state testing is complete. Science is tested only in the fifth grade. Results from the 2015 measure of academic performance at the local school are shown in Table 19.

Table 19

*Results of the State Fifth Grade Science Test at the Local School*

| State Science Scores | 2014-2015(%) |
|---|---|
| Limited Command | 56.9 |
| Moderate Command | 34.5 |

| | |
|---|---|
| Strong Command | 8.6 |
| Distinguished Command | 0 |
| Strong and Distinguished Command | 8.6 |

As the results show, it is crucial that science instruction not only occurs but that it is aligned with the state's performance levels if students are to be academically prepared to engage in further science instruction. The instruction does not begin in the fifth grade. It must begin in earlier grade levels to build upon concepts and skills as the students move through each of the grade levels.

The key stakeholders are the teachers, students, parents, school, and district. The teachers, school, and the district will want to know how their students performed, not only individually, but overall as a school. Parents will want to know how their child performed as a way to ensure they are meeting the performance levels. They will also want to know how the teachers, the school, and the district are preparing their child for college and career readiness.

## Potential Barriers

Potential barriers that may occur are teacher participation, time, and support from the principal. Teachers at the local school may not want to try a new science project. They may have an existing curriculum that is used and will not want to change. Teachers may also feel that a new curriculum will not be a benefit to the students. Another potential barrier is time. Already existing curriculum expectations may not allow for a new nine-week curriculum plan. Also, the third grade teachers may not want to spend the amount of timed needed to learn the new plan. This time commitment includes many components; understanding the related concepts; connecting the standards to the learning experiences; differentiating the lessons; developing word banks of critical language; finding needed supplies for the learning experiences. Principal support is the last potential barrier. To implement the curriculum plan, the principal will need provide money for supplies, support the nine week time commitment, and encourage teacher commitment.

## Project Implications

Third grade teachers will evaluate the nine-week science unit using performance-based evaluation. The science unit developed through the use of local state’s common core standards. Each learning experience is aligned to one or more of these standards, and a criterion is set for what every child should know. The expectation is every child will meet science standards. The four levels of performance from highest to lowest are; Distinguished Command; Strong Command, Moderate Command, and Limited Command. Students performing Distinguished Command are academically well prepared to engage in futures studies in the content area of science. Students performing at Strong Command are academically prepared to engage successfully in further studies in the content area, Science. Students performing moderate command will likely need academic support to engage successfully in the Science content area. Lastly, students who demonstrate a Limited Command will likely need extensive academic support to engage successfully in further studies in Science. After each of the nine learning experiences, students will be given a performance-based assessment to determine what command level each student is performing. The performance-based assessments include creating and labeling, describing, categorizing, completion of learning stations, identification, and the design of experiments.

A focus at the local school was placed on reading, writing, and math. Because of this, classroom teachers tend to disregard science instruction and fit it into their schedules when they can or wait until state testing is complete. Science is tested in the fifth grade in the state.

**Summary**

Section 3 provides the description a nine week earth science unit for third grade students. Eight Thinking Maps are described as well as which map and why they are used for each of the weekly lessons. A review of the literature focuses on academic vocabulary, academic vocabulary in science, critical questions, and earth science. A timeline is provided for the unit and the unit may start at any time of the school year. A performance based assessment is used to evaluate student work for each lesson. For the project to be successful attention to amount of time needed to implement. Administrators and teachers need also support the project and its implementation.

Section 4 shares a reflection of the work. Project strength and limitations are described. Consideration is given to alternative approaches, scholarship and project development as well as the importance of the work. Future research is also discussed.

# Section 4: Reflections and Conclusions

## Project Strengths and Limitations

Transfer of Thinking Maps to science content gives students and teachers a way to organize their thinking throughout the stages of the scientific method. The goal of the project was to transfer the success of *A Language for Learning*, *Write from the Beginning…and Beyond*, and Thinking Maps on writing instruction to the content area of science. The great quantity of science academic vocabulary can be logically mapped into effective ways of learning. Students were taught how each map aligned with different areas of thinking in their writing instruction, which then translated to the content area, science. The student and teacher become partners in the classroom. Students were offered autonomy to organize their thinking in ways that were logical for them. Thinking Maps automatically differentiates instruction for individual students. This differentiation allows the teacher to become a facilitator of learning while students work their way through the scientific method. The teacher can focus on student groups or one student at a time. Misconceptions of scientific thinking are easily seen on the maps, which allowed for quick discussion to address and correct the misconception.

Buy-in from grade-level teams was central to continuity of instruction. Continuity provided a connection between each classroom. Students would talk the same language of the Thinking Maps which would provide for consistent instruction. The administrative teams' support was also necessary. For the program to be implemented, understanding how the maps work, and their positive effect on student learning, was required. Without the support of the school administration, *A Language for Learning* and

*Write from the Beginning…and Beyond* professional development could not have occurred. Professional development was crucial for understanding how to implement the maps. The cost of the program may prohibitive. Not only is there a cost associated with professional development, but there is also a sizeable cost in purchasing the needed resources.

## Recommendations for Alternative Approaches

At every grade level three through fifth, the staff must be vested in implementing the program in order for it to succeed. Training time during the work day was a must. Another suggestion was for consistent encouragement from teacher leaders and the professional program developers. These supports helped to maintain ongoing enthusiasm.

Administration at the local school needed to find a way to provide professional development and to pay for the associated costs. Options include grant writing and outreach to the parent–teacher association. The local district's educational foundation provides funds to grants writers—anyone from the local school—who gives a powerful rationale for their needs. . The parent-teacher association may also raise money for local school. The suggestions above could cover the cost of purchasing the curriculum and the accompanying training.

## Scholarship, Project Development and Evaluation, Leadership and Change

The project study enabled teachers to implement a nine week science unit. The project was developed with the teacher in mind. Lesson focus, resources, key vocabulary, and assessments are outlined for the teacher. Though this unit is all-encompassing, it can be modified to the school, to the students' needs, and for available resources and supplies. This nine week project concentrated on science in the local school. Developing a timeline to include nine weeks of science instruction presented a stumbling block for the local school. Because there was a significant difference between writing scores before and after the implementation of *A Language for Learning* and *Write from the Beginning…and Beyond,* it is important that these programs are expanded to other content areas.

Prominent topics of the project were as follows: curriculum planning, earth science, academic vocabulary, academic vocabulary in science instruction, and critical questions. Research of each of these topics took time and patience. Literature for each of these topics are limited in scope. This lack of literature indicates the importance of this project. The project may the existing body of literature and provide a much-needed resources for scholars.

State standards provide lesson focus. Development of the unit focused on these standards and the themes of each of the standards. Key content vocabulary is abundant and easily geared toward third grade learners. The content vocabulary effortlessly matched the state's standards. Locating available resources to enhance instruction proved problematic. It was difficult to provide age appropriate media for the targeted age group. Many of the online videos, slide show, and reproducibles are geared toward an older audience of learners. Determining the learning outcomes established a path for working backward to create lesson focus, resources, and key vocabulary.

The time and research it takes to develop a nine-week unit of study are intimidating. With limited time, and with a student-based focus, it is impractical for teachers to create their own. School curriculum departments are better suited for this undertaking.

## Reflection on Importance of the Work

Science education is paramount to the future of our nations' youth. Data shows that the United States is not keeping up globally. With the quickly advancing technological world it is essential that the Sciences be included in the classroom. It is also important for students to be creative thinkers. *A Language for Learning* and *Write from the Beginning…and Beyond* are statistically proven in this study to logically lead the way. David Hyerle has developed this way and *A Language for Learning* and *Writing from the Beginning…and Beyond* provides this. Change is difficult for teaching staff and new programs take time to implement. Professional development of *A Language for Learning* and *Write from the Beginning…and Beyond* must be carried out in an approach that will not insult nor add to discontent of already overloaded teachers. A collaborative effort of all in the school is essential.

Not only do the teachers need to support the implementation of *A Language for Learning* and *Write from the beginning…and Beyond*, but school leaders must do so as well. School leaders need to listen to teachers. Reflection of what it is like to be an overtaxed teacher is a must. To gain support from the staff, school leaders will need to include teachers reflectively and in collaboration. Analytical discussions followed by thoughtful and constructive feedback may well lead to the implementation of the program.

