Impact of Virtual Science Demonstrations on Homeschooled K-4th Grade Students

Culminating Experience

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Abstract

The purpose of this qualitative action research study was to determine the impact of virtual science demonstrations on homeschooled students in kindergarten through fourth grade. Would the use of online science demonstrations affect students' academic achievement, attitudes towards science, and engagement with science? The researcher placed ten standards-based science experiments online. Five homeschooling students and their parents participated in the study. The researcher instructed parents and students on how to access the experiments and related material. Students and parents were expected to participate in six experiments during the four-month time-period. Data included academic pretests and posttests, attitude surveys, monthly interviews, and experiment completion forms completed during each experiment. Results showed students were engaged while participating in experiments, some students made academic gains, and all students showed an increase in positive attitudes towards science. The positive results will be used to guide future projects using online resources in the same setting.

Impact of Virtual Science Demonstrations on Homeschooled K-4th Grade Students

The purpose of this study was to determine the impact of virtual science demonstrations on homeschooled students in kindergarten through fourth grade. Less than half of fifth graders at a homeschool and independent study charter school, scored proficient or above on the fifth grade California Standards Test for science, the first year California tested for science. The researcher sought to determine the effect of online science demonstrations on students' academic achievement, attitudes, and engagement.

Prior to designing the study, an informal survey of and discussions with the charter school parents showed that many parents do not have their children participate in hands-on science activities at home but would like some support to do so. The reported reasons for the lack of hands-on experiments included a shortage of time, materials, and experience. Yet, the Science Content Standards for California Public Schools include investigation and experimentation as a component for every grade level.

Statement of Problem

The purpose of this study was to investigate the impact of virtual science demonstrations on homeschooling parents and their students in grades K-4. Homeschooling parents daily instruct and interact with their students. The researcher sought to determine if the use of virtual science demonstrations would affect parents' engagement in science education and students' academic achievement, attitudes, and engagement in science education.

Statement of Significance

Less than 50 percent of fifth graders at the charter school scored proficient or above on the fifth grade Science Standards Test; less than half of students surveyed participated in hands-on science activities; and many of the students viewed science education negatively. Participants' parents reported rarely completing hands-on science experiments with their students.

Research Questions

This study sought to answer three questions:

- Would the use of virtual science demonstrations improve student learning?
    - Anticipated outcome was that the use of virtual science demonstrations would improve student learning.
- Would the use of virtual science demonstrations affect students' attitudes towards learning science?
    - Anticipated outcome was that the use of virtual science demonstrations would improve students' attitudes towards learning science.
- What impact would the use of virtual science demonstrations have on student and parent engagement in their science education?
    - Anticipated outcome was that students would be more engaged in science education.

Definitions

For the purposes of this study, student engagement was defined as a student's participation in the science experiments. Virtual refers to "occurring or existing primarily online" (http://www.merriam-webster.com/dictionary/virtual). Virtual science demonstrations refer to teacher produced demonstrations of science experiments recorded and placed online.

Description of Innovation

This project addressed the needs of homeschooled students and their parents by providing recorded science experiments and related materials on a newly created website. The researcher recorded and posted ten science experiments, supporting grades K-4 Science Content Standards for California Public Schools. The experiments used inexpensive household materials. The science experiments and assessments were created using the Understanding by Design model by Wiggins and McTighe (2011). The researcher recorded and posted the experiments to the following website: https://sites.google.com/site/primarygradesscienceathome/home

The homeschooling parents mentioned in previous informal discussions that they would appreciate support for hands-on experiments for their children. They mentioned that experiments were too complicated, too expensive, and too time consuming. The study's website was set up to address these concerns by consolidating resources and providing video demonstrations of each experiment's procedures. The website format included a homepage with a video demonstrating how to access website components including the ten recorded experiments. Experiments included erosion, layers of the earth, weathering, seeds and light, seeds and water, water movement in plants, gravity, matter, motion, and two of the states of water.

The researcher informed parents and students that the purpose of the website was to help homeschooling parents include hands-on science experiments with their science curriculum and mentioned that the state of California included an investigation and experimentation component to their science standards. The researcher described that the standards state, "Scientific progress is made by asking meaningful questions and conducting careful investigations" (California Curriculum Development and Supplemental Materials Commission, 2004, p.30). The researcher also informed the parents of the current study's research questions regarding the impact of virtual science demonstrations on student achievement, attitude, and engagement.

The researcher instructed students and parents on the effective use of the website. During a face-to-face meeting, the researcher showed participating students and parents the website and provided them with the link. The demonstration included showing the parents the homepage (See Figure 1) and describing each component. The researcher showed the students and parents the video on the homepage that described the suggested use of website and how it could be accessed for reference as needed.

Figure 1. Homepage from website

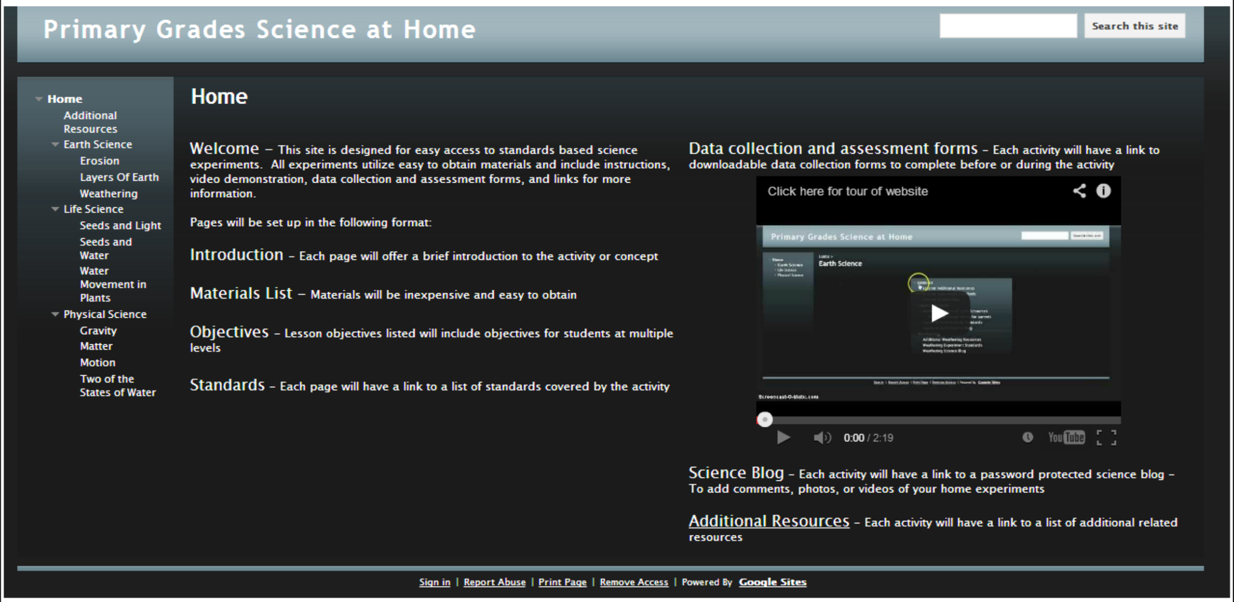

Figure 1 shows a screenshot of the website's homepage. Each experiment's page was set up in a similar format.

The researcher began training the parents and students by showing them the navigation bar on the left side of the page. By clicking the arrow next to the word home, three main topics opened up. The topics included earth, life, and physical science with three to four experiments listed for each (See Figure 2). By clicking on the experiment titles, parents and students saw how to access each experiment's main page. The features on each experiment's page included lesson objectives, a material list, standards, a blog, experiment completion forms to download, and links to supporting subject matter content.

Figure 2. Navigation Bar

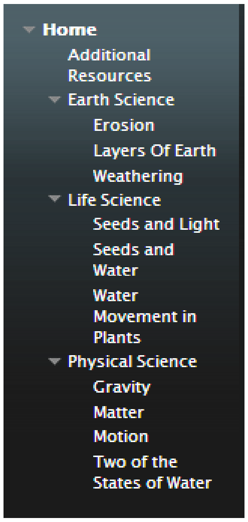

Figure 2 shows the expanded navigation bar for the website.

Addressing parental concerns regarding the cost of science experiments, the material lists contained inexpensive and easy to obtain items (See Figure 3).

Figure 3. Matter Experiment Material List

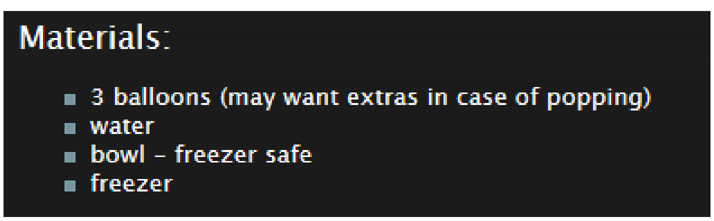

Figure 3 shows the materials needed for the matter experiment.

