JTAR

EDITORS

GIL NAIZER
APRIL SANDERS
LAURA ISBELL
TAMI MORTON
SUSAN WILLIAMS

Journal of Teacher Action Research - Volume 5, Issue 1, 2018,
practicalteacherresearch.com, ISSN # 2332-2233

JTAR

Journal of Teacher Action Research
Volume 5, Issue 1, 2018

THE VALUE OF INTEGRATING SCIENCE AND LITERACY FOR STRUGGLING STUDENTS

Emily A. Holtz

Texas A&M University

Lynne Masel Walters

Texas A&M University

Abstract With the implementation of Common Core Standards in 2010 came the mandate that students would be reading 50% nonfiction by fourth grade, 55% nonfiction by middle school, and 75% nonfiction by high school (National Governors Association, 2010). As a result, Common Core aligned curricula now include many science-based nonfiction texts. With greater importance placed on informational text, students are facing more challenges in vocabulary and overall understanding of the texts. Many texts are science-based; however teachers have been forced to push the science aside to fill gaps in reading. Hands-on science lessons are being dropped in favor of teaching more reading strategies (Vick, 2016). This presents teachers with challenges in engaging their students in the lessons and students with challenges in learning science vocabulary and understanding the text. To address these challenges, a research project, implemented in a third grade inclusion classroom in New Mexico, combined applied science and reading. The purpose was to determine if student understanding, engagement and achievement are affected when hands-on science lessons are integrated into the existing ELA curriculum. Results of the study showed that students demonstrated increased understanding of academic vocabulary and text, increased interest in informational books, and increased scores when writing to an informational task.

Keywords: teacher action research, science education, content area literacy, hands-on learning, nonfiction units of study, student engagement, informational writing

Introduction

It is another busy day in a third grade classroom in New Mexico. Students are settling in after returning from recess and are ready to start the reading lesson about their newest informational text, *Weather,* by Seymour Simon. This is a Lexile Level of 1065, a text considered appropriate for seventh graders; therefore it is recommended that this text be read

with adult guidance. Although this level of text is inappropriate in a third grade classroom, it is part of the required curriculum for the district and included in the day-to-day lessons. Students are asked to use illustrations, graphics, and the text itself to ask and answer questions pertaining to cloud types, the water cycle, types of precipitation and how this precipitation is formed, as well as ocean currents and wind patterns across the world.

Needless to say, students immediately begin to struggle to make sense of this text. They are lacking in background knowledge and they are quickly losing interest in the task at hand. Students find it difficult to discuss this book and engage in their typical think-pair-share routine. The Common Core Standards pertaining to reading informational text discusses reading texts that are rigorous and include high academic vocabulary (Shared Responsibility, 2017). Comprehension strategies are used to teach this text, but the teacher believed that there must be a more engaging method to build understanding along with reading proficiency.

In thinking about Common Core, we can look to 2010. This is when New Mexico adopted the Common Core State Standards (CCSS), along with 44 other states and the District of Columbia (Shared Responsibility, 2017). Many districts in New Mexico found their students ill-prepared to meet the new, more rigorous standards in the Common Core. The district where this third grade classroom is located deemed it appropriate to adopt new curricula in English Language Arts (ELA) and mathematics to fill the gaps that the New Mexico State Standards created.

The newly adopted ELA curriculum meets the third grade CCSS requirement of a 50/50 split between informational texts and literary texts. With greater importance placed on informational text, students are facing more challenges in vocabulary and overall understanding of the texts. Many texts are science-based. However teachers have been forced to push science aside to fill gaps in reading. When science is neglected in favor of more reading instruction in K-3, students are behind in their science knowledge when they begin fourth grade. The focus of this research will be on the informational piece of the district-mandated curriculum. Because this curriculum has a heavy science component in regards to reading, the research considered whether student understanding and engagement are affected when hands-on science lessons are integrated into the existing ELA curriculum.

Literature Review

The scope of research pertaining to science and literacy integration is expansive, but much of it focuses on the importance of using literacy to support science concepts, rather than using science to enhance literacy. Previous research demonstrates the use of reading, writing, and oral language to support students' ability to understand abstract science ideas (Sterling & Goor, 1998). While the current project looks at the science/literacy relationship from the reverse direction, evidence can be found in previous research that, when the curriculum integrates science and literacy, students show improvement in oral and written language, as well as in overall comprehension of the literature related to the particular science subject (Sterling & Goor, 1998).

