Inquiry-based learning and its effects on students' achievement and interest in science classes

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Abstract: Oftentimes, students receive around 30 minutes of science instruction time in elementary school. It's important for students to develop how to critically think and solve real world problems, making science instruction even more valuable. This study explores using the Pedaste et. al. (2015) inquiry-based learning approach for science instruction and how it affects students academic achievement, intrinsic motivation, as well as effort. In this action research project, which took place 4 days a week for 4 weeks during science instruction time, students learned through an inquiry-based approach. The results showed that students increased their knowledge in scientific concepts as well as being more intrinsically motivated. However, students did not report a change in their effort.

Introduction and Justification

Recent data suggests that in elementary school classrooms, on average, the instructor spends less than two instructional hours per week on science education (Brand & Moore, 2011). Some schools split time between science and social studies instruction. An important goal of education for students is to develop scientifically literate citizenry (Bodzin & Beerer, 2003). When students approach their coursework like professional scientists, they are more likely to develop problem-solving skills and critical thinking tools that can be used in their future work (Brand & Moore, 2011; Pedestal et al., 2015; Wang et al., 2015). Moreover, under Next Generation Science Standards (2013), students are expected to develop science literacy through inquiry.

Students can become more scientifically literate when they engage in active learning through inquiry-based learning (Brand & Moore, 2011). Learning is most effective when students think like scientists, directing their own investigations and transforming their experiences into knowledge (Barrow, 2006; Şimşek & Kabapınar, 2010). In science instruction, teachers may feel uncomfortable with content and thus resort to worksheets and definitions (Brand & Moore, 2011; Brush & Saye, 2017; Wang et al., 2015). However, well-crafted educational experiences can help students develop the problem-solving and critical thinking skills necessary to become scientifically/historically literate citizens. Teachers must provide students with rich educational experiences that allow them to think critically about the content and engage in self-directed problem-solving. An inquiry-based learning approach can address both of these needs by providing students with transferable skills and allowing them some ownership of their learning. Students may engage more deeply with the content and become more intrinsically motivated as learning becomes student-centered and takes into account their own interest, questions, and previous knowledge (Ryan & Deci, 2000). If students are able to pursue their interests, they may also put more effort into their work because they may be more interested in learning and understanding the content rather than just completing the assignment for a grade (Ryan & Deci, 2000).

Due to accountability pressures, teachers often feel the need to teach subject matter as isolated facts rather than higher-order concepts (Anderson, 2011). However, students tend to forget those facts unless they are connected in meaningful ways (Boykin & Noguera, 2011). Inquiry-based methods allow students to engage in meaningful learning by taking ownership of their learning and participating in processes practiced by professionals. This includes inquiring, researching, questioning and analyzing to make conclusions. Previous research provides ample evidence that inquiry-based learning approaches benefit students in higher education grades. However, inquiry-based approaches are less common in elementary settings due in part to teachers' doubts about their content knowledge and ability to guide younger students to think like professional scientists (Barrow, 2006; Bodzin & Beerer, 2003; Gormally et al., 2009).

Literature Review

Conceptual Framework

Inquiry-based learning is a strategy that allows students to follow methods and practices similar to those used by professionals to construct knowledge. In doing so, students develop the skills to use scientific information to solve problems and make everyday decisions (Brand & Moore, 2011). Inquiry may be central to the reform of science teaching and learning (Blanchard et al., 2009). The American Association for the Advancement of Science (1993) similarly recommends inquiry-based learning for science instruction. There is no one definition of inquiry-based learning, but all definitions point to an approach that is (a) student-centered, involves (b) active learning and participation, and (c) application of problem-solving skills (Gormally, 2009; Brush & Saye, 2017; Pedaste et al., 2015). Inquiry-based learning can be divided into different phases of inquiry: orientation, conceptualization, interpretation, conclusion, and discussion (Pedaste et al., 2015). Throughout these phases, students take responsibility over their own learning. Problem-based inquiry is a subcategory of inquiry-based learning in which students are provided with an unstructured problem without a clear solution. This allows the learning to become student-centered (Brush & Saye, 2017).