Each experiment contained lesson objectives and standards. The researcher explained that the experiments were designed to meet standards for students in kindergarten through fourth grade. The researcher showed the parents that each experiment contained a list of lesson objectives, and students depending on grade level should meet at least one objective. The researcher showed parents that each experiment contained a link to a page showing the standards related to the experiment. By clicking on the standards link one could access grade specific expectations for each experiment. For instance, the matter experiment contained four objectives designed to meet the needs of multi-age students. The objectives stated that students will

1. understand there are three main states of matter -each state of matter has properties
2. understand matter can change forms
3. be able to make and record observations
4. be able to make predictions and compare results with predictions

The researcher showed parents that according to the standards page kindergarten students would be expected to meet the third objective because the California standards state kindergarten students should communicate observations orally and through drawings. In the matter experiment, students communicated their observations by drawing on the experiment completion forms. Third grade students were expected to meet the first objective knowing that matter has three forms: solid, liquid, and gas. See Figure 4 for a list of objectives and Figure 5 for a list of standards for the matter experiment. The researcher showed parents the other experiment pages and discussed how the learning outcomes vary by grade level. All science experiments posted addressed one or more of the current kindergarten through fourth grade Science Content Standards for California Public Schools.

Figure 4. Objectives for the Matter Experiment

Objectives – Students will

- understand there are three main states of matter
  - each state of matter has properties
- understand matter can change forms
- be able to make and record observations
- be able to make predictions and compare results with predictions

Figure 4 shows the objectives for the matter experiment. Objectives shown cover multiple grades.

Figure 5. Standards for Matter Experiment

CA Science Content Standards Covered – Scientific progress is made by asking meaningful questions and conducting careful investigations.

Kindergarten

- Students know water can be a liquid or a solid and can be made to change back and forth from one form to the other
- Observe common objects by using the five senses.
- Communicate observations orally and through drawings.

First Grade

- Students know solids, liquids, and gases have different properties.
- Students know the properties of substances can change when the substances are cooled.
- Draw pictures that portray some features of the thing being described.

Second Grade

- Write or draw descriptions of a sequence of steps, events, and observations.

Third Grade

- Students know matter has three forms: solid, liquid, and gas.
- Predict the outcome of a simple investigation and compare the result with the prediction.

Fourth Grade

- Formulate and justify predictions based on cause-and-effect

Figure 5 shows the Matter Experiment's California Content Standards for Science grades kindergarten through fourth.

The researcher showed the students and parents the experiment completion forms. Each experiment page contained a link to access and download forms. The forms contained spaces for predictions, places for drawings of observations, and guiding questions. The researcher explained to the students and parents that the forms could be filled out while either watching the recorded videos or ideally while replicating the experiments. The researcher explained that parents could record student dictation if needed. See Figure 6 for page one of the matter experiment's experiment completion form.

Figure 6. Experiment Completion Form

Matter

What I know about matter

____

____

____

Predict what will happen to the balloon that is placed in the freezer

Observe and record what you notice about the balloon before it goes in the freezer	This what I **predict** the balloon will be like after the freezer
____________________	____________________
____________________	____________________
____________________	____________________

Figure 6 shows page one of the matter experiment's experiment completion forms

Each experiment page contained an embedded video demonstrating step-by-step how to complete the experiment. The researcher demonstrated accessing each video. The researcher instructed parents to use the experiments along with their textbooks. For instance, when the textbook discussed matter students should complete the matter experiment. Each experiment video began with a materials list followed by a question such as, “What do you know about matter?” As the videos progressed step-by-step directions were given. For instance, in the matter video, viewers were told to attach one balloon to a spigot and fill the balloon with water. Still pictures of the step were shown. The matter video continued by showing and telling viewers how to fill the other balloons, what to do with each balloon, and when to use the experiment completion forms (See Figure 7). Each video posed guiding questions throughout the experiments.

Figure 7. Matter Experiment Video

Figure 7 shows the screenshot of the Matter Experiment's step-by-step video

In addition, each experiment’s main page contained a link to an additional resources page. The additional resource pages provided links to outside resources. The resources provided additional related content including videos, websites, and books (See Figures 8 and 9). Some resources required passwords, and the researcher provided passwords to the students and parents prior to the study. The researcher suggested using the links to supplement textbook instruction on the topics prior to and after completing the experiments.

Figure 8. Additional Resources

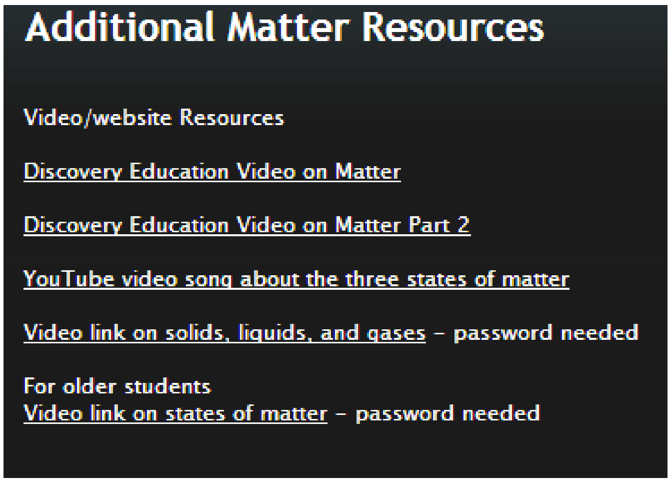

Figure 8 shows video and website resources for the Matter Experiment.

Figure 9. Additional Educational Resources

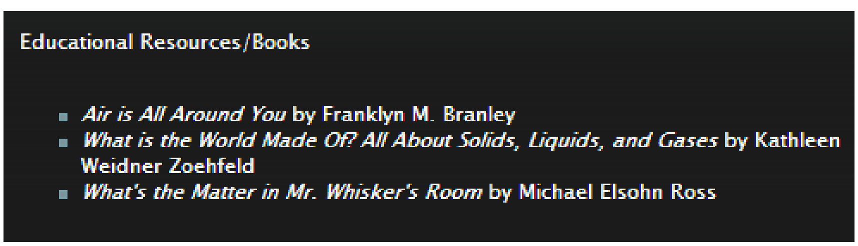

Figure 9 shows books related to the Matter Experiment.

Following the demonstration, the parents visited the website to ensure they were able to access the material from their home computers. No technical difficulties existed. Students and parents were encouraged to watch and duplicate six experiments during the four-month study.

Survey of Literature

Over the past several years, the national emphasis on improving English Language Arts and Mathematics standardized tests results has left little time for science education. "International tests demonstrate that U.S. students have fallen behind their international peers in math and science" (Epstein & Miller, 2011, p. 5). Dejarnett (2012) commented "**e**lementary students often learn about scientific theory and the nature of science rather than doing scientific investigations for themselves" (p. 80). In addition, the National Center for Education Statistics (2012) mentions "science education is not just about learning facts in a classroom - it's about doing activities where students put their understanding of science principles into action" (p. 1). Yet, students often have not had the opportunity to learn scientific principles beyond what they read and hear via lectures. According to the Science Framework for California Public Schools: Kindergarten through Grade Twelve, with New Criteria for Instructional Materials (2004), students in grades K-8 should have 20-25 percent of their science instructional time devoted to hands-on science activities (p.11).

Research has shown that attitudes towards science education are important too. In a study by Sun, Lin, and Yu (2008) "up to 75% of the students surveyed indicated that they preferred using the Web-based virtual lab to reading text-books only" (p. 1411). The current study sought to increase students' achievement, increase student and parent engagement, and positively affect students' attitudes towards science education though the use of virtual science demonstrations.

The full literature review consisted of studies on five main topics: current data on student achievement in science including the homeschooled population, the effects of various teaching methods on student achievement, the effects of students' attitude on student achievement, the effects of student engagement on student achievement, and technology's effects on student achievement, attitude, and engagement. The full literature review may be accessed at the following link:

https://drive.google.com/file/d/0B6eLKKTrbROBNkxOY1NLR1BHb2s/edit?usp=sharing

Methodology

Setting

This qualitative study focused on homeschooled students and their parents. Participants attended one independent study charter school in a small suburban California city. All participants received their daily instruction at home with their parents as the primary educators. According to the charter school's handbook, parents were actively involved in the lesson planning, instructing, and correcting of assignments for their children. Parents and students met with a supervising teacher at least once every 20 school days to review student's assignments, collect work samples, discuss any problems or areas of concern, and collaboratively assign work for the upcoming month (Horizon Charter School, 2012).

Participants

Five male students participated in the study. Participants included one kindergarten student, one first grade student, one second grade student, one third grade student, and one fourth grade student. All students, except the third grade student, had been homeschooled exclusively. The third grade student attended a traditional public school for kindergarten and half of first grade. The third grade student was classified as an English Language Learner as determined by the California English Language Development Test (CELDT). The first grade student's primary language was not English, though he was not classified as an English Language Learner. All five students scored basic or below basic on standardized language arts and mathematics benchmarks in August 2013, the beginning of the school year. All students participated in multi-grade science lessons with their siblings. The five participants belonged to two families. The kindergarten, second, and fourth grade students belonged to one family, and the first and third grade students belonged to another family.

Data Collection

Researcher collected qualitative data. Qualitative data included transcriptions of interviews and experiment completion forms analyzed to determine the levels of understanding on Anderson and Krathwohl's revision of Bloom's Taxonomy (2001). Pretest and posttest results, pre study and post study attitude survey data, and Google Analytics data showing frequency and dates of website use were analyzed using narrative format as the small study size did not generate enough data to be analyzed statistically.