Research shows that, by integrating science and ELA, students' understanding, motivation and engagement increase (Fello, Raquette, & Jalongo, 2006; Guzzetti & Bang, 2010; Neuman, Kaefer, & Pinkham, 2016; Wheatley, Gerde, & Cabell, 2016). Neuman *et al.* (2016) explain that integration of high interest science concepts and vocabulary instruction enables students to compare and contrast across a variety of texts using common vocabulary to support their reasoning. With the utilization of vocabulary across content and context, student comprehension was enhanced.

Vocabulary is not the only recorded improvement when integration is involved; writing also is improved. Wheatley *et al*. (2016) contend that "incorporating writing opportunities into science creates a necessary symbiotic relationship that promotes both writing and science in ways that cannot be accomplished if these areas were taught independent of the other" (p. 84). Research in this area demonstrates that, when students are able to apply scientific practices to reading and writing, they find science more comprehensible and exciting.

This is especially true for students with special needs. Today, many schools, such as the one studied here, have inclusive environments, meaning that there are general education students, special education students and English Language Learners (ELL) in the same classroom. In these inclusive settings, it is difficult to engage all students. It is also difficult to help special education students and ELL students make sense of above-grade level texts. Sterling and Goor (1998) argued that hands-on science would help because it "provides endless opportunities for students to develop the language arts skills of reading, writing, speaking, and listening" (p.124). Lee and Buxton (2013) maintain, "literacy involves learning to think and reason. It also involves learning to view and visually represent ideas and information, as well as in text" (p.38) The research concludes that subgroups of students, created by language and ability, will only benefit from hands-on science activities.

Overall, the literature advocates for integrating science and literacy in any classroom for any age because this is advantageous for student understanding of complex scientific texts. The elementary school in which this research took place struggles from year to year to move its lowest scoring students forward. This research will help to determine if integrating hands-on science and literacy can help theses students' progress.

Research Questions

- How will student understanding of key vocabulary be affected when vocabulary is taught across the contents of English Language Arts and Science?
- What is the impact of the integration of hands-on science lessons into the reading process on students' level of interest in informational texts?
- How does hands-on science instruction impact students' ability to write an informational piece over a prescribed topic?

Methodology

Participants. This study took place in a third grade classroom in a fast growing mid-sized city (100,000+) in New Mexico. Of the twenty-five students, 44% were non-Hispanic White, 40% Hispanic, 8% Black, and 8% were Native American. This matches the make-up of the school. Seventeen of the twenty-five students received free or reduced priced lunch. This class was also an inclusion setting, meaning that some students participated in an Individualized Educational Program (IEP). Seven students had an IEP due to a Specific Learning Disability (SLD). Of these seven, three also received Speech services in the areas of articulation and language development. One student, who has been diagnosed with autism, qualifies for special education in the areas of Speech and SLD.

The school is rated "D" by the New Mexico Public Education Department (PED). This rating is based on an A, B, C, D, F scale, with A being highest and F lowest. It is considered a D school because of its inability to demonstrate sufficient growth from year to year and to move the lowest students ahead on the state's standardized exam. This test consists of a fifty-fifty split between informational and fictional texts and examines students' ability to determine the meaning of words. It also measures a student's writing skills, as assessments include the narrative, explanatory and opinion genres. Because the third graders will be tested over comprehension, vocabulary and writing, this research will examine achievement in all three areas.

Instructional Practice. As part of the district's core curriculum, each teacher is required to teach English Language Arts (ELA) for 120 minutes daily. Each teacher also has science kits provided by the Smithsonian Institute. The ELA Module being implemented here is "Seeking Explanations." This unit took approximately three weeks to complete. Students read two informational texts, *Weather* by Seymour Simon and *Living Through a Natural Disaster* by Eve Recht. Each of these texts is adult directed, meaning that the teacher reads the texts aloud. After reading, students answered questions that they first discussed with a partner and then shared with the whole group.

The questions were written by the curriculum developers to be part of the core of instruction. These questions challenged students to review the text in order to answer accurately. Students also had an opportunity to explore vocabulary and determine word meaning through discussions over the texts. The Smithsonian science kit, which provided the hands-on experience, was related to "Seeking Explanations" because students were asked to observe and explain the effects of water on land through the use of stream tables. It utilized stream tables made of plastic storage containers with sand, gravel, clay, and humus. Divided into groups of four, students had to mix these components and then would use various methods to pour water through the system.