Benefits of Inquiry-Based Learning

Barron and Darling-Hammond (2008) define inquiry-based learning as a student-centered approach that involves developing skills for critical thinking, problem solving, and an active learning approach focusing on questioning. The teacher acts as a facilitator of learning and can guide students through think-alouds and questions that solicit reflection to encourage a deep conceptual understanding, which allows the change from teacher-centered to student-centered (Gormally, 2009; Katan & Baarts, 2021, Pedaste et al., 2015). Deep engagement with the content allows learning to be driven by open questions and multiple-solution strategies (Maaß & Doorman, 2013). In inquiry-based approaches, questions should solicit reflection to maintain a deep conceptual understanding (Gormally, 2009; Katan & Baarts, 2021, Pedaste et al., 2015).

Inquiry-based learning can be a powerful instructional approach if the teacher understands it and has the tools to execute it (Windschitl, 2004). To guide the learning process, teachers often must model how to engage in scientific investigation (Barron & Darling-Hammond, 2008). Prompts and questions that require higher-order questioning and thinking will better guide students through the learning process (Blanchard et al., 2009; Bodzin & Beerer, 2003).

Pedaste Model

Pedaste et al. (2015) reviewed 32 articles on inquiry-based learning and outlined how definitions and themes overlapped in descriptions of the inquiry phases. They developed an inquiry-based learning model framework for science that includes five general phases: orientation, conceptualization (subtheme: questioning and hypothesis generation), investigation (subtheme: exploration, experimentation, and data interpretation), conclusion, and discussion (subtheme: communication and reflection). These phases are not linear and may be fluid when applied. The Pedaste model allows students to engage in an authentic scientific discovery process and involves the application of several problem-solving skills (Pedaste et al., 2015). In this approach, students think and learn like scientists. Namely, they ask questions, create solutions, and solve problems by planning and investigating (Wang et al., 2015).

The Pedaste model of inquiry-based learning allows students to engage in an authentic scientific discovery process and involves application and strengthening of critical thinking and several problem-solving skills (Pedaste et al., 2015; Wang et al., 2015). These skills, in turn, can be used when students encounter similar problems and content in the future (Hmelo-Silver et al., 2007). Inquiry-based approaches require students to engage in the scientific process in deeper, more meaningful ways. Throughout Pedaste et al.'s (2015) five inquiry phases, students lead the learning process. By acting as scientists, they create more memorable and personally relevant experiences.

Acar and Tuncdogan (2018) explored the extent to which using the Pedaste model for inquiry-based learning enhanced student innovation. They found that learning comes from grasping and transforming an experience into knowledge (Acar & Tuncdogan, 2018). If students are able to experience the Pedaste model, it can help them grasp the information and have a deeper understanding. Inquiry-based learning allows students to retain and transfer academic skills more readily than traditional methods (Hmelo-Silver et al., 2007). Through Pedaste's (2015) five inquiry phases, students lead the learning process. This allows them to develop critical thinking skills and problem-solving skills (Wang et al., 2015; Pedaste et al., 2015). Deep engagement with the content allows learning to be driven by open questions and multiple-solution strategies (Maaß & Doorman, 2013).

Although inquiry-based learning has been explored in a variety of higher education contexts, few studies have documented its benefits in elementary school settings. However, the model has rarely been tested in an authentic classroom setting.

Present Study

The purpose of this study was to explore the influence of Pedaste et al.'s (2015) inquiry-based approach on students' academic performance, intrinsic motivation, and effort in science. The following research questions were developed:

- To what extent does inquiry-based learning increase students' understanding of scientific concepts?
- To what extent does inquiry-based learning influence students' intrinsic motivation in science?
- How does inquiry-based learning affect students' effort in science?
- What elements of inquiry-based learning did students report liking and not liking?

