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The Effectiveness of Project-Based Learning Using Digital Storytelling Technology on Improving Second-Grade Students' Performance of Science Standards

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THE EFFECTIVENESS OF PROJECT-BASED LEARNING USING DIGITAL STORYTELLING TECHNOLOGY ON IMPROVING SECOND-GRADE STUDENTS' PERFORMANCE OF SCIENCE STANDARDS

by

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ABSTRACT

The purpose of this study was to find the effectiveness of digital storytelling technology integration through a project-based learning approach using digital stories combined with hands-on guided inquiry science lessons. As a teacher researcher, the focus was on the effectiveness in the performance of second-grade students using higher-order thinking science standards. For a period of ten weeks, the researcher through comparative action research investigated how emergent technology integration improved the performance of two second-grade classrooms implementing three higher-order thinking life science standards. A total of 27 students from two second-grade classrooms volunteered for this research. For the study, a pretest and posttest from Classroom A and Classroom B were utilized for the quantitative data analysis. A web-based rubric was created to assess the science digital story and student journals. The students also completed a self-assessment progression scale at the end of the study. The data collected showed an improvement in the performance of second-grade students using higher-order thinking science standards with technology integration.

This thesis is dedicated to the memory of Mom and Hilde. Your continuous love, wisdom, and spirit are with me always. To Olga for your continuous encouragement and loving friendship, you have been an uplifting blessing in my life. Last but never least, to my loving husband, Richard, and to my amazing children. I appreciate all the great sacrifices made and your unconditional support while pursuing this milestone. I hope you follow our values knowing nothing in life is free and everything comes with hard work, sacrifice, honesty, and dedication. Education will be your best investment. Your support carried us through. To each of you, I dedicate this effort.

"With God all things are possible." Matthew 19:26

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CHAPTER ONE: INTRODUCTION

As teachers, we face the challenges of teaching 21st century learners, and our continuously evolving curriculum standards (Sunnibrown.com, 2011). Florida's standards for Mathematics, English Language Arts, Social Studies, Science, and Technical Subjects consist of a Depth of Knowledge (DOK) Model of Cognitive Complexity framework (Department of Education, 2017). According to CPALMS, this framework is defined as a structure to help align the cognitive demands of today's standards and corresponding assessments needed for Florida learners. Florida has now moved towards a DOK complexity model to incorporate the cognitive demands presented by standards and curriculum. Since all standards follow this framework, the Florida science standards then are based on this same Depth of Knowledge/Cognitive Complexity framework (Webb, Alt, Ely, & Vesperman, 2009). This framework is designed to challenge students to think critically and analytically. Students are required to become problems solvers using higher cognitive skills. The implementation of the framework requires new teaching strategies or different ways of teaching for students to demonstrate deep knowledge (A brief report: Framework for K–12 science education, 2011). As an educator, implementing these higher-order thinking standards in the classroom may mean using a different teaching approach to help students adapt to the new academic challenges posed.

Along with greater demands on students of these revised academic standards, science as a content area also continues to evolve. According to the National Research Council (NRC), in order to keep up with the demands of science the complexity of its standards is designed to support students' meaningful learning in science and engineering; therefore, the

NRC has developed a framework, that is based on a wealth of research supporting science education, (National Research Council, 2012). The NRC notes many 21st century students will face unique challenges in the future—environment, energy, and health—requiring in-depth knowledge in science and engineering to find viable solutions. As defined by Blair (2012), 21st century learners demand quick technology access for knowledge and are skillful in engaging in learning at a whole new level through, critical thinking, creativity, communication, and collaboration. Today many tools used in the class can provide students with the opportunities needed to become critical thinkers (Intel Education Project Based Learning, 2010). Along with the use of new technological tools, teacher also may need a new approach to teaching to meet these new higher levels of engagement and student learning.

Relationship of Science, Technology and 21st Century Learning

Teachers can build 21st learning concepts using technology to reach a higher level of student outcomes in today's science classrooms. As an observer in a developing society, today's world and classrooms are inundated with some form of revolutionized technology. The workforce is increasingly dependent on new technology; therefore, it is very likely science and technology will continue to influence the lives of students in K-12 settings for years to come (Jenkins, 2002). If society is immersed with technology, how does this affect our students? According to Dr. Larry Rosen, schools continuously use strategies that are more effective for an aged generation, while modern students are growing within an informational internet frenzy (Rosen, 2010). He continues to point out, students are born surrounded by a wealth of digital devices, and teachers need to change instruction to suit the digital demands. Technology has transformed society, the workforce, students, and education; certainly, it has transformed science. Science has improved in just about every field: medical science, space science, weather and robotics (Bull, Gess-Newsome, & Luft, 2008). Based on this information, it is of no surprise educators are seeking for newer methods to integrate 21st century learning, technology and science.

When implementing technology, the importance relies on using it to enhance learning, and the main focus should be the content and not the technology (Kolb, 2017). According to Kolb, student growth does not happen solely with technology; but, through instructional, and teacher interaction as well. Guided inquiry lends itself to that needed teacher interaction. Teachers leading science instruction through a guided hands-on inquiry approach can allow elementary students to communicate scientific concepts, gain familiarity with science vocabulary and demonstrate understanding of scientific concepts within their findings (Colburn, 2000). Guided inquiry is a teaching technique that involves students being actively engaged in learning through questioning, data analysis, and critical thinking (Florence, 2011). This type of teaching strategy combined with technology was the perfect blend of tools to support emergent science learners in kindergarten through third grade. The hands-on approach of guided inquiry requires a teacher to guide an investigation, while students follow along until they gradually learn to question, investigate, and explore materials independent of the teacher as the leader of the investigation (Collier, Johnson, Nyberg, & Lockwood, 2015). The purpose of implementing guided hands-on inquiry in the classroom was to allow younger students, who were new to inquiry, to develop necessary skills to become more independent inquiry-based thinkers. Instructional scaffolding is “a process through which a teacher adds support for students in order to enhance learning and aid in the mastery of tasks" (The Iris Center, 2005, p. 1). Guided hands-on inquiry is an instructional scaffolding approach through the ideology of Vygotsky's "Zone of Proximal Development" (ZPD), that provides students with enough assistance to boost and achieve a complex task (Vygotsky, 1978). This stepping stone approach is valuable for younger inquiry learners to develop independent thinking. However, realizing students are 21st century learners, and as previously defined, learners will need to be quick at accessing knowledge and will need to use their creativity through the use of technology (Blair, 2012), the use of technology in the science classroom seemed like a logical step in teaching. Therefore, this action research was framed in Project Based Learning (PBL). The use of PBL is a teaching method that will help integrate all of the components needed for research. Through PBL students are able to obtain needed skills when researching an engaging problem or complex question (Buck Institute for Education, 2012). "A growing body of academic research supports the use of PBL in schools as a way to engage students, cut absenteeism, boost cooperative learning skills, and improve test scores" (Curtis, 2001, p. 1). Innovative, impacting, and higher-order thinking science standards require a fresh instructional approach such as PBL to scaffold higher-order thinking, this technique was natural to blend with a technology oriented problem-solving approach for the students.

As an educator, a strong curiosity led the investigation if a PBL approach would improve instruction and increase the performance of young students. Knowing the stakes are high for students, knowing the students learn differently, and science is continually evolving, a higher-order thinking project using technology was implemented. Furthermore, students were to create a digital technology-based project to communicate their scientific thinking using higher-order thinking science standards.

Purpose of Study

The purpose of this study was to determine the effectiveness of technology integration through PBL in a guided hands-on science instruction, and the effectiveness of this combined approach to enriching instruction for second-grade students as they attempted to master higher-order thinking science concepts. Mastery in this study was defined as students reaching a 70% or higher in the post assessment. The question that drove the research was:

1. What effect does digital storytelling technology have, when used in embedded in project-based learning, on improving second-grade students' mastery of higher-order thinking science standards?

Rationale for Study

As a teacher, continuously self-reflecting on the evolution of the science position in our school was important. It is always ideal to seek for best practices in order to effective deliver instruction. Admittedly, evolving as an elementary science teacher has been a work-in progress. This professional growth has occurred through a gradual learning process in finding ways to engage students in learning. After the first six months of obtaining the science position, regrettably, the instruction consisted of ineffective drilling methods, lectures, and rote memorization – a transferring method (Beasley, 2005). Students' lost interest in learning through this inept instructional method. Through extensive professional development, professional courses, the science lab progressed with its instruction through the science core state standards. Book studies and workshops, facilitated the needed knowledge on how to implement inquiry-based learning in the classroom while scaffolding greater independence in the inquiry process through structured hands-on activities. The main method used in the science lab involved structured-inquiry consisting of providing students with materials and procedures to conduct an investigation, so students can develop their own observations and find the outcome (Colburn, 2000).

The Florida standards are demanding and challenging and as they began to emerge the school administrators realized there was a need for supplemental instruction in order to support student learning; therefore, it was decided to incorporate a science enrichment program through the special area subjects to help classroom teachers and students reinforce these skills. The special areas rotation consisted of subjects such as: physical education, music, and art. The science enrichment program, kindergarten through fifth grade, became a part of the special subjects' rotation. Because of the science rotation, teachers began to observe their students recalling science concepts, and retelling vocabulary words, and making learning connections. Since students were making connections, a need existed to continue to enhance student learning. The science enrichment program established student learning connections and wondered if students could be supported to explain and elaborate their findings in science through technology.

In the science classroom, time was limited and each grade level rotated through the class 40 minutes a day, with the exception of Wednesdays, which consisted of 30 minutes. Every six weeks, for the duration of the school year, each elementary grade level visited the science lab for a week. In the special area rotations, students rotated weekly between music, art, science, and physical education. The job of the science resource teacher was to assist all elementary grade level teachers by providing science standards support and reinforcement of the higher complexity standards. The goal was to closely work with teachers to streamline the lessons in order to support instruction effectively. Extensive planning and creativity took place in order to embed strategies to address students' varied learning interests within a time limit.

Obtaining the science position led to a lengthy journey to change the old-fashioned practices and make room for a PBL model, molding into the newer learning styles of students. During the spring of 2008, thanks to grant funding, the tremendous support of our school and parents, and the local nursing home, a strategically planned butterfly garden project was elaborated through a school science club. This project revolutionized the way student designed projects and student learning occurred around the demands of the science standards. The number of standards covered in the project was invaluable and countless, yet the motivation for student learning was certainly more inspirational (Curtis, 2001). The outdoors project brought out the children's innate curiosity, their urge for answers, as well as their motivation to learn leaving an everlasting impression on their parents (Penuel & Means, 2000). The science club allowed the students to partake in the outdoor garden creating projects about plant species and their butterfly host. Students used their unknown creativity, designing their own plant digital story to collaboratively narrate their findings (Moursund, 2003).

During the summer of 2010, after completing an Intel course at the University of Central Florida through the Lockheed Martin Academy, there was an extensive insight about the advantages of engaging students in learning through the course titled Using Technology in Mathematics and Science to put everything into perspective. This course created a sudden epiphany for me realizing how students learned differently and how students are immersed in technology. Why not further engage students and integrate digital technology? A broadened knowledge on PBL was obtained. Through UCF and the advantage of teaching elementary students, assignments were easily geared towards the younger grade levels and the new practices were applied in the science enrichment classroom. There was a need to measure how utilizing these new digital technology methods would affect the outcome of learning within the science classroom. However, through the course, it was noted that PBL was not simple and required extensive thought and planning (Intel Education Project Based Learning, 2010). The Buck Institute for Education, (BIE), defines PBL as is a teaching method which engages students in learning essential skills through an inquiry process, based on real world questions, and creates a final product or task (Buck Institute for Education, 2012). Armed with new knowledge and a desire to try it, a mission was embarked upon to try this academic strategy, PBL. Using PBL could be a remarkable tool for students to dig a mile deep rather than covering a mile wide of information (Hallerman, Larmer, & Mergendoller, 2011). In other words, PBL could allow the students to deeply explore the science standards instead of just barely covering the surface of this complex content area.

New knowledge allowed for brainstorming of new projects and for ways to get second-grade students to improve their skills in explaining and elaborating upon their scientific findings using the tools available through technology. The study was not to analyze the outcome of performance through a project designed to bombard students based on a long list of science standards, but instead to focus on higher-order thinking life science standards. One high level complexity and two moderate level complexity life science concepts were the main focus of the science project. The study was created to find if PBL would give students a fresh new learning approach, allowing them to explain and elaborate on science concepts. The science concepts focused on in this study were as follows: (Schools, 2014):

1. "2.N.1.1 Raise questions about the natural world, investigate them in teams through free exploration and systematic observations, and generate appropriate explanations based on those explorations (High Complexity)" (p. 3).

2. "2.L.16.1 Observe and describe major stages in the life cycles of plants and animals, including beans and butterflies. (Medium Complexity)" (p. 20).

3. "2.L.17.1 Compare and contrast the basic needs that all living things, including humans, have for survival. (Medium Complexity)" (p. 22).

Through students being asked to use digital technology to construct a personal multimedia, or digital story presentation, the goal was to determine if a PBL approach would enhance their learning outcomes. This study was designed to find the effectiveness of implementing technology, through PBL, in the science classroom measuring how digital learners did or did not increase their comprehension of higher-order thinking science standards. The plan was to engage second graders in medium and complex science content for a period of six weeks in life science. Over the six-week period, learning was focused on students investigating a variety of legumes, finding their properties and differences, thinking about the basic needs required to help beans grow, making observations of the changes, recording those changes and then interpreting their findings by producing a creative digital movie (PBL).

Significance of the Study

As a standards driven school, like many in the district, my school strove to find teaching methods to help students achieve higher performance on standards-based tests. States are heading towards more complex standards while stakes are rising in a competitive global market. The National Academies of Sciences, Engineering and Medicine states, "The movement by most of the states to adopt common standards in mathematics and in language arts has prompted the call for comparable standards in science to guide state reforms" (p. 1), changing current educational expectations. Evolving state science standards often are leveled based on Webb, Alt, Ely and Vesperman's research (2009) by the depth of knowledge and the cognitive complexity needed in the science classroom. These adapted science state standards are based on a framework of cognitive levels of knowledge by Webb, which ensure the standard and the student knowledge required by the standard matches the assessments given (Sibley & Marconi, 2008). Changes in the standards are continuous and the National Research Council (NRC) has developed a new framework to help students' transition into complex state science standards. The standards are currently being redrafted and finalized in this new framework to include: science and engineering practices, crosscutting concepts, and core ideas (A brief report: Framework for K–12 science education, 2011). According to the framework, these elements will assist students so that by the end of high school they should have sufficient science and engineering knowledge to carry on a discussion and become effective problem solvers. The science and engineering practices involve students asking questions and solving problems, using and creating models, planning and carrying out investigations, analyzing and interpreting data, using math, constructing explanations for findings, and obtaining, evaluating, and communicating information. The cross cutting concepts in science are designed to expose students to cause and effect scenarios, patterns, scale models, cycles, functions, stability, and change. The core ideas in the framework organizes science branches into related topics. Teachers need to acquire new instructional methodologies as the standards continue to change and become more challenging.

Teachers also need to consider how to focus on eliminating old lecture and drill teaching techniques. In the United States, this transmission style of teaching, passively sharing of knowledge, in science classrooms produces lower level cognitive thinking in students as well as a dislike for science (Beasley, 2005). The transfer method of instruction is not compatible with today's 21st century learners and the modern technology that is revolutionizing society. Astonishingly, teachers remain beholding to these primitive instructional models reliant on textbooks as the "primary sources of knowledge, conveyed through lecturing, discussion, and reading" (Barron & Darling-Hammond, 2008, p. 1). Teachers need to continuously seek ways to be more effective, and a technology project can be the key to uncover students' higher thinking skills. Based on the *Science Instructional Plans* created by the district most of the elementary science standards are categorized as moderate to high complexity, and fewer science standards are listed as low complexity levels

(Schools, 2014). According to the Florida Department of Education, high complexity standards require heavy demands on students' thinking and engages students in "abstract reasoning, planning, analysis, judgment, and creative thought" (Department of Education, 2012, p. 2). Moderate-complexity standards involve more flexible thinking where the student is expected to use informal methods of reasoning and problem-solving. As evidenced in these standards, the stakes are higher and more challenging for students; thus, teachers need to seek more effective methods to reach higher level learning. As students progress into the 21st century, teachers are making strides to be better prepared through workshops designed to implement effective teaching methods focusing on the Common Core, technology, and subject content (Monroe, et al., 2008). Teachers need time and support to go beyond learning the new standards to being willing to change their practice to implement them in the most effective ways possible.

Today's students are part of a sub generation called iGeneration. Whittaker defines this sub group as a small percentage of younger individuals within the Generation Y (Wittaker, 2010). Berry, in Teaching 2030, defines the iGeneration to be born in the last ten to 15 years, uses technology, differently than their parents and teachers (Sunnibrown.com, 2011). The members of iGeneration are vividly engaged with the development and the progression of technology. Rosen (2010) affirms how our newer iGeneration, dependent on technology, differs from those lectures our parents' teachings, which were lecture-based; today's iGeneration is more inclined to communicate through hand held electronic devices and computers. Students do not want to learn through lecture they want to be interactive. Like technology, the workforce is continually changing, and today a greater demand for "21st century skills are needed, which means students have the essential tools and skills for this new career process" (Barron & Darling-Hammond, p. 3). Students need to utilize their new tools to be successful. Today's students need to learn how to "learn how to learn" in order to become the problem solvers of the future (Intel Teach to the Future, 2003). Therefore, as a science teacher, it was important to realize students are all multi-taskers, digital learners, who have learned to communicate through technology. Since the National Science Education Standards state "effective science teaching depends on the availability and organization of materials, equipment, media and technology" (p. 44), students' needed to be engaged and eager to learn.

Through UCF courses and professional development, a high interest was developed in Project-Based Learning (PBL) because of its constructivist approach and non-traditional method of teaching (Buck Institute for Education, 2012). The appeal about PBL is in the strategy that focuses on the learner; an ideology supported by Dewey. The ideal of "learning by doing", dates back as far as the early 1900's (National Education Association, 2013). Learning should reside increasingly with the learner and not the teacher or the lesson (Glasersfeld, 1989). The thought of implementing PBL in science instruction is the foundation of creating academic connections. According to the National Education Association [NEA], PBL allows students to make learning meaningful by connecting it through real world applications (National Education Association, 2013). During the summer of 2010, after completing an Intel course at the University of Central Florida (UCF) through the Lockheed Martin Academy more insight about the advantages of engaging students in PBL learning broadened the need for newer methodologies. Research supports the use of

PBL in schools as a way to engage students, cut absenteeism, boost cooperative skills, and improve test scores" (Vega, 2015). PBL moves away from the mundane lecture and towards student engagement. The Intel course further expanded on the many skills that can be incorporated into projects, which include teaching students to negotiate through cooperative/collaborative groups as they negotiate complex issues.

The significance of the study was to change – and improve –teaching methods by incorporating technology. Over the past 6 years, the school has focused on technology as a tool to create a curriculum to enhance student understanding. The school has actively engaged the students in the scaffolding of PBL, beginning in lower grade levels; consequently, the school hosts workshops, which offer teachers the opportunity to learn how to design effective projects to build/develop higher learning projects for all levels. Instructional scaffolding was important in the school to support students to their learning and mastery of their science tasks. The process entailed to build on students' technological experiences and technological knowledge as they are learning new skills (The Iris Center, 2015). Because the school is located close to a natural preservation area, it possesses a wealth of environmental science resources that enhance PBL. The Department of Education sends the results of standardized assessments such as the FCAT science. Using these test results, the school leaders wanted to find better methods of instruction to improve test scores. The school adopted a new approach of using digital technology as one of the positive contributors to the future increase in test scores and student engagement. Through the efforts of grant writing, providing extra funding, our technology facilitator and grade level teachers developed curriculum rich projects for teachers, students, and parents. Although our school continually fosters technology and scaffolding of PBL in our classrooms, based on previous experience, PBL requires extensive time for preparation, execution, and assessment. Yet teachers must be willing to be open minded and learn to engage students in learning through careful planning and effective preparation (Intel, 1997). This means, with additional planning, the validation is not the project, but seeing the students engaged in learning and growing from the experience.

Like many other schools, my school has invested in upgrades and new technology. Due to these expenditures, it is important to find out how effective technology is in impacting science practices. It is important to be able to give students the opportunity to apply what they learn and communicate it in how they know best – with technology. Although the science standards are continuing to change and develop, the Depth of Knowledge framework in the current standards was used to create a PBL to test the effectiveness in the science classroom (Webb, Alt, Ely, & Vesperman, 2009). The definitions provided below are shared to clarify any terms used in this study.

Definitions

5E Learning Cycle Model

The 5E learning cycle model is an instructional method that supports a science inquiry based instruction which include the five "E's" structure: engage, explore, explain, elaborate, and evaluate (Bybee & Landes, 1990)

- The engaging element consists of generating essential questions to incite curiosity amongst the children. This creates a sense of wonder, and captures the attention of students, and allows them to create their own hypothesis. Often used in the classroom and stated to the children as an "I wonder" question.