Other stakeholders, namely the community and parents, should be included in the dialogue. Making available the importance of Science education and the value of organized thinking may increase public support. Modeling how the program work in the classroom may well be beneficial. Though statistics are often overwhelming, providing a glimpse of where the United States lies academically in comparison to other countries, may spur conversations and gain support of *A Language for Learning* and *Write from the Beginning…and Beyond*. One thing is for sure, collaborative and reflective dialogue must take place among all stakeholders.

**Implications, Applications, and Directions for Future Research**

Parents, students, teachers, and local school and district administrators need to be informed of the results of this study and its potential impact on writing achievement, not only for students at the local school but students in the entire district as well. Based on the results of this study, the adoption of the writing program *A Language for Learning* and *Write from the Beginning…and Beyond* should warrant serious consideration. Fidelity and accountability of all stakeholders to this writing program is necessary for student success. As such, student writing skills, regardless of economic status, can improve. The local district provides training and professional development for all teachers during the summer months. Local trainers, many of which are teachers in the district, could provide the professional development. Educators at thinkingmaps.org suggest a four step method. First, develop a plan to implement the program. Second, conduct teacher training and provide an eight-week introduction of the maps for students. Third provide follow-up training. Last, assess accountability to the implementation of the writing program and assess student achievement. Use this last data to address school-wide goals.

This study also adds to the developing body of evidence of positive correlations between *A Language for Learning* and *Writing from the Beginning…and Beyond* and writing achievement scores. David Hyerle, the author of this writing program, conducts and allows others to conduct research through his non-profit organization. As someone conducting research of this program as an outside entity, this study will contribute to the body of research of *A Language for Learning* and *Write from the Beginning…and Beyond*. Results are generalized to one school in the local district. Recommendation is other schools in the district that are using *A language for Learning* and *Write from the Beginning…and Beyond* be included in further research. It is also highly recommended that a longitudinal study follow trends, patterns, and growth. This study could occur at the local school or among schools in the district that are using this writing program. Adding qualitative data, such as teacher observations and surveys, would allow for more robust findings and add depth to the research. Accountability to this writing program is paramount in its success on writing achievement. Collecting data on fidelity to implementation and accountability to administrators would also augment the depth of the research.

## Conclusion

The current study suggests that *A Language for Learning* and *Write from the Beginning…and Beyond* improves writing achievement for third, fourth, and fifth grade students at the local school. This research is important to the local school and local school district because of current poor writing achievement scores. Statistically significant results from this research indicate a need for further dialogue among educators as to what will help students achieve the writing success expected of them and the writing success they deserve. Involvement of teachers and other stakeholders will lead to understanding the importance of *Language for Learning* and *Write from the Beginning…and Beyond* to our students' education. Reflection of the encouraging studies of this program is vital. Thoughtful and logical plans for implementation is required. All stakeholders must be included in the process. The success of the program hinges on this.

# References

Alamar, A. (2013). Building substantive engagement through the use of connection prompts. *Journal of Education and Training Studies, 1*(2), 103-112.

Amador, J. M. (2016). Teachers' considerations of students' thinking during mathematics lesson design. *School Science and Mathematics, 116*(5), 239-252.

Anthony K. J. & Frazier, W. M. (2009). Undiscovered ideas. *Science Scope*, *33*(1), 20-27.

Ashbrook, P. (2013). The STEM of inquiry. *Science and Children,* 51(2), 30-31.

Beesley, A. (2009). *Measuring classroom assessment with a work sample*. (Report NO. ED508465). Location: McREL International.

Bennett, M. (2012). Delving into critical literacy in the elementary classroom. *Canadian Journal of Action Research, 13*(1), 65-68.

Beeth, M. E., Cross, L., Pearl, C., Pirro, J., Yagnesak, K., & Kennedy, J. (2001). A continuum for assessing science process knowledge in grades k-6. *Electronic Journal of Science Education, 5*(3).

Bright, N. H. (2011). Five habits of highly effective teachers. *School Administrator, 68*(9), 1-5.

Brooks, J. G. (2005). Thinking about learning. *Hofstra Horizons, 13*(1), 13-18.

Bruner's theory on constructivism. Retrieved from http://www.teach-nology.com

Brunstein, J. C. & Glaser, C. (2011). Testing a path-analytic mediation model of how self-regulated writing strategies improve fourth graders' composition skills: A randomized controlled trial. *Journal of Education, 103*(4), 922-938.

Burden, B., & Silver, J. (2006, Month). Thinking maps in action. Teaching, *Thinking, & Creativity, Spring,* 38-43. Retrieved from http://www.thinking foundation.org/research/graduate_studies/pdf/teachthinkingarticle.pdf

Bryce, N. (2011). Meeting the reading challenges of science textbooks in the primary grades. *The Reading Teacher, 64*(7), 474-485. doi:10.1598/RT.64.7.1McDonald

Byrne, J., Downey C., & Souza, A. (2013). Planning a competence-based curriculum: The case of four secondary schools in England. *The Curriculum Journal 24*(3), 335-350.

Cervetti, G. N., Elfrieda, H., Pearson, P., McClung, N. A. (2015). Factors influence the difficulty of science words. *Journal of Literary Research, 47*(2), 153-185.

Cohen, J. (1988). *Statistical power and analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Lawrence Earlbaum Associates.

Cohen, L., Manion, L., & Morrison, K. (2003). Experiments, quasi-experiments and single-case research. (5th Ed). *Research methods in education* (pp. 214-218). New York: RoutledgeFalmer.

Cohen, Marisa T. & Johnson, F. L. (2014). Improving the acquisition and retention of science material by fifth grade students through the use of imagery interventions. *Instructional Science 20*, 925-955.

Colorado Department of Education (August, 2014). 2014 Colorado student assessment and growth results. Retrieved from http://www.cde.state.co.us/

Connor, C., Rice, D. C., Canto, A. I., Sutherland, S. A., Underwood, P., Sible, K., . . . Morrison F. J. (2012). Child characteristics by science instruction: Interactions in second and third grade and their relation to students' content-area knowledge, vocabulary, and reading skills gain. *The Elementary School Journal*, *113*(1), 52-75.

Correnti, R., Matsumura, L., Hamilton, L. S., & Wang, E. (2012). Combining multiple measures of students' opportunities to develop analytic text-based writing skills. *Educational Assessment*, *17*, 132-161.

Creswell, J. W. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches.* Los Angeles, CA: SAGE Publications, Inc.

Creswell, J. W. (2012). *Educational research planning, conducting, and evaluating quantitative and qualitative research.* Boston, MA: Pearson Education, Inc.

CTB/McGraw Hill (2013). *Transitional Colorado assessment program reliability and validity measures.* Retrieved from http://www.ctb.com

Danoff, B., Harris, K. R., & Graham, S. (1993). Incorporating strategy instruction within the writing process in the regular classroom: Effects on the writing of students with and without learning disabilities. *Journal of Reading Behavior*, *25*, 295-322.

Day, M.,Stobaugh, R., & Tassell, J. (2012). Creating science assessments that support inquiry. *Science Scope 35*(8), 54-59.

Dunn, M. W., & Finley, S. (2010). Children's struggles with the writing process: Exploring storytelling, visual arts, and keyboarding to promote narrative story writings. *Multicultural Education,* 18(1), 33-42.

Fazio, X., & Gallagher, T. L. (2013). Morphological development for science-based texts in elementary schools. *International Journal of Science & Mathematics Education,* 12(6), 1407-1423. doi:10.1007/s10763-013-9470-4

Festus, A. B., & Seraphina, M. (2016). Curriculum planning and development in mathematics from the formative stages. *Journal of Education and Practice, 6*(2), 62-66.

Finnigan, K. S. (2010). Principal leadership and teacher motivation under high stakes accountability policies. *Leadership and Policies in Schools, 9*(2), 161-189. doi:10.1080/15700760903216174

Gallagher, M. (2012). How principals support teacher effectiveness. *Leadership, 41*(3), 32-35, 37.

Gallagher, M. L. (2011). Using thinking maps to facilitate research writing in upper level graduate courses. *Journal of Family & Consumer Sciences Education, 29*(2), 53-56.

Gettings, M. (2016). Putting it all together: STEAM, PBL, scientific method and the studio habits of mind. *Art Education, 69*(4), 10-11.