Methods

Participants

The participants were students in my internship placement, and as such were a convenience sample. They were 22 third grade students (7 boys, 15 girls) from an elementary school in Southern Maryland. Of those 22 students, 19 are classified as Caucasian, one as Hispanic, and two as Multiracial. Two of the 22 students were Individualized Education Plan holders for speech and language.

Description of Inquiry-based Lesson

Each science lesson was 30 minutes long. Before the lesson, students completed a Likert-type scale of intrinsic motivation and the scientific concept quiz. Students' scores were recorded and kept confidential.

At the start of the unit, students were taught the mini lesson and read an excerpt in their science textbook, *Exploring Science* by National Geographic (2015), about living in groups. The excerpt highlighted that some animals may live alone or in groups and outlined reasons why some live in groups. It was only two pages and provided a basic foundation of knowledge students could use to generate questions.

The rest of the lesson was designed to be both student-centered and student-driven. Students were guided to think of different animals and generate questions regarding whether they thought different animals lived in groups or alone. Afterwards, I told students that they need to use their generated questions to start to explore for more information to provide conceptualization of the standard ("3-LS2-1: Construct an argument that some animals form groups that help members survive" (Next Generation Science Standards, 2013)). Students then had to demonstrate their knowledge through completion of a project they developed. To help guide students to pick an animal they want to research, I had a pre-generated list of different types of animals that live in groups that students could choose from.

The next day I gave students time to refine their generated questions based on the previous lesson. Before students got into groups, we discussed how scientists use the scientific method to answer questions and developed a chart for our class to use for the remainder of the unit. We talked about what it meant to ask "good" and "bad" questions. Students then got into small groups to discuss and share their questions. After they had been given time to think through their questions in small groups, students were asked to share and discuss their questions as a whole class. This discussion included some consideration of what makes a question good and if it can be answered using something measurable. We made a class list of all the things that we thought each project needed to contain.

The following day students were told that they would design a research project on animals that live in groups and reasons why they live in groups in order to survive. They identified an animal, the names for a group of those animals, and information about why they live in groups (i.e., due to environment, safety, need to get food, protection and defense, and coping with change). We developed the project the previous day as a class and I had turned it into a checklist for the students to use while completing their projects. Students were told they could present the information in multiple ways (e.g. essays, presentation, video, PSA, poster, etc.). As a class, we came up with a list of expectations for completing their projects, which also helped to outline a rubric for the class. Each student was graded on the same rubric to see if they made a compelling presentation that proves they understand that some animals form groups that help members survive. Students were assigned partners, but using equity sticks, they then decided which animal they wanted to research.

The following day, students were given a few moments to check over their refined and polished questions to figure out where to start with researching. Students collaborated in groups and I walked around to guide discussion and to make sure they were still asking questions relevant to the standard. Students spent time collecting information and creating their projects. This is when students interpreted and investigated the new information they found and built on their preexisting knowledge to form new knowledge.

Students presented their projects and allowed 5 minutes for questions after each presentation. Students completed a worksheet to take notes for each student's presentation. While students presented, I informed them that they would be leading and answering questions because they were now experts on their subject. Students learned about different animals, why they lived in groups, and the external factors that contributed to animals living in groups.

It should be noted that throughout the inquiry-based learning lesson, students were encouraged to ask questions. Students had to continually refer back to the questions they generated on their own, questions generated with their partners, and questions generated with the whole class. The unit was flexible based on students' needs. At the conclusion of the lesson, students again completed the interest questionnaire and scientific concepts quiz.

Data Collection

For this mixed-methods study, I collected several types of data (Table 1). Students completed a brief assessment of the lesson content before and after the implementation of the lesson (see Appendix A). The questions aligned with Maryland's Common Core State Standards for science and were provided by the textbook, *Exploring Science* (2014).