- The exploring aspect consists of student hands on experimenting or conducting an activity that will allow them to make observations and collect data to prove a hypothesis that we generate.
- The explanation piece goes hand in hand with the exploration piece in which students are able to find an explanation in their exploration phase. Often referred to the class as "Explain, how do you know?" or "Explain, what happened?"
- The elaborate phase of the 5e Model gives the students the ability to expand their knowledge and achieve higher-order thinking. Students are able to make develop inferences.
- Finally, the evaluate aspect allows the teacher to formally assess the students on what they learned within each of the phases: engage, explore, explain and elaborate. (Bybee & Landes, 1990).

Constructivism through Project-Based Learning

Students construct their own understanding and knowledge of the world through experiments, experience & reflection (Intel, 1997). In a digital classroom, the constructivist approach is based on the following (Gordon, 2003):

- It provides students the opportunity to unravel their own ideas and absolves them from fact-driven curricula
- Students make connections to real world scenarios, reformulate their own ideas, and reach conclusions through the use of technology
- Students understand the complexity of the world and learn how to make interpretations
- Students responsible for their learning
- Teacher poses a problem of relevance such as: How can we prove beans go through a life cycle?

In today's world, technology constructivism supports new teaching methods. These new tools will allow teachers to save time and the rush to gather resources (Gordon, 2003). Constructivism is a social theory that requires the social interaction of students, leading them to construct knowledge and build a base (Moursund, 2003).

Collaborative Learning

For the purpose of this study collaborative learning refers to classroom discussion which gets students to talk about their thinking while trying to make sense of higher-order thinking science concepts.

Cooperative Learning

Kagan (1990),defines cooperative learning as a structural process which helps children interacts to accomplish a task or create an end task. Some teachers in this elementary school use Kagan Cooperative Learning strategies to partner up students to accommodate different levels of learning. Through the use of technology, students learn from each other while helping others (Moursund, 2003). The self-assessment cooperation rubric in Figure 1 was used to measure student accountability, assessing cooperative learning as part of the 21st century social cooperative skills.

Today we:		
	Yes	**No**
Took Turns:	______	_____
Helped each other	_____	______

Figure 1: Cooperation Rubric
(Ellis & Whalen, 1990)

Depth of Knowledge (DOK)/Cognitive Complexity Classification

Depth of Knowledge is a framework which indicates the degree of complexity in standards and the requirement for assessment (Webb, Alt, Ely, & Vesperman, 2009). This assessment has to equally assess the complexity of the standards.

My research will be based on two of categories of the Depth of Knowledge/Cognitive Complexity Classification:

- Moderate Complexity: Requires a reasoning level that goes through different steps or processes. Problem solving skills are required to help student make reasonable decisions. Students may require using some background knowledge to make inferences. At the end of an investigation students should be able to describe examples and apply the concepts learned. Students can compare and contrast by using facts and properties (Department of Education, 2008).
- High Complexity: Requires a higher-order thinking process. Students require planning and using creative thought to carry on an investigation. For the purposes of this project students will design a project and make conclusions based on their data. Students will resolve problems as they progress in the project and communicate with their group peers. At the end of the project students will be able to analyze their data and come up with their own conclusions (Department of Education, 2008).

Digital Natives

Pensky (2001a) defines digital learners as children who are socializing through various means of electronic devices and have grown interacting with technology that continues to evolve today (Pensky, 2001b). These are children who spend a number of hours on videogames, cell phones, or computers (Rosen, 2010). The Generation Y, (a generation between 18 and 30 years-old), like its younger Generation Z, (a generation under 18 years-old), are digital natives (Wittaker, 2010). In this study, this last younger generation also is referred to as the iGeneration.

Digital Storytelling

The study will implement digital storytelling as a PBL approach. It is a valuable resource that can help students communicate with others and capture the attention of other students and easily engage a classroom (Robin, 2017). Furthermore, digital storytelling is an essential skill which provides infinite applications to communicating ideas (New, 2005). According to New, if done properly, digital storytelling can have an amazing effect while entertaining and informing audiences.

Additionally, Morra (2013) explains that digital storytelling encourages students to creatively bring out content knowledge instead of absorbing information. Morra indicates by bringing together images, music, text, and voice, students can demonstrate learning in all content areas and throughout all grade levels, while also fostering their 21st century skills. Digital storytelling is a familiar process after receiving training, helping to productively use the technology in the science classroom. It has allowed the students to become creative storytellers through a given topic, conducting some research, writing a script, and narrating a story (Robin, 2008). Digital story requires a particular process, Figure 2, used with author permission, shows the process implemented in this study.

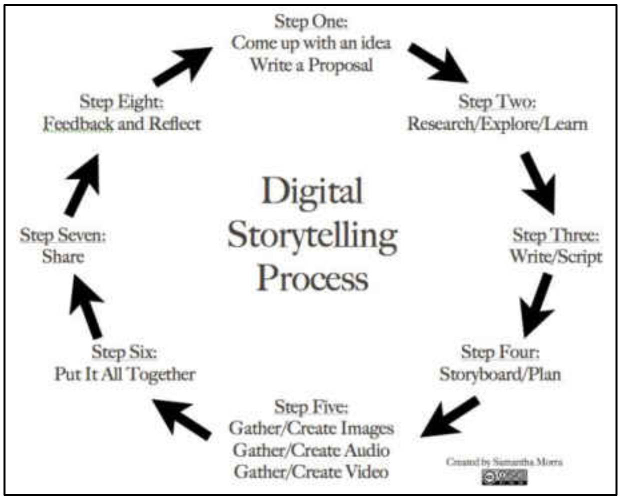


Figure 2: 8-Step Digital Storytelling Process
Source: Creative Commons
https://samanthamorra.com/2013/06/05/edudemic-article-on-digital-storytelling/

For the purpose of this study, instructional scaffolding replaced Step Four: Storyboard/Plan with a simple storyboard template to assist the children to design and create their movies. The software implemented, Frames 4, is designed by Tech4Learning. The goal of their stories was to inform their audience of their scientific thinking and findings. After a series of hands-on activities, through images, graphs, voice-overs, and music the students were to communicate their knowledge of the life science standards implemented (Educase Learning Initiative, 2007). The simple and user-friendly software, called Frames 4, was used to allow students to express their thinking in their stories.

Domain 1DQ1: Providing Clear Learning Goals and Scales (rubrics)

As part of our teacher evaluation, we are required to keep track of student progress using learning goals written with simple verbiage for student understanding, and based on the standards taught. The learning goals are self-assessed by students using a scale progression the learning goal used were part of the self-evaluation in this study. The learning goals were evaluated for student understanding using the following criteria:

Table 1: District Guidelines for Scales

Subject: 2nd grade Science		
Standard: SC.2.L.14.1 (human body parts), 2.N.1.3 (ask how do you know)		
Topic (Keywords): Human Body		
4.0	**In addition to Score 3.0, in-depth inferences and applications that go beyond instruction to the standard** **The student will:** • Create a model of the human body including labels of the major organs (and skeleton). **No major errors or omissions regarding the score 4.0 content**	
	3.5	In addition to score 3.0 performance, in-depth inferences and applications with partial success
3.0	**The student will:** be able to distinguish human body parts and their basic functions. • Identify the major human body organs (and skeleton) on a diagram. • Recognize the basic functions of the major human organs (and skeleton). **No major errors or omissions regarding the score 3.0 content (simple or complex)**	
	2.5	No major errors or omissions regarding 2.0 content and partial knowledge of the 3.0 content
2.0	**The student recognizes and describes specific terminology such as:** • Brain • Heart • Lungs • Stomach • Muscles • Skeleton **The student will:** • Recognize the body parts that relate to the senses and explain their function **No major errors or omissions regarding the simpler details and processes but major errors or omissions regarding the more complex ideas and processes**	
	1.5	Partial knowledge of the score 2.0 content, but major errors or omissions regarding score 3.0 content
1.0	With help, a partial understanding of some of the simpler details and processes and some of the more complex ideas and processes.	
	0.5	With help, a partial understanding of the score 2.0 content, but not the score 3.0 content
0.0	Even with help, no understanding or skill demonstrated	

Source: District K-12 Science Framework

Hands-on (Structure-Inquiry)

In order to help younger students develop knowledge and understanding of scientific ideas, a scaffolding teaching method used in the classroom provides an open-ended question and guidance to draw a conclusion through the use of science manipulatives (Martin-Hansen, 2002). In a science classroom, implementing inquiry instruction versus traditional lecturing methods allows students to use higher cognitive skills and thinking because students consider a problem and search for an answer (Tweed, 2009). Inquiry prepares students for collaborative work and they easily can learn to make sense of the natural world around them (Tweed, 2009). Structured-inquiry is a method which provides materials, procedures but not the outcomes of the inquiry (Colburn, 2000). For the purpose of the study, manipulatives were teacher provided and selected. The term structures-inquiry is used in this research in order to define the teaching method used with the younger grade levels, kindergarten through third grade.

iGeneration

iGeneration is a generation roughly between ages 11 and 31 years-old (Rosen, 2010). According to Rosen the iGeneration are mostly children in elementary school through high school. These children are multitaskers who are consumed by technology devices and spend much of their time immersed in it (Rosen, 2010).

Project-Based Learning (PBL)

The PBL approach in this research study integrated technology through the students producing a digital story to show performance of the three main science standards. Today PBL is a teaching practice that focuses on collaboratively working in a project in order to develop content knowledge; but it began as a response to low enrollments and general dissatisfaction with medical education (Barrows, 1996). The use of PBL helps develop student content area knowledge and skills through a task which promotes student inquiry and a final product (Intel, 1997). The PBL approach used in this research integrated technology by which students produced a digital story in order to demonstrate the performance of three main science standards. Typically, PBL instruction is based by students choosing and investigating their own questions (Colley, 2008). However, for the purposes of this study, due to the age of the subjects, and time limitations to conduct the study, the project was teacher guided based on two second-grade life science state standards and one nature of science standard. It is important to define problem-based learning as it is sometimes used synonymously with Project-Based Learning, (PBL). Problem-Based learning differs from PBL in that it focuses on a particular problem.

Technology Through Digital Story

Robin (2017) notes there are various definitions for digital story, but most ideas are focused around one main idea: telling stories through a type of technology multimedia. This study acquired permission to use and implement Frames 4 by Tech for Learning (see Appendix D). To present the topic a digital story requires digital graphics, text, recorded audio narration, video and music.

Robin (2017) portrays digital storytelling to implement the following components:

1. Devices that capture images, use of photography or images,
2. Devices that capture audio such as microphones,
3. Literacy skills including research, writing, problem-solving, and presentation skills,
4. Student and teacher engagement through meaningful messages,
5. Promotes 21st Century Skills,
6. Software for creating digital media,
7. Well equipped computers capable of large storage capacity (Robin, 2008).

21st Century Skills

The Partnership for 21st Century Skills is an organization that was developed to advocate career readiness skills in a global competitive market (The Partnership for 21st Century Skills, 2011). Today's 21st century skills are based on innovation, creativity, critical thinking, problem solving, communication, cooperation, information, and media/technology skills (Intel, 1997). The 21st century skills implemented in this study will focus on collaboration, creativity, information, technology skills and problem solving. The experimental second-grade group will design digital stories incorporating the mentioned 21st century skills as well as three higher-order thinking life science standards.

CHAPTER TWO: LITERATURE REVIEW

Introduction

In a standard driven school, like many in the district, schools are being evaluated based on student performance. As a teacher, it is important to search for techniques to increase student performance on state and district assessments; accountability is high. While working in a digital technology oriented school, the teacher focus has been to produce ways to motivate students to learn, the research in the literature review revealed enthusiasm is not sufficient to incorporate PBL. Teachers need to develop more than enthusiasm for learning; they need to develop lessons that engage and challenge students. In fact, according to Herold (2016), researchers have found that many teachers have not made the transition necessary to incorporate the digital technology that already exists in their classroom. In turn, this lack of digital technology integration is an ineffective approach when attempting to engage students' desire to learn more about a topic, which increases their learning (Curtis, 2001). In their study, Lin et al. (2017) suggests that the common factor in the effectiveness of digital learning lies in teachers. When teachers properly plan, researchers have found students that engage in PBL took responsibility for their learning, their peers' learning, and scored significantly higher in their assessment (Iwamoto, Hargis, & Vuong, 2016). When examining their data, Schneider et al. found their 12^{th} grade PBL students scored well or higher than their non PBL group (Schneider, Kracjcik, Marx, & Soloway, 2002). Planning and teacher interactions are not the only components of successfully measuring PBL. According to Gill (2017) assessment is a key component to determine the success and PBL requires more than traditional assessments. In a collection of studies Vega (2015) suggests PBL did more than just improve scores, student comprehension, but also that retention rates dropped. However, indications of PBL being successful are noted in professional fields of medicine and effective in training professionals (Strobel & Barneveld, 2009).

Incorporating digital story telling technology into the science enrichment program parallels the fact that the school also adopted science as a special area to enhance the science instruction already implemented by teachers in their classrooms. Due to science being supported through specials with additional time devoted to this content area, an opportunity was provided to test PBL as a tool to improve student performance in science during the instructional time. The focus of this study was to determine if PBL effectively improved student performance in three life science benchmarks ranging from moderate to high complexity. The question driving this research is: What effect does PBL through digital storytelling technology have on improving second-grade students' mastery of higher-order thinking science standards? This question was derived from a review of the literature summarizing the emerging digital learners in today's elementary classrooms, how PBL aligns with this generation of learners, and how digital storytelling could provide a platform in PBL to enhance students learning outcomes, specifically focused on science instruction.

A New Generation of Digital Learners

Learners in all subject areas today have at their fingertips a plethora of technology devices such as tablets, computers, laptops, smartphones, and others. Pensky (2001b) describes today's students as digital learners who are children who have grown up with the modern technology that continues to revolutionize evolve rapidly within our society. This constant and ongoing exposure to multiple platforms of technologies have created learners who the ability to multitask and use an array of tools to help them communicate and learn (Rosen, 2010). According to Walsh (2011), today's children are more electronically connected, spending more than 53 hours a week with all types of media and multitasking at the same time. Although children multitask, Pensky (2001b) pondered this question: *Do they really think differently?* In his article, Pensky states that neuroplasticity is the latest research in neurobiology which practically states that the brains of Baby Boomer's are different from those of the iGeneration. Pensky found, based on the stimulation surrounding the individual, the brain could reorganize itself continuously from childhood to adulthood affecting the thinking process.

Today, it is not difficult to find students spending the majority of their time surrounded by, and using, computers, videogames, and many other electronic devices (Rosen, 2010). Unfortunately, many teachers, digital immigrants, who grew up outside of the stimulated digital technology era assume students, digital natives, learn using the same old-fashioned methodologies (Pensky, 2001a). This fallacy carries the notion that teachers, digital immigrants, should continue with their old-fashioned teaching methods in the classroom keeping them from staying current on new research on how children learn, emerging digital technology tools for the classroom, new curriculum resources, and more. This disconnect between students and teachers further prevents effective instruction in the classroom. Teachers need to realize computer games, email, the Internet, cell phones and instant messaging are integral parts of student lives (Rosen, 2010) and hence have the power to help them learn. Yet how they learn too is changing. One way to consider greater student learning is through PBL.

Project-Based Learning

History of Project-Based Learning

The use of PBL is quickly evolving because of its high level, real world application (Moursund, 2003). According to the Buck Institute for Education [BIE], PBL is not a new approach, but rather a method that has taken over a decade to develop its place within instruction (Buck Institute for Education, 2012). The use of PBL has slowly developed due to teachers' uneasiness that PBL doesn't "cover" all of the content area standards, especially those standards assessed in high stake standardized assessments; accountability. Although, introducing projects in a curriculum is not a new concept, the application of PBL through digital storytelling technology has indeed evolved with time as has the way students think and learn differently (Intel, 1997). This instructive model has evolved from medical and engineering schools in order to build students real world applications, understanding of crucial content and concepts essential to that discipline of study (Schneider, Kracjcik, Marx, & Soloway, 2002). Consequently, in primary schools, PBL is being implemented to improve student engagement and comprehension (Intel, 1997).

The constructivist concept of "learning by doing", a philosophy proposed early on by Confucius and Aristotle, is an approach where students can construct their own knowledge through real world application (Grant, 2002). Dewey, and early 20th Century American educational theorists expanded on this concept, and proposed learning for students, in the classroom, should be based on the students' self-experiences and interests (Moursund, 2003). Dewey believed by preparing students through active, real world experiences, they would "learn by doing", and thus better understand the concepts before them. Later in the 20th century, Piaget expanded this ideology further by stating students learn best when conducting investigations, and collaborating with peers to construct new knowledge (Grant, 2002).

Another 20th century educational theorist, Montessori, incorporated a similar approach in her early childhood intervention education (Boss, 2011). She too, believed learning occurred best through self-experiences in environments that fostered learning versus environments where children were forced to listen (Boss, 2011). Montessori's philosophy targeted learning environments that encouraged children to be active problem solvers and not passive listeners. This technique was the foundation for the creation of PBL (Moursund, 2003).

Over the past 25 years, PBL has evolved into an educational approach to engage students in learning content knowledge by, building a deeper understanding of complex concepts through real world applications (Hallerman, Larmer, & Mergendoller, 2011). The concept of PBL merged the philosophies of Dewey, Piaget and Montessori and today has integrated essential 21st century technology skills (Intel Teach to the Future, 2003). The use of PBL is a tool to deliver content to students and build stronger skills in the classroom by creating an engaging and positive learning experience for students (Hallerman, Larmer, & Mergendoller, 2011). A core concept that is a benefit of PBL is the ability to assess student learning outcomes.

Assessment in Project-Based Learning

The use of PBL calls for authentic assessment, and in a well-planned project, the final project is targeted for a learning audience, where the student will be able to teach their audience what has been taught (Miller, 2011). Students learn better when they teach the material to someone else (Everding, 2014). Project based learning requires teachers to carefully plan projects that target the specific standards they want to ensure students learn (Miller, 2011). To implement and assess PBL effectively, teachers need to evaluate the quality of students' projects and measure performance of both the standards and the project (Penuel & Means, 2000).

The assessment component of PBL ensures teachers measure both the what and how of instruction in a collaborative and inquiry learning environment. Three important components drive PBL: assessment, classroom activities, and curriculum (Barron & Darling-Hammond, 2008). In a PBL teaching method "evaluation tools, such as assignment guidelines and rubrics" measure good projects and monitor team work (Barron & Darling-Hammond, 2008). Furthermore, PBL provides checklists and rubrics to help students monitor their progress and understand expectations (Intel Education Project Based Learning, 2010). Checklists enable students to easily monitor their progress and check off the requirements of the process, while rubrics allows them to know how they will be evaluated and the criteria they need to meet in order to be successful on the project.

One tool to consider using for PBL is the use of digital storytelling. According to Tech4learning (2012) digital storytelling engages students in learning while combining media to create a vision of their understanding. Storytelling is an ancient tradition changed today through digital technology. Mathews-DeNetale notes, storytelling and learning are essentially one because the process of writing a story entails in making meaning (Matthews-DeNatale, 2008). Digital storytelling combines narration in a digital content (Educase Learning Initiative, 2007). According to Lenz (2013), some learning theorists believe that story telling as a pedagogical technique; can be effective across the curriculum. Constructing a narrative and communicating it effectively requires the storyteller to think carefully about the topic and consider the audience's perspective (Educase Learning Initiative, 2007). This type of digital storytelling aligns with showing understanding of the complex standards found in science.

Benefits of Project-Based Learning

Research shows the emergence of benefits of PBL. The Challenge 2000 Multimedia Project (MMP) a 5-year study funded by the U.S. Department of Education, provided mentoring and support to teachers integrating PBL in their classrooms (SRI International, 2001). The MMP study indicated classrooms using digital technology performed higher than students not using technology. The researchers also conveyed students acquired better teamwork and problem solving skills. Penuel (2000), found students utilizing digital technology to be more engaged, having higher self-accountability for learning, having increased collaboration skills, and having greater achievement gains then by students labeled low achievers (Penuel & Means, 2000). The MMP study highlights the importance of employing digital technology to engage learners and foster a positive learning environment that yields higher student performance.

According to an article in Edutopia (2015), further studies have demonstrated when PBL is properly used, it can help students remember content for longer periods of time (Vega, 2015). Some studies show that PBL increases student performance in high-stakes tests, as well as improving problem-solving skills and collaboration skills (Strobel & Barneveld, 2009). These researchers in their studies validated the importance of implementing PBL in the classroom. When well planned, PBL is an effective tool in the classroom (Intel Education Project Based Learning, 2010) According to Intel Education (2010), PBL does requires extensive planning; however, once it is implemented the results are noted to be rewarding for both, teachers and students.