Gilbert, J. & Graham, S. (2010). Teaching writing to elementary students in grades 4-6: A national survey. *The Elementary School Journal, 110*(4), 494-518.

Graham, S., Bollinger, A., Booth Olson, C., D'Aoust, C., MacArthur, C., McCutchen, D., & Olinghouse, N. (2012). Teaching elementary school students to be effective writers: A practice guide (NCEE 2012- 4058). Washington, DC: National Center for Education Evaluation and Regional Assistance, Institute of Education Sciences, U.S. Department of Education. www.ies.ed.gov

Graham, S., Harris, K. R., & Mason, L. (2005). Improving the writing performance, knowledge, and self-efficacy of struggling young writers: The effects of self-regulated strategy development. *Contemporary Educational Psychology, 30*(2), 207-241.

Graham, S., McKeown, D., Kiuhara, S., & Harris, K. (2012). A meta-analysis of writing *Psychology, 104*(4), 879-896. doi:10.1037/a0029185

Graham, S., & Perin, D. (2007). The effectiveness of an explicit instruction writing program for second graders. *Journal of Educational Psychology, 99*, 445-476.

Hewing, G. (1991). *Constructivist learning theory*. Paper presented at the Connecticut Educators Computer Association Conference, Connecticut.

Holzman, S. (2004, April). *Thinking maps: Strategy-based learning for English language learners (and others!)*. Paper presented at the 13th Annual Administrator Conference, Sonoma County Office of Education: California. Retrieved from www.scoe.org

Huff, K. L. (2016). Addressing three common myths about the next generation science standards. *The Science Teacher.* 83(1), 55-57.

Hyerle, D. (2000). Visual tools for mapping minds: A field guide to using visual tools. Alexandra, Virginia: Association for Supervision and Curriculum Development.

Hyerle, D. (2004, April). *Thinking maps as a transformational language for learning*. Retrieved from https://www.sagepub.com/sites/default/files/upm-binaries/6577_hyerle_ch_1.pdf

Hyerle, D. (2012). *Thinking maps research summary*. Retrieved from http://designsforthinking.com

Hyerle, D., & Williams, K. (2009). Bifocal assessment in the cognitive age: Thinking maps for assessing content learning and cognitive process. *The New Hampshire Journal of Education,* 32-38.

Isaacson, S. (2004). Instruction that helps students meet state standards in writing. *Exceptionality; A Special Education Journal, 12*(1), 39-54. doi:10.1207/s15327035ex1201_4

Jing, X., & Perkins, K. (2013). A conceptual paper on the application of the picture word inductive model using Bruner's constructivist view of learning and the cognitive load theory. *Interdisciplinary Journal of Teaching and Learning, 3*(1), 8-17.

Jones, A. L., & Stapleton, M. K. (2017). 1.2 million kids and counting-mobile science laboratories drive student interest in STEM. *PLOS Biology,* 15(5), 1-8.

Juvova, A., Chudy, S., Neumeister, P., Plischke, J., & Kvintova, J. (2015). Reflection of constructivist theories in current educational practice. *University Journal of Educational Research, 3*(5), 345-349. doi 10.13189/ujer.2015.030506

Krajcik J., & Vaarelas, M. (2007). Urban primary-grade children think and talk science: curricular and instructional practices that nurture participation and argumentation. *Science Education*, *92*(1), 65-95. doi:10.1002/sce

Leithwood, K., Steinbach, R., & Jantzi, D. (2002). School leadership and teachers' motivation to implement accountability policies. *Educational Administration Quarterly, 38*(1), 94-119. doi:10.1177/0013161x02381005

Leonhardt, A. (2005). Using rubrics as an assessment tool in your classroom. *General Music Today, 19*(1), 10-16.

Levin, B. (2012). Balance trust and accountability, *The Phi Delta Kappan, 94*(1), 74-75.

Lipsey, M. W. (1990). *Design sensitivity: Statistical power for experimental research.* Newbury Park, CA: Sage.

Lodico, M. G., Spaulding, D. T., & Voegtle, K. H. (2010). *Methods in educational research.* San Francisco, CA: John Wiley & Sons, Inc.

Long, & Carlson (2011). Mind the map: How thinking maps affect student achievement. *Networks, 13*(2), 1-7.

Lunenburg, F. C. (2011). Theorizing about curriculum: Concepts and definitions. *International Journal of Scholarly Academic Intellectual Diversity. 13*(1), 1-6.

Mabie-Hicks, K. (2006). *An examination of student performance after two years of thinking maps implementation in three Tennessee schools*. (Doctoral dissertation, Walden University, 2006). Retrieved from http://www.waldenu.edu

Manning, C. M. (2011). Improving reading comprehension through visual tools. In D. Hyerle & L. Alper (Eds.), *Student success with thinking maps* (pp. 1-22). Retrieved from http://www.thinkingfoundation.org

Marincola, E. (2006). Why is public science education important? *Journal of Transitional medicine*. doi:10.1186/1479-5876-46

Marri, A. R., Perin, C. Crocco, M. S., Riccio, J. F., Rivet, A., & Chase, B.J. (2011). Content-driven literacy: One approach to urban secondary education. *The New Educator, 7*(4), 325-351. doi: 10.1080/1547688X.2011.619948

Marzano, R. J., Gaddy, B. B., & Dean, C. (2000). *What works in classroom instruction?* Denver, Colorado: Association for Supervision and Curriculum Development, McREl, International.

McCann, T. M., Jones, A. C., & Aronoff, G. (2010). Truths hidden in plain view. *Kappan*, *92*(2), 65-67.

Morgan, G. A., Leech, N. L., Gloeckner, G. W., & Barrett, K. C. (2011). *IBM SPSS for introductory statistics: Use and interpretation* ($4^{th}$ Ed.). New York, NY: Taylor and Francis Group, LLC.

Mott, M. S., Moore, J. J., & Shannon, T. M. (2010). Administrator's electronic checklist a teacher accountability system for building transformation, *Academic Leadership, 8*(3), 1-5.

Murphy, K. R., & Moyers, B. (1998). *Statistical power analysis: A simple and general model for traditional and modern hypothesis test.* Mahwah, NJ: Erlbaum.

Nagy, W., & Townsend, D. (2012). Words as tools: Learning academic vocabulary as language acquisition. *Reading Research Quarterly, 47*(1), 91-108. doi:10.1002/RRQ.011

Lee, J., Grigg, W. S., Donahue, P. L. (2007). *The Nation's Report Card: Reading 2007* (NCES 2007). National Center for Statistics, Institute of Education Sciences, U.S. Department of Education, Washington, D.C.

Kena, G., Aud, S., Johnson, F., Wang, X., Rathbun, A., …Kristapovich, P. (2014). *The Condition of Education 2014* (NCES 2014-083). U.S. Department of Education, National Center for Education Statistics, Washington, DC. Retrieved from http://nces.ed.gov/pubsearch

National High School Center at the American Institutes for Research (2012, February). *High school improvement: Indicators of effectiveness.*

National Science Teachers Association Board of Directors. (2002). Elementary school science. Retrieved from www.nsta.org

Ness, M. (2013). Moving students' questions out of the parking lot. *The Reading Teacher*, *67*(5), 369-373.

Palumbo, A., Kramer-Vida, L. (2012). An academic curriculum will close the achievement gap. *The Clearing House, 85*(3), 117-121. doi:10.1080/000986552012.655345

Park, D.Y., & Park, M. (2013). Examining features of earth science logical reasoning and authentic scientific inquiry demonstrated in a high school earth science curriculum: A case study. *Journal of Geoscience Education, 61*(4), 364-377.

Portnoy, L., & Rabinowiz, M. (2014). What's in a domain: Understanding how students approach question in history and science. *Educational Research and Evaluation, 20*(2), 122-145. doi:10.1080/13803611.2014.885844

Pressley, M., Wharton-McDonald, R., Mistretta-Hampston, J., & Echevarria, M. (1998). Literacy instruction in 10 fourth grade classrooms in upstate New York. *Scientific Studies of Reading, 2*(2), 159-194. doi: 10.1207/s1532799xssr0202_4

Pruitt, S. L. (2014). The next generation science standards: The features and challenges. *Journal of Science Teacher Education, 25*(2), 145-156. doi:10.1007/s10972-014-9385-0

Reid, M. J. (2014). Ethic of practicality analysis of successful group curriculum planning by teachers. *Interchange, 45*(1-2), 75-84. doi:10.1007/s10780-014-9222-6

Regan, K., & Berkeley, S. (2012). Effective reading and writing instruction: A focus on modeling. *Intervention in School and Clinic, 47*(5), 276-282.