Researcher collected data to answer three research questions. (1) Would the use of virtual science demonstrations improve student learning? Data collected included science achievement pretests, posttests, monthly interviews, and experiment completion forms completed during experiments. Students took an assessment prior to accessing the virtual science demonstrations and took a posttest at the end of a four-month time-period. The researcher administered the assessments and collected the results during monthly face-to-face meetings. Researcher placed assessment results in a graph showing the comparison of each student's pretest and posttest results. Researcher included a narrative discussing the results. Interviews were transcribed and coded to determine any emerging patterns. The researcher used students' experiment completion forms to determine their level of understanding according to Anderson and Krathwohl's revision of Bloom's Taxonomy (2001). (2) Would the use of virtual science demonstrations affect students' attitudes towards learning science? Students took the Modified

Attitudes Towards Science Inventory before and after the use of the website. Participants completed the attitude surveys during face-to-face meetings. The attitude survey consisted of ten statements using a five point Likert-type scale. Statements included five self-concept of science and five desire to do science items. Researcher placed results in a graph showing results from both surveys and included a narrative discussing the results. Researcher interviewed students and parents during monthly interviews. Interviews were transcribed and coded to determine if any patterns emerged. Results were presented in narrative format. (3) What impact would the use of virtual science demonstrations have on student and parent engagement in science education? Data collected during monthly face-to-face meetings included transcriptions of interviews and experiment completion forms completed during viewing or replicating the experiments. Researcher transcribed and coded interviews to determine any patterns. The researcher recorded findings in narrative form. In addition, the researcher enabled Google Analytics to track website use. The researcher equated greater use of the website with greater engagement.

Assumptions

Researcher assumed students would engage in six or more virtual science demonstrations during the four-month time-period. Students would complete experiment completion forms while watching or replicating the experiments. The researcher assumed that pretests and posttests would be valid as they were created using a backwards design process (Wiggins & McTighe, 2011). Researcher assumed attitude survey results and assessment results would be generalizable only to the charter school, as they would reflect the specific project and school population. Researcher assumed that students would answer interview questions honestly and document their experiences on the experiment completion forms and in their science journals.

Limitations

This study had limitations. Participating students were homeschooled and their participation depended upon parental participation. Prior to the project, researcher encouraged parents to commit to participation for the full length of the project, September through January. The virtual science demonstrations were housed on a website, and thus the study depended upon internet accessibility and reliability. In addition, students' attitudes towards science may have changed during the project due to factors other than the online science demonstrations such as more emphasis on science by researcher and parent and not because of the project itself. Prior to the study a suggested order of topics was offered and encouraged, however parents could choose to follow a different sequence.

Delimitations

Researcher designed the study for kindergarten through fourth grade homeschooled students. Participants were from one charter school and participated in study during the fall of 2013. Results of the study were intended to guide future projects within the same setting. The results were not generalizable to a traditional school setting in which students are grouped by grade level, taught by a classroom teacher as opposed to the parent, and are on site for classes not at home.

Timeline

Preparation for the study began during the summer of 2013, and the entire project and paper were completed by April 2014. Researcher completed the project website structure during the month of June. The researcher designed, recorded, and placed the ten science experiments on the website during the month of July. The researcher introduced the study to the participating students and parents during the month of August. Students and parents signed consent and assent forms during the month of August. During the month of September, the researcher instructed students and parents on the use of the website, journal, and downloading techniques. In addition, students took science pretests and attitude surveys. Students began using the website during the month of October and weekly oversight of the website began. The researcher interviewed students and parents, collected experiment completion forms, and reviewed progress during monthly face-to-face meetings, October through January. During the month of January, students took final attitude surveys and posttests. In addition, the researcher interviewed students and parents. The researcher completed the literature review during the months of September through January. The researcher analyzed the data during the month of February, completed the rough draft during the month of March, and completed the final draft during the month of April (See Appendix D for timeline graphic).

Special Considerations

Special considerations for this study included the need for website advice and the need to increase the researcher's student population. The charter school's technology coordinator provided advice on how to set up the website. The researcher contacted the school's regional administrator during the spring of 2013 regarding the study's student population. The researcher had five students committed to the study at the end of the spring 2013 semester. The researcher requested having additional students in kindergarten through fourth grade assigned for the fall 2013 semester. However, the school's administration assigned a new regional administrator during the summer resulting in a lack of assignment of additional students. Therefore, only five students participated in the study.

Procedures

Preliminary steps. Prior to beginning the study, the researcher took several steps. Parental consent and student assent to participate forms were signed. A regional administrator from the charter school, similar to a principal, signed an administrative consent form to allow the study (See Appendices A, B, and C for forms). The school's technology coordinator agreed to give advice on the procedures needed to set up the website to house the demonstrations. The researcher created the website to include ten science demonstrations. Science demonstrations, experiment completion forms, and pretests and posttests, were created using a backwards design process (Wiggins & McTighe, 2011).

The ten experiments recorded and placed on the website included three earth science experiments, three life science experiments, and four physical science experiments. The earth science experiments included erosion, the layers of the earth, and weathering. The life science experiments included seeds and light, seeds and water, and water movement in plants. The physical science experiments included gravity, matter, motion, and two states of water. Each experiment included the following items:

- an introduction
- a list of objectives
- a materials list
- content standards including California state science standards for grades K-4, Next Generation Science Standards, and NETS standards
- experiment completion forms to be completed by students during the experiments
- a video showing the procedural steps for the experiments
- a link to an optional blog page
- additional resources offering related content

Use of website. Beginning in September 2013, the researcher asked participating students and parents to use the newly created website. The website housed ten science experiments and additional resources. The researcher asked parents to complete six experiments over the four-month study time-period.

Participants choose experiments; they covered related content either in their textbook or by using the additional resources housed on the website; and they viewed the recorded experiments. Participants completed experiment completion forms while either viewing the experiments or replicating the experiments. The researcher collected the forms at monthly meetings.

The researcher enabled Google Analytics to track website use as a means of measuring student and parent engagement. The researcher sought to answer the third research question: What impact would the use of virtual science demonstrations have on student and parent engagement in science education? The conservative definitions of student engagement as discussed by McMahon and Portelli (2004) describe engaged students as students doing what they are supposed to be doing. McMahan and Portelli (2004) mentioned observation of specific behaviors as a means of measuring such engagement. The data from Google Analytics showed when and for how long participants accessed the site. The researcher measured engagement by recording website use.

Data collection tools. The researcher gathered data collection tools. The researcher created science pretests and posttests during the lesson design phase to ensure the tools assessed the content presented in the experiments. Assessment questions were differentiated by grade levels. The researcher obtained and modified a Likert-type attitude survey, and the researcher wrote interview questions to pose to students and parents. The researcher created experiment completion forms for students to use during experiments. Goggle Analytics was enabled to collect website activity data.

Following the creation of the website and collection of the tools, the researcher instructed students and parents on the use of the website including how to access recorded demonstrations of experiments, how to download experiment completion forms, and how to use the additional resources. In addition, researcher placed a recording of how to use the website on its homepage for reference if needed.

Pretest and posttest. Participants took study pretests in September 2013 and identical posttests in January 2014. Assessment items included standards based, grade level material created during the lesson design phase. The researcher assigned five points per assessment item. The researcher determined point values for possible answers prior to administering the pretest. For instance, one item asked students to name the three states of matter. Participants earned five points for naming all three states, three points for naming two of the states, one point for naming one state, and zero points if no states were named. In addition, the researcher categorized each assessment item according to Anderson and Krathwohl's revision of Bloom's Taxonomy to analyze depth of understanding. Researcher administered pretests and posttests to help answer the first research question: Would the use of virtual science demonstrations improve student learning? Researcher recorded each assessment score and compared the pretest results to the posttest results.

Participants completed the assessments both in writing and orally. The fourth grade student completed all questions in writing, and the kindergarten through third grade students completed questions both in writing and orally with the researcher recording the dictation.

***Attitude survey*.** Participants completed the Modified Attitudes Towards Science Inventory (Weinburgh, & Steele, 2000) prior to using the using the science demonstration website and following the four-month time period in which the website was available for use. The researcher administered the attitude survey to answer the second research question: Would the use of virtual science demonstrations affect students' attitudes towards learning science? The attitude survey consisted of ten statements using a five point Likert-type scale. Statements included five self-concept of science and five desire to do science items. Survey included three statements written in the negative such as "I do not do very well in science." Researcher scored these items in reverse order such as a five was scored as a one. Participants completed the survey individually with the researcher. Researcher read survey statements aloud. Participants responded by pointing to an emoticon representing their answer. Choices included strongly disagree, disagree, undecided, agree, and strongly agree. Researcher recorded responses (See Appendices E and F).

The researcher placed the survey results in a graph for comparison. A narrative accompanies the graph describing the differences between the two surveys.

Interviews. Researcher interviewed students and parents prior to use of science website and monthly during the four-month time-period. The researcher conducted the interviews with students and parents to answer the three research questions: (a) Would the use of virtual science demonstrations improve student learning? (b) Would the use of virtual science demonstrations affect student's attitudes towards learning science? (c) What impact would the use of virtual science demonstrations have on student and parent engagement in science education? Researcher asked students pre-determined and follow-up questions. Researcher recorded responses. Questions included asking participants to discuss the science experiments completed each month. The researcher asked for and recorded open-ended comments and feedback from parents (See Appendix G).

The researcher transcribed and coded the interviews to pull out any emerging patterns. Results were written in narrative format.