Benefits to Students

The rewards to students according to the Intel Designing for Effective Projects educator program, PBL engages students in learning, enhances cooperative learning skills, improves performance, and cuts down on absenteeism. Some of the benefits listed in the PBL teaching program are:

- Improved student attitudes and increases student attendance (Thomas, 2000)
- Provided student opportunities to learn deep content and 21st century skills (Ravitz, Hisxon, English, & Mergendoller, 2012, April)
- Student performance increased, and students became more responsible for their own learning process (Boaler, 1999).
- Students learned many of the necessary 21st century skills such as collaboration, communication, critical thinking and problem solving, as well as technology implementation (The Partnership for 21st Century Skills, 2011).
- Technology driven learning environments in innovative classrooms were found to revolutionize learning (Barron & Darling-Hammond, 2008).
- Students took seriously their learning and took on their assigned role in PBL (Intel Teach to the Future, 2003).

Since PBL is student centered, learning takes place within a group whether students are designing a project about a particular concern or designing a multimedia project. The use of PBL provides students the opportunity to creatively portray their learning (Moursund, 2003). Furthermore, PBL learning has been proven to benefit students through different subject matters by increasing student performance through engaged learning (Shepherd, 1998).

Benefits of PBL to Address Standards and Differentiation of Instruction

The relationship of PBL to engagement is clearly established, but this practice also is a clear way to align with the standards in numerous content areas and to ensure variance or differentiation in instruction based upon the array of learners' skills in the classroom. In relation to standards, today's schools acknowledge their curriculum is "a mile wide and an inch deep", with too much information to realistically cover in one school year (Hallerman, Larmer, & Mergendoller, 2011). Knowing that teachers are required to cover so many standards, implementing PBL can be a challenge for many teachers, and it may even be overwhelming (Grant, 2002). Trying to design a project for every standard can become an insurmountable task. Continuous projects, within any content area could be overwhelming and while limiting projects reduces stress on the teacher (Scott, 1994) limiting learning in today's high stakes testing and higher-order thinking standards is the ultimate challenge.

One way to deal with more complex standards, learning and assessment is to consider the use of digital storytelling technology. Despite the promises of digital technology to save time for teachers, to learn new tools is a challenge in itself. Yet with a PBL approach the students are the drivers of digital storytelling technology and teachers are the leaders of content. This duality has been shown that in a digital technology driven classroom, students are more eager to learn (Edutopia Staff, 2009) through the creation of their project as they are better able to identify and use the different types of media.

Another potential powerful aspect of PBL is students are given more ownership for their learning. Yet to turn the learning over to students, teachers need proper professional. Teachers can benefit by learning how to best apply PBL in their classrooms (Intel Teach to the Future, 2003). to find effective ways to reach students of different learning abilities. Since differentiated instruction is a direct result of properly designed PBL, this tool can enrich both teacher ability to instruct a wide range of students and impact the learning of a range of students (Yetkiner, Anderoglu, & Capraro, 2008) because it allows teachers to:

- establish cooperative groups,
- create appropriate assessments,
- select tools aligned with the content and student learning needs.

All of these measures meet various learning styles, and levels in a PBL classroom. A teacher's theoretical background on PBL is important for the success and the positive outcomes of the project. If a teacher does not believe or is not knowledgeable in constructivism or cooperative learning, students may not benefit from an approach that revolves around these theories (Yetkiner, Anderoglu, & Capraro, 2008).

Project-Based Learning in Science Inquiry

Standardized assessments are slowly effacing the traditional method of paper and #2 pencils in favor of computerized assessment (PARCC, 2012). To meet this transition, school districts are taking the necessary steps to improve computer performance and literacy. Because of computer assessments, computers are now being used for more than instruction; they are being used for teaching, researching, and creating, as well as assessments. As stated before, digital technology is everywhere, including in public schools. The federal government has spent more than $3 billion on digital materials and continues to strive to make internet and online access affordable (Herold, 2016). The use of digital technology is increasing in our schools in order to prepare students for a competitive global economy and to meet the evolving standards and high stakes testing; more is being expected of students.

Teachers continuously seek innovative ways to deliver instruction to engage students. According to Solomon (2003) using PBL in a traditional school setting, is undoubtedly a challenge requiring teachers to make extensive changes in the way they plan, prepare, teach, and assess. Students must modify the way they learn. However, she also states "communication, teamwork, and time management join math, language, and other subject-area content as new essentials for students. And the teacher's role no longer includes just delivering instruction or expecting students to repeat facts on tests" (Solomon, 2003, p. 20). These subjects should not be separated in classroom instruction, rather, taught in tandem, so students understand the relationship that exists between all disciplines. Students should not learn topics in isolation, but rather how to use their skills in necessary disciplines to create a successful project that exhibits what they learned.

Students today are more inclined to use various forms of technology in all realms of life (Moursund, 2003). Today's iGeneration effectively communicates and collaborates through the use of electronic devices, and they spend much of their time using e-mail, electronic mailing lists, forums, and other online applications to gather information (Rosen, 2010). Today, the online resources available for student research encompass online museums, online encyclopedias, and online libraries (Solomon, 2003). Students today creatively use their electronic devices to help them learn (Rosen, 2010). According to Rosen (2010), 21st century students feel more comfortable immersing themselves in the use of digital technology. For students, computers link them to the outside world and to knowledge inaccessible 25 years ago. Due to its versatility, digital storytelling technology is clearly an important tool in today's classroom for teaching and learning.

Digital technology is a key component of PBL as a diversity of tools are available for classroom instruction (Solomon, 2003). Moursund (2003) indicates, PBL is supported through research by:

- Constructivism,
- Motivation Theory,
- Inquiry-Based Learning
- Cooperative Learning
- Individual and Collaborative Problem Solving,
- Peer Instruction,
- Problem-Based Learning.

According to the National Research Council (2012), “inquiry”, which is a key component of PBL, requires critical thinking a skill lacking in many science classrooms. In addition, inquiry needs to be developed in younger grade levels through scaffolding, a teaching theory introduced in the late 1950’s by Bruner, a cognitive psychologist (Vygotsky, 1978). Vygotsky (1978), described scaffolding as a process where teachers model how to solve a problem, then allow students time to work, offering help as needed. Scaffolding provides students support as needed. Additionally, inquiry-based learning creates a student-centered classroom which connects open ended questions with hands-on exploration (Colburn, 2000). Inquiry prepares students how to work collaboratively, as well as how to better understand the natural world (Tweed, 2009). In order for inquiry-based learning to be successful, the teacher must be willing to give up some control what the students do and allow them to drive the process of exploration (Colburn, 2000). This type of learning science is the foundation of the PBL processes. Hence, Jenks, and Springer (2002) note “Technology, PBL, and science can all come together to create a significant tool” (p. 45).

When incorporating PBL in a science classroom, teachers should consider how to integrate science process skills while allowing students to investigate the natural world (Panasan & Nuangchalerm, 2010). Stoddart and colleagues (2000) stated computer tools allow students to act like scientist, learning to manipulate abstract concepts while learning content in the context of real world problems (Stoddart, Abrams, Gasper, & Canaday, 2000, p. 1221). When adding PBL to any subject area, teachers should allow students to use their own creativity to express themselves in their projects (Moursund, 2003). Students should not be hindered by what the teacher thinks the project should look like. Students should be allowed time to work through problems and try multiple approaches. If planned properly, using PBL helps students achieve the skills required for problem solving aligned with many career skills needed in life (Edutopia Staff, 2009).

Negative outcomes of Project Based Learning

Despite numerous benefits of PBL in science, results of some studies have shown unfavorable outcomes when compared to the implementation of traditional science process skills (SRI International, 2001). In a comparative study conducted in Thailand, 5^{th} grade students who applied PBL, rather than inquiry-based learning in science, did not have any gains in performance, process skills, or analytical thinking (Panasan & Nuangchalerm, 2010). In this study not only did PBL fail to show change in performance levels of student learning, but it also showed dissatisfaction from the teachers in the use of the approach. In an article published by Grant (2002) he states that implementing PBL can be an overwhelming experience for teachers. He emphasizes that PBL is a time-consuming strategy that requires more time to develop and less time to spend in other areas of the curriculum.

Students who are not able or are inexperienced in working in cooperative groups also can have greater difficulty adapting to a PBL approach (Johnson & Johnson, 1989). If a classroom culture has never adopted a collaborative work environment, teaching students how to interact with each other and implementing a PBL approach could be overwhelming (Grant, 2002). Teaching students to work collaboratively should be implemented slowly and scaffolded.

Additionally, according to Wenglinsky (1998), critics point out three negative aspects of digital technology based classrooms:

- First, cognitive theories of education indicate learning has important social skills needed. “Students learn not only because they process information, but also because of the complex reinforcements they receive from teachers and the socialization process in which learning is embedded. As computers move from being mere supplements to being the core of the learning environment, they limit opportunities for social interaction, thus interfering with the learning process.
- Second, there are historical factors tracing teachers’ unwillingness to adapt digital technology in their classrooms. Teachers must be willing and open minded to use digital technology introduced in schools. Critics portray technology as an unlikely tool to improve student performance because

teacher have historically feared or refused to adapt new digital technology. It can be complex and presents more obstacles for teachers to overcome "No matter how many computers are available in the classroom, if teachers are unwilling to use them for instruction, they are unlikely to have much impact on students.

- Third, cost factor is not comparable to academic gains making schools risk a high cost factor in exchange for academic results" (p. 9).

Furthermore, in the research of Kulik and Kulik (1991) they discuss that although implementing digital technology shows academic gains in subject areas, the results are not comparable to the cost of maintaining computers. The literature review depicts PBL as effective in some respects: collaboration, research skills, communication, problem-solving skills, student engagement and use of higher-order thinking skills; however, most studies have been made at the professional or high school level and additional research is needed to find its effectiveness in performance at the K-5 levels (Schneider, Kracjcik, Marx, & Soloway, 2002).

Digital Story Telling and Relevance to Education

The goal of digital technology in education is to prepare today's students for a new tomorrow (Lenz, 2013). Education may seem to resist change by harassing a traditional classroom; however, our society will continue to grow a technologically dependent economy and education will have to catch up (Lenz, 2013).

One of those forms of technology, and a PBL tool, is digital stories. Digital storytelling has been found to be an approach to improve motivation, attitudes, and problem-solving skills in students (Hung, Hwang, & Huang, 2012). Like PBL, digital storytelling is slowly developing and slowly becoming known in classrooms (Robin, 2008). Jakes (2005) denotes digital story telling "a truly authentic learning experience" which not only integrates the use of technology, but it also fosters differentiated learning, or the different intellectual capabilities of a student (Jakes, 2005). Through this form of technology, digital storytelling, students can develop a persuasive voice to be creative using technology. Furthermore, digital storytelling allows introverted students to develop concepts without having to deal with an audience allowing them to feel more successful (Jakes, 2005). Jake also affirmed milestones can be accomplished when students with disabilities are able to "narrate" their findings through the voice-over recordings. Students enjoy hearing themselves narrate their thoughts and view their success on the screen.

Digital storytelling is an important component for this study that will be incorporated into the final project created by students. The reason digital story is being used as part of the PBL aspect is because it easily lends itself to students obtaining technology literacy. Through this approach, students develop the ability to use computers and other digital technology methods to potentially improve their learning (Robin, 2017). According to Robin, digital technology demands in schools are driving teachers to use digital resources within the curriculum and digital storytelling pushes out the old fashioned methods of textbooks, worksheets, and workbook pages. 21st century skills demand children develop the ability to communicate with classmates, read e-books, receive and send e-mail, evaluate online references, and prepare research projects using proper presentation software (Intel Education Project Based Learning, 2010).

According to Tech4learning, digital storytelling also engages students in learning while combining media to create a vision of their understanding of the material (Tech4 Learning, 2012). Storytelling is an ancient tradition, adapted today to digital technology. Mathews-DeNetale notes, storytelling and learning are essentially one because the process of writing a story entails in making meaning (Matthews-DeNatale, 2008). Digital storytelling combines narration in a digital content, with the content students have recently learned. Their expression of ideas while developing the digital storyboard highlights the multiple facets of their learning. According to Lenz (2013) some learning theorists believe that story telling as a pedagogical technique can be effective across the curriculum because constructing a narrative, and communicating it effectively, requires the storyteller to think carefully about the topic, while also considering the audience's perspective (Educase Learning Initiative, 2007).

Summary

Though the research on PBL is continuously developing, a positive research base is evolving in favor of this teaching method in schools (Edutopia Staff, 2009). After reviewing many articles and books, a positive take on PBL was present with regard to its effectiveness in the classroom. The same can be said for PBL on the impact of learning new technologies. For example, Penuele (2000) conducted a five-year study showing digital technology is a powerful way to reform teaching and learning (SRI International, 2001). Although the use of digital storytelling technology and PBL could be a time-consuming approach, a sense of wonder questioned the worth of these tools within the science special course as a way to address higher-order thinking standards and most importantly impact student learning. Through personal experience, the success of PBL is known to occur for both the teacher and the students, but the process requires careful planning and preparation, as well as a willingness to allow students to have the opportunity for self-discovery. Hence, the reason of embarking on this study to uncover if in fact digital storytelling technology through PBL would impact learning gains of higher-order thinking science standards in second-grade classrooms.

CHAPTER THREE: METHODOLOGY

The purpose of this study was to use high to moderate complexity life science standards to evaluate the effectiveness of a PBL approach, using digital storytelling technology, in the performance of 2nd grade students. The second-grade students involved in the study were randomly assigned to two groups, and the final data for this research was used to measure the effectiveness of PBL for higher-order thinking life science standards. The research methods for this study consisted of quantitative strategies, which included a pre and post standards-based assessment, a student self-assessment, a teacher developed scale and rubric to assess the students' science journals, and a final digital story project. The design of this study included classroom setting, description of the randomly assigned participants, instruments used to collect data, limitations of the study, and analyses of the information gathered during this study over an 11-week period.

Setting

In 2007, the science program in our school was established in order to provide additional support to classroom teachers and students by reinforcing higher complexity level science standards. In order for all students to equally take advantage of the program, science was included in the special areas schedule. The student population rotated through a weekly schedule that included science, art, music and physical education. Each student spent 40 minutes, daily, attending a special, with the exception of specials being 30 minutes on Wednesdays, due to early dismissal.

The special areas schedule consisted of a six-week rotation alternating a full week of science, art and music with a week of physical education. The table below shows an example of the schedule.

Table 2: 6-Week Special Areas Schedule

Rotation #1 **Aug.13-Sept. 21 (40 min M, T, TH, F and 30 min W)**					**revised**	8/9/2012
1st Rotation						
WEEK OF	**Purple Group**	**Blue Group**	**Red Group**	**Green Group**	**Yellow Group**	**Orange Group**
Aug 13 – Aug 17, 2012	**PE-1**	**Art**	**PE-2**	**Music**	**PE-3**	**Science**
Aug 20 – Aug 24, 2012	**Art**	**PE-2**	**Music**	**PE-3**	**Science**	**PE-1**
Aug 27 – Aug 31, 2012	**PE-2**	**Music**	**PE-3**	**Science**	**PE-1**	**Art**
Sept 3 – Sept. 7, 2012	**Music**	**PE-3**	**Science**	**PE-1**	**Art**	**PE-2**
Sept 10 – Sept. 14, 2012	**PE-3**	**Science**	**PE-1**	**Art**	**PE-2**	**Music**
Sept 17 – Sept. 21, 2012	**Science**	**PE-1**	**Art**	**PE-2**	**Music**	**PE-3**

In the school year, the special areas consisted of a total of six rotations and each rotation consisted of six weeks each. The 2012-2013 school year consisted of approximately 38 weeks allowing a total of six complete rotations and one final two-week rotation. Table 2 shows the first rotation and the first six weeks. During that time, each rotation consisted of: three physical education classes (sections), music, art, and science. Every grade level rotated through the special areas and every individual teacher was assigned a color. If a grade level consisted of less than six teachers, then all of the teachers would have to break up their students and create color coded groups in order to even out the students in each corresponding specials area. If the grade level consisted of more than six teachers, then only one teacher would have to break up students and place them in a teacher's assigned color-coded group.

Due to a county mandate, the rotations required three physical education classes, or sections, (physical education 1, 2, and 3). For example, 5th grade students assigned to the purple group, rotated through a week of physical education in between every week of Art, Music, and Science. Physical education consisted of three classrooms, or sections, at once for a full week.

Initially, the planned study was to take place in the regular second-grade science enrichment schedule; however, it would have limited the amount of student time to invest in the study, because the rotation schedule would not allow the group of second graders to rotate through the cycle more than six times in the school year. For this reason, two second-grade classrooms were used to supplement the student time needed.

Knowing the special areas schedule would not permit ample classroom time to conduct this study, two teachers volunteered their second-grade classes in order to do so. The study took place over 11-weeks. Each week, visits were alternated to the two second-grade classes from October 1, 2012 through December 20, 2012. Classroom time was limited to 30 minutes of instruction, thus this additional science enrichment was taught at the end of the day, in addition to the daily curriculum areas and classroom instruction. Furthermore, the teachers requested the study be completed by Winter Break in December. This request hindered the study, but it allowed more daily time with the students. As requested, the study began promptly in October and was completed before the students left for Winter Break. Due to the 11-week limitation, some students did not complete some of the digital stories, and a further in-depth study to compare the basic needs of living things had to be truncated.

Additional internal threats included subject characteristics such as ethnic background, socio economic status, and prior knowledge on the subject. Due to the period of time of the study, as students became more developmentally skilled, maturation also posed a threat.

Research Design

The primary focus of this research was to find the effectiveness of digital storytelling technology through PBL to improve the performance of higher-order thinking science standards in second-grade students. The findings of the study were to used to improve science teaching practices. This research is considered to be an example of action research, which "is conducted by one or more individuals or groups for the purpose of solving a problem or obtaining information in order to inform local practice" (Wallen & Fraenkel, 2009, p. 16221). Action research studies can be effective in particular practices, and they encourage needed changes if results are favorable to a group of individuals (Wallen & Fraenkel, 2009). Action research is a sense of obtaining knowledge and gathering information to improve the complexities of teaching and learning (Glanz, 2014). In order to determine the effectiveness of digital storytelling technology integration using PBL, this research required data from two different groups of students; one group implementing the regular structured-inquiry plus PBL and the second group implementing only the regular structured-inquiry instruction.

The University of Central Florida Institutional Review Board, considered this study to be exempt, due to its basis in education, which required to notify the parents of the participants through a parent letter sent out prior to beginning the study (see Appendix A).

This experimental action research study used two voluntary second-grade classrooms with students who were randomly placed in these classrooms by our administration and by our office staff prior to the school year beginning. One of the second-grade classrooms applied PBL strategies, and the second classroom applied the strategic hands-on guided inquiry based practices. The experimental group from this point forward is referred to as Group A, and the control group referred to as Group B. In order to compare the effectiveness of digital storytelling technology using PBL the control group focused only on a hands-on science approach. Group A, the experimental group, integrated PBL into the hands-on science approach in order to create a digital story. For this study, the independent variable is the method of instruction, and the dependent variable is the performance of the students on the standards. The experimental aspect of this action research occurred over 11-weeks.

While two second-grade classroom teachers volunteered their classroom time and students to conduct this study, neither classroom teacher was involved in, or participated in the study. For a period of 11-weeks, during the last 30 minutes of the day, the primary investigator took over the classroom time to conduct this study. Seven weeks were spent with Group A as the experimental group, consisting of seven male students and five female students. Four weeks were spent with Group B as the control group, consisting of eight males and seven female students. The difference in the amount of weeks spent in Group A and Group B was three weeks; however that instruction was supplemented with Group B during the regularly schedule science special area schedule.

To keep the consistency of classroom practice, each group equally participated in the same hands-on, structured-inquiry science activities about the bean life cycles; however, the experimental group incorporated technology through a digital story project to demonstrate their understanding of the life cycle. From October 1st to December 14th, on an alternating weekly basis, both second-grade groups were visited on a daily basis. During this time, the three-moderate complexity life science standards about the bean life cycle and butterfly life cycle were taught for the first time. The experimental classroom was visited first in order to perform hands-on activities pertaining to moderate complexity life science standards and integrate their knowledge and observations into a digital story using Frames 4 by Tech 4 Learning. Group B, performed the same hands-on science activities using only a guided-inquiry approach.

A pre and posttest provided the Quantitative Data for this study. All students completed the same pretest prior to beginning our bean life cycle unit. The assessment was created through an online teacher tool called Science Fusion Exam View Test Banks. This tool created a customized assessment targeting the specific life standards used in this study. Considering action research provides for teachers to "develop their own instrument to make them locally appropriate" (Wallen & Fraenkel, 2009, p. 1622).This tool was a convenient form of assessment because it was a tool obtained through the county science textbook adoption. With publisher authorization, a sample of this assessment is included in Appendix C of this study. Group A using the PBL digital storytelling approach also used a rubric to assess the team work and the goals of the project. The basic guidelines for this rubric were obtained through PBL BIE (Buck Institute for Education, 2012). Group B, using no experimental treatment, used a modified rubric to evaluate their science journals. For self-evaluation, students kept a daily log to help evaluate their collaboration and a weekly performance scale to monitor their comprehension of the life cycle (see Figure 1). The data obtained from both groups was compared with each other in order to make an overview about the group using the PBL approach and the group using the hands-on science approach. In order to monitor the progress of the study, a checklist was designed to help log all of the students' accomplishments (see Appendix B).