Ritchhart, R., Turner, T., & Hadar, L. (2009). Uncovering students' thinking about thinking using concept maps. *Metacognition Learning, 4*(2), 145-159.

Rogers, L. A., & Graham, S. (2008). A meta-analysis of single subject design writing intervention research. *Journal of Educational Psychology, 100*(4), 879-906.

Ross, D. K. & Cartier, J. L. (2015). Developing pre-service elementary teachers' pedagogical practices while planning using the learning cycle. *Journal of Science Teacher Education,* 26(6), 573-591. doi:10.1007/s10972-015-9439-y

Rumohr, F. (2013). Reflect and inquiry in stages of learning practice. *Teaching Artist Journal 11*(4), 224-233.

Rusman, (2015). Curriculum implementation at elementary schools on "Best Practices" done by elementary school teachers in planning, implementing, and evaluation the curriculum. *Journal of Education and Practice 6*(21) 106-223.

Sharratt, L., & Fullan, M. (2013). Capture the human side of learning: Data makeover puts students' front and center. *Journal of Staff Development, 34*(1), 44-48.

Sheehy, M. (2002). Illuminating constructivism: structure, discourse, and subjectivity in a middle school classroom. *Reading Research Quarterly, 37*(3), 278-308.

Sibold, C. (2011,Winter) Building English language learners' academic vocabulary strategies & tips. *Multicultural Education*, 24-28.

Sims, D. (2001). *Improving student writing using reading and writing integration strategies.* (Master's Thesis, Saint Xavier University, 2001). Retrieved from www.files.eric.ed.gov

Smith, T. (2014). Lesson planning. *Research Starters*, 1-6.

Spiegel, J. (2003). The metacognitive school: Creating community where children and adults reflect on their work. *New Hampshire Journal of Education, 2*, 48-54.

Steel, K. A. (2009). *Thinking Maps and School Effectiveness: A Study of a UK Comprehensive School.* Retrieved from http://www.thinkingfoundation.org/research/case_studies/st-roberts/st_robert.html

Steiner, D. M. (2014). Labor market, world: The limits to growth. *Value Inquiry Book Series.* Retrieved from http://www.brill.com/online-resources

Stoelinga, S. R. (2011). Pressuring teachers to leave: Honest talk about how principals use harassing supervision. *Phi Delta Kappa, 92*(4), 57-60.

Tani, S. (2014). Geography in the Finnish school curriculum: part of the 'success story'? *International Research in Geographical and Environmental Educations 23*(1), 90-101.

The Thinking Foundation. Retrieved from www.thinkingfoundation.org

Thinking maps. Retrieved from http://www.thinkingmaps.com

Uccelli, P., Galloway, E. P., Kim, H. Y., & Barr, C. D. (2015, Spring). *Core academic language skill: Moving beyond vocabulary knowledge to predict reading* comprehension. *SREE*

U. S. Department of Health, Education, and Welfare, Office of Education. (1966). *Towards excellence in teaching* (Publication No. ED015143).

Van Booven, C. (2015). Revisiting the authoritative-dialogic tension in inquiry based elementary science teacher questioning. *International Journal of Science Education, 37*(8), 1182-1201. doi:10.1080/09500693

Walker, G. (2013). Glimpses of utopia: A lifetime's education. *International Schools Journal, April 2014*(2), 8-15.

Walker, G. (2014). The significance of Jerome Bruner. *International Schools Journal 33*(2).

Wallace, C. S. (2012). Authoritarian science curriculum standards as barriers to teaching and learning: An interpretation of personal experience. *Science Education, 96*(2), 291-310.

Wang, C. (2011). *International Education Studies 4*(3). doi:10.5539/ies.v4n3p62

Wattsjohnson, Y. M. (2005). Quilting for social change. *Teaching Artist Journal, 3*(3), 175-183.

Weathers, J. M. (2011). Teacher community in urban elementary schools: The role of leadership and bureaucratic accountability. *Education Policy Analysis Archives, 19*(3), 1-42.

Weiss, L. A. (2011). *The effect of thinking maps on students' higher order thinking skills*. (Doctoral dissertation). Retrieved from www.csun.edu. (86786.)

Weiss, T. H. (2013). Any questions? Want to stimulate student curiosity? Let them as the questions! *Science and Children, 50(*9), 36-41.

Wenke, J. (2009). *McKinley Elementary School:* Retrieved from http://www.thinkingfoundation.org/research/case_studies/mckinley/mckinley_cs.html

Wessels, S. (2013). Science as a second language: Integrating science and vocabulary instruction for English language learners. *Science and Children*, *51*(1), *50*-53.

Wharton-McDonald, R.., Pressley, M., Mistretta-Hampton, J. (1997). *Outstanding literacy instruction in first grade: Teacher practices and student achievement.* (Report No. 81). Washington, D.C.: Office of Education Research and Improvement.

White, M. J., & Bruning, R. (2005). Implicit writing beliefs and their relation to writing quality. *Contemporary Educational Psychology, 30*(2). 166-189.

Wysession, M. E. (2013, April/May). The next generation science standards and the Earth and space sciences: The important features of Earth and space science standards for elementary, middle, and high school levels. *Science and Children,* 17-23.

Yu, F.-Y., & Chen, Y.-J. (2013). Effects of student-generated questions as the source of online drill-and practice activities on learning. *British Educational Research* *45*(2), 316-329.

Appendix: The Project

Thinking Maps and Science Instruction

## Introduction

Statistically significant results found in the study using Thinking Maps and Write from Beginning…and Beyond on writing achievement prompted the development of this curriculum plan. This curriculum was developed to address low science scores based on results from the 2015 measure of academic performance at the local school. The results of the state fifth grade science test at the local school is represented in Table 1. This nine week plan offers students hands on, investigative, and inquiry based lessons. The author of *A Language for Learning* and *Write from the Beginning…and Beyond* recommend using this program cross curricular in the content areas.

Table A1

*Results of the State Fifth Grade Science Test at the Local School*

| State Science Scores | 2014-2015 |
|---|---|
| % Limited Command | 56.9 |
| % Moderate Command | 34.5 |
| % Strong Command | 8.6 |
| % Distinguished Command | 0 |
| % Strong and Distinguished Command | 8.6 |

I created this curriculum plan to address the need to increase test scores in science at the local school. This unit of study is based on the theory that cross curricular transfer of Thinking Maps to other content areas will improve science achievement at the local school. Thus, it is crucial to execute this unit to increase student learning in science which in turn will increase test scores at the local school.

This unit of study is written using third grade state level expectations. It has the capacity to be implemented by third grade teachers at the local school as well as schools throughout the state and universally. For the purposes of immediate use the local school will implement the curriculum in the third grade. This grade is chosen in order for later grade levels to continue to build upon concepts and skills used through Thinking Maps.

Goals for this nine week unit are modeling the use of Thinking Maps for students, gradual release to students to create and show ownership of their maps, and assessment of student success as well as teacher success. The nine week Earth Science unit may begin at any time during the school year. When the nine week period of instruction is selected, planning will begin. Third grade teachers will plan before implementation begins.

## Project Goals and Learning Outcomes

Third grade teachers will work together to implement the nine week Earth Science unit at the local school. Goals for this nine week unit are modeling the use of Thinking Maps for students, a gradual release to students to create and own their maps, and assessment of student success as well as teacher success. The nine week Earth Science unit may begin any time during the school. In the past, Thinking Maps showed significant results in increasing writing achievement. This use of Thinking Maps is transferable across content area, one of which is science.

**Description of Thinking Maps**

Each of the eight Thinking Maps are used to organize thinking in different ways. The thinking process used in a Circle Map is defining in context. This map is made up of two concentric circles with key ideas placed in the inner circle and what is known about the key ideas in the outer circle. The Bubble Map looks like a web but is only used with adjectives or adjective phrases. This map is used for describing qualities. The key idea is in the center and the outlying bubbles hold the descriptors. A Double Bubble Map is similar to a Venn diagram. It is used for comparing and contrasting characteristics. Tree Maps are used for classification and organization and is a way to outline the main topic, main ideas, and details. A Brace Map is used to show part to whole. The whole can be broken into parts and subparts. The Flow-Map is used for sequencing events. It may also contain sub-stages of the events. A Multi-Flow Map is used to show cause and effect. The event is placed in the middle and the causes come before the event and the effects after the event. The eighth map is a Bridge Map. This map uses analogies and metaphors. A Bridge Map is used to show a relationship between the concrete and abstract.