In one lesson they determined that more water flowing led to more erosion and deposition. In another, students concluded that water moved around large objects within the stream table. At

the beginning of each lesson students were asked a focus question. Their experiments, observations and discussions should enable students to answer the question by the end of the lesson. Each focus question incorporated the key vocabulary from the two informational texts. The science portion of the unit was taught for one week in conjunction with the ELA unit and two weeks following the wrap up of the texts. Students participated in this active research for approximately five weeks.

Along with whole group reading instruction, students also had independent reading time built into each day. Each week students would book shop within the classroom library. They were able to choose from a variety of texts that interested them. They stored these books in their personal book boxes and read them throughout the week. The independent reading time was approximately 20-30 minutes each day. They could work with a partner or read online texts for an additional 20-30 minutes daily.

Data Tools, Application, and Analysis. Prior to beginning the science lesson, students were given a vocabulary pretest (Appendix A) based on their learning from the texts, *Weather* and *Living Through a Natural Disaster*. The teacher/researcher then incorporated these same words from the text throughout the science lessons and asked students to utilize the words during discussions with science groups and in the observations they wrote in their science notebooks. Following the science unit, students were given the same vocabulary test as a post science test. This allowed the teacher/researcher to compare data to answer the question: *How will student understanding of key vocabulary be affected when vocabulary is taught across the contents of English Language Arts and Science?*

- To measure student interest in informational texts, the teacher/researcher developed an observational tool (Appendix B). Each week for the last three weeks of the research project, the teacher/researcher monitored each student's choice of self-selected texts. This allowed the teacher/researcher to determine *the impact of the integration of hands-on science lessons into the reading process on students' level of interest in informational texts.*

For the final project of the unit, students wrote a newspaper article describing the effects of weather (water) on land and people. This was not a totally new type of assignment. Students had similar projects earlier in the term; for example one writing task was to create a magazine article after researching space. The rubric (Appendix C) for each of these tasks was the same; so the teacher/researcher was able to compare her students' previous writing scores to the score from their newspaper article to determine *How hands-on science instruction impacts students' ability to write an informational piece over a prescribed topic.*

Results and Discussion

Overall, the results of this research project were positive, if only slightly in some areas.

Question 1: How will student understanding of key vocabulary be affected when vocabulary is taught across the contents of English Language Arts and Science?

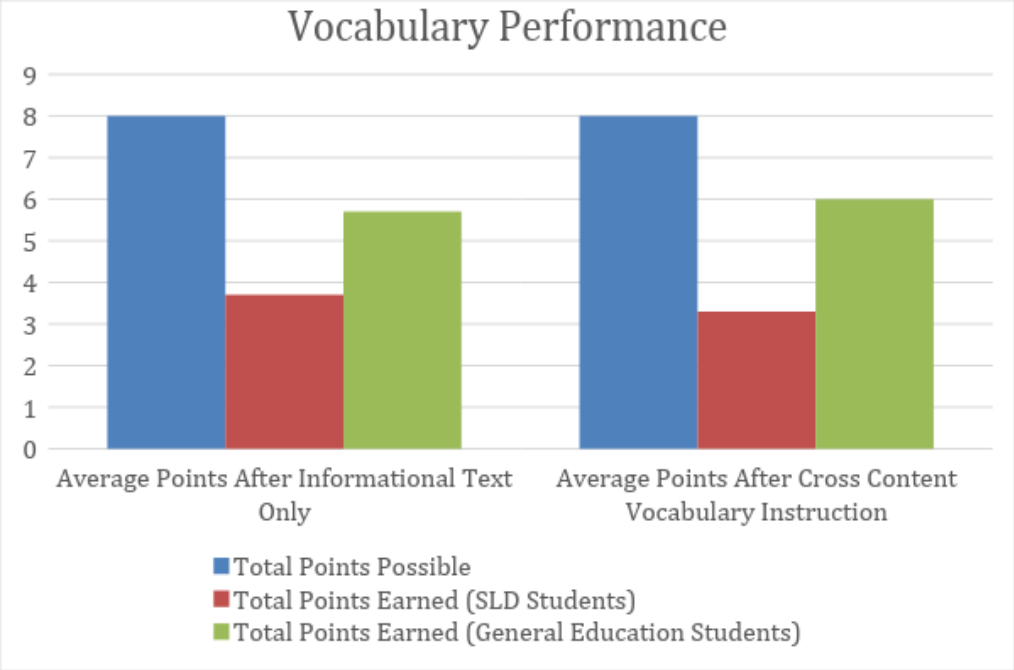
To measure student understanding of vocabulary, students were given a vocabulary test (Appendix A). This test consisted of six multiple-choice questions, two of which had two correct answer choices; therefore there was a possibility of eight total points. The teacher/researcher read each question and answer choice aloud to ensure understanding. The questions were written to correlate to Common Core State Standards