Students also completed a questionnaire before and after the lesson (see Appendix B). This questionnaire was given to students to gauge their intrinsic motivation about science. This was adapted from Ryan's (1982) Intrinsic Motivation Inventory. Students were provided five statements regarding their feelings about science in which they had to choose their response on a 5-point Likert-type scale. An example item is "I am never interested in science topics."

After the completion of the unit, students were also asked to respond to open-ended questions describing their favorite and least favorite parts of the lesson that day on the bottom of the affective questionnaire. Students were also asked the same questions after implementation of the instructional approach. Students' responses were used to complement the affective intrinsic motivation questionnaire and thus provide greater insight into students' feelings.

Table 1: *Research Questions and Data Sources*

Research Question	Data source 1	Data source 2
1. To what extent does inquiry-based learning increase students' understanding of scientific concepts?	Pre-post scientific content quiz	
2. To what extent does inquiry-based learning influence students' intrinsic motivation in science?	Pre-post survey: Interest/enjoyment in science topics (Likert-type scale)	
3. How does inquiry-based learning affect students' effort in science?	Pre-post survey: Effort in science class (Likert-type scale)	Field notes
4. What elements of inquiry-based learning did students report liking and not liking?	Pre-post survey: Student reaction (Open-ended items)	

Data Analysis

Students' pre and post scientific content assessments were analyzed using a paired t-test to determine how students' scores changed after receiving instruction using the inquiry-based approach. Students' pre and post interest questionnaire responses were also analyzed using a paired t-test to determine how students' interest changed after receiving instruction using the inquiry-based approach. All students' responses were kept confidential.

Validity

The questions for the pre/post scientific content quiz were pulled from the National Geographic textbook that students use and as such provided a measure of the content that had undergone previous review.

Results

To what extent does inquiry-based learning increase students' understanding of scientific concepts?

Using the data collected from pre/post assessment, field notes, artifacts, and the pre/post- affective questionnaire, the findings regarding the research question, *To what extent does inquiry-based learning increase students' understanding of scientific concepts,* were significant. The *p*- value was less than .05 showing that my inquiry-based learning did increase students' understanding of scientific concepts. Given that my *p*-value was 0.01 there was a significant change in understanding from pre-assessment to post-assessment for the effect size. This indicates that there was a medium effect in how significant the students' change in understanding from the pre-assessment to post-assessment was.

Table 2: *Paired two-tailed t-test Comparing Pretest and Posttest Scores*

	n	*M*	*SD*	*p*	*d*	*BF*
Pretest	22	3	1.35	.01	0.44	3.43
Posttest	22	3.59	1.33			

Students' average on the pre/post assessment increased significantly. The increase was moderate in size, from a 3 to a 3.6, an increase of 17%. The inconsistency of the COVID-19 pandemic likely affected this outcome. Students had difficulties with finding their own research through multiple sources, and thus their frustration level was higher. Due to time constraints, students did not have as much time to complete the project as anticipated. In future research, with a more stable environment and more time allotted, it is possible students could make even more gains.

To what extent does inquiry-based learning influence students' intrinsic motivation in science?

Students completed a pre and post Likert-type scale that contained five questions (see Appendix B). Of those five questions, four questions measured students' intrinsic motivation. The Likert-type scale was scored 1-5 (1 being negative and 5 being positive responses to the question).

Figure A. Means of student pre and post unit questionnaire responses for each of the five questions that measured students' intrinsic motivation.