The choice of the Thinking Map to use is based on the organizational method which is needed for the lesson. Not all Thinking Maps are necessary for this Earth Science unit. A Bridge Map is not necessary as none of the lessons call for organizing thinking from the concrete to the abstract. The maps chosen below are based on the thinking process students may use for each week’s learning.

**Implementation Timeline**

Table 2 below provides week by week lessons, the appropriate Thinking Map to use, and the reasoning behind using the map.

Table A2 *Week by Week Guide of Earth Science Unit*

| **Lesson** | **Thinking Map** | **Thinking Process** |
| --- | --- | --- |
| Week 1: Layers of the Earth | Tree Map | A Tree Map is used for this lesson to organize information about each of Earth's layers. The four layers are the main ideas of the lesson and the details provide description of each layer. |
| Week 2: Landforms | Bubble Map | A Bubble Map is used for describing things using adjectives and/or adjective phrases. Each of the landforms studied; plains, plateaus, mountains, oceans, valleys, and continents have distinct adjectives to describe them. |
| Week 3: Types of Rocks | Tree Map | A Tree Map is used for this lesson to organize information about each type of rock. Igneous, sedimentary, and metamorphic rock are the main ideas of this lesson, and the details provide description of each type. |
| Week 4: The Rock Cycle | Multi-Flow Map | A Multi-Flow Map is used for this lesson to show how temperature and pressure effect the rock cycle. |
| Week 5: Minerals | Double Bubble Map | A Double Bubble Map is used for this lesson to compare and contrast the properties of minerals. |

| | | |
|---|---|---|
| Week 6: Components of Soil | Brace Map | A Brace Map is used for this lesson to identify the whole, soil, and then break down the whole into the layers of soil. |
| Week 7: Weathering and Erosion | Flow-Map | A Flow Map is used for this lesson to show a sequence of events. This map will show what happens when weathering and erosion occur. |
| Week 8: Natural Disasters | Multi-Flow Map | A Multi-Flow Map is used for this lesson to show a sequence of events. This map will show what happens when a natural disaster occurs. |
| Week 9: Earth's Resources | Circle Map | A Circle Map is used for this lesson to show key ideas, the resources; minerals, rocks, sand, and oil, and show what students know about each. |

The Thinking Maps for this unit of study are; a Circle Map, a Bubble Map, a Double Bubble Map, a Flow-Map, a Multi-Flow Map, and a Brace Map. It is important to model the map used for the week on day one of the week. Students make their maps by replicating each step in their science notebook. You can check student understanding by walking around the room and observing while they work.

The Circle Map is the planning tool used for this unit. Topics to teach each week are listed and the order in which to teach each topic is written above. The Circle Map is shown in Figure 1 and serves to guide this Earth Science unit.

**Week by Week Science Unit**

## Maps Activities Exemplars


*Figure*: *A1*: Model of teacher planning for Earth Science unit using a Circle Map.

Week one focuses on the layers of the earth. Use a Tree Map to model the components of Earth's layers. Begin with the heading, Layers of the Earth. Underneath, write the four layers. Lastly, write descriptors of each layer. Students should copy this in their science notebooks. An example of this Tree Map is presented in Figure 2. An accompanying activity for the week is shown in Figure 3.

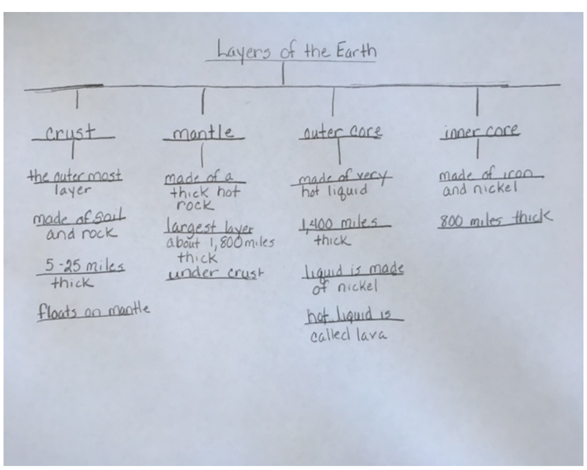



*Figure A2*: Layers of the earth using a Tree Map.

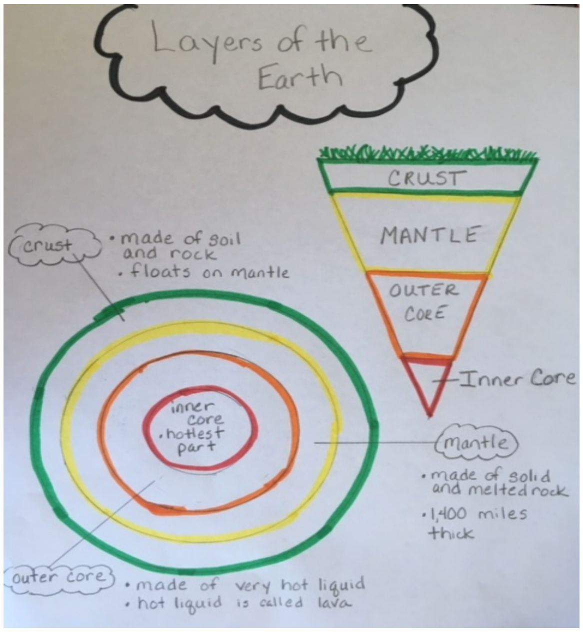



*Figure A3*: Exemplar of student work to demonstrate learning of week one.

Week two focuses on Earth's landforms. A Bubble Map is used to show Earth's landforms during week two. The name of the landform is placed in the center of the Bubble Map. Choose adjectives and/or adjective phrases to describe the landform. Place these around the landform circle using spokes to connect each adjective and/or adjective phrase. Chose any number of landforms to teach. The same method is used for each landform. Students write each landform using the Bubble Map on separate pages in their notebook. Figure 4 shows an example of a Bubble Map using the landform, plains. Figure B5 shows a cumulative activity to follow this week's lesson.

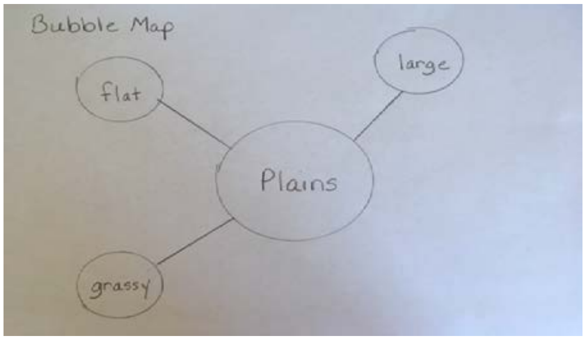



*Figure A4*: Bubble Map which displays adjective for the landform plains.

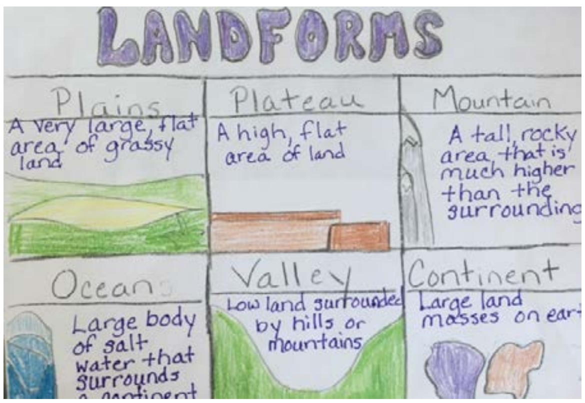



*Figure A5*: Exemplar of student work to demonstrate learning of week two.

A Tree Map is again used for week three. Students may recall parts of a Tree Map from week one but will need further modeling. Start the map with placing the topic, Rocks, as the heading. Below, write the three types of rocks; igneous, sedimentary, and metamorphic. Last of all, write descriptors beneath each. An example of this is shown in Figure 6.