This test was administered after the students read *Weather* and *Living Through a Natural Disaster*. Because the school traditionally struggles in moving the lowest performing students forward, the teacher/researcher provided separate results for Students with a Learning Disability (SLD) and General Education (GE) students. In this initial test, SLD students averaged 3.7 points out of 8 possible points, or an average of 46%. GE students averaged 5.7 points out of a possible 8 points (71%). The range of vocabulary test scores for the first administration was 25% to 100% with two students scoring a 100% and two students scoring 25%. These scores indicate that, for students with SLD, reading the text alone and simply discussing the key vocabulary (precipitation, absorbed, destroy, meander, erosion, monitor) did not lead to proficiency.

This test was given a second time after students had the opportunity to use these same vocabulary words (precipitation, absorbed, destroy, meander, erosion, monitor) during hand-on science activities Along with incorporating these words within the context of the focus questions and discussions, students were also required to use words in context when writing about the effects of land and water after experimenting with stream tables.

The data from the second administration of the vocabulary test showed a slight increase for GE students to 6.0 points earned on average out of 8 points possible. This correlated to a 75% average score, an increase of 4%. Students with SLD showed a decrease in their average, only scoring 3.3 points out of 8 possible demonstrating a drop in percentage from 46% to 41%. The range in the second administration was 13% to 100%, this time with five students scoring 100%. The student with the lowest score in both tests was the student with autism, which brought down the SLD average. The next lowest score in the range was 38%, which was an improvement over next lowest the first test (25%).

Figure 1: Pre and Post Vocabulary Performance



Overall General Education students benefited from the cross content teaching of vocabulary. Students with a Specific Learning Disability also benefited from this type of teaching even though their test results did not show an increase. Observation by the teacher/researcher revealed that the students openly discussed the meanings of these words and used them in the context of writing and discussion during hands-on science lessons. In fact, it was only one student with SLD who showed a decrease in his score therefore lowering the overall results; the other SLD students' scores stayed the same.

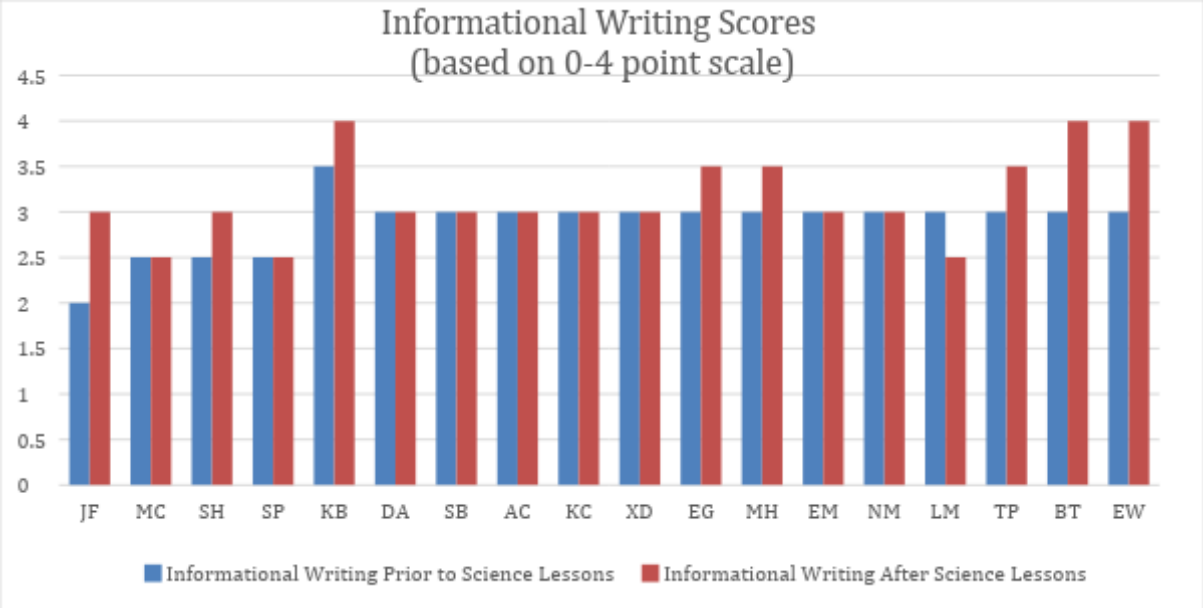
Question 2: What is the impact of the integration of hands-on science lessons into the reading process on students' level of interest in informational texts?