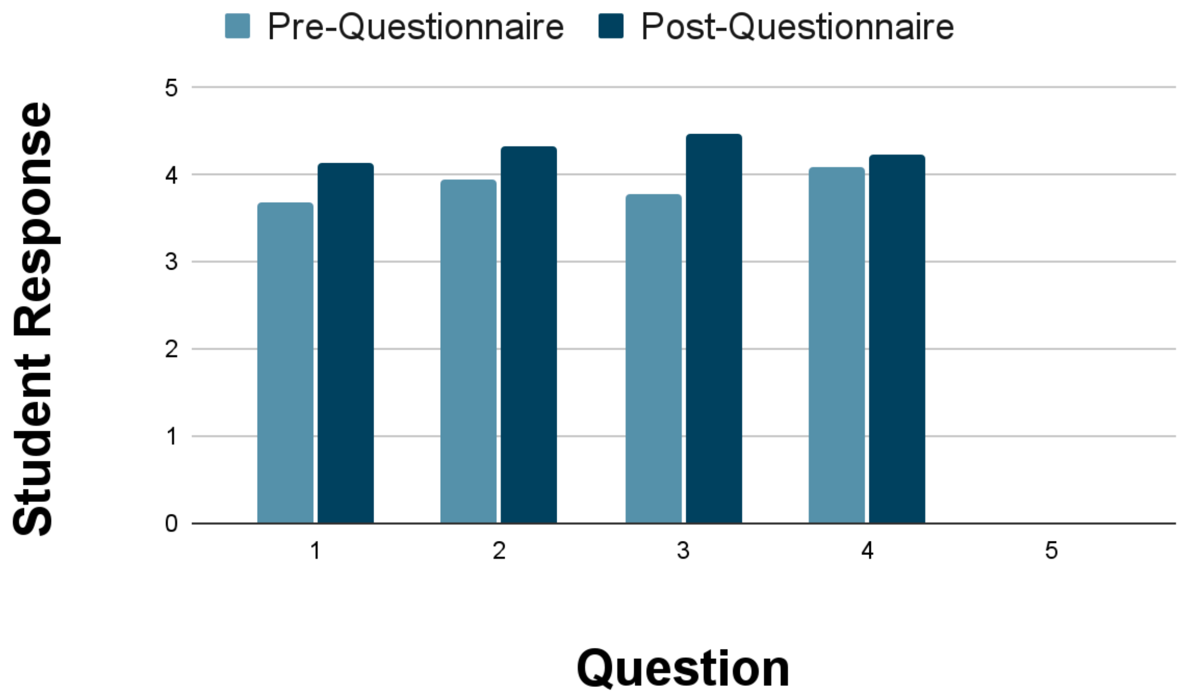

Table 3: *Paired two-tailed t-test Comparing Intrinsic Motivation Pretest and Posttest Scores*

	n	*M*	*SD*	*p*	*d*	*BF*
Pretest	22	3.88	0.87	.01	0.54	2.98
Posttest	22	4.29	0.67			

The results from the t-test indicate that students' intrinsic motivation increased significantly between the pre and post questionnaires (Table 3) with a *p*-value of 0.01. There was a medium effect size (Cohen's D= 0.54). Given that my p-value was 0.01, there is evidence that students were more intrinsically motivated after completing the inquiry-based learning method. Also, the bayesian factor (BF) favors the alternative hypothesis, further supporting that my intervention increased intrinsic motivation.

How does inquiry-based learning affect students' effort in science?

Students completed a pre and post Likert-type scale survey that contained five questions (see Appendix B). In order to determine if students' effort towards science changed as a result of an inquiry-based learning approach, I conducted a two-tailed, paired-sample t-test. I calculated the class average for each of the five Likert-type scale statements, with "one" indicating low effort in science, and "five" indicating high effort in science (Figure A). Of those five questions, one question measured students' effort.

Figure B. Means of student pre and post unit questionnaire responses for each of the five questions that measured students' effort.