Setting/Participants

The school, within central Florida, serves a large urban community. It has a student population of approximately 560 students, and it employs a professional staff of nearly 70. Like many urban communities, a large percentage of the school-aged population comes from families with limited economic means, with 54% of the students eligible for federal free and reduced-price lunch. In 2012 the school served a population of 52% Caucasian, 23% Hispanic, 12% African American, 5% Asian, and 8% other

The science program at the school was created to serve as enrichment to the science curriculum and part of the special areas rotation. The science curriculum was unique from the other special areas in that it did not formally assign grades or formally assesses any of the students; thus, the science enrichment program teacher did not assign report card grades. The enrichment curriculum was based on the Next Generation Science State Standards, and it focused primarily on reinforcing the high cognitive skills taught in the standards. The purpose of the science enrichment program was to help support teachers and students with science instruction in their regular classrooms. The program served the entire student population, kindergarten through fifth grade. It also used a variety of hands-on materials to help scaffold science instruction across grade levels using a structured-inquiry approach for younger grade levels and guided inquiry for older grade levels. As a part of the overall science instruction, a 5E learning model was the template used to design the science lessons (Bybee & Landes, 1990). These educational researchers have provided extensive input in the 5-E model as part of constructivism and research continuously supports this method for conceptual change (Bybee & Landes, 1990).

During summer, the school administration closely looks at each grade level and its student population. The administration proceeds to create classroom rosters and assigns them to each grade level teacher. The second-grade rosters are turned into the teachers during the first few teacher workdays at the beginning of the school year.

The participating classrooms had a small population size due to the small number of students schoolwide. Each classroom had their unique classroom management and classroom layout set by the volunteering classroom teachers to prevent confusion or sway the study, none of the classroom rules, culture, or management procedures were changed in order to conduct the study. The seating arrangements set up by both classroom teachers were based on Kagan (1990) cooperative learning strategies and at this point in the year, the students in the classrooms were comfortable with their classroom set up, management, classroom procedures, and norms. Both classroom teachers decided by choice to implement Kagan cooperative learning strategies in their classrooms. Fortunately and coincidently, this practice was already established in both classrooms and was a variable that remained constant throughout the study. The use of cooperative learning did not conflict, but actually complemented the purpose of the study by having already established grouping procedures.

The experimental classroom, Group A, was composed of seven male students and five female students. Group A consisted of one student identified as having a learning disability, no students who were English language or gifted learners. The control classroom, Group B, consisted of eight males and seven female students. Group B consisted of no students identified as having a learning disability, English language, or gifted learners. Most of the students were considered of average academic ability and performed on grade level. The students' ages ranged from seven to eight years old.

Both groups covered the same science standards, and students were evaluated using the same Science Fusion pretest and posttest, rubrics, and teacher checklist. Additionally, the second-grade students were challenged by integrating one math common core standard. This common core standard was not evaluated in any of the assessments, but was added as a challenge so students could connect science investigations to data collection.

Instrumentation

The only instrumentation used to collect comparable data in this study was obtained from the district science adoption (see Appendix C). The assessments were similar and created through a test generator in order to specifically select multiple-choice questions required to measure the Life Science standards used for this study. The same content was measured through a pre and post assessment composed of the same 20 multiple-choice questions, and each assessment was scored using the automatically generated key (see

Appendix B). The useful online test generator is a customizing tool which created the assessments based on the selection of individual standards. The assessment was customized to measure the performance of each individual standard implemented in this study.

The county text adoption particularly focuses on the Florida science standards. Although the text content was not used to deliver instruction, the assessment component was used to measure the proficiency of students in the selected life science standards. In a study conducted to find the instructional effectiveness of Houghton Mifflin Harcourt – Science Fusion, the Fusion testing instruments used to generate the data were “considered to be highly reliable test designed to measure growth on science skills and knowledge related to a single unit of instruction” (Educational Research Institute of America, 2012, p. 24). Thus, the research teams and teachers at the research site deemed the assessment relevant and effective to determine student performance.

Additional assessments were created to track the progress of students in both groups. The rubric used to score the final projects in Group A evaluated the following skills (Buck Institute for Education, 2012):

- Time management
- Organization and neatness
- Collaboration
- Clear Thoughts
- Science learning goals (purpose)

Students in both groups were responsible for note taking in their science journals; however, a rubric was created to evaluate science journals in Group B. The rubric used to evaluate journals in Group B was based on the following (Buck Institute for Education, 2012):

- Time management
- Collaboration
- Delivery
- Creativity
- Project learning goals (purpose)

Ordinal scales were used within rubrics to evaluate each of the categories above. The purpose of the ordinal scale was to show a ranking from high to low (see Appendix B) (Wallen & Fraenkel, 2009). Each category had a total of three possible points, for a total of 15 points for each product, the digital story, and science journals. The scales were used to evaluate the students using the rubric in order to demonstrate performance between 3 being the highest score and 1 being the lowest.

The rubrics were obtained through the BIE website and were modified for grade level appropriateness. The BIE has been training educators to use of PBL and focuses on engaging student learning through digital technology (Buck Institute for Education, 2012). The BIE website provides an extensive amount of resources to support PBL, and it is a research-based program that offers educators training on how to effectively create stronger classrooms (Buck

Institute for Education, 2012). Due to its positive educational reputation, the rubrics were deemed appropriate for this study.

A unique component of this study is that the teacher evaluation system requires students to track their own progress through scales designed by the county for each standard. Domain one in our student evaluation system requires communicating goals and obtaining student feedback through use of learning goals and performance scales. The students used this self-assessment to track their own progress of the learning goals. The scales were shown in a table to show how students measured their distinct levels of knowledge and skills related to the specific learning goals. The maximum score obtainable on the scale, a 4, was obtained if a student was able to go above and beyond the understanding of the learning goal by being able to infer and apply learned objectives to real life situations. If students evaluated themselves on a scale of a 3, students felt they obtained mastery of the learning goal with minimal errors. A scale of 2 indicated minimal mastery of the learning goal with some errors; a scale of 1, students required a considerable amount of help to partially achieve the learning goal; and a scale of 0 indicated no mastery or understanding of the learning goal even with help. See Table 3 for an example of the scale.

Table 3: Scale Progression

Week 1 **2.N.1.1** (HIGH COMPLEXITY) – HIGH COMPLEXITY) Raise questions about the natural world, investigate them in teams through free exploration and systematic observations, and generate appropriate explanations based on those explorations (C-PALMS, 2010). **Learning Goal:** Evidence you explored parts of the bean and the changes of your bean with your teammate.	
Scale	**Learning Goal**
4	I am an advanced scientist that is able to think, plan an experiment, grow different beans and know how to compare each one.
3	I am an independent scientist that knows all of the vocabulary we learned, is able to observe the growth of my bean, explore my bean, and come up with good explanations on the changes of my bean.
2	I am a simple scientist that knows the vocabulary we learned, is able to observe the growth of my bean and explore my bean, but I could not explain why my bean changed.
1	I am a dependent scientist needing help learning the vocabulary, finding out how to observe the growth of my bean and how to explore it. I had to work with my shoulder partner to come up with good explanations on the changes of my bean.
0	I am not a scientist because with help I was not able to learn the vocabulary, I did not understand how to observe my growing bean and I could not explain the changes in my bean.
Week 2 **2.L.17.1** (MODERATE COMPLEXITY) Compare and contrast the basic needs that all living things, including humans, have for survival (C-PALMS, 2010). **Learning Goal:** Show the basic needs your bean needs to grow.	
Scale	**Learning Goal**
4	I am an advanced scientist that is able to think on different ways of growing beans by using different materials and explain the changes in my bean.
3	I am an independent scientist that knows all of the vocabulary we learned and knows all of the basic needs my bean needs to survive.
2	I am a simple scientist that knows the vocabulary we learned and is able to know just a few of the basic needs my bean needs to survive.
1	I am a dependent scientist that needs help learning the vocabulary and help understanding some of the basic needs my bean needs to survive.
0	I am not a scientist because with help I was not able to learn the vocabulary, I did not understand how to the basic needs help my bean survive.

Scale	Learning Goal
Week 3 **2.N.1.1** (HIGH COMPLEXITY) Raise questions about the natural world, investigate them in teams through free exploration and systematic observations, and generate appropriate explanations based on those explorations (C-PALMS, 2010). **Learning Goal:** Explored and created explanations of the bean with your teammate	
Scale	**Learning Goal**
4	I am an advanced scientist able to think, plan an experiment, grow different beans and know how to compare each one.
3	I am an independent scientist knowing all of the vocabulary we learned, is able to observe the growth of my bean, explore my bean, and come up with good explanations on the changes of my bean.
2	I am a simple scientist knowing the vocabulary we learned, is able to observe the growth of my bean and explore my bean, but I could not explain why my bean changed.
1	I am a dependent scientist in need of help in learning the vocabulary, finding out how to observe the growth of my bean and how to explore it. I had to work with my shoulder partner to come up with good explanations on the changes of my bean.
0	I am a scientist but I was not able to learn the vocabulary, I did not understand how to observe my growing bean and I could not explain the changes in my bean.
Week 4 **2.L.16.1** (MODERATE COMPLEXITY) Observe and describe major stages in the life cycles of plants and animals, including beans and butterflies (C-PALMS, 2010). **Learning Goal:** Describe the life cycle of the bean and show its steps.	
Scale	**Learning Goal**
4	I am an advanced scientist able to think, plan an experiment, grow different beans, use different materials and explain the life cycle of each.
3	I am an independent scientist learned all of the vocabulary, is able to observe and describe the different stages in the life cycle of my bean.
2	I am a simple scientist that knows the vocabulary we learned, is able to observe the growth of my bean but I can only explain some of the stages in the life cycle of my bean.
1	I am a dependent scientist needing help in learning the vocabulary, finding out how to observe the growth of my bean and describe the different stages in the life cycle of my bean.
0	I am a scientist but I was not able to learn the vocabulary, I did not understand how to observe my growing bean and I cannot describe the different stages in the life cycle of my bean.

Procedures

Prior to the beginning of the study, the second-grade students were read the letter of consent to inform them of the study, see Appendix A. This study kept all science instruction the same for both groups of students with the one variance being the use of digital storytelling technology as a PBL The science enrichment program does not formally grade students and does not assign grades. For the purposes of this study, the only difference between the science enrichment program and the study groups was the setting of instruction, and the use of assessments to collect data. A summary explanation form was submitted to IRB stating the assessments conducted in this study were solely used to collect data, and the parents were informed of their children's involvement in the project.

Since the study was exempt parent signatures for participation were not required, but parents were properly informed of the parameters of the study. The parents were notified the study was conducted during the last 30 minutes of the day, and it did not interfere with any of their children's regular classroom instruction. Parents and students were notified the purpose of the assessments used in the study were to collect data, and none of the students would receive formal grades based on these tests (see Appendix A). The pretest was administered to both groups at the beginning of the study, and the study concluded 11-weeks with the post test. In addition to being informed of the study, parents and students were also given the choice to opt out from taking the assessments or taking part in the study. None of the students or parents opted out of the study and all were included in the results of this study.

The activities planned for this study required 11-weeks of instruction. The activities were based on two life science standards, Big Idea 16: Heredity and Reproduction and one nature of science standard, Big Idea 1: The Practice of Science. Table 4 shows the standards used to evaluate the project.

Table 4: Standards Guiding This Study

Nature of Science – Big Idea 1: The Practice of Science
• **2N.1.1 (High Complexity)** Raise questions about the natural world, investigate them in teams through free exploration and systematic observations, and generate appropriate explanations based on those explorations. **(C-PALMS, 2010)**
Life Science – Big Idea 16: Hereditary and Reproduction
• **2.L.16.1 (Moderate Complexity)** Observe and describe major stages in the life cycles of plants and animals, including beans and butterflies. • **2.L.17.1 (Moderate Complexity)** Compare and contrast the basic needs that all living things, including humans, have for survival. **(C-PALMS, 2010)**
MACC.2.MD.4.10– Math Common Core Standard
Draw a picture graph and a bar graph (with single unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph. **(C-PALMS, 2010)**

During the first few weeks of the school year, classroom teachers conducted a series of assessments providing insight on the students' academic abilities. The volunteering classroom teachers shared the data collected, and this information was used to arrange students to create a cohesive learning environment.

Experimental Classroom, Group A, (Digital Technology using PBL)

The experimental classroom, Group A, required seven weeks to complete instruction. Due to the addition of PBL, Group A required additional classroom time and used three additional weeks in order for students to expand their scientific thoughts into the creation of digital stories. The study began with Group A, on October 1, 2012, alternating weeks, and ending on December 20, 2012. The study for this group concluded before students left for

Winter Break. The classes met consecutively each day the last three weeks from December 3rd, 2012 through December 20th, 2012. However, the last two days of the study comprised of early dismissal days. The pretest for Group A was given on October 1st at 2:20 p.m., and students were given the 30-minute period to complete the test. The posttest was given on December 20, 2012, at 12:20 p.m. and students completed the test within the 30-minute time frame.

The activities in Group A were conducted in a total of seven weeks. During the first four weeks, Group A participated in exploring hands-on activities and making notes in their science journal about what they were learning of the life cycle. The additional three weeks allowed students in this group to compile their science hands-on instruction and journal entries into a digital story, which allowed them to create projects that elaborated on and explained their findings. The projects were evaluated based on four main components (Buck Institute for Education, 2012): time management, collaboration, creativity, delivery and learning goals.

The software used to create the animations was from Tech 4 Learning called Frames 4. Images of samples were used in this study and obtained with permission, (see Appendix D). The digital stories included: animation, drawings, narration, and music (Educase Learning Initiative, 2007). Once the hands-on activities and journals were completed, students in Group A proceeded to create their digital story. In order to assist the young students, a template of the storyboard was developed so students filled in the template using their journal as a source of information. The digital story was their tool to explain and elaborate their findings (see Figure 7).

Control Classroom, Group B, (No Technology)

The control classroom, Group B, required four weeks of instruction to complete the study. During the initial period of four weeks, a hands-on approach to learning Big Idea 1 and 16. Group B began the study on October 8, 2012, alternating weeks through November 30, 2012. Since Fall Break consisted of two school days, this week was skipped, and soon resumed the study the following week, November 26th. The study began with the pretest given on October 8th, where the students were given the allotted 30 minutes to complete the assessment. The study for this group of students concluded with the posttest on November 30, 2012. Students were given the test at 2:20 p.m. and were given the 30-minute period to complete it.

The control group, Group B, consisted of four weeks and applied a hands-on approach, and like the variable classroom, students also used science journals to make entries. The activities in Group B were also based on learning of the life cycle.

Daily Classroom Procedures

A timeline of daily procedures for this study has been added to Appendix E. Each group was previously grouped by their classroom teacher based on learning ability to help student success. Both classroom teachers set up their seating arrangements by pairing up their students based on Kagan Cooperative Learning strategies (Kagan, 1990). Teachers also had established classroom procedures and students were very familiar on how to work with their shoulder partners. Students learned cooperative strategies at the beginning of the school year and were taught by their classroom teachers. Each group during the first four weeks began the period of an engaging question followed with guided exploration. The deviation of the study began at week five when Group A began the story boards for their project. Through collaboration of the classroom teachers, the lessons were based on life science standards in order provide students a fresh introduction on the life cycle of beans, while also comparing the teaching methodologies. This consistency helped not to skew the results of the posttests, because students had the same amount of instruction.

Based on the daily procedures in Appendix E students evaluated themselves on the learning goals using a self-assessment scale implementing the guidelines imposed by the county. These scales were used to track student progress on a weekly basis (see Table 3).

Science as Enrichment

For this study, the science enrichment occurred in both second-grade classrooms implemented during the last 30 minutes of the day. The two participating groups of second-grade students received an additional 30 minutes of science enrichment in their regular classroom; but it did not interfere with the regular curriculum schedule.

The purpose of the science enrichment program was not to assess students. The purpose of the program was to simply add additional instruction of the science standards without assigning students grades or implementing formal assessment procedures. The enrichment program was used to expand students' science knowledge and provide additional hands-on activities. For the purpose of the study, as a difference in the students' science enrichment, both classrooms were asked to take a pretest to find their background knowledge on the life science standards used in the study. Students were told this test would not count as a formal grade, but they should do their best. Each day, at the beginning of the class, students were engaged with essential questions such as: Have you ever thought how many types of beans are there? Have you ever had 4-bean soup? Where do you think different beans come from? Following these questions, students in both groups participated in the same hands-on activities each day we met.

The science enrichment was consistent for both 2nd grade classrooms, Group A and B, since both explored different types of beans. Students were given four different types of beans, and they made close observations of their properties. After making a chart about the properties, students proceeded to their challenge common core math standard which consisted of representing a data set and solve simple problems using information presented in their bar graph (C-PALMS, 2010).

Each pair of students, in both classrooms, received a clear CD case. which was set up in a table filled with an variety of materials such as: gravel, sand, soil, water spray bottles, brown paper bags, paper towels, pictures of a window, and pictures of blowing air. Collaboratively, with their shoulder partner, students picked one type of seed and selected, from the table, the basic needs they thought would help their bean grow. Students were prompted to think "What things will allow your bean to grow?" Based on their choices, students grew their bean based on their choices. The beans were placed inside clear CD cases for observation and measurement (see Figure 3).

Figure 3: Beans Grown in CD Cases

During the next couple of weeks, both groups of students worked independently on collecting data about their bean. All students used a science journal to collect data, make observations, and draw diagrams. As part of their standard instruction, students needed to learn to compare objects. The purpose for students to collect data, such as the different properties of the beans, was for property comparison purposes. Students graphed their results and collected data to show quantities.

Once the hands-on activities and journals were completed, students in Group B concluded their activities and data were collected. Students in Group A continued the study and created their digital story. At the end of the allowed time, students were asked to complete the post assessment to measure what they had learned within the period of the study about the complex stages of the life cycle.

Methods of Data Collection / Analysis

The two study conditions, experimental classroom and control classroom, were compared to find the effectiveness of digital storytelling technology through PBL of higher-order thinking science standards (Wallen & Fraenkel, 2009). Pre-test and posttest data were gathered for comparison since the subjects in the study were randomly selected. Quantitative methods were gathered from the assessments in each group of students, Group A and Group B. Students were assessed in their classrooms at the beginning and at the end of the study. At the start of the study, students in the experimental classroom, Group A, began with a pretest and at the end of the study students received a posttest. Just like the experimental group, Group B, the control classroom, also began the study with the same pre-test. Both groups of students were given a 30-minute period to complete the assessment. Then at the end of the study a posttest was administered. The pre and posttests allowed to compare students' knowledge of concepts studied during the action research project, and the pretest allowed to evaluate the background students brought before any instruction. The posttest allowed to compare each student's growth after applying the different teaching methods. The test was generated, and permission obtained (see Appendix C), through Houghton Mifflin Harcourt School Publishers - the county adopted science text. The same questions were given to both groups and both assessments consisted of the same questions in order measure the students' performance with the standards and comparing outcomes for comparison on the implementation of the PBL.

The Houghton Mifflin Harcourt School Publisher assessment consisted of multiple-choice questions and received a percentage value out of 20 total questions. To obtain the percentage of correct questions, the number of correct answers was divided by the total number of 20 questions and multiplied by 100. Tables were created to show the scores in percentages obtained per student, (see Tables 5 and 6), and each student was coded using a pseudo name to protect their identity.

Other than the pre and posttests, students' science journals and projects were teacher evaluated with rubrics and based on five different criteria: work being complete, neat and organized, sharing ideas, demonstrating daily learning, and showing their team learned three goals. Customized rubrics were obtained through Buck Institute for Education and modified to evaluate student progress for this lesson (see Appendix B). As part of our teacher evaluation system, students are required to self-assess their progress. The study implemented student scales and were used to track progress. Students in the study could evaluate their weekly progress through the use of a scale based on the three science standards.

Each pre and post assessment provided a list of raw data which was analyzed by obtaining the average mean, the median, the standard deviation of each pre and post assessment. The mean and standard deviation were obtained to show the distribution of test scores between Group A (technology group) and Group B (no technology). The z-scores were calculated to measure the distance of raw scores from the mean in simple standard deviation units (Wallen & Fraenkel, 2009). The z-scores were obtained to show the gain in performance between the pre and posttest for both groups of students. The z-scores were calculated as follows (Wallen & Fraenkel, 2009):

$$\text{z-score} = \frac{(\text{Raw percent score} - \text{mean})}{\text{standard deviation}}$$

Comparing the performance of the two groups was calculated to determine if any relationship existed between the experimental and control group (Wallen & Fraenkel, 2009).