The data are listed in the Appendix and labeled Item B: Observational Checklist. It is evident from this that student interest in informational text increased from week one to week two and three. Students were more interested in learning about weather, land and water and chose texts on these topics during self-selected time. The overall average of informational texts selected for the class in week one was 23.9%. This average increased to 38.8% in week two. In week three, the average percentage of informational texts chosen was 36%. This was not as

high as week two, but was still significantly higher than week one, which was prior to science instruction.

Question 3: How does hands-on science instruction impact students' ability to write an informational piece over a prescribed topic?

Figure 2: Pre and Post Informational Writing Scores



Prior to this lesson, students had other opportunities to write informational texts over a given topic. The grading system is standards based; therefore students receive grades in the range of 1-4. One is significantly below proficiency, two is nearing proficiency, three is proficient, and four is exceeds expectations. Based on the Term 2 average for the writing standards, the class averaged a 2.9 standards based grade. The lowest student score was 2.0 and the highest writing score during Term 2 was 3.5. The median score was 3.0 and 13 students in the class scored 3.0 in Term 2.

After the initiation of the experimental conditions, with science integrated into the reading and writing process, students were asked to write a culminating news article that would capture the ideas behind their created dams and the effects of the water on the land. Many students deviated slightly and created a television report with dialogue and made themselves into newscasters. While this was not the original assignment, the students were extremely excited to take this route and even sought to record their "broadcasts."

Student enthusiasm was reflected in the scores for the writing assignment. The class average rose to a 3.05 standards based grade. This means that while the class was not proficient during Term 2, with a 2.9 average, they rose to proficiency, with a 3.05 average grade. The scores showed an increase to 2.5 for the lowest student score and 3.5 for the highest student score. While in Term 2, only two students scored a 3.5 and four students scored a 2.5, with the second writing task two of the four students increased to 3.0, and five students scored a 3.5.

Another point to note was the engagement of the students and their willingness to participate and to expand the writing process into a published news report. In previous informative/explanatory writing assignments, students have been compliant, but not excited. Given the increase in proficiency as well as this level of excitement regarding the finished product, the hands-on science activities had a positive impact on student writing.

Limitations

There were a number of limitations with this research. The major concern was time. All teachers in the school are required to continue moving forward in instruction of the district-mandated curriculum. This was a difficult task, requiring that the day be rearranged in order to continue with the hands-on science lessons related to the informational texts.

Additionally, students may have been on information overload in regards to their age. According to DiCarlo (2009), this could discourage deep learning. To attempt to "cover the content" would limit students to simply learning facts without the ability to apply their knowledge to solve novel problems (DiCarlo, 2009). By attempting to cover content, the instructor may have been limiting student depth of knowledge, therefore negatively impacting their ability to use and retain the concepts presented.

Secondly, the results of student interest in informational texts were potentially skewed. The first week does provide an accurate baseline of student choice of text. However, in the second and third week, the school's librarian was having a reading contest to raffle a bicycle to one boy and one girl. She asked students to read and report on informational texts. Each time a student completed a text and reported to her, she would enter his or her name into the raffle. This makes it difficult to determine if student interest was based on the contest, the subject being studied, or the overall interest in the genre. Note, however, that the contest did not require students to choose science-related informational texts. The fact that they selected books on the topics covered in the unit may have been influenced by the experimental intervention.