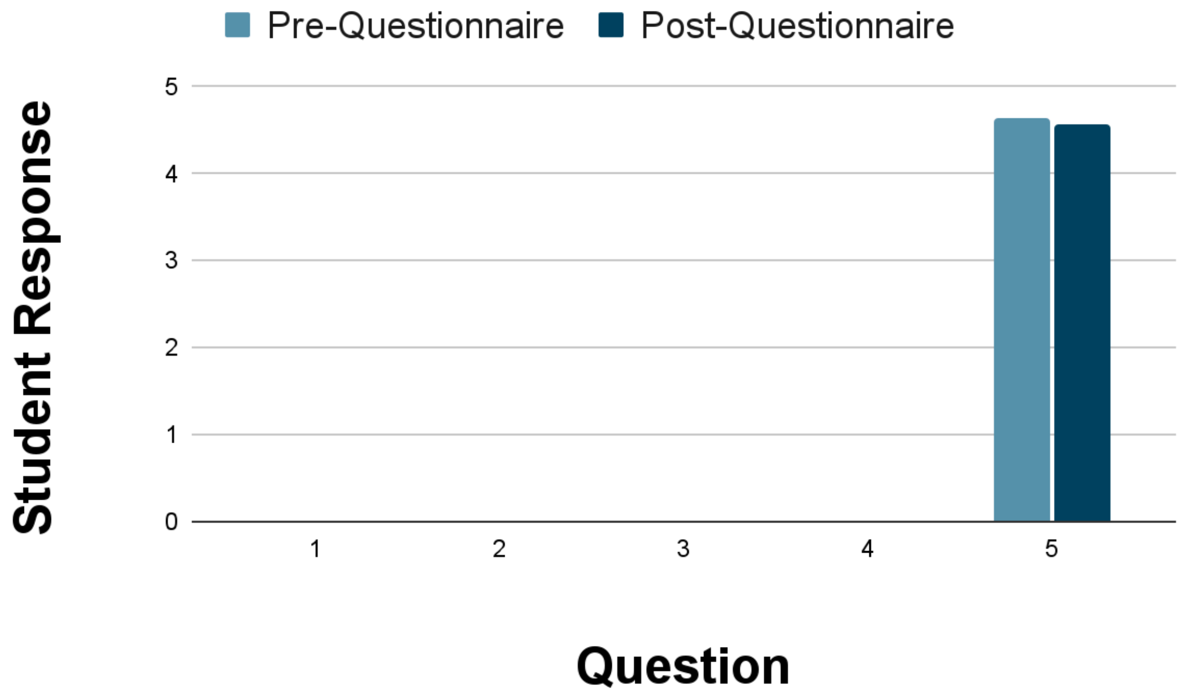

Table 4: *Paired two-tailed t-test Comparing Effort Pretest and Posttest Scores*

	n	*M*	*SD*	*p*	*d*	*BF*
Pretest	22	4.64	1.05	.41	0.06	4.37
Posttest	22	4.58	1.00			

The results from the t-test indicate that students' effort did not change significantly between the pre and post questionnaires (Table 4). However, this may be due to a ceiling effect because students reported positive feelings towards effort in science (maximum score of 5) during the pre affective questionnaire . Thus, there was very little room for improvement between the scores (Figure B).

What elements of inquiry-based learning did students report liking and not liking?

Students reported liking the lesson that used an inquiry-based learning approach. Students reported liking using tools to complete their projects (ex. Google Slides) and choosing which animal they wanted to research. I did not get much feedback from students indicating dislike for elements of the inquiry-based learning unit, but one student noted how it was frustrating to find all of the information from the provided sources. Multiple students also reported this verbally during their in class research time.

Discussion of Results

Overall, the results of this study are consistent with the previous research related to an inquiry-based learning approach and its influence on academic achievement (Gormally, 2009; Katan & Baarts, 2021, Pedaste et al., 2015). After implementation of this unit, students gave an oral presentation in which they taught the class about the individual animal they researched. Following the Pedaste model (2015), students engaged in the authentic scientific process. Students had a choice in the animal they wanted to research and the results supported Ryan and Deci's (2000) research that more meaningful content delivery and engagement will increase students' intrinsic motivation to learn. Students experienced frustration throughout the process, but developed new critical thinking and problem solving skills in order to complete the project.

While the current study did not focus on teacher perceptions, it is important to note that I had read the research discussed in the literature review prior to implementation of the project, thus I had a positive view of inquiry-based learning prior to instruction. It is a possibility that my views on this learning approach may have influenced my perception of its instructional effectiveness based on previous research.