Experiment completion forms. Each experiment posted to the website included a link to download experiment completion forms. The researcher used the experiment completion forms to gather data to answer two research questions: (a) Would the use of virtual science demonstrations improve student learning? (b) What impact would the use of virtual science demonstrations have on student and parent engagement in science education? The students completed the forms while watching or while replicating the experiments. Students used the forms to record their predictions prior to completing the experiments, record their observations during the experiments, and answer questions throughout the experiments. The researcher created the forms during the lesson design phase to include the lesson objectives and collected the completed forms during monthly face-to-face meetings.

The researcher categorized each item on the forms using the six levels of Anderson and Krathwohl's revision of Bloom's Taxonomy. For instance, items asking students to observe and record were categorized as knowledge level items; items requiring students to predict what would happen were categorized as understanding level; and items asking students to draw conclusions were categorized at the evaluation level. The researcher recorded the total number of items by level for each experiment. The researcher tabulated the number of items completed by each student at each level and described the data in narrative format explaining its relationship to the first research question involving student achievement.

The researcher used the experiment completion forms as evidence of student engagement. Completion of the forms indicated student engagement.

Data analysis. The researcher analyzed the data to answer the three research questions. The researcher used pretest and posttest data, interviews, and experiment completion forms to determine if the use of virtual science demonstrations improved student learning. Pretest and posttest scores were placed in a graph with an accompanying narrative describing the comparison of scores to the number of experiments completed. The researcher transcribed and coded interviews to determine if any patterns related to academic achievement emerged. The researcher categorized the items on the experiment completion forms using Anderson and Krathwohl’s revision of Bloom’s Taxonomy. Each form was reviewed and each item was marked as completed correctly or incorrectly. Results were tabulated and described in narrative format. Lastly, the researcher analyzed each experiment to determine if grade level standards were met by each student. For instance, the matter experiment supported two first grade standards. The researcher determined from a review of posttest data, interviews, and experiment completion forms if the standards were fully met, partially met, or not met. The researcher analyzed each experiment completed and described the results in an accompanying narrative.

The researcher used monthly interview data and attitude surveys given prior to and following the use of the website to determine if the use of the virtual science demonstrations affected students’ attitudes toward learning science. The attitude survey consisted of ten statements using a five point Likert-type scale. The researcher tabulated survey scores and placed information in a graph. A narrative describing data accompanied the results. The researcher transcribed and coded student and parent interviews to determine any emerging patterns. Results were written in narrative format.

The researcher used experiment completion forms, interviews, and Google Analytics to determine the impact of the virtual science demonstrations on student and parent engagement. The researcher used the completion of experiment completion forms as evidence of student engagement. The researcher transcribed and coded student and parent interviews to determine any emerging patterns. Results were written in narrative format. The researcher enabled Google Analytics to track website use. The data showed the frequency and time the website was visited. The researcher equated greater use of the website to greater student and parent engagement. Results were described in narrative format.

Results

To determine if the use of virtual science demonstrations improved student learning, the researcher used three forms of data: pretest and posttest data, transcribed and coded interviews, and data collections forms.

Pretest and posttest scores were placed in a graph with an accompanying narrative describing the differences in scores (See Figure 10). The kindergarten student participated in one experiment and his test scores improved by 25 percentage points. The first grade student participated in seven experiments and his test scores improved by 13 percentage points. The second grade student participated in one experiment and his test scores improved by 10 percentage points. The third grade student participated in seven experiments and his test scores improved by 17.5 percentage points. The fourth grade student participated in one experiment and his test scores remained the same. Reviewing the data, no patterns emerged between the number of experiments students participated in and the differences in their pretest and posttest scores.

Figure 10

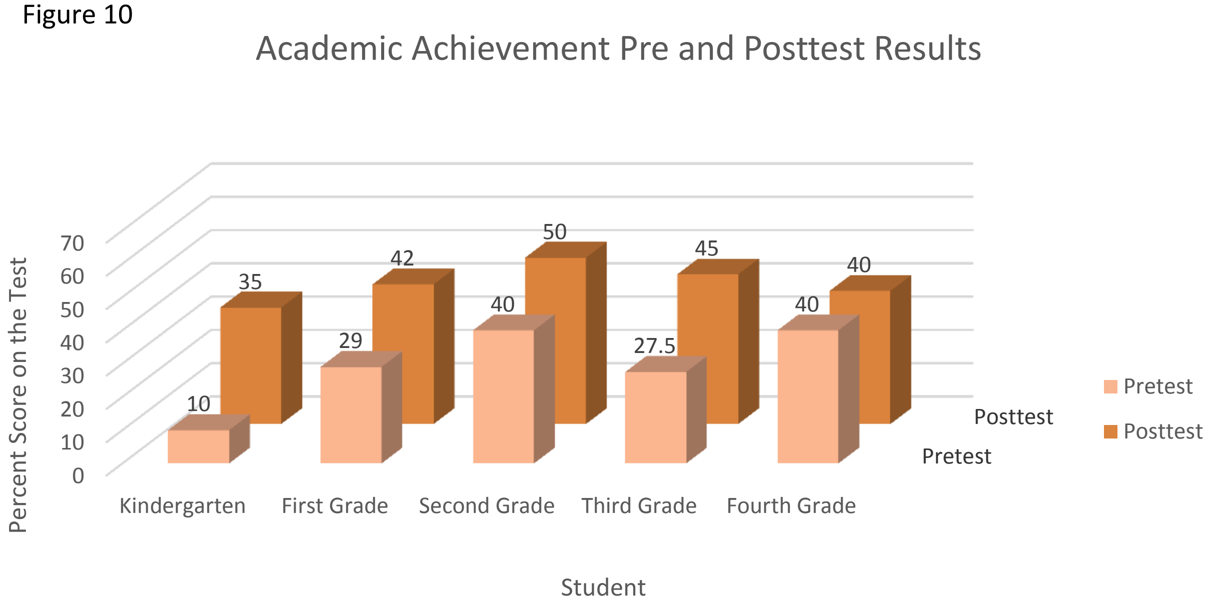

Figure 10 shows pretest and posttest data for students kindergarten through fourth grade. Scores are presented in percentages.

The researcher completed further analysis of the results comparing differences in points between tests and the experiments completed. The researcher sought to determine if a relationship existed between the test scores and the experiments completed. Items on the pretest and posttest covered a variety of experiments. Students took the same pretest and posttest regardless of the experiments they completed. In analyzing the data, the researcher found that most of the changes in scores from pretest to posttest were on items that were associated with experiments completed by the students.

The kindergarten student’s score increased by ten points, 25 percent, from the pretest to the posttest. The ten-point increase came from four questions. Each of these questions included information from the one experiment completed. For instance, the tests asked the student to observe and record an object. He earned one point on the pretest and three points on the posttest for his drawings of an object that he observed. The weathering experiment he completed required students to observe and record information using drawings. The student also had a gain of five points on a question that asked students to describe how two things were different. The weathering experiment also asked students to describe the differences between two objects. The results indicated participation in the one experiment likely contributed to the increase on the posttest.

The first grade student's score improved six points, 13 percent. Looking at the pretest and posttest by question, the increase in score came from questions related to the experiments he completed. For instance, the student named the three states of matter on the posttest but not the pretest. He completed seven experiments including the matter experiment. The results indicate that participation in the experiments likely contributed to the increase in score on the posttest.

The second grade student's score increased by five points, ten percent. Four of the five points came from two questions related to material covered in the one experiment completed from the website. The student was able to describe similarities and differences between two objects on the posttest as well as during the weathering experiment. The other point differences came from two questions unrelated to the experiment completed. The second grade student's results show that his participation in the one experiment likely contributed to the growth on the posttest.

The third grade student's score increased by seven points, 17.5 percent, from the pretest to the posttest. Looking at the data, most of the increase occurred on questions related to the experiments completed. For instance, the student completed the gravity experiment, and he was able to give an example of gravity on the posttest but not the pretest. The third grade student's gains came on items related to the experiments he completed indicating the increase in score was likely related to the experiments completed.

The fourth grade student showed no difference on his pretest and posttest. Looking closely at the questions, only one question on the test related to the one experiment completed. The student earned five out of five points for this question on the pretest, which left no room for growth on the posttest.

Each of the five students accurately completed at least one question on the posttest related to experiments they completed. With the exception of the fourth grade student, the students increased their scores on the posttests on items related to the experiments they completed. Students' scores on the posttest remained unchanged for some items. Most of these items were related to experiments the students did not complete. For instance, the tests included life science experiments using seeds and plants. The students did not complete the life science experiments, and their scores showed no change on these items.

In addition to the test data, the researcher transcribed and coded interviews to determine if any patterns related to academic achievement emerged. One pattern related to academic achievement emerged showing the students recalled information better when referring to their experiment completion forms than without the forms. Students used forms frequently to discuss procedures, recall results, and discuss application of results. Students often failed to remember what they did for science until they reviewed their forms. Once looking over their experiment completion forms, students discussed what they did for science in greater detail than before viewing the documents.

The researcher also analyzed the experiment completion forms using Anderson and Krathwohl's revision of Bloom's Taxonomy. Using students' experiment completion forms each item or question was categorized according to the six levels of the taxonomy. The levels used were knowledge, understand, apply, analyze, evaluate, and create.