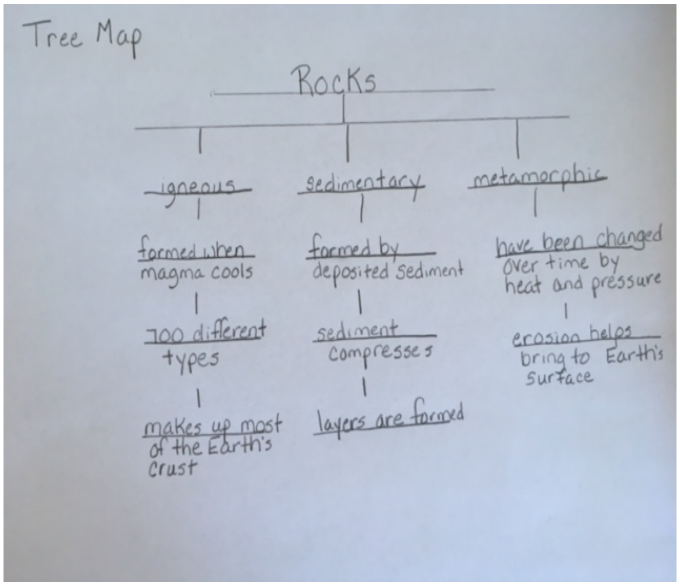



*Figure A6*: Types of rocks using a Tree Map.

A Flow Map is used to demonstrate the rock cycle during week four. Place the three types of rock in separate rectangles across the top of the paper. Use an arrow between each type to show this as a sequence. Underneath each type of rock place what causes each rock to move through the cycle. Figure 7 shows a model of this Flow Map. Figure 8 shows an example of a cumulative activity.

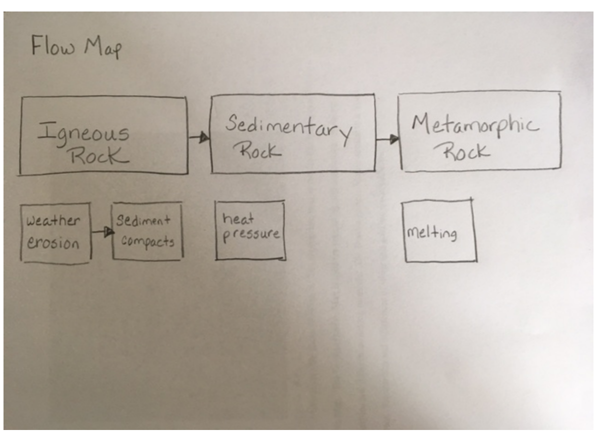



*Figure A7*: Flow Map showing the flow of the rock cycle.

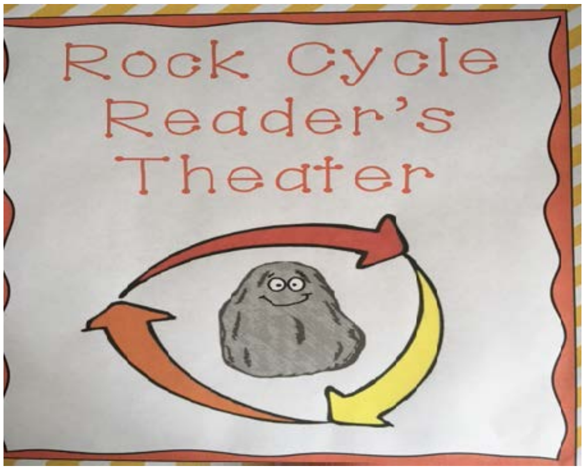



*Figure A8*: A reader's theater activity to reviews the types of rocks and the rock cycle.

During week five students learn about minerals. The map used for this lesson is a Double Bubble Map. A Double Bubble Map compares and contrasts and is similar to a Venn diagram. An example of two minerals to compare are gold and silver. Place the name of a mineral in a circle one-third and two-thirds, respectively, in the center of the paper. Contrasts are arranged on the outside of the mineral using a spoke to connect the contrast to the mineral. Place similarities in the center between the minerals. These, too, are attached but are connected to both minerals. A Double Bubble Map may be used to compare and contrast other minerals. Students use a clean page in their science notebook for each map created. Figure 9 models a Double Bubble Map comparing and contrasting silver and gold. As a cumulative activity students may make a Power point as a way to show their learning. A link to display of how this might look like comes after Figure 9.

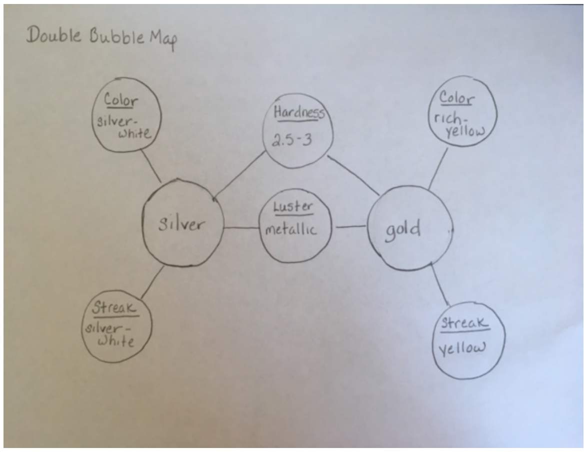



*Figure A9*: Double Bubble Map to compare and contrast minerals.

Students may use a Power point presentation to display their learning of minerals. A framework of what to include in the Power point is presented by the teacher. Students may choose the mineral they would like to study. The Power point presentation below is an example of a concluding project for week five.

Mineral PP.pptx

A Brace Map is used for week six. The topic of week six is the components of soil. A Brace Map shows how the parts of soil are broken down from whole to part. In the center, approximately ½ inch from the left border, write soil layers on a vertical line. Use curly brackets to separate the parts of soil from the soil layers. The soil layers: humus, topsoil, subsoil, and bedrock are written on four horizontal lines. The soil layers are then further broken down into substances that comprise each layer. Again, use curly brackets to separate these. An example of a Brace Map displaying soil layers whole to part along with a visual exemplar are illustrated in Figures 10 and 11

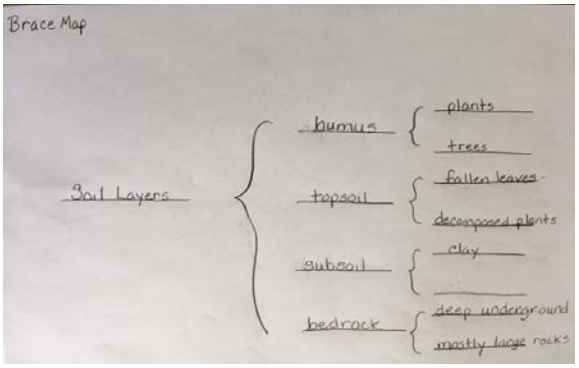



*Figure A10*: Brace Map showing the whole to part.

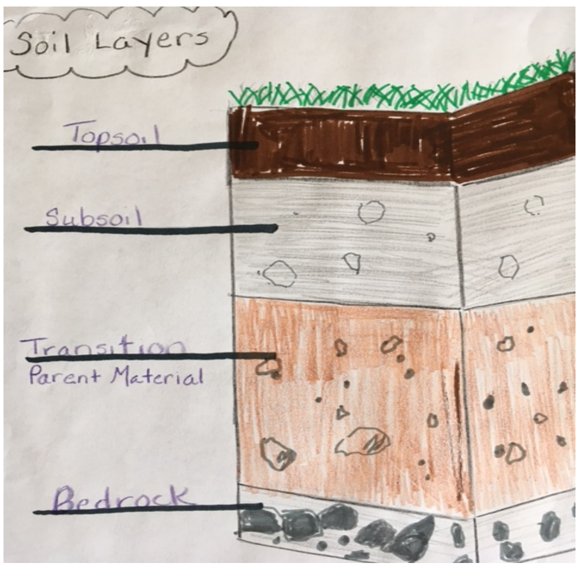



*Figure A11*: A visual example showing the layers of soil.

The Flow-Map shown in Figure 12 displays the flow and causes of weathering and erosion. The words weathering and erosion and the initials of each are placed in individual rectangles at the top of the paper. Arrows between connect the rectangles to show the progression. Because there is not room at the top of the page draw an arrow from right to left and bring down to continue the flow to the word deposition. The combination of weathering, erosion and deposition ends the flow. The sub-stages of weathering, erosion, and deposition are written boxes below these topics respectively.