Finally, participants showed no increase in effort throughout the inquiry-based learning unit. Even though analysis of students' pre and post affective questionnaire responses did not show a statistically significant result (possibly due to ceiling effects), students appeared to be putting forth high levels of effort throughout the unit via my own observation. This was apparent through frustration for many students as they had never been challenged using a student centered approach similar to this one before; their frustration with the process indicated their high levels of investment in the project. Many reported enjoying the hands-on aspects of the unit, especially the challenge of creating their own form of representation of the information found through some sort of presentation.

Conclusions and Implications

One of my goals is to push my students to interpret and solve real world problems. When they grapple with these challenges, not only are they learning the curriculum, but they are also collaborating and using technology to master the content. Through inquiry-based learning, we shift from teacher centered instruction to student centered instruction. We cultivate the knowledge and skills needed for students to engage deeply in the curriculum by developing critical thinking and problem solving skills through an authentic process. This study, in keeping with previous research, makes it clear that students' academic achievement and intrinsic motivation increase as a result of this teaching approach. While this study does not demonstrate a statistical increase in student effort, observations of students at work throughout the unit indicates that students were engaged and working with great effort in both individual and collaborative tasks. Students also reported through their affective assessment, although they may have been frustrated, positive responses were given in regards to the inquiry-based learning method.

Limitations

While this study demonstrated some relevant findings about the effects of inquiry-based science instruction, it does not come without a few limitations. One limitation is that the sample size was 22 participants, one third grade class. The main limitation of this study stemmed from long-term educational disruptions caused by the COVID-19 pandemic. This is the first time in two years that students have been back in the traditional classroom setting. Students attended school synchronously and asynchronously last year through a hybrid approach that, ironically, did not develop student's technology skills at the same rate as the traditional classroom instruction they were missing. Designing this project, I anticipated that students would be more adept at navigating technology in an educational context than they actually were. Students spent a significant amount of time trying to use Schoology to access the sources and struggled in navigating this and in the production of their presentations. This created a significant time constraint for students to complete their projects.

Time was also a limitation because students only have 30 minutes a day dedicated to science or social studies. Students also do not have science instruction on Friday due to their Friday binders (recieve their work from the week to take home and get signed). In addition to the instructional blocks being brief, during the 28 days students were scheduled to work on the project there was 1 school closing and 2 delayed openings due to snow. On days with delayed openings, students do not have science or social studies instruction.

Implications

Due to the results of this project, I plan to use inquiry-based learning in my future classroom. This research has various implications for the classroom. Students were actively engaged throughout the entire learning process. Students used instructional tools like checklists and graphic organizers to help them compile their research. They developed questions to figure out more information about the specific animal. Students were faced with new academic challenges for their science instruction.

I believe that inquiry-based learning can be used for all ages and in different content areas. This is an authentic process for students to develop critical thinking and problem solving skills. Based on my reported scores, students also enjoyed this process, despite feeling frustrated during the process. Students needed to collaborate with their partners to create an oral presentation focused on their animal. Students had the choice to pick not only the animal, but also the format in which they presented their information. These components of choice and guided research are the key elements of inquiry-based learning projects. Through the entire process and their final presentations, students showed mastery of the science content, indicating that an inquiry based approach and an emphasis on student skills supports content learning standards while keeping students motivated and working hard.

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Appendix

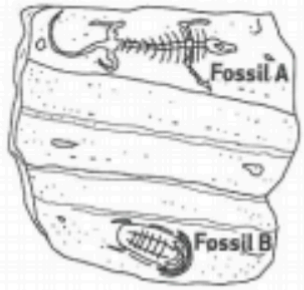
Appendix A

Name:__________________________________ **Date:_____________________**

Directions: Please answer the following questions. Circle the correct or **best** answer possible.