The kindergarten student correctly completed all knowledge level items, two of three understanding level items, zero out of one application items, and zero out of one evaluation item for the weathering experiment. The results showed the kindergarten student responded correctly more often to the lower levels of questions.

The first grade student completed seven experiments. He accurately completed all of the knowledge and understanding levels. He correctly completed eight out of nine application levels, six out of eight analysis levels, all of the evaluation level entries, and four of the six creativity levels of entries (See Table 1). The first grade student completed all items at the lower levels correctly and most items at the higher levels.

Table 1

First grade student's experiment completion form information.

	Gravity	Motion	Erosion	Weathering	2 states of matter	Matter	Layers of the Earth
Knowledge	11/11	1/1	8/8	5/5	22/22	12/12	4/4
Understand	6/6	2/2	2/2	3/3	3/3	13/13	6/6
Apply	0/0	1/1	0/0	0/1	0/0	7/7	0/0
Analyze	1/3	1/1	1/1	0/0	2/2	1/1	0/0
Evaluate	2/2	0/0	1/1	1/1	6/6	1/1	0/0
Create	1/1	1/2	0/0	0/0	2/3	0/0	0/0

Note. Table 1 shows the number of correctly completed items on the experiment completion forms as categorized by Anderson and Krathwohl's revision of Bloom's Taxonomy.

The second grade student completed one experiment, weathering. The student correctly completed all of the knowledge, understanding, and evaluation items and zero out of one application items for the weathering experiment. The data showed the second grade student accurately completed both lower and higher-level items.

The third grade student completed seven experiments. He accurately completed all of the knowledge and understanding levels. He correctly completed eight out of nine application levels, six out of eight analysis levels, all of the evaluation level entries, and four of the six creativity level of entries (See Table 2). The third grade student accurately completed all of the lower and most of the upper level of items on the experiment completion forms.

Table 2

Third grade student's experiment completion form information.

	Gravity	Motion	Erosion	Weathering	2 states of matter	Matter	Layers of the Earth
Knowledge	11/11	1/1	8/8	5/5	22/22	12/12	4/4
Understand	6/6	2/2	2/2	3/3	3/3	13/13	6/6
Apply	0/0	1/1	0/0	0/1	0/0	7/7	0/0
Analyze	1/3	1/1	1/1	0/0	2/2	1/1	0/0
Evaluate	2/2	0/0	1/1	1/1	6/6	1/1	0/0
Create	1/1	1/2	0/0	0/0	2/3	0/0	0/0

Note. Table 2 shows the number of correctly completed items on the experiment completion form as categorized by Anderson and Krathwohl's revision of Bloom's Taxonomy.

The fourth grade student completed only one experiment, weathering. The student correctly completed all of the knowledge, understanding, application, and evaluation entries for the weathering experiment. The fourth grade student completed all lower and higher level items for the experiment.

Overall, all five students accurately completed the responses on the lower levels of Anderson and Krathwohl's revision of Bloom's Taxonomy, and with the exception of the kindergarten student, students completed many of the higher level items. Data from the first and third grade students showed they completed seven experiments and completed most items.

Finally, the researcher analyzed each experiment to determine if grade level standards were met by each student. The researcher analyzed posttest data, interviews, and experiment completion forms to determine if students met grade level standards.

The kindergarten student fully met 2 out of 2 standards during the one experiment completed. The first grade student fully met 9 standards, partially met 1 standard, and did not meet 2 out of 12 standards during the seven experiments completed. The second grade student fully met 1 and partially met 2 out of 2 standards during the one experiment completed. The third grade student fully met 9 out of 9 standards during the seven experiments completed. The fourth grade student fully met 1 out of 1 standard during the one experiment completed. These results showed each student met at least one standard for the experiments completed.

To determine if the use of virtual science demonstrations affected student attitudes towards science, the researcher used an attitude survey given before and after the four-month use of the website. The attitude survey consisted of ten statements using a five point Likert-type scale. The researcher tabulated survey scores and placed information in a graph (See Figure 11). Statements included five self-concept of science and five desire to do science items. Survey included three statements written in the negative such as “I do not do very well in science.” Researcher scored these items in reverse order according to the survey’s scoring directions. A five on one of these items was scored as a one, a four was scored as a two, a three remained a three, a two was scored as a four, and a one was scored as a five.

Figure 11

Attitude Survey Results

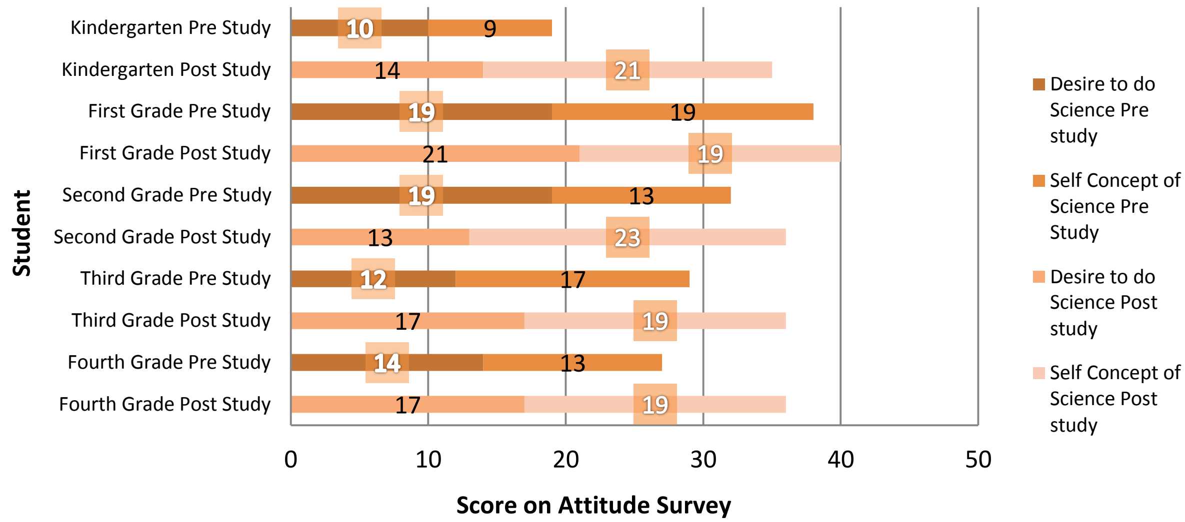

Figure 11 shows results from the atittude survey given prior to the study and following the four-month study period. Survey included questions regarding a desire to do science and one's elf concept of science.

The results show all five participants had increases in their attitudes towards science scores over the course of the four-month time-period. Breaking down overall scores, the data shows that four out of five students showed increases in their desire to do science and four out of five students showed increases in their self-concept of science with the fifth student showing no change.

Three of the students completed one experiment from the website and two students completed seven experiments. The kindergarten student completed one experiment and showed an overall increase in positive attitude toward science of 16 points. His desire to do science increased four points whereas his self-concept of science increased 12 points. The first grade student completed seven experiments and showed an overall increase in positive attitude towards science of two points. His desire to do science increased by two points and his self-concept of science remained the same. The second grader completed one science experiment and showed an overall increase in positive attitude towards science of four points. His desire to do science decreased six points whereas his self-concept of science increased ten points. The third grade student completed seven experiments and showed an overall increase of seven points. His desire to do science score increased by five points and his self-concept of science increased by two points. The fourth grade student completed one science experiment and showed an overall increase in positive attitude towards science of nine points. His desire to do science increased three points and his self-concept of science increased by six points.

Further analysis, however, showed differences between the students' scores. The kindergarten student had the greatest increase in overall score and completed one experiment. This student also had the lowest initial overall, desire to do science, and self-concept of science scores. The first grade student had the smallest increase in overall score, had the highest initial score, and participated in seven experiments.

In addition to the attitude surveys, the author transcribed and coded the interviews to determine if any patterns emerged regarding student and parent attitudes. The interviews showed one pattern: Both parents and students had positive attitudes about science when discussing the experiments completed. Student interviews focused mainly on academic achievement and engagement whereas the parent interviews were open-ended. The parents commented their students liked completing the experiments. One parent said, "They get excited, really excited." The same parent mentioned during a different interview, "They had a lot of fun." The other parent stated that her students "liked to do [the experiments.]" The parents also mentioned that they liked the experiments. One parent said, "It put me at ease" and "It was very easy to follow the experiment; I liked that." The second parent stated, "I really like the experiments" and "I liked it because it was not difficult." The interview data indicated positive attitudes towards the website experiments.

The researcher used experiment completion forms, interviews, and Google Analytics to determine the answer to the third research question: What impact would the use of the virtual science demonstrations have on student and parent engagement?

First, the researcher used the completion of experiment completion forms as evidence of student engagement. The researcher collected the forms monthly. Instructions given to parents and students stated that students could complete the experiment completion forms while watching the virtual science demonstrations or while replicating the experiments. All students completed the forms while replicating the experiments. The researcher defined student engagement as a student's participation in the science experiments. The completion of the experiment completion forms showed that the kindergarten, second grade, and fourth grade students participated in one experiment. The first and third grade students participated in seven experiments. By definition, the first and third grade students were more engaged as they completed more experiments.

Second, the researcher enabled Google Analytics to track website use. The data showed the frequency and time the website was visited. Using the definition of engagement as a student's participation in the experiments from the website, data from Google Analytics showed how often and when students and parents used the website (See Figure 12). The data shows 23 visits. Data showed two times each month during November, December, and January visits occurred. Comparing this data to the experiment completion forms, the dates corresponded with times that experiments were completed.