Two frequency polygons compared the percentages of performance gains between both groups of students in the posttest (Wallen & Fraenkel, 2009). The two frequency polygons were used to show any correlation between both teaching methods; gains in Group A (with technology) and gains in Group B (no technology).

The second set of data were generated from the science journals and final projects. A rubric was used with Group B to evaluate the science journals, which monitored progress for each standard, with a total possible of 15 points. Group A was evaluated using a rubric to assess the content of the final PBL projects with a total possible of 15 points. In the instrumentation section of this chapter, the rubric components are listed. The three comparable components of each rubric for Groups A and B are as follows: time management, collaboration, and meeting learning goals.

A bar graph was also used to display the results of the performance scale. The scales were averaged to present student self-assessed progress toward achieving the weekly learning goals.

Conclusion

The action research could have benefited from additional time in order to collect additional data and analyze data between the two groups. The instruments were selected to create a valid comparison between Groups A and B to determine if learning differences occurred due to the use of PBL. The pretest and posttest were used to measure gains in performance in both groups of students. The same tests were implemented to gauge pre-knowledge and post-knowledge, as well as determine if the PBL was the source of any difference in knowledge. The rubrics, using ordinal scales, measured essential criteria in the digital stories and journals to show how students were receiving and processing the lessons each day. Finally, the performance scale allowed students to self-assess their progress, which enables the researcher to determine when/how the PBL is making a difference in the lesson. Each instrument was analyzed separately to ultimately determine any trends in difference between the group of students implementing digital storytelling technology and the group of students given instruction without technology.

CHAPTER FOUR: DATA ANALISYS

Introduction

The purpose of this action research was to find if PBL through digital storytelling technology was effective in improving the performance of second-grade students on an assessment using one high complexity and two moderate complexity life science standards, to learn about the major life cycles of plants and animals. A total of 27 students voluntarily participated in the study outside of the science enrichment schedule. The two volunteered classrooms were categorized into two groups: Group A, the experimental digital storytelling technology based group, and Group B, as the control non-technology group. The students participated in an 11-week study: Group A seven weeks and Group B four weeks, but both with equal amounts of time just the time each week varied. The data collected were analyzed to find if digital storytelling PBL was a more effective approach in improving student performance using higher-order thinking science standards. The pre and posttest, and the rubric, were the main sources used to find if a relationship existed between both teaching methodologies in order to answer the question posed: What effect does digital storytelling technology have, when embedded in PBL, on improving second-grade students' mastery of higher-order thinking science standards?

Results of Pretest and Posttest

The pretest and posttest allowed to compare student growth using two different instructional methodologies. The data for both groups of students was examined; although, 13 students in Group A were assessed, one of the students had such a poor outcome and struggled with all concepts scoring 50% in pre-assessment and 55% on post assessment. It was determined that for the purposes of this study his data would not be relevant and it was removed. The outcome of the remaining 12 students is shown in Tables 5 and 6 displaying scores on the pre and posttests obtained by dividing the total number correct responses by the total number of questions. The pre and post assessments for both groups were closely evaluated and after close analysis it was decided to eliminate two of the assessment questions in the posttest. None of the students were successful answering these two questions and determined it was due limited short period of the study which prevented to cover question #20 and #2 in the post assessment. The total number of correct questions was divided out of 18 questions, instead of 20 questions, to obtain the post assessment percentage. The tables shows the median rank, percentage of improved scores and the standard deviation of each pre and post assessment. The raw percent score, the mean and standard deviation was obtained to show the distribution of test scores between Group A (technology group) and Group B (no technology).

Table 5 and Table 6 shows the results of both groups including the total percent of improved scores from pretest to posttest. The z-scores were obtained to show the improvement in posttest scores, and the z-scores were calculated as follows (Wallen & Fraenkel, 2009). The z-scores are displayed on Figure 4.

$$\text{z-score} = \frac{(\text{Raw percent score} - \text{mean})}{\text{standard deviation}}$$

Table 5: Test Scores Group A
(Technology Group)

Student pseudo names	Pretest	Posttest	% Improved	Z-score test improved scores
1.Nic	66.7%	94.4%	41.7%	2.0565
2.Peter	61.1%	77.8%	27.3%	1.1594
3.Sofie	61.1%	72.2%	18.2%	0.5928
4.Rach	72.2%	83.3%	15.4%	0.4185
5.Mac	77.8%	88.9%	14.3%	0.3500
6.Allie	88.9%	100.0%	12.5%	0.2387
7.Ollie	83.3%	88.9%	6.7%	-0.1249
8.Mos	88.9%	94.4%	6.3%	-0.1509
9.Jake	94.4%	100.0%	5.9%	-0.1738
10.Nick	94.4%	100.0%	5.9%	-0.1738
11.Kailani	88.9%	83.3%	-6.2%	-0.9299
12.Tristan	83.3%	61.1%	-26.7%	-2.2024
Median	**83%**	**89%**	**6.67%**	**-0.1249**
Stand. Deviation	0.1166	0.1164	0.1604	

Table 5 shows 10 out of the 12 students in Group A, the experimental group using digital storytelling technology, has shown growth from the pre-test to the posttest. The data displays only a 6.67% improvement in scores. The median shows there is a slight difference in student percent improved scores; however, the data does not show a significant correlation in the improved scores. Group A had two outliers; student 1 and student 12. Student 1 being a high achieving student scored significantly lower in the pre-test; however, this student was often affected by upper respiratory medical conditions. During the pre-test, student 1 was very uncomfortable with medical symptoms. The second outlier, student 2, was affected by hyperactivity and at times he had emotional breakdowns. During the pre-test this student had an outstanding day; but, unfortunately his emotional state of mind, as observed by myself and his classroom teachers, was not as stable during the posttest potentially explaining the difference in his results.

Table 6: Test Scores Group B
(No Technology Group)

Student pseudo names	Pretest	Posttest	% Improved	Z-score test improved scores
1. Abri	55.6%	94.4%	70.0%	2.8922
2. Cris	55.6%	77.8%	40.0%	1.3741
3. Casy	72.2%	100.0%	38.5%	1.2963
4. Eli	72.2%	88.9%	23.1%	0.5178
5. Ari	83.3%	94.4%	13.3%	0.0248
6. Allie	83.3%	94.4%	13.3%	0.0248
7. Ash	83.3%	94.4%	13.3%	0.0248
8. Coll	83.3%	94.4%	13.3%	0.0248
9. Dallie	77.8%	83.3%	7.1%	-0.2885
10. Joe	88.9%	94.4%	6.3%	-0.3337
11. Nathan	94.4%	100.0%	5.9%	-0.3523
12. Cam	88.9%	88.9%	0.0%	-0.6499
13. Torie	94.4%	94.4%	0.0%	-0.6499
14. Mandy	100.0%	94.4%	-5.6%	-0.9310
15. Jack	77.8%	72.2%	-7.1%	-1.0114
Median	**83%**	**94%**	**13.33%**	**0.0248**
Stand. Deviation	0.1248	0.0753	0.1976	

Table 6 shows 11 out of the 15 students in Group B, the control group using no technology, presents improvement in scores from the pre-test to the posttest. The data displays an improvement of 13.33%. The median shows there is a higher difference in the percent of improved scores and the data shows a more significant correlation in improved scores. Group B, no technology, demonstrates a higher percentage of improved scores than Group A, digital storytelling technology implementation. Group B had one outlier. Student 1 was a high achieving student who does well when she is on task and under medical treatment. During the pre-test, this student was not under medical treatment and struggled with staying focused for the first few weeks of the study. By the end of the study, this student excelled when placed under medical care and pulled through making great gains in overall academic achievement in all classes and this same change can be observed in the posttest.

The Z-scores for improved test scores are displayed in Figure 4 and compares the results for both groups. The z-scores allow the raw scores of the two different groups to be compared (Wallen & Fraenkel, 2009).

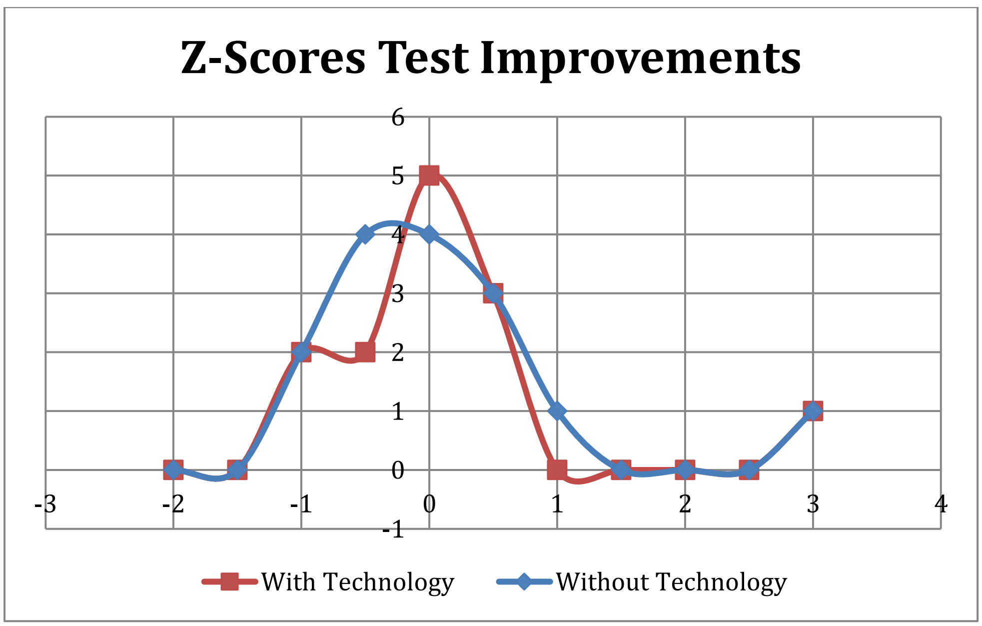


Figure 4: Z-Scores Showing Test Score Improvements

After students' gains were calculated, Group A demonstrated a slightly higher average on increased scores in the posttest. The z-scores help to make a comparison between both groups by determining the mean and standard deviation for each of the percentages of gains (Wallen & Fraenkel, 2009). By looking at the Z-Scores, Group A exhibited slightly better performance on the assessments than Group B.

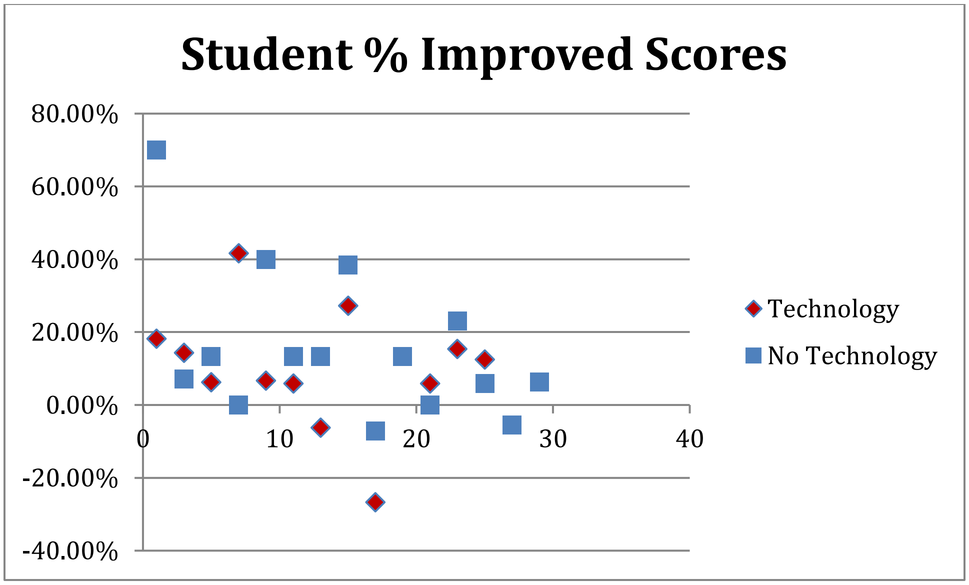


Figure 5: Distribution of Student % Improved Scores

After comparing the data shown in Tables 5 and 6, Figure 5 shows the distribution of the percent of improved scores for both groups. Most of the improved scores for both groups are within the center of the distribution indicating that just about equal number of students showed similar improved results in the assessment. Group A shows 6.67% of the students with a slight improvement, while Group B shows 13.33% of the students with slight gains in their post assessment scores. Out of 12 students, Group A had 10 students show an improvement in the posttest; 83% of the students made slight gains. Out of 15 students, Group B had 11 students show improvement in the posttest and two showed a slight decrease in scores; overall, 73% of the students made gains in Group B. Based on the post test results, digital storytelling technology using PBL did not have a great significant difference on test results. This small improvement could be the result of numerous factors including the short period available to complete the projects and that the students in Group A had to learn science and in some cases new technological tools and their mastery of new technology was not measured as a variable in this study. Table 7 depicts the variances between both the pre-test and posttest for both groups.

Table 7: Test Scores Comparison Both Groups

	Instruction Method	Number of students	Median Rank	Stand. Deviation
Pre-Test	Digital Technology (A)	12	83%	**0.1166**
	No Technology (B)	15	83%	**0.1248**
Posttest	Digital Technology (A)	12	89%	**0.1164**
	No Technology (B)	15	94%	**0.0753**
Variances	Digital Technology (A)		**0.0136**	**0.0135**
	No Technology (B)		**0.0156**	**0.0057**

Depending on the number of subjects and the amount of data collected, the distribution of data tends to have a normal distribution (Wallen & Fraenkel, 2009). Due to the small sample size tested in each group, and due to the study being evaluated with one assessment, the distribution curve is close to normal. Figure 5 shows the distribution of z-scores for the test improvement from the pretest to posttest. The scores tend to decrease in frequency the farther away from the middle, but due to the data being focused on one assessment, some scores were found outside of the middle distribution (Wallen & Fraenkel, 2009). The slight shift in curves between both groups of students, shown in Figure 5, demonstrated an insignificant improvement in test scores from those students implementing digital storytelling technology, Group A. The curve in Group A has a slight shift to the right. The data shows some gains in the test scores in Group A. There is one student in the group who's test result was an outlier in the data set. This student showed struggle both at the beginning and conclusion of study.

Projects and Science Journals

The projects and science journals were assessed based on rubrics obtained through the Buck Institute for Education. Only three of the components for each rubric were comparable: Time management, collaboration and meeting learning goals. Students were evaluated on the journals based on time management (completion), organization, collaboration, accountability and learning goals. Students in both classrooms were able to do the same hands-on activities, were able to learn the same standards and use the same daily layout in the science journal. The rubrics helped compare these components between Group A and Group B.

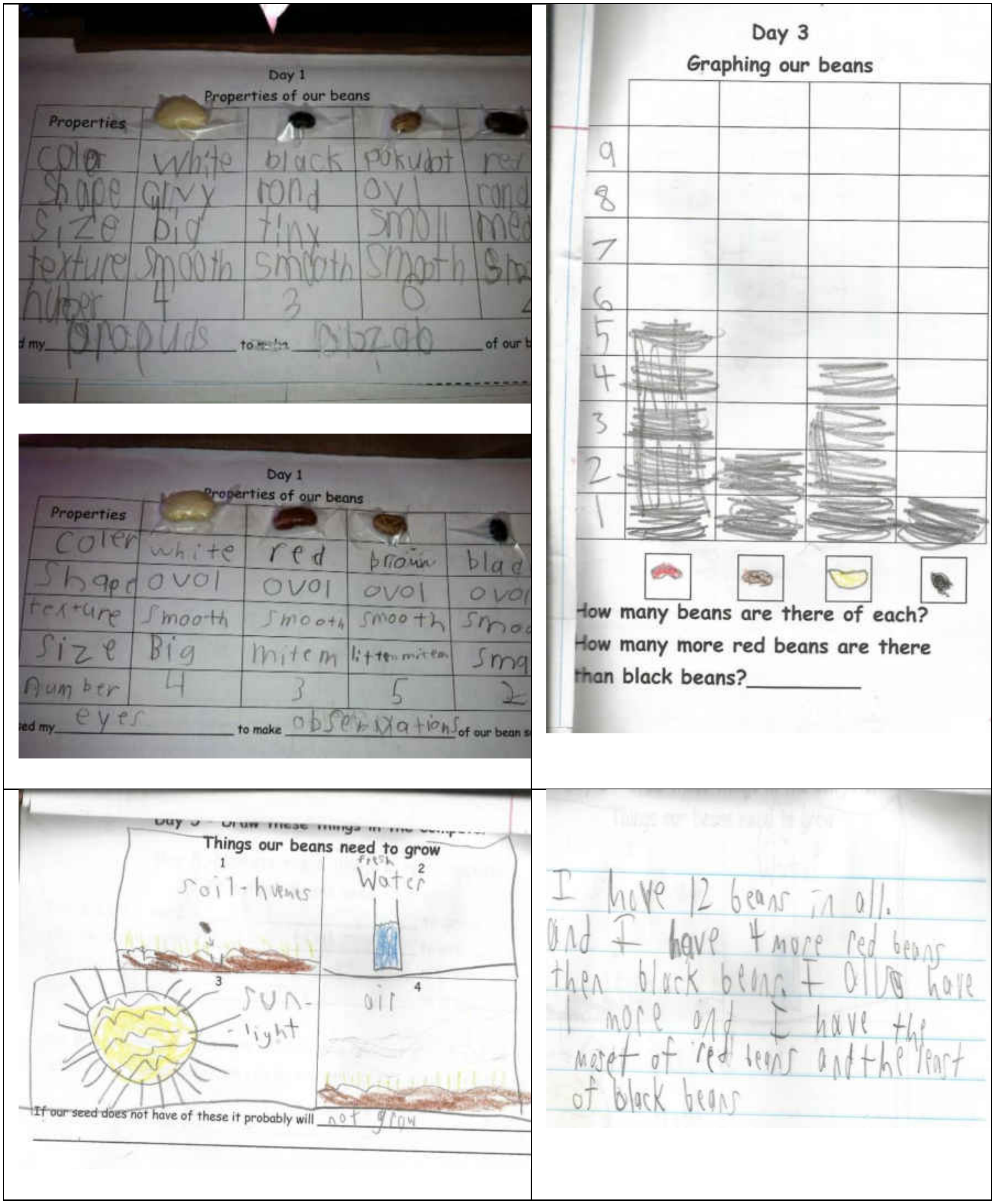


Figure 6: Student Journal Entries

In order to assist the young students in Group A, a template of the storyboard was created and students filled in the template using the data collected in their journals as a source of information. The results of the digital story are shown in Figure 8. This template was their tool to explain and elaborate on their findings, about the life cycles of beans (see Figure 8).

Figure 7: PBL Storyboard Sample

Table 8 shows the rubric results used for the digital stories, PBL, completed in Group A. The rubric was based on five components (Buck Institute for Education, 2012):

- Time management – Students needed to show proper use of time and completion of project.
- Collaboration – Students needed to show collaboration during creation of project and shared ideas.
- Delivery – Students needed to show proper use of voice and presentation for audience delivery.
- Creativity – Students needed to show creativity with creation of graphs, pictures and animations.
- Goals – Students needed to show in their presentation at least three of the learning goals listed on the rubric.

Table 8: PBL Rubric Group A

Student pseudo names	Time Management	Collaboration	Delivery	Creativity	Goals	Total Rubric Score out of 15
Nico	1	1	2	2	2	8
Rach	1	1	2	3	2	9
Mack	2	3	2	2	2	11
Ollie	2	2	3	2	2	11
Sophie	2	2	3	2	2	11
Chris	2	2	3	3	2	12
Jari	2	2	3	3	2	12
Nick	2	2	3	3	2	12
Perk	2	2	3	3	2	12
Ali	2	2	3	3	3	13
Jake	2	2	3	3	3	13
Kai	3	3	3	3	2	14
Mos	3	3	3	3	2	14
Average	**2**	**2.076**	**2.769**	**2.692**	**2.153**	**11.692**

Table 9: Science Journal Rubric Group B

Student pseudo names	Time Management	Collaboration	Organization	Clear Thoughts	Goals	Total Rubric Score out of 15
Cristin	2	2	2	2	1	9
Abriana	3	1	2	1	3	10
Arielle	2	2	2	2	2	10
Dalton	3	2	2	2	2	11
Elian	2	2	2	2	3	11
Colin	2	3	2	3	3	13
Ethan	2	3	3	2	3	13
Kamran	2	3	3	3	2	13
Amanda	2	3	3	3	3	14
Ashley	3	3	3	2	3	14
Jacob	3	3	3	2	3	14
Abi	3	3	3	3	3	15
Cassie	3	3	3	3	3	15
Joseph	3	3	3	3	3	15
Toryn	3	3	3	3	3	15
Average	**2.53**	**2.6**	**2.6**	**2.4**	**2.67**	**12.8**

The PBL and the science journals were assessed based on a modified rubric obtained through Buck Institute of Education (see Figure 7). The rubrics also helped evaluate the different components. Tables 8 and 9 show the rubric results used for Group A and Group B.