This leads to questions about the use of an observational checklist. When considering student interest in informational text, it seems necessary to provide more comprehensive ways of gathering data. In future research, other tools should be used to provide clearer data. This

might include asking students about their choices, rather than simply counting the number of fiction versus nonfiction texts. Likewise, it might be valuable to include a survey, with some open-ended questions to gauge student interest in a variety of texts. This survey would be useful as a beginning, middle and end of year task, rather than just at the beginning of a three-week unit and again at the end. Allowing more time for student perception to change would contribute to more credible results.

Conclusion

Even with the limitations of the study and the changes, the data point to the importance of integrating hands-on learning into the reading and writing process, especially in relation to science. DiCarlo (2009) stated that "active processing of information, not just passive reception of that information, leads to learning" (para. 11). In many classrooms, teachers read a text, discuss key vocabulary, and ask a variety of comprehension questions. This type of teaching leads to minimal engagement among students. When children are given opportunities to apply knowledge in hands-on ways and learn concepts across content, they are no longer passive receivers of information, but active and engaged learners of both science and language.

About the Authors

Emily Holtz is currently an Instructional Coach in Texas, and has previously taught third grade, kindergarten and pre-kindergarten in New Mexico. She graduated from Texas State University with a BS in Interdisciplinary Studies and earned a MEd in Curriculum and Instruction from Texas A&M University-College Station. Emily will begin the PhD program in Curriculum and Instruction at Texas A&M University in the Fall of 2018. Email: emilyholtz@tamu.edu

Lynne Masel Walters, Ph.D. is an Associate Professor in the Department of Teaching, Learning and Culture at Texas A&M University. She teaches the action research course and works with her graduate students to publish the results of their classroom-based projects. Dr. Walters's research interests are in multicultural education and the ways to increase reflective and critical thinking by pre-service teachers. She also teaches and studies the use of digital storytelling in K-16 classrooms. Dr. Walters received her doctoral degree from the University of Wisconsin-Madison. Email: lynne-walters@tamu.edu

---

References

DiCarlo, S. (2009). Too much content, not enough thinking, and too little fun. *Advances in Physiology Education, 33*(4), 257-264. doi: 10.1152/advan.00075.2009

Fello, S., Raquette, K., & Jalongo, M.R. (2006) Talking drawings: Improving intermediate students' comprehension of expository science text. *Childhood Education, 83*(2), 80-86.

Guzzetti, B., & Bang, E. (2010). The influence of literacy-based science instruction on adolescents' interest, participation and achievement in science. *Literacy Research and Instruction*, 50(1), 44-67.

Lee, O. & Buxton, C. (2013). Integrating science and English proficiency for English Language Learners. *Theory Into Practice, 52*(1), 36-42.

National Governors Association Center for Best Practices and Council of Chief State School Officers. (2010). Common Core State Standards (English Language Arts). Washington, D.C.: National Governors Association Center for Best Practices and Council of Chief State School Officers.

Neuman, S., Kaefer, T., & Pinkham, A. (2016). Improving low-income preschoolers' word and world knowledge: The effects of content-rich instruction. *The Elementary School Journal, 116*(4). 652-671.

Shared Responsibility of Students' Literacy Development. (2017). In *Common Core State Standards Initiative*. Retrieved from http://www.corestandards.org/ELA-Literacy/introduction/key-design-consideration/

Sterling, D.R. & Goor, M.B. (1998). Science for your students. *Intervention in School and Clinic, 34*(2), 123-125.

Vick, M. (2016). Beyond the textbook: But not just hands on. *Science & Children, 53*(7), 76-80.

Wheatley, B., Gerde, H., & Cabell, S. (2016). Integrating early writing into science instruction in preschool. *The Reading Teacher, 70*(1), 83-92.

Appendix A: Vocabulary Test

Directions: Read each question. Then circle the best answer.

1. **Read this sentence from *Weather*.**

    - **Water that falls to the ground in liquid or solid form is called precipitation.**

Circle two answers that are examples of precipitation.

A. Cloud

B. Rain

C. Snow

D. Groundwater

2. **Read this sentence from *Weather*.**

    - **Some of the sun's energy is reflected back into space. The rest is absorbed through the atmosphere.**

What does absorbed mean in this sentence?