Figure 12. Google Analytics covering the four-month study period.

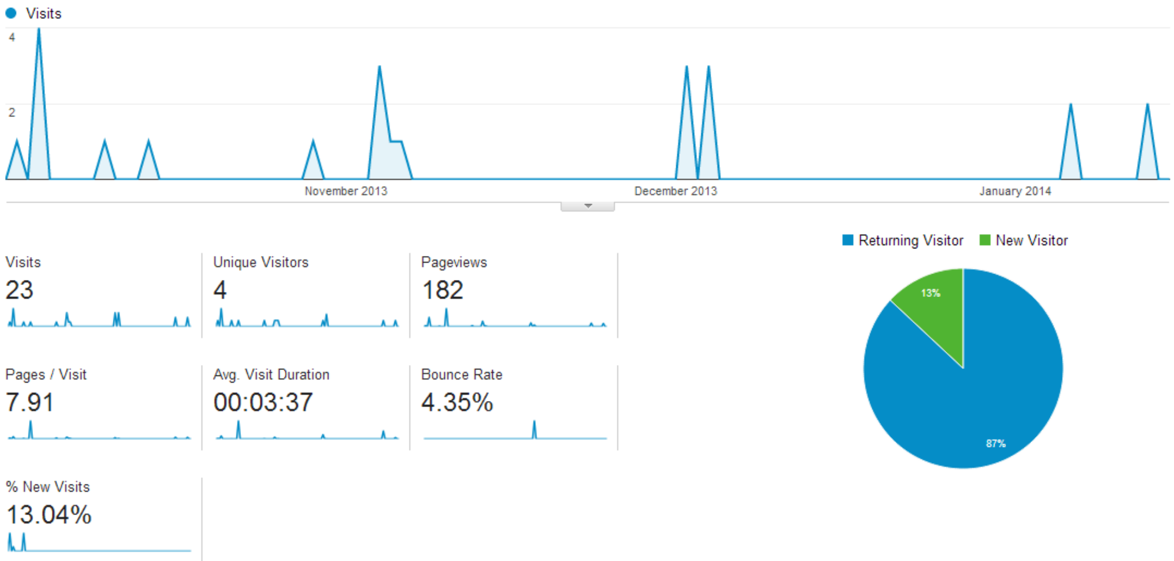

Figure 12 shows date from the website during the four months. Data shows an average visit time of 3:37 minutes and 23 visits.

Looking more closely at one of the visit times during January, one can see a picture of page views and time spent for one experiment (See Figure 13). According to the data, one viewer accessed the site twice on the same day. The average visit was 9:37 minutes. During the January interview, one parent mentioned completing an experiment on this date. The parent stated she visited the site first to get a list of materials and download the experiment completion forms, and then she revisited the site to watch the step-by-step video. The first visit required much less time than the second did. Using the data from both graphics and the parent interview data, the average time spent per visit may not only reflect the time spent replicating experiments but also include preparing for experiments.

Figure 13. Google Analytics for one date.

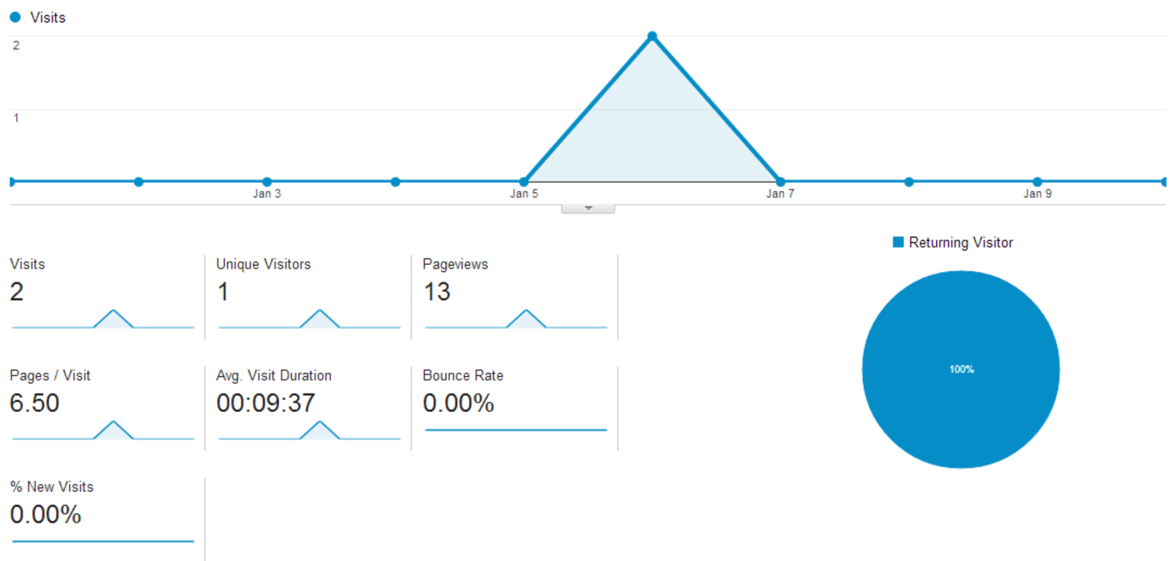

Figure 13 shows data for January 6. One visitor accessed site two times for an average of 9:37 minutes.

Finally, the researcher transcribed and coded student and parent interviews to determine any emerging patterns in regards to student and parent engagement. The first pattern to arise showed that most experiments conducted during the four-month study period came from the website created for the study. Students discussed the completed experiments during monthly meetings. The first and third grade students completed seven experiments, and all experiments came from the website. The kindergarten, second, and fourth grade students completed two experiments each, one from the website and one from other curriculum during the final month of the study. Students were engaged, as previously noted by the experiment completion forms, but the interview data revealed that three students also engaged in one additional experiment.

The other pattern to emerge from the parent interviews related to parent use of the website. The month prior to the use of the website, both parents mentioned completing no hands-on experiments. Following the introduction of the website, parents said they participated in the experiments and commented on their feelings regarding the experiments and the website. Parents responded positively about the website and their use of it. Parents gave the following reasons for liking the website: the website's ease of use, the systematic instructions given during the video demonstrations, and the opportunity to watch the experiments prior to conducting them. One parent stated, "It was easy to use and they understood what we were going to do from watching the clip." The other parent said,

> "I liked it because it was not difficult. It was very easy to follow. The video was easy to follow. We would pause and go on and pause and go on as we worked our way through the experiment. It put me at ease because it was… this is what you do, step-by-step-by-step. It was good."

Parents mentioned that they and their students understood the experiments' concepts and procedures well and were engaged during experiments. For example, one parent mentioned, "I think [the experiments] help the boys understand better. They like to do them, and I think they pay more attention." During a later interview the parent commented, "They talk a lot more when we do the experiments." Completing the experiment completion forms throughout the experiments was mentioned as well. One parent commented, "We watched the whole thing and talked about it, and then we watched a little at a time. We stopped and did each part, and the boys filled out the papers and then we would watch some more. I liked it a lot." The other parent mentioned, "I liked having the papers to write on." When asked about the website and how it was set up, one parent said, "It made doing experiments easy and not so overwhelming. I liked seeing how to do it, too" and "Nothing was not helpful. It was really good." The same parent also commented, "I like to follow [the recordings.] It is easier for me than for me to do them by myself." Results showed positive engagement with the website and experiments regardless of the number of experiments completed.

Discussion

This study addressed one of the needs of homeschooled students and their parents by providing recorded science experiments and related educational materials on a newly created website. The website was created to help meet the recommendation of the state of California that students in grades K-8 devote 20-25 percent of their science instructional time to hands-on science activities (California Curriculum Development and Supplemental Materials Commission, 2004). To determine the impact of the online science demonstrations this study sought to answer three questions. A discussion of findings for each question follows.

The first research question asked if the use of virtual science demonstrations would improve student learning. The anticipated outcome stated that the use of virtual science demonstrations would improve student learning. The researcher reviewed results from the pretests and posttests, transcribed interviews, and reviewed the experiment completion forms. The results showed gains on the posttest by all except one student. The gains appeared to be related to the experiments completed leading the researcher to assume participation in the experiments contributed to the increases. Further analysis showed that pretest and posttest results showed no patterns emerged between the test results and the number of website experiments completed. Transcribed interview results showed students recalled information better while looking at their experiment completion forms than without their forms. Having the visual cues also helped them recall information better at monthly meetings. The two students that completed seven experiments were from a home where English is not the primary language spoken. Though the first grader was not labeled as an English Language Learner, he and the third grade sibling spoke Russian as their primary language. The use of alternative assessments is considered a best practice for educating English Language Learners (Cary, 2012). An alternative assessment such as one using pictures or real objects should be considered in future projects.

Finally, analysis of experiment completion forms using Anderson and Krathwohl's revision of Bloom's Taxonomy showed most students did reach multiple levels of understanding while completing the experiments. Students showed they reached the higher levels of understanding while completing the experiments by being able to apply, evaluate, and create.

The results showed some evidence that students improved academically following the use of the website. Future research should consider using visual cues on the pretests and posttests to aid students, especially English Language Learners.