The average of three common criteria in both rubrics, the digital stories, PBL, rubric, and the science journals rubric are displayed in the bar graph in Figure 9. This graph shows a comparison in the results between both groups of students; Group A (with technology) and Group B (no technology).

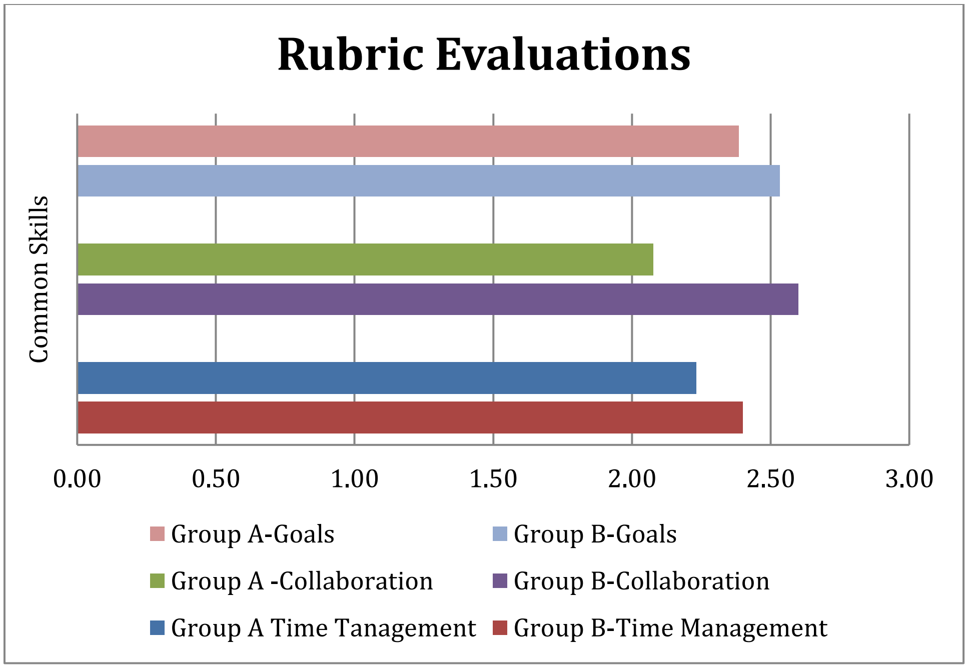


Figure 8: Rubric Evaluations Comparison Chart

The bar graph in Figure 9 shows the outcomes in the three common criteria assessed by both rubrics. In order to receive the maximum of three points in the rubrics, three learning goals had to be evident in the digital stories of Group A, and in the science journals of Group B. When analyzing the outcome of the learning goals, only 18% of the students in Group A had the opportunity to incorporate all three learning goals in the digital stories, this lowered the average score to 2.2 points. However, 73% of the students in Group B were able to demonstrate clearer evidence of all three learning goals into their final product, which earned a higher average score of 2.67 points. Collaboration in Group A showed an average score of 2.08 points, and Group B showed an average score of 2.6 points. Time management had lower average of two points in Group A, due to students trying to figure out the different software features. Students in Group A had difficulties trying to make quick choices when selecting animation features and spent unneeded time experimenting with the software, which inhibited the students' progress.

The student performance scale seen in Figure 10 exhibit student self-assessment. At the end of the week, students self-evaluated their performance using the scale progression shown in Table 3, in the Instrumentation section of this study. The results in Figure 10 indicate that most students felt they acquired key vocabulary words and foundational concepts with some degree of help. Most of the students felt they were able to obtain more complex concepts showing more enthusiasm to learn. Students in Group B showed a greater confidence in their performance at the end of each week.

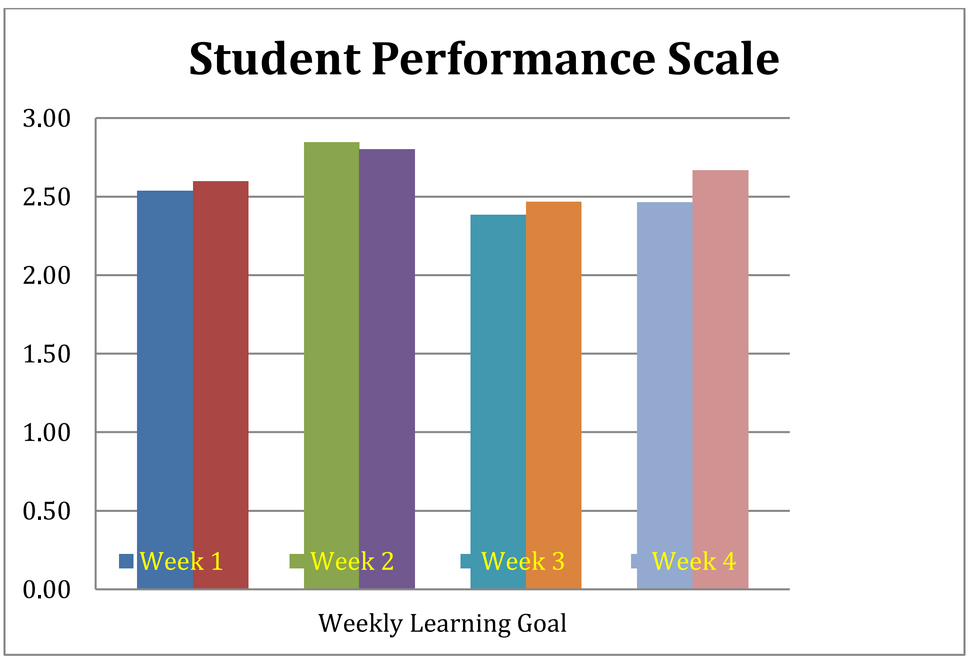


Figure 9: Student Performance Scale Bar Graph

The ideal ranking for students to fall on this scale is a score of 3. This scale identifies proficiency in the weekly learning goal. The gar graph indicates the learning goal on week two ranked the highest for both groups. Both groups were fairly confident in the learning goal of week two consisting of describing and identifying the basic needs of a plant. Students in both groups scored the lowest in week three consisting of a higher complexity standard that required students to clearly explain the changes in the life cycle of a bean.

Overall, the graphs show that the use of PBL with technology did not make a negative or positive impact compared to the control group. The reason for that equality in outcomes could relate to so many different variables, which will be discussed further in chapter 5. From this action-based research study, the use of PBL with technology was neutral in impact, but students did say they learned using technology and yet both groups enjoyed the projects and did learn.

CHAPTER FIVE: CONCLUSION

Introduction

From the beginning of this academic journey, the main goal was to grow as an educator and find effective strategies to deliver instruction when teaching higher-order thinking science standards. Through two randomly assigned groups of second-grade students, the final data in this study measured the effectiveness of digital storytelling technology through PBL on higher-order thinking life science standards. The methodology included a description of the limitations, research design, setting, participants, instruments, procedures, data collection, and analyses. The purpose was to understand from a teacher perspective if digital storytelling technology through the use of PBL would help students improve their understanding of higher-order thinking standards. The question that drove this research was:

1. What effect does digital storytelling technology have, when embedded in PBL, on improving second-grade students' mastery of higher-order thinking science standards?

Discussion

Based on the experience obtained in the study PBL is, in fact, a constructivist and a "learning by doing" approach. Students were able to construct their own knowledge through the exploration of the planned life science standards and students were able to develop their own thinking in communicating their results through the use of digital storytelling technology. During the course of this study, the role of a teacher was to guide, monitor, and support student learning in all of the activities of PBL. Through the experience of this study, it was evident that the digital stories created by the students allowed them to explore their thoughts and utilize a new method to present their findings. One positive outcome not captured by the data collected was many of the quiet students liked to narrate concepts without having to speak out in front of their classmates. This provided an opportunity for students to participate who usually remained quiet in class. The results for implementing PBL may have been slim, but the creativity of the digital stories created by the students in Group A, served as evidence to demonstrate their comfortability in working with digital technology.

The results of the study showed students in both groups benefited in some way from receiving additional science support during this 11-week investigation. I found that PBL required careful planning time, organization and classroom time to elaborate on the process. Collaboration played a big part when implementing PBL. Vygotsky's (1978) theories, based on the importance of children's social interaction in their development, support the premise of PBL. Although social interactions are evolving at a young age, the students in Group A struggled with their collaborative efforts, and it was more difficult for them to come to a consensus and quick decision making. This finding reveals that PBL requires a little more maturity in collaboration skills. As scaffolding continues during the year, and children mature, these students will eventually grow to interact with their peers. This would make PBL more effective as students learn more about digital storytelling technology and gain more experience with the process.

Undoubtedly, the study was a rewarding experience, and the results showed some student gains, it is my belief the gains would have been greater had the students been afforded additional time. The data collected demonstrated some improvement in higher-order thinking science standards but not as significant of a difference that might have occurred if appropriate classroom time had been allotted to the PBL activities. The children became mesmerized with digital storytelling and fascinated with the newness. The exhilarating experience of a new form of technology plus the student time involved in learning the use of the digital tool was not accounted for. The children needed to overcome the newness of the digital tools. Teaching the use of the software prior to the study also may have impacted the outcome and caused time to run out. The experience of conducting the study gave me the capability of reflecting on a few of the many variables that could have been better documented, and analyzed, by using pre and post surveys, additional self-evaluation scales, and interviews. Additional formative assessments would have been advantageous to further show that students could in fact explain and elaborate their scientific thinking through digital stories, and as a result of the enhanced PBL component, versus the additional science instruction. Also using the measure of a paper-pencil test, may not have reflected the type of learning that occurred in PBL.

Considering the evidence collected and gained experiences, things that could be changed in the study are allocating more time when conducting a study using PBL. In this study, PBL did not greatly enhance the learning in my hands-on science instruction, instead the additional learning time in the science enrichment was more significant, because Group B had a positive and similar results to those results of Group A. The reason for these lack of changes and potential variance in time should be considered in any future studies to be conducted.

Another factor that could have benefited the results was the opportunity of conducting the study in the established science enrichment classroom, allowing the student sample to work under the established science classroom culture, science classroom management, and science classroom routines. In view the winds of change swiftly moved into our school, the science program began the process of being terminated. Fortunately, the student sample was preserved and pushing into two established classrooms helped obtain data from students that were familiar to the science program. Even if the same student sample participated in the study the challenge for the young students to adapt a different teaching style and disrupt their flow of instruction.

Future Use of Digital Technology Through PBL

In order to understand digital storytelling technology and PBL, teachers need to implement different software tools and establish collaborative strategies. Understanding the effectiveness of digital technology requires a focus on the curriculum and the students' learning goals. To do this, teachers should have a clear understanding on how to use digital storytelling technology to enhance teaching and student engagement. Science educators must try to be open and willing to adapt to instruction and use alternative methods.

Science instruction can present curriculum challenges. Implementing inquiry in an elementary classroom can be challenging and even more so in earlier grade levels. Adding digital technology to deliver instruction requires more teacher planning and additional classroom time to teach the students; but, when done right, it stimulates students' learning. Through this study, in order to embrace digital technology in any subject area, the culture school had to shift to become more implementation based. The previous principal urged the use of additional time for science and hands-on instruction; unfortunately, the recent principal had no choice but to cut the science program. Time is limited in many of classrooms and yet teachers are required to find ways to integrate various methods of technology into their classrooms without additional time. The technology facilitator in my school has been able to introduce teachers on how to use new applications, while it has been a challenge to learn how to bring that type of instruction into cross-content instruction. Because my school has been driven by digital technology, all classroom teachers have the opportunity to evaluate students differently, yet that skill set varies by teachers and classrooms. Furthermore, because of this rich technology access and implementation philosophy my school has the ability to implement PBL, whereas other schools may not, but the most effective approach from this study is one we are still trying to figure out in our daily instruction.

I feel from this study, school culture is an essential component to use PBL, and I still believe the use of technology is the key. I found from observation that students in Group A struggled with student time management during the project. Because of their young age, students in this group were not looking for an effective approach to create their movies and had limited skills with this aspect of PBL. The main objective was to communicate their scientific thoughts and ideas; however, the many different tools and features of the software proved to be a distraction for some students from the main learning goal. The students seemed to easily navigate the tools in the software but choices of what to produce in their movie were difficult to make between peers. Collaboration was also a struggle for students at this young age.

As a teacher, I have been exposed to many professional development opportunities to integrate technology with a purpose, and finding ways to formally assess technology projects is not simple. With the pressure of accountability, PBL assessments needs to be aligned with high stakes assessments and evolving standards to emerging and accepted practice in the classroom. The future of PBL with technology integration needs richer assessment tools. In this study more sensitive and further developed technology rubrics could have been used to add a layer of evaluation of the students' learning of technology skills. Other skills also are a component of PBL, such as 21st century learning skills or college and career standards, that could also assessed through additional PBL developed rubrics. The students in this study were only measured on their gains in science standards, but they also may have acquired 21st century skills and technological skills, which could have detracted or enriched their science knowledge. This more robust assessment is a component that should be considered in future research on PBL and the use of digital technology in teaching science standards.

Researchers such as Wenglinsky, Grant and SRI International have stated the negative outcomes of PBL and one negative component is the time-consuming teaching approach and unfortunately our educational environment limits the time teachers have to properly plan for an effective detailed PBL lesson. Even though digital technology is often embedded into general lessons, most complex digital projects can be led by school technology facilitators, and can be implemented after state-wide standardized testing. Technology through PBL is a gamble for some teachers, and many do not want to take a chance by giving up precious class time for an extended project because of the pressure of student performance on standardized assessments. If time is embedded within the school day, even once a week, to increase knowledge and engagement of students in real world applications this seems like a valuable use of time. This time could even be through after school academic clubs as a way to further use PBL. After school programs could create digital technology clubs to offer students the chance to freely engage in creativity within science content. Students could communicate their science thinking in this clubs through an array of digital tools and software. These school clubs could offer a solution to the stress of the very limited academic time of teachers to enrich science instruction through PBL during the academic year. Clubs could offer an alternative to incorporate this methodology into routine instruction .

As a teacher, this study revealed how much young students can learn in science through discovery and the use of technology. Technology integration in our school is part of the classroom, and as a teacher I will continuously find ways to enhance my curriculum. Although this study did not show PBL as making a significant impact in mastering higher-order thinking science standards, it did show students who used technology went above and beyond the use of old-fashioned textbook instruction and were able to still learn the same concepts.

Recommendations

When using any technology tool within the curriculum, it is extremely important for teachers to seek quality professional development and find alternative ways for students to communicate scientific findings and thoughts. As a teacher, I found the digital technology integration in my study was an exhilarating experience. Students were engaged and students were connected with their learning. Not only do teachers need to receive proper training, but also it is important to keep up to date with new evolving technology. When using any type technology in the classroom, it is also important to guide students and for the teacher to take on the role of a facilitator; allowing the curriculum to guide student learning rather than allowing technology to override the curriculum. Technology should simply be a tool aligned to student learning goals.

A recommended technology project is digital storytelling. There are various digital story telling software and selecting an ideal user-friendly software is key. Teachers should consider using digital story software aligned with a PBL project model, but to remember this process is time consuming; however, it was a great project for the introverted children and for the children who had difficulty expressing themselves. Finding the ideal digital story software for my classroom helped my students provide a voice in their creative diagrams. This tool encouraged my students to plan, draft, and correct errors in their thinking. Digital story is an effective technology tool as it encourages student thinking and student problem solving skills. It is important to use a criteria detailed rubric when assessing this project, such as creativity, collaboration, etc. The use of this digital technology allowed my students to record voice-overs and narrate their scientific findings. The students thoroughly enjoyed listening to themselves and learned from each other's narrations. I would recommend other teachers use this tool with their science instruction and PBL activities. However, consider first teaching students how to use the tool prior to using for a PBL content assessment.

When using digital storytelling as a technology tool, students need time to properly learn and plan to use the tools effectively. Teachers should search for grade, skill and age appropriate planning worksheets to support students and they should create a rough draft outline on the computer or on paper prior to completing a final digital product. Prior to students executing a digital story, teachers should allow students time to plan out their digital stories.

In my opinion, PBL should be part of elementary instruction integrate into the curriculum. Not all of the curriculum lends itself to PBL; however, when implemented it will create more active learners while students do their own research. The PBL model requires good classroom management and established daily procedures. Cooperative learning is a classroom culture that needs to be set prior to incorporating small group projects. Student collaboration is an important factor for PBL so creating a climate for student collective learning is important. Teachers trying PBL for the first time need to know that it does require time for planning and execution, but in the end, it is a learning experience for both teachers and students.

For future research, when conducting an investigation using PBL ample time is needed to plan, prepare, and execute an effective project (Intel, 1997). While the data collected in this study showed minor improvements affecting higher-order thinking science standards, the lack of time to collect more data and extend the lesson prevented the PBL from being fully tested. In future studies, data should be augmented and analyzed by using additional assessments such as pre and post surveys, additional self-evaluation scales, and interviews in order to have a better assessment of different learning outcomes that might emerge from PBL. Additional time to further expand the projects and collect data would have been advantageous in this study to measure further improvement in students' performance in these higher-order thinking science standards. Data collected on attitude surveys was needed to compare the attitudes in learning from both groups of students and would have given a better overview on how students felt about PBL and their learning.

What I have learned in using PBL is children are naturally curious and have an urge to try to find the "why" of their surroundings. Science, when taught to an appropriate age level, engages children through discovery. During my experience teaching science, I have found that children thrive using hands-on activities. As children mature and are continuously exposed to science through hands-on activities and technology, I believe they will begin to make sense of their understanding of science and have value in their 21st century world.

APPENDIX A:
UCF IRB LETTER AND FORMS

University of Central Florida Institutional Review Board
Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, Florida 32826-3246
Telephone: 407-823-2901 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

Approval of Exempt Human Research

From: **UCF Institutional Review Board #1**
FWA00000351, IRB00001138

To: **Mariella M Dorr**

Date: **April 30, 2012**

Dear Researcher:

On 4/30/2012, the IRB approved the following activity as human participant research that is exempt from regulation:

Type of Review:	UCF Initial Review Submission Form
Project Title:	Effectiveness of Project-Based Learning on Second Grade Students' Performance in Complex Science Standards
Investigator:	[redacted] Dorr
IRB Number:	SBE-12-08203
Funding Agency:	None

***NOTE: Please secure approval from the [redacted] School District before beginning this research study.**

This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made and there are questions about whether these changes affect the exempt status of the human research, please contact the IRB. When you have completed your research, please submit a Study Closure request in iRIS so that IRB records will be accurate.

In the conduct of this research, you are responsible to follow the requirements of the Investigator Manual.

On behalf of Sophia Dziegielewski, Ph.D., L.C.S.W., UCF IRB Chair, this letter is signed by:

Signature applied by Janice Turchin on 04/30/2012 02:17:58 PM EDT

IRB Coordinator

May 29, 2012

Ms. Mariella Dorr

Dear Ms. Dorr,

I am in receipt of the proposal and supplemental information that you submitted for permission to conduct research in the Schools. After review of these documents, it has been determined that you are granted permission to conduct the study described in these documents under the conditions described herein.

Your school principal has the authority to decide if he/she wishes to participate in your study. Therefore, your first order of business is to contact the new principal and explain your project and seek permission to conduct the research. You are expected to make appointments in advance to accommodate the administration and/or staff for research time. Please do not use or courier mail to disseminate your research information.

Please forward a summary of your project to my office upon completion. Good Luck!

Sincerely,

Anna-Marie Cote

January 19, 2012

To Whom It May Concern:

I have received a copy of the abstract for Mariela Dorr's thesis entitled "[illegible] Effectiveness of Project Based Learning of Complex Science Standards". She is proposing this study for the fall of 2012 through her Master's program at University of Central Florida. I am very pleased to endorse and recommend approval of this study in two of her second grade classrooms at next year.

Mrs. Dorr has been recognized repeatedly by her peers and an exemplary teacher. Her ability to motivate and excite children through investigation and inquiry is evidenced on a daily basis. Students gather in the early morning and present their independent findings or observations on a public board. Students' confidence in their scientific understanding has soared since we added her Science class to our special rotation. It is no wonder Mrs. Dorr has been honored to be selected as a [illegible] Teacher of the Year.

If Mrs. Dorr's thesis proposal is approved for next year I am confident the students will prove that project based inquiry is rigorous but most engaging. It is a fact that this form of planning and instruction is most relevant and vital in our classrooms. Previous experience with projects will enable this teacher to formulate a powerful unit of study. I know the students will reap the benefits!

If I can be of further assistance in the process of approval, please feel free to contact me.