Figure 13 is an experiment in which students may demonstrate concepts learned during the week.

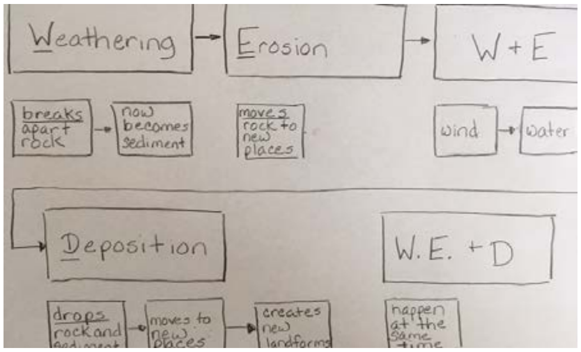
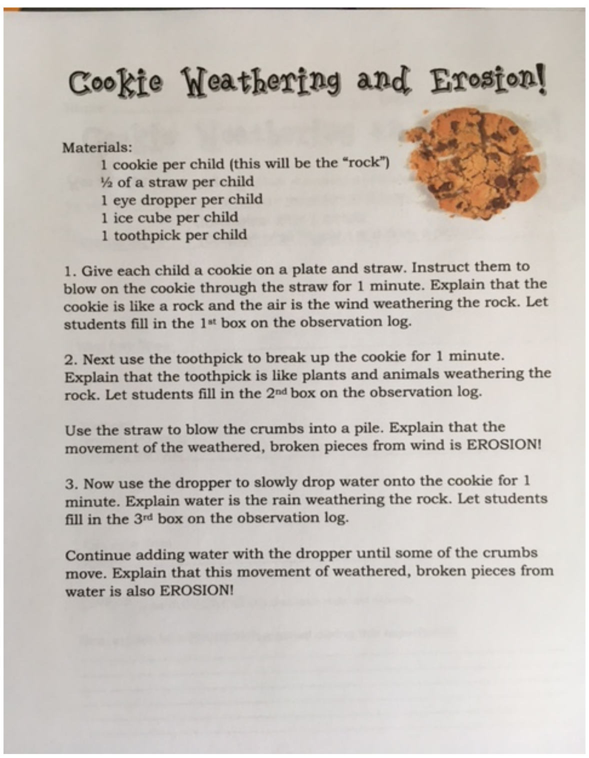



*Figure A12*: The flow of the process of weather, erosion, and deposition.



Cookie Weathering and Erosion!

Materials:

1 cookie per child (this will be the "rock")
½ of a straw per child
1 eye dropper per child
1 ice cube per child
1 toothpick per child

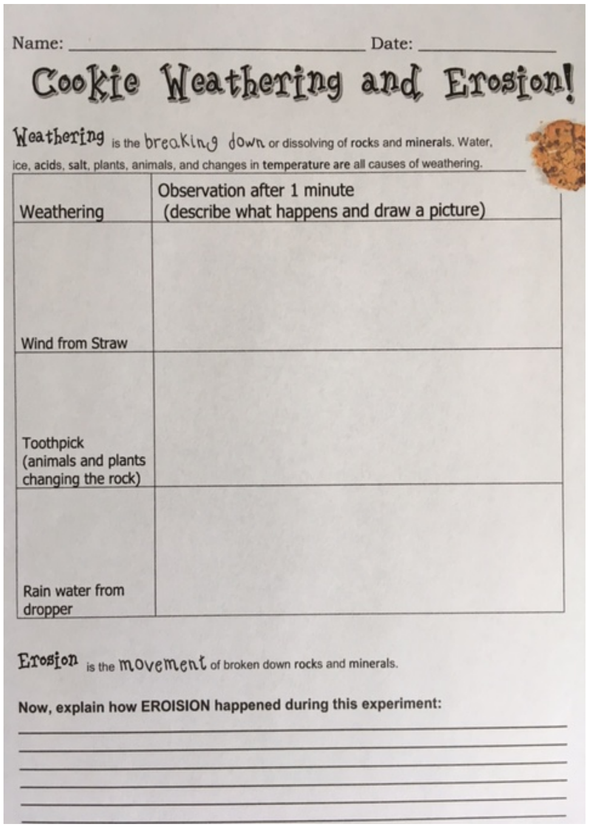
1. Give each child a cookie on a plate and straw. Instruct them to blow on the cookie through the straw for 1 minute. Explain that the cookie is like a rock and the air is the wind weathering the rock. Let students fill in the 1st box on the observation log.

2. Next use the toothpick to break up the cookie for 1 minute. Explain that the toothpick is like plants and animals weathering the rock. Let students fill in the 2nd box on the observation log.

Use the straw to blow the crumbs into a pile. Explain that the movement of the weathered, broken pieces from wind is EROSION!

3. Now use the dropper to slowly drop water onto the cookie for 1 minute. Explain water is the rain weathering the rock. Let students fill in the 3rd box on the observation log.

Continue adding water with the dropper until some of the crumbs move. Explain that this movement of weathered, broken pieces from water is also EROSION!



Name: ____________________ Date: __________

Cookie Weathering and Erosion!

Weathering is the breaking down or dissolving of rocks and minerals. Water, ice, acids, salt, plants, animals, and changes in temperature are all causes of weathering.

| Weathering | Observation after 1 minute (describe what happens and draw a picture) |
|---|---|
| Wind from Straw | |
| Toothpick (animals and plants changing the rock) | |
| Rain water from dropper | |

Erosion is the movement of broken down rocks and minerals.

Now, explain how EROISION happened during this experiment:

*Figure A13*: Cookie weathering erosion experiment.

A Multi-Flow map is used for week eight, natural disasters. This map is used to show cause and effect. Choose an example of a natural disaster. Firs,t place the name of the natural disaster in a rectangle in the center of the paper. To the left place what causes this disaster. Use arrows to point these causes to the natural disaster. On the right side use arrows pointing out to show the effect of these causes. Figure 14 shows an example of the cause and effect of a volcanic eruption. Figure 15 shows a game that students may play to demonstrate learning.

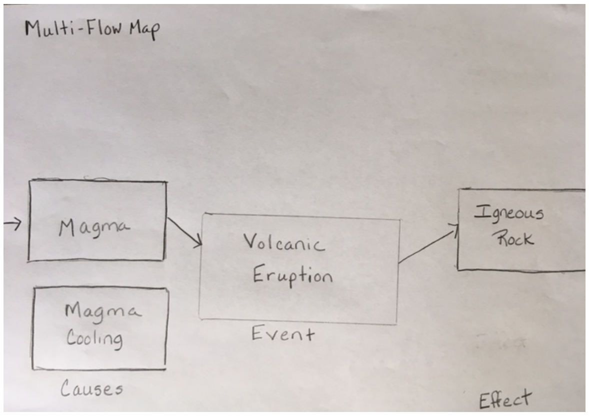
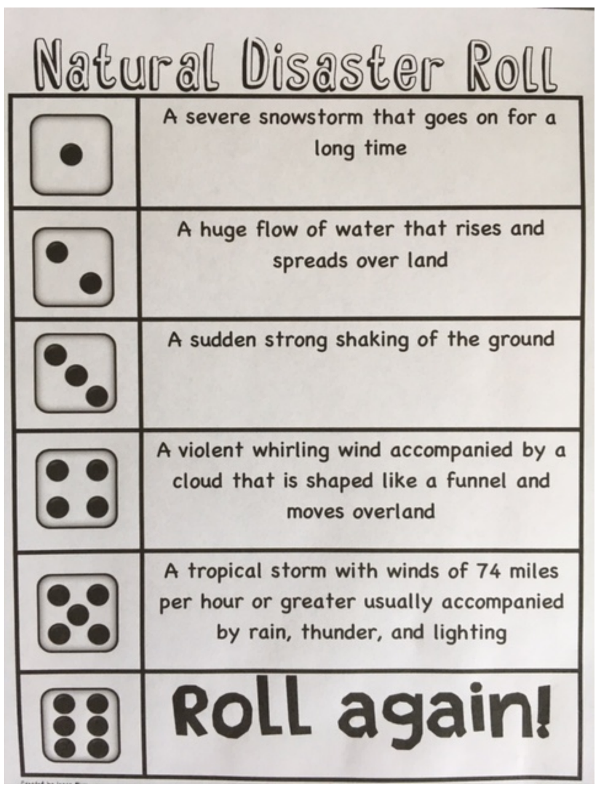



*Figure A14*: Multi-Flow Map model of the causes and effect of a natural disaster.