The second research question asked if the use of virtual science demonstrations would affect students' attitudes towards learning science. The anticipated outcome was that the use of virtual science demonstrations would improve students' attitudes towards learning science. Researcher reviewed results from the pre study and post study attitude surveys. The results showed increases in positive attitudes for all participants regardless of whether they completed one or seven experiments from the website. The greatest increase came from the kindergarten student that only completed one experiment. His initial score was lowest allowing for greater growth. It is possible that the student's initial score was low due to a lack of experimentation prior to the study. Completion of one experiment from the website could have been enough to affect his attitude towards science. The student with the smallest gain and highest overall initial score completed seven experiments. This initial score may have been higher because of greater involvement with science in the past. His homeschooling parent may have included more science activity in the past leading him to a more positive view of science at the beginning. Additional discussions with parents regarding their students' attitudes towards science may provide alternate reasons for the differences in scores. Discussions could include the parents' perceptions of student attitudes before, during, and after the experiment.

The increases in scores on the attitude survey may have been the result of the use of the website; however, the increases may also be a result of more emphasis on science by the researcher and parent. Each month the researcher spent time discussing science experiments in depth with each student. The increase in interest on the researcher's part may have influenced the students. Future research should consider ways to minimalize the possible effects of the researcher's interest.

While reviewing the interviews, the researcher noted a pattern in regards to attitudes. The researcher found the data showed students' and parents' attitudes were positive in regards to the science experiments. Parents and students liked having the experiments to follow. Initially parents were reluctant to complete science experiments. The interview data showed the parents not only completed the experiments but also enjoyed doing so.

The third research question asked if the use of virtual science demonstrations would affect student and parent engagement in their science education. The anticipated outcome was that students would be more engaged in science education. The researcher reviewed results from experiment completion forms, interviews, and Google Analytics. Students were indeed engaged as shown by their completion of experiments. Engagement was defined for this experiment as a student's participation in the science experiments.

The definition used for this experiment was a conservative definition similar to McMahon and Portelli (2004) who described engaged students as doing what they are supposed to do. However, other definitions exist. Spires, Lee, and Turner (2008) in their study on technology and student engagement did not clearly define engagement, but they mentioned that activities were engaging when students had fun or were able to choose their activity. According to the interview transcriptions, students had fun. One parent commented in regards to her students completing the experiments that "They get excited, really excited." Using both definitions, students were engaged by the online science experiments.

Results showed parents were also engaged with the experiments. Prior to the study, parents commented that experiments were too complicated and time consuming. The parents did not include the experiments in their homeschooling activities. During the study, parents completed the experiments from the website and cited that the recorded video demonstrations made completing the experiments easy. In addition, parents were engaged with their students. The interview data showed students and parents talked about the experiments. Parents had an opportunity to be engaged with the experiments and their students during the study.

Looking at the results by student the researcher noted differences. The kindergarten student completed one experiment and showed growth on the posttest. He also showed an increase in positive attitude according to the survey data. His interviews and experiment completion forms showed he was engaged and enjoyed the one experiment completed. He completed lower level items according to Anderson and Krathwohl's revision of Bloom's Taxonomy. The age of the student and the lack of previous science education could account for the growth on the attitude survey. He may have had little prior experience with science experiments and thus the completion of only one may have been enough to explain the difference in scores.

The first grade student completed seven experiments, showed growth on the posttest and small increase on the post study attitude survey. He correctly completed items at higher and lower levels of Anderson and Krathwohl's revision of Bloom's Taxonomy and met most of the grade level standards for the experiments. His interviews showed he understood the experiments, but he needed visual cues to recall the information. Future studies should include the use of visual cues. The first grade student showed the experiments helped him learn and engage in science.

The second grade student completed one experiment, showed growth of ten percent on the posttest and some increases on the post attitude survey. The student partially met the grade level standards on the completed experiment and successfully completed both lower and higher levels of questions according to Anderson and Krathwohl's revision of Bloom's Taxonomy. The student's data showed he was engaged during the experiment. The second grade student's attitude survey showed the student's self-concept of science improved over the course of the study. It is not possible to know if the improvement was only a result of the experiment as the increased emphasis on science during the study may have contributed to the growth. Though the student only completed one experiment, he showed improvement in his attitude and understanding of the experiment

The third grade student completed seven experiments, showed an increase of 17.5 percent on the posttest, and an increase in attitude according to the survey. The student's engagement was apparent as he completed seven experiments, talked more during the experiments, and really enjoyed completing them. It is possible that the increase in hands-on activities contributed to the increases in learning and attitude. The student relied upon his experiment completion forms during the interviews. Use of hands-on and scaffolded material may benefit this student and future studies.

The fourth grade student completed one experiment, showed no change from pretest to posttest, and showed an increase in attitude according to the survey. The lack of change from the pretest to the posttest could be a result of completing only one experiment or it could be a reflection of the tests' design. Most of the items on the tests related to experiments not completed by the student. Looking at the interview data and the experiment completion forms showed the student understood the concepts of the completed experiment and successfully completed items at various levels of Anderson and Krathwohl's revision of Bloom's Taxonomy. The fourth grade student's attitude was positive according to the survey and the interviews. Though he only completed one experiment, the student was engaged and learned from the experiment.

The parents involved in the study showed positive improvements. Both parents cited concerns about completing experiments prior to the study and responded positively to the experiments from the website. The parents had positive attitudes and were engaged with the experiments.

The first and third grade students and their parents speak Russian as their primary language. These students showed improvements in attitude, achievement, and engagement. Their mother stated the boys really enjoyed the experiments and talked more than usual while completing them. The use of video demonstrations, hands-on materials, and experiment completion forms may have helped both the students and the parent. According to Cary, "Instead of just giving directions to (English Language Learning) students, specifically model what you expect them to do. In other words, show them how to accomplish the task and give an example of exactly how the final product should look" (2012). The students and their parent were able to watch and replicate experiments easier by following the step-by-step instructions.

Overall, the study showed the students were academically engaged, had positive attitudes, and learned the material presented in the experiments. Results from this study are not generalizable as the sample size was too small and the student population was homeschooled.

Results of the study were intended to guide future projects within the same setting. Positive results would lead to the addition of similar online resources. The study showed some positive increases in student achievement, attitudes, and engagement over the course of the four months leading the researcher to the conclusion that the use of the website was helpful and the addition of similar resources could be a useful tool for homeschooling parents.

Suggested next steps include interviewing other supervising teachers and parents regarding the types of resources they would like to see added and checking assessment data for areas of needed support. Questions to ask include:

- Is there a desire to add additional science experiments, or links to more sources of related content information?
- Is there a need, according to assessment data, or an interest in providing a similar website with social studies, math, or English content?

The answers to these questions will provide a direction for future projects.

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Appendix A

Human Subjects Academic Research—Informed Consent Form

Student Researcher's Name: Lisa Behnke

Title of Project: Impact of Virtual Science Demonstrations on Homeschooled K-4th Grade Students

I am asking for your voluntary participation in an academic research project for my master's degree. Please read the following information about the project. If your student will be allowed to participate, please sign in the appropriate box below.

Purpose of the Project: The purpose of this project is to determine if the use of virtual science demonstrations will have an effect on students' attitudes towards science and student engagement.

If your student participates, he or she will be asked to: Access an online website at least six times, view simple experiments, write about the experiments in a journal, and if possible conduct similar experiments at home. In addition, students participating will be asked to document participation in a journal, in photos, or on video. Uploading documentation to website will be encouraged but optional. You and your student will be asked questions regarding the project at monthly learning record meetings.

Time required out of school for participation: This project will be done as part of your student's homeschool science curriculum.

Potential Risks of Study: There are no anticipated risks to participating in this study. Experiments will not involve dangerous materials or procedures. If an experiment is a concern, student may watch it online and write about it in journal and not replicate the experiment.

Benefits: By participating in this project, students will have the opportunity to learn about science in multiple ways rather than using their textbook alone. In a 2008 research study "up to 75% of the students surveyed indicated that they preferred using the Web-based virtual lab to reading text-books only" (Sun, Lin, & Yu, 2008).

How confidentiality will be maintained: Participating students will not be identified by name. If students participate by uploading journal comments, photos, or videos they will be asked to not use names and refrain from showing faces. Website will be reviewed weekly to ensure confidentiality.

If you have any questions, please feel free to contact:

Lisa Behnke lbehnke@hcs.k12.ca.us 916-765-4625

Voluntary Participation:

Participation in this project is voluntary. Students who choose not to participate will still be able to access website and complete the activities, but will be left out of the data collection. Please be aware that if you decide to participate, the project will take place during the fall semester and the student will be asked to participate for the entire project length.

By signing this form, I am stating that I have read and understand that information above. I freely give my consent/assent to participate and permission for my child to participate.

Printed Name of Student	Date
Parent Signature:	

Appendix B

Human Subjects Academic Research – Informed Assent Form

Lisa Behnke, Supervising Teacher and student at California State University, Sacramento, is asking you to participate in a research project. The project is about the use of an online website for science. This research is important because it may help to determine if using online demonstrations are useful and if I should create more.

You will be asked to visit the website at least six times, view science demonstrations, and write about the demonstrations in a journal. You will also be encouraged, but not required, to do the science activities at home and take pictures or video, and upload these to the website.

Your parents have already been asked whether it is OK with them for you to be in this research, but if you decide not to participate, no one will be upset with you.