Respectfully,

Child Assent

Good morning class! You probably don't know that I go to school, too. I attend the University of Central Florida. I go to school at night and during my summer break. While you are in my class this year, I will be working on a research project. The only difference in our class will be every Monday we will take a test to see how much you know about Earth Science. In order to see how much we learned during our week, every Friday we will take another test just to see how much more we learned about Earth Science. We will write in our journals like we always have in order to show how much you know learn about science. (Group #1) You will be using cameras, laptops or we will be visiting the computer lab. You will be creating a digital movie about what you learned about rocks and soil. (Group #2) You will be using lots of our science materials and writing down what you learn in your journals. You may continue to do our science activities and choose not to do the tests on Monday and Friday; however it will be great to see how much we learn and grow. Would you like to do this?

September 23, 2012

Dear Parents/Guardians:

I am a graduate student at the University of Central Florida under the supervision of faculty member, Dr. Robert Everett, conducting research on the effects of Project-Based Learning in the performance of high and moderate cognitive level science standards. The purpose of this study is to asses if students perform better using technology integration when addressing high and moderate cognitive standards as a part of their science enrichment instruction.

This letter is to simply inform you, your student will be introduced to life science and nature of science standards integrating technology and hands-on instructional strategies. Students will keep journals that will contain their daily thoughts and feelings regarding their conclusions and findings in their daily experiences with the science curriculum. The study will be conducted inside their regular classroom using the last thirty minutes of the day. During the last thirty minutes of the day I will bring all necessary materials for your child to conduct an enriching science investigation. Students are regularly scheduled reading activities which will be part of their science investigation. Their classroom curriculum will not be affected. The research will not take any time from the main subject areas. Also, students and parents will not be provided additional responsibilities to complete at home.

The purpose of this research is to enhance the science program at Layer Elementary. This special area enrichment program will continue to provide enrichment to your child; therefore, no grades will be reflected on report cards. Hence, the activities in this study will not receive formal grading your child will not be affected by their performance in the assessments.

As part of my study, I will be asking your child to complete a Pre and Post-Test, regarding what they have learned. I also plan to analyze their journal entries for the purposes of my research. Although the children will be asked to write their names on their work, their identity will be kept confidential to the extent provided by law. Pseudonyms or coding will be used in all research reports.

Your student's grades on the assessments and the tasks will be gathered for statistical purposes only. Participation or nonparticipation in this study will not affect your child's grades in any way. Your child can opt out to do the assessments without penalty and continue doing the engaging science activities. I appreciate your continuous support in enhancing your child's science instruction.

If you have any questions about this research project, please contact me at (407) 871-8063 or my faculty supervisor, Dr. Everett at (407) 823-5788. Questions or concerns about the research participants' rights may be directed to the UCF-IRB department, University of Central Florida Office of Research, Orlando Tech Center, 12443 Research Parkway, #302, Orlando, FL 32826. The phone number is (407) 823-2901.

Sincerely,

Mrs. Mariella Dorr

University of Central Florida	***Human Research Protocol Template*** IRB Template Version Date 11/19/2010

1) Protocol Title
Effectiveness of Project-Based Learning on Second Grade Students' Performance in Complex Science Standards

2) Investigator(s)

Mariella Dorr

3) Objectives
How effective is Project-Based Learning in increasing 2nd grade students' performance in complex science standards?

Objective of research is to measure the effectiveness of student performance using medium and high complexity standards.

Objective: To implement technology through digital story for students to communicate the learning process of three Earth Science complex standards.

4) Background

As a standard driven school, like many in our district, our school strives to seek for teaching methods that help our students achieve performance. Our new science state standards have changed and are classified based on a Depth of Knowledge/Cognitive Complexity (Web Alignment Tool, 2005). The recently adapted science state standards are based on cognitive levels of knowledge by Norman Webb in order to "ensure the standards and the level of student demonstration required by that standard matches the assessment items" (Sibley and Marconi, 2008). In the United States transmission style teaching in science classrooms produces lower level cognitive thinking in students as well as a dislike for science (Beasley 2006). Based on our science instructional pacing guide most of our standards are categorized as moderate to high complexity. Fewer

University of Central Florida

Summary Explanation for Exempt Research

EXPLANATION OF RESEARCH

Title of Project: Effectiveness of Project-Based Learning on Second Grade Students' Performance in Complex Science Standards

Principal Investigator: Mariella Dorr

Other Investigators: None

Faculty Supervisor: Dr. Robert Everett
Your child is being invited to take part in a research study. Whether you want to share the data of the assessments is up to you.

How does Project-Based Learning improve student performance in complex science standards in my second grade students? This comparative action research thesis will investigate how Project-Based Learning can improve the performance of two second grade classrooms with three complex Earth science standards. The subjects in the study are two different second grade classes each consisting of approximately twenty students.

In this action research, the science curriculum will continue to remain the same and guided by the science standards. As you know, the purpose of the science enrichment program has been to provide additional support to your child and will continue NOT assign any grades to your child's report card. The science grade you see in your child's report card is assigned by the home base teacher. The enrichment program has been incorporated as part of the special areas rotation which consists of Art, Music, Physical Education and now for the sixth year it includes Science. The regular science enrichment program will not be affected and will continue to provide support. The pre-test and post-test given to the students will not be recorded in the grade book and will be evaluated just for data purposes. The assessments and

Use for a final report to close a study.

General Study Information:

Study Name
Effectiveness of Technology Integration on Second Grade Students' Performance in Complex Science Standards
Investigator Name
Mariella M Dorr

Study Information:

Today's Date
02/07/2013
IRB Number
SBE-12-08203
Research ID Number
N/A

Enrollment Statistics

Enrollment Statistics

Total number of participants enrolled:

If no gender information collected, leave male/femal boxes blank

	*Since Activation	*Since Last Approval	Male	Female
Total locally:	28	28	16	12
Total all sites:	28	28	16	12

Total number of participants enrolled locally by ethnic origin since activation of the study:

Investigators will need to monitor these numbers if they are conducting VA research, or if required by the IRB. Otherwise, enter the number in "Other/Unknown."

Caucasian	Black	Hispanic	Asian Pacific Islander	American Indian Alaska Native	Other Unknown
					28

Total number of participants enrolled locally by vulnerable populations.

Children	Prisoners	Fetuses	Cognitively Impaired	Students/Employees	Other
28					

Financial Interest Declaration

- "Financial Interest Related to the Research" means any of the following interests in the sponsor, product or service being tested, or competitor of the sponsor held by research personnel or their immediate family
- "Research Personnel" means any individuals involved in the research i.e. investigators, research associates/staff, study coordinators, lab monitors.

University of Central Florida

University of Central Florida Institutional Review Board
Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, Florida 32826-3246
Telephone: 407-823-2901, 407-882-2012 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

Acknowledgment of Study Closure

From : **UCF Institutional Review Board #1**
FWA00000351, IRB00001138

To : **Mariella M. Dorr**

Date : **February 11, 2013**

Dear Researcher:

On 2/11/2013 the IRB conducted an administrative review of the FORM: Study Closure Request that you submitted in iRIS. The study has been closed within the system.

This report is in regards to:

Type of Review:	Study Closure
Project Title:	Effectiveness of Technology Integration on Second Grade Students' Performance in Complex Science Standards
Investigator:	Mariella M Dorr
IRB Number:	SBE-12-08203
Funding Agency:	
Grant Title:	
Research ID:	N/A

As part of this action:

- The research is permanently closed to enrollment.
- All participants have completed all research-related interventions.
- Collection of private identifiable information is completed.
- Analysis of private identifiable information is completed.

Thank you for notifying the IRB of this modification.

On behalf of Sophia Dziegielewski, Ph.D., L.C.S.W., UCF IRB Chair, this letter is signed by:

Signature applied by Joanne Muratori on 02/11/2013 09:40:14 AM EST

Joanne Muratori

IRB Coordinator

Submission Reference Number: 016720

APPENDIX B:
ASSESSMENTS USED

Name: ________________________ Class: ___________________ Date: __________

Pre-Assessment
Life Science

Multiple Choice

Identify the choice that best completes the statement or answers the question.

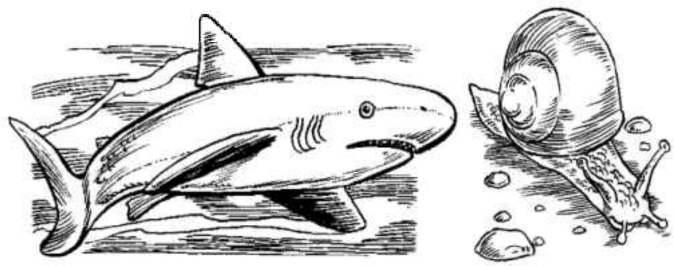
____ 1. Why do animals need shelter?

A. to get food

B. to get water

C. to stay safe

_____2. What do these animals need to live?



A. food

B. soil

C. sunlight

____ 3. Which of these can a bird use to meet its needs for both food and shelter?

A. an insect

B. a rock

C. a tree

____4. What can you observe about a bean seed by using a hand lens?

A. the shape of the bean seed

B. the way the bean seed feels

C.the way the bean seed smells

____ 5. Andrea planted a bean seed and kept it in a warm, light environment. She planted another bean seed and kept it in a cold, dark environment. Which bean seed will most likely grow better?

A. The bean seed in the warm, light environment will grow better.

B.The bean seed in the cold, dark environment will grow better.

C. Both bean seeds will grow the same way.

____ 6. What is a seedling?

A. a young plant

B. the part of a plant that makes fruit

C. the part of a plant that grows into a new plant

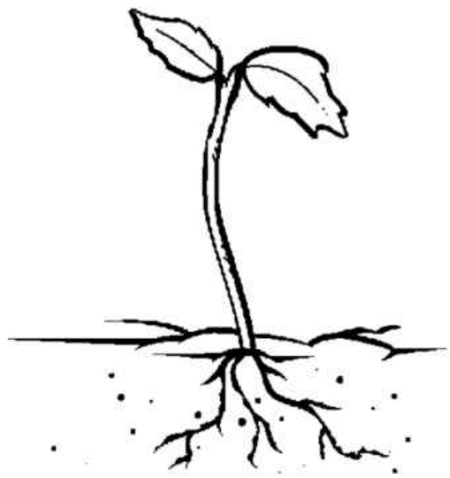
____ 7. Which part of a plant holds seeds?

A. a fruit

B. a leaf

C. a stem

____ 8. Which part of a plant's life cycle is shown?

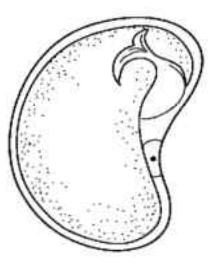


A. adult plant

B. seed

C. seedling

____ 9. Which part of a plant's life cycle is shown?



A. adult

B seed

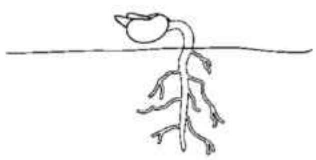
C seedling

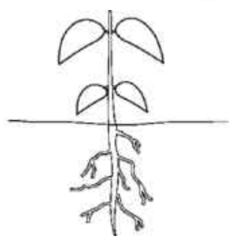
____ 10. What happens at the beginning of a plant's life cycle?

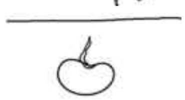
A. The plant dies.
B. The seed germinates.
C. The plant grows flowers.

____ 11. Three bean seeds were planted at the same time.

Which one grew **most** slowly?

A. 

B. 

C. 

____12. What does a plant need from soil?

A. earthworms
B. nutrients
C. rocks

____ 13. What is something a plant needs to survive?

A. nutrients
B. people
C. wind

____ 14. Where do plants get most of the nutrients they need to live?

A. from air
B. from soil
C. from sunlight

____ 15. Which of these living things needs air and water to live?

A. only the bird
B. only the plant
C. both the bird and the plant

____ 16. How do plants get the food they need to survive?

A. Plants do not need food to live.
B. Plants eat food like animals do.
C. Plants use sunlight to make their own food.

____ 17. What can you infer about a plant that gets light, water, and warmth?

A. It will grow well.
B. It will not grow well.
C. It will die.

____ 18. Gabriel is looking at this plant in his backyard.

He knows it is an adult plant. How does he know?

A. The plant has leaves.
B. The plant has a flower.
C. The plant has a stem.

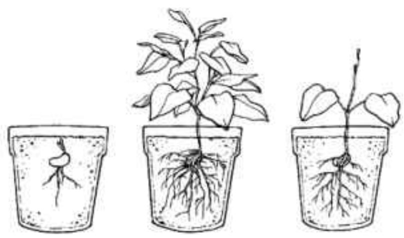
____ 19. Which is something you can observe with your senses alone?

A. Bean plants need water to grow.

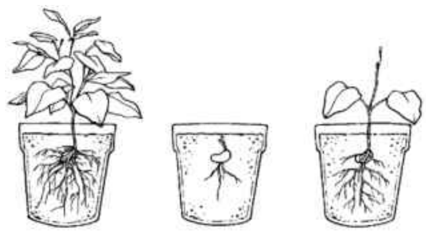
B. Bean plants need sunlight to grow.

C. Bean plants have green leaves.

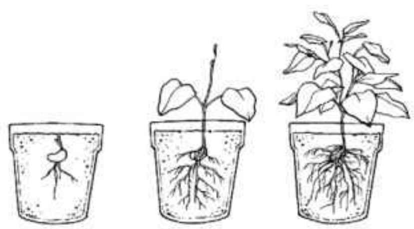
____ 20. Which shows the correct order of the life cycle of a bean plant?



A



B



C

LIFE SCIENCE ANSWER SHEET

MULTIPLE CHOICE

1. ANS: C

Answer A is incorrect because animals do not use their shelters to get food.
Answer B is incorrect because animals do not use their shelters to get water.
Answer C is correct because shelters protect animals from harm and keep them safe.

DIF: Moderate | Webb Rating: 2 | Bloom's Traditional: Comprehension | Bloom's 2.L.17.1

2. ANS: A

Answer A is correct because all animals need food to live.
Answer B is incorrect because soil is not a basic need of animals.
Answer C is incorrect because sunlight is not a basic need of animals.

DIF: Moderate | Webb Rating: 2 | Bloom's Traditional: Analysis | Bloom's Revised: 2.L.17.1

3. ANS: C

Answer A is incorrect because a bird cannot use an insect for shelter.
Answer B is incorrect because a bird cannot use a rock for food.
Answer C is correct because a bird can eat fruit or insects from a tree. It can make a nest or live in a hole in a tree.

DIF: Moderate | Webb Rating: 2 | Bloom's Traditional: Analysis | Bloom's Revised: 2.L.17.1

4. ANS: A

Answer A is correct because shape is something you can observe with a hand lens.
Answers B is incorrect because touch is not something you can observe with a hand lens.
Answer C is incorrect because smell is not something you can observe with a hand lens.

DIF: Moderate | Webb Rating: 2 | Bloom's Traditional: Comprehension | Bloom's : 2.L.16.1 |

5. ANS: A

Answer A is correct because bean seeds need warmth and light to germinate and grow.
Answer B is incorrect because bean seeds need warmth and light to germinate and grow.
Answer C is incorrect because the bean seed in the warm, light environment will probably grow better than the bean seed in the cold, dark environment.

DIF: High | Webb Rating: 3 | Bloom's EvaL| Bloom's Revised: .2.L.16.1 |SC.2.N.1.1

6. ANS: A

Answer A is correct because a seedling is a young plant.
Answer B is incorrect because a seedling is a young plant. The flower is the plant part that makes fruit.
Answer C is incorrect because a seedling is a young plant. The seed is the plant part that grows into a new plant.

DIF: Low | Webb Rating: 1 | Bloom's Traditional: Knowledge | Bloom's Revised:2.L.16.1

7. ANS: A

Answer A is correct because the fruit holds the seeds.
Answer B is incorrect because a leaf does not hold seeds. It makes food for the plant.
Answer C is incorrect because a stem does not hold the seeds. It carries water and nutrients from the roots to the leaves.

DIF: Low | Webb Rating: 1 | Bloom's Traditional: Knowledge | Bloom's Revised: .2.L.16.1

8. ANS: C

Answer A is incorrect because the picture shows a seedling, not an adult plant.
Answer B is incorrect because the picture shows a seedling, not a seed.
Answer C is correct because the picture shows a seedling.

DIF: Moderate | Webb Rating: 2 | Bloom's Traditional: Comprehension | Bloom's 2.L.16.1

9. ANS: B

Answer A is incorrect because the picture shows a seed, not an adult plant.
Answer B is correct because the picture shows a seed.
Answer C is incorrect because the picture shows a seed, not a seedling.

DIF: Low | Webb Rating: 2 | Bloom's Traditional: Comprehension | Bloom's Revised:

2.L.16.1

10. ANS: B

Answer A is incorrect because a plant dies at the end of its life cycle.
Answer B is correct because the seed germinates at the beginning of a plant’s life cycle. Answer C is incorrect because a plant grows flowers when it is an adult plant.

DIF: Low | Webb Rating: 1 | Bloom's Traditional: Comprehension | Bloom's Revised:

2.L.16.1

11. ANS: C

Answer A is incorrect because the picture shows a seedling. Answer C shows a picture of a germinating seed. The seed in Answer C grew more slowly than the seed in Answer A.
Answer B is incorrect because the plant is taller and has more leaves than the other two. It grew fastest.
Answer C is correct because the seed has just germinated. It is growing more slowly than the other two seeds, which have roots and have broken through the soil.

DIF: Moderate | Webb Rating: 3 | Bloom's Traditional: Analysis | Bloom's Revised: 2.L.16.1

12. ANS: B

Answer A is incorrect because earthworms are not basic needs of plants.

Answer B is correct because nutrients help plants grow.
Answer C is incorrect because rocks are not basic needs of plants.
DIF: Low | Webb Rating: 1 | Bloom's Traditional: Knowledge | Bloom's Revised: 2.L.17.1

13. ANS: A
Answer A is correct because nutrients help a plant live and grow.
Answer B is incorrect because people are not one of the basic needs of plants.
Answer C is incorrect because wind is not one of the basic needs of plants.
DIF: Moderate | Webb Rating: 1 | Bloom's Traditional: Knowledge | Bloom's Revised:

2.L.17.1

14. ANS: B
Answer A is incorrect because air does not have the nutrients a plant needs to live.
Answer B is correct because soil has nutrients a plant needs to live.
Answer C is incorrect because sunlight does not have the nutrients a plant needs to live.
DIF: Moderate | Webb Rating: 1 | Bloom's Traditional: Comprehension | Bloom's 2.L.17.1

15. ANS: C
Answer A is incorrect because it is incomplete. Both the bird and the plant need air and water to live.
Answer B is incorrect because it is incomplete. Both the bird and the plant need air and water to live.
Answer C is correct because both plants and animals need air and water to live.
DIF: Moderate | Webb Rating: 2 | Bloom's Traditional: Application | Bloom's Revised:

2.L.17.1

16. ANS: C
Answer A is incorrect because plants need food for energy to survive and grow.
Answer B is incorrect because plants do not eat food like animals do. Plants make their own food.
Answer C is correct because sunlight helps a plant make food for energy.
DIF: Moderate | Webb Rating: 2 | Bloom's Traditional: Comprehension | Bloom's 2.L.17.1

17. ANS: A
Answer A is correct because a plant that gets light, water, and warmth should grow well. Answer B is incorrect because a plant that gets light, water, and warmth should grow well.
Answer C is incorrect because a plant that gets light, water, and warmth should grow well.

DIF: Moderate | Webb Rating: 2 | Bloom's Traditional: Analysis | Bloom's Revised: 2.L.16.1

| SC.2.N.1.1

18. ANS: B

    Answer A is incorrect because both young plants and adult plants can have leaves.
    Answer B is correct because only adult plants can grow flowers.
    Answer C is incorrect because both young plants and adult plants have stems.

DIF: Moderate | Webb Rating: 3 | Bloom's Trad Application | Bloom's Revised: 2.L.16.1

19. ANS: C

Answer A is incorrect because it is an idea you can infer from observations.
Answer B is incorrect because it is an idea you can infer from observations.
Answer C is correct because it is an observation you can make with your senses alone.

DIF: Moderate | Webb Rating: 2 | Bloom's Traditional: Comprehension | Bloom's 2.L.16.1 |

20. ANS: C

Answer A is incorrect because it shows a seed germinating, an adult plant, and a seedling. This is not the correct order of the life cycle of a plant.
Answer B is incorrect because it shows an adult plant, a seed germinating, and a seedling. This is not the correct order of the life cycle of a plant.
Answer C is correct because it shows a seed germinating, a seedling, and an adult plant. This is the correct order of the life cycle of a plant.