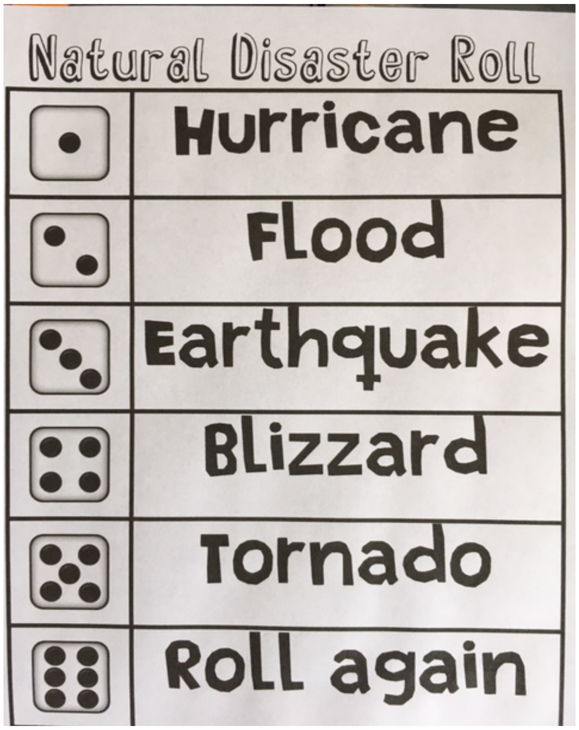



*Figure A15*: Game to review different types of natural disasters.

To display cause and effect of natural disasters a Multi-Flow Map is demonstrated below. The example used is volcanic eruption. Place the event in the middle of the page. The event is the volcano in this example. The causes of volcanic eruption are magma and magma cooling. The causes are placed to the left of the event with arrows pointing to the effect. The effect of the magma, magma cooling, and the volcanic eruption is igneous rock. The event is the volcanic eruption and the effect of the eruption is igneous rock. The map is shown in Figure 16.

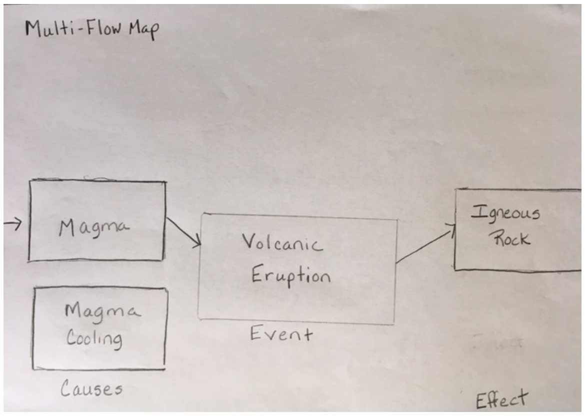



*Figure A16*: Multi-Flow Map portraying the cause and effect of a volcanic eruption.

Week nine is the last of the Earth Science unit. Topics during this week include natural resources and man-man resources. A Circle Map is used for both of these. In the first Circle Map place the words natural resources in the inner circle. In the outer circle place examples of natural resources. Inside of the rectangle provide examples of natural resources and how they are used and why they might be necessary. The same procedure is also completed for man-made resources. Both Circle Maps are shown in Figure 17 and Figure 18.

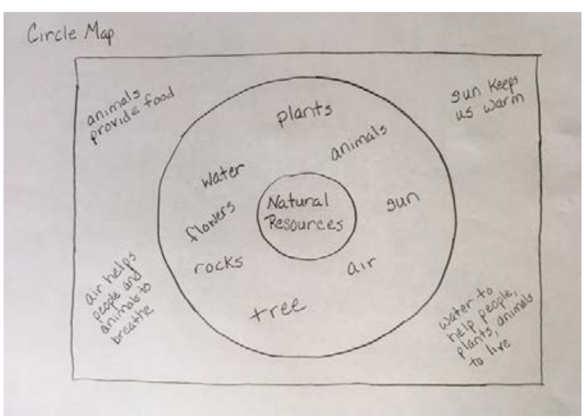



*Figure A17*: Circle Map showing natural resources, examples, and why they may be important.

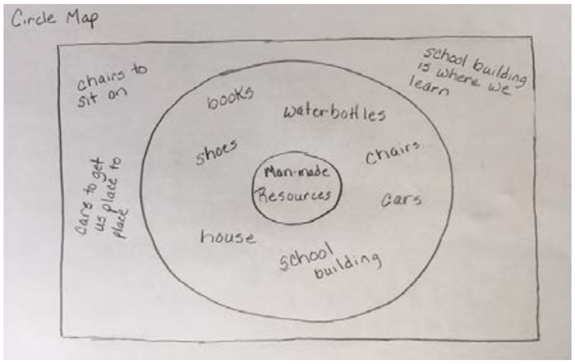



*Figure A18*: Circle Map showing natural resources, examples, and why they may be important.

To accompany week nine, Earth's Resources, four Earth Day activities are presented below. These activities offer suggestions for cumulative activities in which students may engage. Eliciting help from other grade levels is an option to sustain these activities. Also, students may establish other activities for Earth Day.

- set up a recycling center at school
- plant a school garden
- make bird feeders
- organize walk to school days

Thinking Maps naturally provide assessment of student learning and teacher use. An evaluation of the maps, either during or after construction, reveals if they show the appropriate thinking process for the lesson. This evaluation is the same for both the student and teacher. One to one conferences with students will strengthen knowledge of how to choose and execute the maps correctly. The examples of the maps in Appendix A are models in which to evaluate both teacher and student. The ease of both teacher and student evaluation is a highlight of the use of Thinking Maps.

**Teacher Survey**

An informal survey contributes teacher voice in their use of Thinking Maps. Table 3 displays questions in this survey. The survey leads to an informal, non-threatening discussion of the maps and their implementation. The survey itself is not to be collected but rather used to be a springboard for the discussion.

Table A3 *Informal Teacher Survey*

| | |
|---|---|
| Question 1 | What are your thoughts on the ease of implementation in your classroom? |
| Question 2 | How do you feel now? |
| Question 3 | How did students react to using the maps? Were the reactions positive or negative? |
| Question 4 | Were you able to assess student learning based on examples of their maps? |
| Question 5 | Did you feel prepared to introduce each of the maps? |
| Question 6 | How might you use the maps in different content areas? |
| Question 7 | Were the maps useful in understanding students' thinking processes? |
| Question 8 | Were students able to transfer their thinking to the content taught? |
| Question 9 | Other comments, suggestions, feelings? |

## Conclusion

This nine week curriculum plan provides teacher with weekly lessons which include specific Thinking Maps for each lesson as well as example of each map, the reason why the specific map is used, and student product exemplars. Needed materials require little time for teachers to gather. These materials include paper or notebook to model each of the maps during instruction, masters of games including dice, Reader's Theater, and Weathering and Erosion experiment supplies; straws, toothpicks, and water dropper. Access to a projector and screen is also needed. Student materials required are also limited in scope. Necessary materials are crayons, science notebook, and access to a laptop or computer. Several resources that may be useful are listed below.

**References**

Hyerle, D., & Yeager, C. (2007). *A language for learning*. Cary Indiana: Thinking Maps, Inc.

Landforms. Retrieved from https://www.pinterest.com/aessner/ss-unit-2/

Layers of the Earth. Retrieved from https://www.teacherspayteachers.com/Product/Earth-Science-Interactive-Notebook-1321667

Natural Disasters. Retrieved from https://www.teacherspayteachers.com/Product/Natural-Disasters-Dice-Roll-2485857

Rock Cycle. Retrieved from https://www.teacherspayteachers.com/Product/The-Rock-Cycle-Readers-Theater-1108922

Soil Layers. Retrieved from https://www.pinterest.com/funibunismith/soil/

Thinking Foundation. Retrieved from https://www.thinkingfoundation.org

Thinking Maps. Retrieved from https://www.thinkingmaps.com

Weathering and Erosion. Retrieved from https://www.teacherspayteachers.com/Product/Interactive-Cookie-Weathering-and-Erosion-Experiment1177206