Please write your name and today's date on the line below if you are willing to be a part of the research.

____

Signature of Participant
Date

Appendix C

Human Subjects Academic Research - Administration Consent Form

Student Researcher's Name: Lisa Behnke
Title of Project: Impact of Virtual Science Demonstrations on Homeschooled K-4th Grade Students

I am asking for approval of voluntary participation in an academic research project for my master's degree in educational technology. Please read the following information about the project.

Purpose of the Project: The purpose of this project is to determine if the use of virtual science demonstrations will have an effect on students' attitudes towards science and student engagement.

Students participating will be asked to: Access an online website at least six times, view simple experiments, write about the experiments in a journal, and if possible conduct similar experiments at home. In addition, students participating will be asked to document participation in journal, in photos, or on video. Uploading documentation to website will be encouraged but optional.

Time required out of school for participation: This project will be done as part of the student's homeschool science curriculum.

Potential Risks of Study: There are no anticipated risks to participating in this study. Experiments will not involve dangerous materials or procedures. If an experiment is a concern, student may watch it online and write about it in journal and not replicate the experiment.

Benefits: By participating in this project, students will have the opportunity to learn about science in multiple ways rather than using their textbook alone. In a 2008 research study "up to 75% of the students surveyed indicated that they preferred using the Web-based virtual lab to reading text-books only" (Sun, Lin, & Yu, 2008).

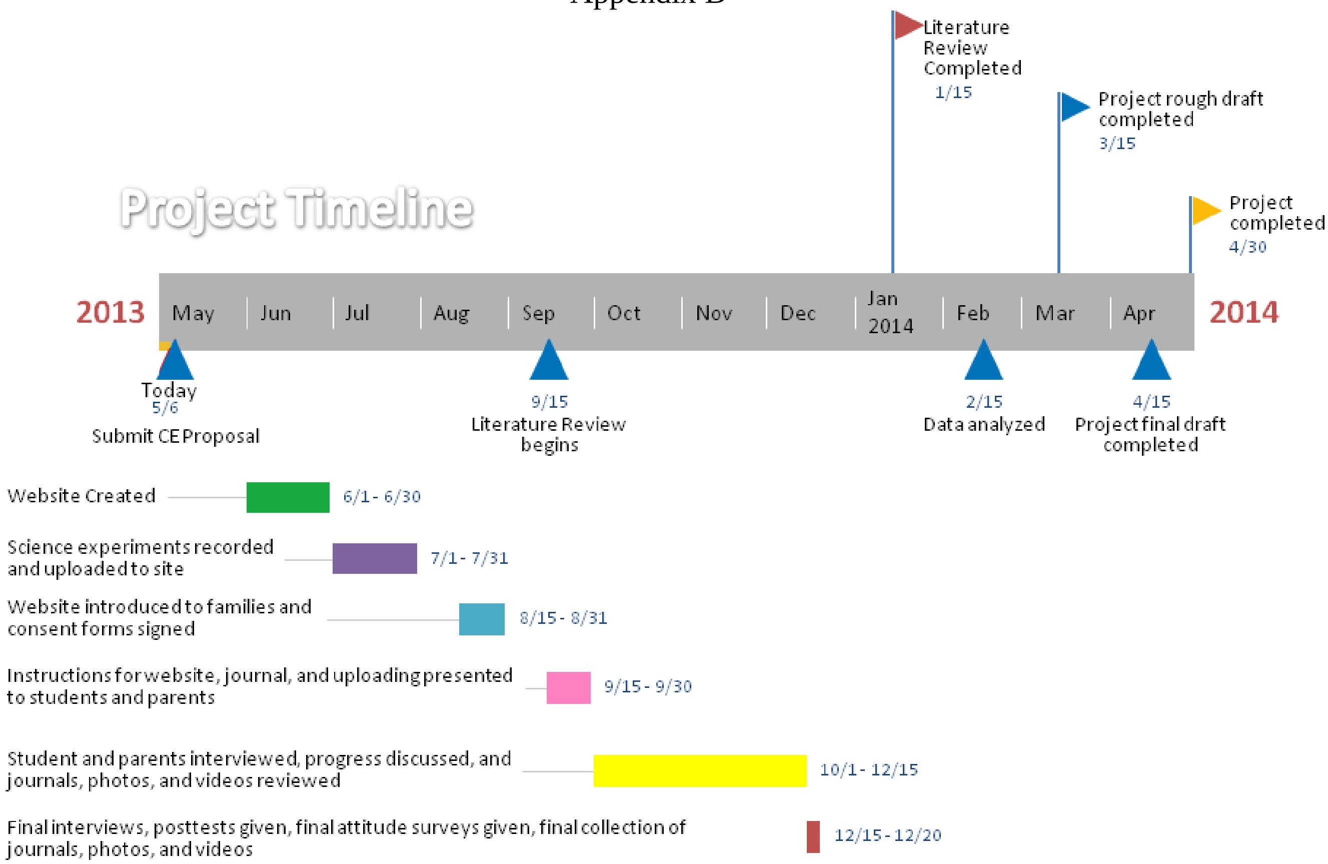
How confidentiality will be maintained: Participating students will not be identified by name. If students participate by uploading journal comments, photos, or videos they will be asked to not use names and refrain from showing faces. Website will be reviewed weekly to ensure confidentiality.
If you have any questions, please feel free to contact:

Lisa Behnke lbehnke@hcs.k12.ca.us 916-765-4625

Voluntary Participation:
Participation in this project is voluntary. Students who choose not to participate will still be able to access website and complete the activities, but will be left out of the data collection. Participating students will be asked to participate for the entire fall 2013 semester.

Printed Name and title of Administrator	Date
Signature:	

Appendix D


Project Timeline
Literature Review Completed
1/15
Project rough draft completed
3/15
Project completed
4/30
2013
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan 2014
Feb
Mar
Apr
2014
Today
5/6
Submit CE Proposal
9/15
Literature Review begins
2/15
Data analyzed
4/15
Project final draft completed
Website Created
6/1 - 6/30
Science experiments recorded and uploaded to site
7/1 - 7/31
Website introduced to families and consent forms signed
8/15 - 8/31
Instructions for website, journal, and uploading presented to students and parents
9/15 - 9/30
Student and parents interviewed, progress discussed, and journals, photos, and videos reviewed
10/1 - 12/15
Final interviews, posttests given, final attitude surveys given, final collection of journals, photos, and videos
12/15 - 12/20

Appendix E

Modified Attitudes Towards Science Inventory

The following statements are about the study of science. Please listen to, and read, each statement carefully. Use the following scale to show how much you agree or disagree with each statement.

If you STRONGLY DISAGREE (1)	● (2) (3) (4) (5)	**NO!**
If you DISAGREE (2)	(1) ● (3) (4) (5)	NO
If you are UNDECIDED (3)	(1) (2) ● (4) (5)	I don't know
If you AGREE (4)	(1) (2) (3) ● (5)	Yes
If you STRONGLY AGREE (5)	(1) (2) (3) (4) ●	**YES!**

It is important that you respond to every statement, and that you fill in only one number per statement.

1. Science is something that I enjoy very much.	(1) (2) (3) (4) (5)
2. I would like to do some extra or un-assigned reading in science.	(1) (2) (3) (4) (5)
3. Science is easy for me.	(1) (2) (3) (4) (5)
4. Sometimes, I read ahead in my science book.	(1) (2) (3) (4) (5)
5. I usually understand what we are talking about in science.	(1) (2) (3) (4) (5)
6. No matter how hard I try, I cannot understand science.	(1) (2) (3) (4) (5)
7. I like the challenge of science assignments.	(1) (2) (3) (4) (5)
8. I often think "I cannot do this." when a science assignment seems hard.	(1) (2) (3) (4) (5)
9. Science is one of my favorite subjects.	(1) (2) (3) (4) (5)
10. I do not do very well in science.	(1) (2) (3) (4) (5)

The Modified Attitudes Towards Science Inventory will be scored using the following scale.

Self-concept of Science = 3, 5, 6*, 8* 10*

Desire to do science = 1, 2, 4, 7, 9

The * indicates that the score will be reversed because the statements were worded in the negative. Higher numerical scores reflect more positive attitudes in all areas.

Survey is modified but based on Modified Attitudes Towards Science Inventory was obtained from http://www.pearweb.org/atis/tools/7

The website credits the following for the inventory:

Weinburgh, M.E. & Steele, D. (2000). The modified attitudes toward science inventory: Developing an instrument to be used with fifth grade urban students. *Journal of Women and Minorities in Science and Engineering*, *6*(1), 87-94.

Appendix F

Emoticons used with students' attitude surveys. From left to right the faces were given a value from 5 to 1 to match the attitude survey.

Appendix G
Interview Questions

Questions open-ended to allow for discussion with students. Additional questions may be asked based upon responses. Questions will be asked prior to project beginning and at each subsequent monthly meeting.

1. Tell me about what you did for science this month.
2. Tell me what you remember about that.
3. Tell me about any experiments you did this month.

   What did you notice?
4. Why do you think (results) happened?
5. How do you know?
6. Where did you get the experiment idea?
7. What else did you do for science this month?

Parent Interview questions

1. What else would you like to add about this month's science activities?
2. What did you think about the experiments?
3. What can you tell me about the use of the website?
4. Anything else?