1. Why do animals migrate?
    a. To find food
    b. To cope with changing temperatures
    c. To find water
    d. All of the above
2. How do wolves in a pack help one another?
    a. They hunt large prey together.
    b. They help each other catch small prey.
    c. They act together to relocate their nest.
    d. They hide together from predators
3. What kind of group do fish form for protection?
    a. Pack
    b. Prey
    c. School
    d. Swarm
4. What kind of change do bees cope with by swarming?
    a. Hunting for food
    b. Finding other bees for mates
    c. Finding water on dry days
    d. Finding a less crowded place for a new hive
5. What can living in groups help animals do?
    a. Get food
    b. Defend themselves
    c. Care for young
    d. All of the above
6. Why are some plants and animals no longer living anywhere on Earth?
    a. They decided not to reproduce.
    b. Their environment changed and could no longer support them.
    c. They migrated to other places.
    d. They went undiscovered and disappeared.

Use the picture below to answer question 7.



7. The drawing above shows evidence of organisms that once lived at the location shown in the photo. Fossil A lived on land in a very dry environment. Fossil B lived in water. How has the environment changed over time in this area?
    a. The area changed from a dry environment to a water environment.
    b. The area changed from a water environment to a dry environment.
    c. The area changed from a forest to an ocean.
    d. The area changed from a desert to a wetland.
8. What are fossils?
    a. Types of plants and animals
    b. The actual skin and bones of organisms that lived long ago
    c. Traces of organisms that lived long ago
    d. Environmental changes that took place long ago
9. What can you infer about fossils found in two layers of rock in the same area?
    a. The fossil in the bottom layer is older.
    b. The fossil in the top layer is older.
    c. The fossil in the bottom layer is younger.
    d. Both organisms lived in the same conditions.
10. Fish fossils are found in some deserts, and fern fossils have been found in Antarctica. What evidence does this provide?
    a. That these plants and animals became extinct
    b. That other kinds of organisms may have lived there, too
    c. That plants and animals lived in all places on Earth
    d. That areas on Earth have changed a lot over time
11. How are polar bears able to survive in a cold environment?
    a. Their thick fur and body fat keep them warm.
    b. They stay in the cold only for a short time during the year.
    c. Their bodies do not produce heat so they do not get cold.
    d. They avoid walking in snow or ice.
12. Why would a leopard frog not survive in a dry place?
    a. It needs water to swim for exercise.

   b. It needs water to lay its eggs and keep its skin moist.
   c. Dry soil rubs away the frog's skin.
   d. It eats only food that it catches in water.

13. How does the angler fish use light in the deep ocean?
   a. It follows sunlight to the surface for food.
   b. It feeds only when daylight reaches the deep water.
   c. It produces its own light to attract prey.
   d. It does not need light at all.
14. What do some animals do in winter to survive?
   a. Migrate to colder places
   b. Lose weight
   c. Die off
   d. Migrate to warmer places
15. What can you infer about plants that live in a desert habitat?
   a. They require less sunlight than forest plants.
   b. They produce no food for animals that live there.
   c. They require a great deal of water to survive.
   d. They do not require much water to survive.

Appendix B

Directions: Please color the box with the statement that best represents your feelings about science. Please be as honest as you can!

1	I never enjoy science class.	I usually don't enjoy science class.	Neutral	I usually enjoy science class.	I always enjoy science class.

2	I'm never interested in science topics.	I usually don't find science topics interesting.	Neutral	I usually find science topics interesting.	I always find science topics interesting.

3	I really dislike science class.	I dislike science class.	Neutral	I like science class.	I love science class.

4	I am never engaged in science	I am not usually engaged in science activities.	Neutral	I am usually engaged in science activities.	I am always engaged in science activities.

5	I never try my best in science class.	I usually try my best in science class.	Neutral	I sometimes try my best in science class.	I always try my best in science class.

Open-Ended Questionnaire

Name: ____________________________ Date:________________

1.) What did you like about today's lesson?

What I like about today's lesson is ___________________________________.

2.) What did you not like about today's lesson?

What I do not like about today's lesson is ______________________________.