A. Made smaller

B. Moved in a circle

C. Soaked up

3. **Which word means almost the same thing as damage?**

A. Dangerous

B. Destroy

C. Make ready

4. **Using the map and sentence below from *Living Through a Natural Disaster*:**

    - **The river then meanders eastward across the vast North China Plain before emptying into the Yellow Sea.**

What does meanders mean?

A. Winds

B. Leaves

C. Watches

5. **Which phrases describe erosion?**

A. Wearing away

B. Moving from one place to another

C. Building up

6. Read this sentence from *Living Through a Natural Disaster*

- They use special equipment to monitor changes that could indicate that a disaster is about to occur.

What does monitor mean in the sentence?

A. Observe

B. Influence

C. Measure

Appendix B: Observational Checklist

Each week, student choice of texts was calculated. The green indicates the week with the highest percentage of informational texts selected out of the three weeks.

	Week of March 13, 2017			Week of March 27, 2013			Week of April 3, 2017		
Student	# Books	#Informational	Percent	# Books	#Informational	Percent	# Books	#Informational	Percent
DA	16	1	6%	6	0	0%	9	2	22%
AA	6	0	0%	8	3	38%	8	0	0%
KB	7	1	14%	7	3	43%	8	3	38%
OB	8	4	50%	12	4	33%	12	3	25%
SB	9	2	22%	5	2	40%	6	1	17%
AC	9	6	67%	12	7	58%	11	8	73%
KC	3	0	0%	7	1	14%	8	2	25%
MC	4	1	25%	9	3	33%	7	3	43%
XD	3	0	0%	7	2	29%	5	1	20%
JF	5	1	20%	7	4	57%	7	4	57%
EG	4	1	25%	8	6	75%	5	3	60%
SH	6	3	50%	10	5	50%	5	2	40%
MH	7	0	0%	9	1	11%	9	2	22%
ML	8	0	0%	7	0	0%	4	1	25%
EM	6	1	17%	5	2	40%	3	1	33%
NM	4	1	25%	Absent			Absent		
TM	5	2	40%	Absent			6	0	0%
LM	5	0	0%	Absent			9	2	22%
SP	7	2	29%	9	1	11%	6	2	33%
TP	5	2	40%	11	7	64%	12	7	58%
MS	7	0	0%	7	3	43%	5	3	60%
RS	8	7	88%	4	2	50%	4	2	50%
BT	10	2	20%	10	8	80%	14	10	71%
EW	11	4	36%	11	5	45%	15	5	33%
Averages	6.8	1.7	24%	12.4	3.3	38.70%	7.7	2.9	36%

Appendix C: Grading Rubric

Score	Focus	Organization	Development	Language and Vocabulary	Conventions
4	Informative topic is clearly conveyed, main idea is specific	Organization includes an effective introduction, body, and conclusion; includes an effective visual display to emphasize main idea (pictures of dams in stream tables)	Information is relevant and thorough; includes an abundance of facts and descriptive details	Writing contains a variety of linking words and phrases that connect categories of information within the report	Writing contains correct grammar, usage, spelling, capitalization, and punctuation
3	Informative topic is clear, main idea may need to be more specific	Organization includes adequate introduction, body, and conclusion; includes visual display to emphasize main idea (pictures of dams in stream tables)	Information is adequate and includes facts and details	Writing contains linking words and phrases to connect categories of information within the report	Writing contains a few errors in grammar, usage, spelling, capitalization, and punctuation, but errors do not affect understanding
2	Informative topic is not quite clear, main idea might be too broad or narrow	Organization includes some grouped ideas, but lacks one or more parts; visual display is somewhat connected to the main idea (pictures of dams in stream tables)	Information is uneven or incomplete; insufficient use of facts and details	Writing contains some linking words and phrases to connect categories of information within the report	Writing contains some errors in grammar, usage, spelling, capitalization, and punctuation, and errors somewhat affect understanding
1	Informative topic is vague, main idea is unclear	Organization is poor, may be missing main parts; visual display is not connected to the main idea	Information is poor or nonexistent; few relevant facts and details	Writing does not contain enough linking words and phrases to connect categories of information within the report	Writing contains errors in grammar, usage, spelling, capitalization, and punctuation that affect understanding

0	Possible characteristics that would warrant a 0:	-no response is given	-student does not demonstrate adequate command of informative writing traits	-response is unintelligible, illegible, or off-topic