DIF: Moderate | Webb Rating: 3 | Bloom's Traditional: Analysis | Bloom's Revised: 2.L.16.1

WEEKLY LEARNING SCALE

Vocabulary: reproduce, life cycle, seed, germinate, seedling, science tools, investigate, hypothesis, communicate.	
Week 1 **Learning Goal:** Evidence you explored parts of the bean and the changes of your bean with your teammate.	
Scale	**Learning Goal**
4	I am an advanced scientist that is able to think, plan an experiment, grow different beans and know how to compare each one.
3	I am an independent scientist that knows all of the vocabulary we learned, is able to observe the growth of my bean, explore my bean, and come up with good explanations on the changes of my bean.
2	I am a simple scientist that knows the vocabulary we learned, is able to observe the growth of my bean and explore my bean, but I could not explain why my bean changed.
1	I am a dependant scientist needing help learning the vocabulary, finding out how to observe the growth of my bean and how to explore it. I had to work with my shoulder partner to come up with good explanations on the changes of my bean.
0	I am not a scientist because with help I was not able to learn the vocabulary, I did not understand how to observe my growing bean and I could not explain the changes in my bean.

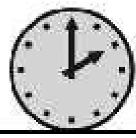
Where do the beans from our soup come from?

Group A – Project-Based Learning Rubric

Your science story should show these learning goals:

- Evidence you explored a part of the bean with your teammate
- Describe the life cycle of a bean
- Show the basic needs your bean needs to grow
- BONUS: Draw a picture or graph to represent the different types of beans

The team worked on time.



1. still learning 2. sometimes 3. almost always

The team was helpful to each other, showing and sharing ideas.

1. still learning 2. sometimes 3. almost always

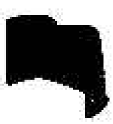
The team spoke with clear voices.

1. still learning 2. sometimes 3. almost always

The team showed creative drawings.

1. still learning 2. sometimes 3. almost always

The team showed three important learning goals.



1. One goal 2. two goals 3. all goals

The team showed the bonus learning goal.

1. One bonus goal point

Total:

Possible: 15

Adopted from BIE: http://www.bie.org/tools/freebies/k-2_teamwork_rubric

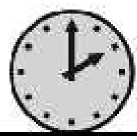
Where do the beans from our soup come from?

Group B – Hands-on learning Rubric

Your science journal should show these learning goals:

- Evidence you explored a part of the bean with your teammate
- Describe the life cycle of a bean
- Show the basic needs your bean needs to grow
- BONUS: Draw a picture or graph to represent the different types of beans

Work in journal was completed.

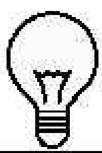


1. still learning 2. sometimes 3. almost always

Work in journal was neat and organized.

1. still learning 2. sometimes 3. almost always

My work shows I shared ideas with my group.

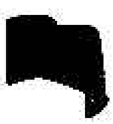


1. still learning 2. sometimes 3. almost always

The journal shows what I learned daily.

1. still learning 2. sometimes 3. almost always

The team showed three important learning goals.



1. One goal 2. two goals 3. all goals

The team showed the bonus learning goal.

1. One bonus goal point

Total:

Possible: 15

Adopted from BIE: http://www.bie.org/tools/freebies/k-2_teamwork_rubric

Self Assessment Cooperative Skills

This week we: Yes Took Turns: _______ Helped each other_____	No ______ ______	This week we: Yes Took Turns: _______ Helped each other_____	No ______ ______
This week we: Yes Took Turns: _______ Helped each other_____	No ______ ______	This week we: Yes Took Turns: _______ Helped each other_____	No ______ ______
This week we: Yes Took Turns: _______ Helped each other_____	No ______ ______	This week we: Yes Took Turns: _______ Helped each other_____	No ______ ______

APPENDIX C:
ASSESSMENT APPROVAL

Zimbra **mariella_dorr@scps.k12.fl.us**

RE: University of Central Florida/Seminole County Public Schools Permission request - 3309

From : Mary L Rodriguez <Mary.Rodriguez@hmhpub.com> Thu, Nov 08, 2012 02:49 PM
Subject : RE: University of Central Florida/Seminole County Public Schools Permission request - 3309 1 attachment
To : Mariella Dorr-Science <mariella_dorr@scps.k12.fl.us>

Dear Ms. Dorr:

Thank you for your inquiry of October 19 requesting permission to reproduce select test questions posted on our Houghton Mifflin Harcourt School Publishers Think Central Site at http://www.thinkcentral.com to be used as an appendix of your dissertation entitled "The Effectiveness of technology implementation to improve 2nd grade student performance using complex to moderate Science Standards" as well as for submission to University of Central Florida.

We are pleased to grant your request to reproduce the text content owned by Houghton Mifflin Harcourt on a one-time basis, provided you agree not to portray Houghton Mifflin Harcourt material in a negative manner. No further use of this material is authorized without our prior written approval. Any copies made of the research paper will be distributed on a gratis basis and you agree to contact Houghton Mifflin Harcourt Publishing Company for additional permission prior to any formal publication of your research paper.

We appreciate your interest in this program. Please contact me if I can provide further assistance.

Sincerely,

Mary Rodriguez
Contracts Associate
Houghton Mifflin Harcourt Publishing Company
9400 Southpark Center Loop
Orlando, FL 32819
Phone: 407-345-3797
Fax: 407-345-2418

From: Mariella Dorr-Science [mailto:mariella_dorr@scps.k12.fl.us]
Sent: Friday, October 26, 2012 2:00 PM
To: Rodriguez, Mary L
Subject: Re: University of Central Florida/Seminole County Public Schools Permission request - 3309

Mary,

APPENDIX D:
SOFTWARE APPROVAL

----- Forwarded Message -----

From: Melinda Kolk <melinda@tech4learning.com>

To: mariella dorr <mariella_dorr@scps.k12.fl.us>

Cc: 'Ulana Korovec' <ukorovec@tech4learning.com>

Sent: Thu, 04 Oct 2012 11:11:02 -0400 (EDT)

Subject: Research and Frames

Hello Mariella,

Ulana Korovec forwarded your message to me. We are thrilled that you want to include Frames in your master's research program on "Effectiveness of Technology Integration on Second Grade Students' Performance in Complex Science Standards."

Consider this email formal permission from Tech4Learning to include any images that use or picture Frames software.

Thank you,

Melinda Kolk

Vice President

Tech4Learning, Inc.

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From:
Mariella Dorr-Science [mailto:mariella_dorr@scps.k12.fl.us]

Sent: Wednesday, October 03, 2012 6:03 PM
To: Mariella Dorr-Science

APPENDIX E:
TIMELINE AND DAILY PROCEDURES

Timeline and Procedures
Grade: 2nd Grade Life Science
Teacher: Mariella Dorr
Title: 4-Bean Soup
Standards: Moderate Complexity Standards

2.N.1.1 (HIGH COMPLEXITY) Raise questions about the natural world, investigate them in teams through free exploration and systematic observations, and generate appropriate explanations based on those explorations.
2.L.16.1 (MODERATE COMPLEXITY) Observe and describe major stages in the life cycles of plants and animals, including beans and butterflies.
2.L.17.1 (MODERATE COMPLEXITY) Compare and contrast the basic needs that all living things, including humans, have for survival. (C-PALMS, 2010)

Group Identification and Procedures:

Group A
Second-Grade Classroom implementing PBL on inquiry approach
Seven Week Time Line and Procedures

1. Teacher created log to monitor student progress throughout the next six weeks.
2. Students played the role of researchers to find the solutions for investigations.
3. For the first four weeks students participated in hands-on activities.
4. For the remaining three weeks students participated in creating their movie in Frames 4.
5. Students worked together in groups of two to collect data and evidence of their findings.
6. During creation of movie: data collector helped team create pictorial representations of their findings. Technology supervisor will place any effects on drawn pictures. Students alternate roles every week. Both students take turns to do recordings.
7. Students will use Tech 4 Learning – Frames 4 to create a narrated depiction of their findings/conclusions.

Group A and B: December 20 December 21
(early dismissal Dec. 19,20, 21)

Wednesday, Dec. 19th 30 Minutes 12:20-12:50
All students go outside to vegetable garden to see progress of bean growth.

Friday, Dec. 30 Minutes 12:20-12:50
Both groups of students will get to taste and eat bean soup.

Week 1
Group A: October 1-October 5

Group A – Fusion Pretest Monday

2.N.1.1 (HIGH COMPLEXITY) – See Table 4

Learning Goal: Provide evidence you explored the bean with your teammate and you drew a picture or graph to represent the different types of beans.

Materials: Variety of beans, medicine cups, CD cases, soil, images, sand, gravel, tape, rulers, lenses, towels, spray bottles

Monday 30 Minutes 2:20-2:50	Tuesday 30 Minutes 2:20-2:50	Wednesday 30 Minutes 1:20-1:50	Thursday 30 Minutes 2:20-2:50	Friday 30 Minutes 2:20-2:50
• Consent Read aloud • Fusion Pretest • Have you ever had bean soup?	**Engaging question:** Are all beans alike?	**Engaging question:** What do the properties of the beans tell you?	**Engaging question:** How can you show the number of beans?	**Engaging question:** What will your chosen bean need to grow?
	Exploration Using your eyes and hands use sight and touch to find the physical properties of the beans students will write down following: • Shape • Size • Color • Texture • Amount Students will identify cups with their names.	**Exploration** Teacher will pass out beans. Students will need to sort the beans based on the properties listed yesterday. Students will use the properties of the beans to tell how they are different and how they are alike.	**Exploration** Teacher will pass out corresponding cups. Students will take inventory of beans and come up with a bar graph to show the quantity of each. Students will begin to think about the quantities of each type of bean. Students will solve simple put-together and take apart problems using the bar graph.	**Exploration** Teacher will previously have set up a table with cups of water, pictures of air and sun, baggies of soil, sand, and gravel, brown paper bags. Shoulder partners will decide which bean to plant. Students will go to designated table and select four needs from the table. Students will select materials to grow bean inside CD case.

Week 2

Group A: October 15-October 18 (Oct. 19 Teacher Work Day)

2.L.17.1 (MODERATE COMPLEXITY) – See Table 4
Learning Goal: Show the basic needs your bean needs to grow.
Materials: Variety of beans, CD cases, soil, images, sand, gravel, tape, rulers, lenses, towels, spray bottles

Monday 30 Minutes 2:20-2:50	Tuesday 30 Minutes 2:20-2:50	Wednesday 30 Minutes 1:20-1:50	Thursday 30 Minutes 2:20-2:50	Friday 30 Minutes 2:20-2:50
Engaging question: What will your chosen bean need to grow?	**Engaging question:** What does your bean need to grow?	**Engaging question:** What will your bean grow to be?	**Engaging question:** What will happen if we take a need away?	**STUDENT NON ATTENDANCE Teacher Work Day.**
Exploration Teacher will pass out all materials to make sure all students are done planting their bean based on their needs. Teacher will label all CD cases with paired student's name. (One CD case for every two students) Students will select materials to grow bean inside CD case. (2 days of planting)	**Exploration** Teacher will pass out CD cases belonging to each pair of students. Students observe any changes in their bean to verify if their bean has the basic needs to grow. Students will make a picture of the four basic needs of their bean. Students will create a daily chart to begin drawing daily differences.	**Exploration** Students will observe their plants and make a picture of what their bean may look like the following week we meet. On a separate page students will draw a hypothetical picture of what bean will look like next week. Student will make a daily log to observe daily changes in their bean.	**Exploration** Teacher will pass CD cases. Students will write in journal sentences of basic needs of bean explaining: What will happen if one of the needs is taken away? Teacher will take one of the Basic needs away and students will observe outcome. Student will make a daily log to observe daily changes in their bean.	

Week 3
Group A: October 29-November 2

2.N.1.1 (HIGH COMPLEXITY) – See Table 4
Learning Goal: Evidence you explored parts of the bean and the changes of your bean with your teammate**.**
Materials: Variety of beans, CD cases, soil, images, sand, gravel, tape, rulers, lenses, towels, spray bottles

Monday 30 Minutes 2:20-2:50	Tuesday 30 Minutes 2:20-2:50	Wednesday 30 Minutes 1:20-1:50	Thursday 30 Minutes 2:20-2:50	Friday 30 Minutes 2:20-2:50
Engaging question: What is inside a bean when it has all its needs?	**Engaging question:** How can you prove your bean has growing parts?	**Engaging question:** How can you show what we did changed our bean?	**Engaging question:** How can you show what we did changed our bean?	**Engaging question:** How can you show the changes of our growing bean?
Exploration Teacher will pass out pre soaked lima beans. Students will take bean apart and draw a picture of what it looks like. Students will be given a diagram as a resource to find all internal parts of the bean. Student will make a daily log to observe daily changes in their bean.	**Exploration** Teacher will pass out presoaked lima bean. Students will take seed apart and conserve all pieces. Students will tape all of the bean parts inside their science journal and label them using a diagram to guide them. Student will make a daily log to observe daily changes in their bean.	**Exploration** Teacher will pass out CD cases with growing bean. Each team of students will discuss and draw/create the plan of investigation we used to show the steps we took to see the bean change. Student will make a daily log to observe daily changes in their bean.	**Exploration** Teacher will pass out CD cases with growing bean. Each team of students will continue to discuss and finish drawing /creating the plan of investigation we used to show the steps we took to see the bean change. Student will make a daily log to observe daily changes in their bean.	**Exploration** Teacher will pass out CD cases belonging to each pair of students. Students observe and draw changes in their bean. Students will write in their journal how their bean has grown over time. Students will compare the stages to a diagram.

Week 4
Group A: November 12 - November 16

2.L.16.1 (MODERATE COMPLEXITY)
Learning Goal: Describe the life cycle of the bean and show its steps.
Materials: Variety of beans, CD cases, soil, images, sand, gravel, tape, rulers, lenses, towels, spray bottles

Monday 30 Minutes 2:20-2:50	Tuesday 30 Minutes 2:20-2:50	Wednesday 30 Minutes 1:20-1:50	Thursday 30 Minutes 2:20-2:50	Friday 30 Minutes 2:20-2:50
Engaging question: How can you draw stages to show the changes in your bean?	**Engaging question:** How can you show the different changes in your plant?	**Engaging question:** How can you show the different changes in your plant?	**Engaging question:** How can you show the different changes in your plant?	**Engaging question:** How can you show the different changes in your plant?
Exploration Teacher will pass out CD cases belonging to each pair of students. Students will continue to observe and draw changes in their bean. Students will water their bean and compare it to the bean we took one need away. Student will finalize daily log before transplanting our bean plant in garden.	**Exploration** Teacher will pass out CD cases belonging to each pair of students. Students will see different pictures of life cycles. Students will try to use diagram to draw the first stage of the life cycle of their bean.	**Exploration** Teacher will pass out CD cases belonging to each pair of students. Students will see different pictures of life cycles. Students will try to use diagram to draw the second stage of the life cycle of their bean.	**Exploration** Teacher will pass out CD cases belonging to each pair of students. Students will see different pictures of life cycles. Students will try to use diagram to draw the third stage of the life cycle of their bean.	**Exploration** Teacher will pass out CD cases belonging to each pair of students. Students will see different pictures of life cycles. Students will try to use diagram to draw the fourth stage of the life cycle of their bean. Transfer bean plants to outside vegetable garden

Week 5 - TECHNOLOGY INTEGRATION
Group A: December 3 - December 7

Monday 30 Minutes 2:20-2:50	Tuesday 30 Minutes 2:20-2:50	Wednesday 30 Minutes 1:20-1:50	Thursday 30 Minutes 2:20-2:50	Friday 30 Minutes 2:20-2:50
Students will learn how to turn on and shut down computers.	Students will begin to use story board templates.	Students will begin by drawing pictures of the different beans.	Students will continue with bar graph. Students will come up with their own way to make a pictorial graph or bar graph.	Students will continue with bar graph. Students will come up with their own way to make a pictorial graph or bar graph.
Students will learn to carry computers with two hands at all times.	Students will begin by drawing pictures of the different beans.	Students will write about the properties of the beans.	Students will write about the different problems they created.	Students will write about the different problems they created.
Students will learn how to access Frames 4.	Students will write about the properties of the beans.	Students will record their voices to match frame content.	Students will record their voices to match frame content.	Students will record their voices to match frame content.
Students will learn how to view and click on each pre-made frame.	Students will record their voices to match frame content. (Voices are to be fluent recordings narrating the writing aspect of each customized frame.)			
Students will learn how to access the tool bars to make drawings.				
Students will learn how to fill a drawing				
Students will learning how to animate.				

Week 6 - TECHNOLOGY INTEGRATION
Group A: December 10 - December 14

Monday 30 Minutes 2:20-2:50	Tuesday 30 Minutes 2:20-2:50	Wednesday 30 Minutes 1:20-1:50	Thursday 30 Minutes 2:20-2:50	Friday 30 Minutes 2:20-2:50
Students will continue with bean needs. Students will display the different needs their bean required to grow. Students will draw pictures showing each need.	Students will draw pictures showing the internal parts of a growing bean.	Students will draw pictures showing the different changes of their bean as it grows. Students will display the different phases.	Students will try to finalize the story board with a drawing of a life cycle of a bean.	Students will use time to create animations and drop music
Students will write about the different needs.	Students will identify the different parts of the inside of a bean.	Students will write about and identify the different phases.	Students are to explain each cycle.	
Students will record their voices to match frame content.	Students will record their voices to match frame content.	Students will record their voices to match frame content.	Students will record their voices to match frame content.	Students will record their voices to match frame content.

Week 7
Group A: December 17 - December 20
(early dismissal Dec. 19,20, 21)

Monday 30 Minutes 2:20-2:50	Tuesday 30 Minutes 2:20-2:50	Wednesday 30 Minutes 1:20-1:50	Thursday 30 Minutes 12:20-12:50	Friday 30 Minutes 12:20-12:50
Students will use time to create animations and drop music	Students will use time to create animations and drop music	Students will use time to create animations and drop music	• Fusion Posttest	Both groups of students will get to taste and eat bean soup prepared by teacher guiding study.
Students will record their voices to match frame content.	Students will record their voices to match frame content.	Students will record their voices to match frame content.		

Standards: Moderate Complexity Standards

2.N.1.1 (HIGH COMPLEXITY) Raise questions about the natural world, investigate them in teams through free exploration and systematic observations, and generate appropriate explanations based on those explorations.
2.L.16.1 (MODERATE COMPLEXITY) Observe and describe major stages in the life cycles of plants and animals, including beans and butterflies
2.L.17.1 (MODERATE COMPLEXITY) Compare and contrast the basic needs that all living things, including humans, have for survival. (C-PALMS, 2010)

Group B
Second-Grade Classroom Implementing Hands-On Instruction Approach
Four Week Time Line and Procedures

The activities and time line following these procedures will be very similar for Group B with the difference of NOT implementing camera and computer time. These students will partake in same hands-on activities.

1. Teacher created log to monitor student progress throughout the next six weeks.
2. Students played the role of researchers to find the solutions for investigations. As a team they will come up with their own conclusions based on their findings.
3. For four weeks students participated in hands-on activities.
4. Students will collect their own data enter it in personal journal.
5. Based on information students will formulate their conclusions.

Materials: Variety of beans, medicine cups, CD cases, soil, images, sand, gravel, tape, rulers, lenses, towels, spray bottles

Group A and B: December 20 December 21
(early dismissal Dec. 19,20, 21)

Wednesday, Dec. 19th 30 Minutes 12:20-12:50
All students go outside to vegetable garden to see progress of bean growth.

Friday, Dec. 20th 30 Minutes 12:20-12:50
Both groups of students will get to taste and eat bean soup.

Week 1
Group B: October 8-October 12

Group B – Fusion pretest Monday

2.N.1.1 (HIGH COMPLEXITY) – See Table 4

Learning Goal: Evidence you explored the beans with your teammate and you drew a picture or graph to represent the different types of beans

Materials: Variety of beans, medicine cups, CD cases, soil, images, sand, gravel, tape, rulers, lenses, towels, spray bottles

Monday 30 Minutes 2:20-2:50	Tuesday 30 Minutes 2:20-2:50	Wednesday 30 Minutes 1:20-1:50	Thursday 30 Minutes 2:20-2:50	Friday 30 Minutes 2:20-2:50
• Consent Read aloud • Fusion Pretest • Have you ever had bean soup?	**Engaging question:** Have you ever had bean soup? Are all beans alike?	**Engaging question:** What do the properties of the beans tell you?	**Engaging question:** How can you show the number of beans?	**Engaging question:** What will your chosen bean need to grow?
	Exploration Using your eyes and hands use sight and touch to find the physical properties of the beans students will write down following: • Shape • Size • Color • Texture • Amount Students will identify cups with their names.	**Exploration** Teacher will pass out beans. Students will need to sort the beans based on the properties listed yesterday. Students will use the properties of the beans to tell how they are different and how they are alike.	**Exploration** Teacher will pass out corresponding cups. Students will take inventory of beans and come up with a bar graph to show the quantity of each. Students will begin to think about the quantities of each type of bean. Students will solve simple put-together and take apart problems using the bar graph.	**Exploration** Teacher will previously have set up a table with cups of water, pictures of air and sun, baggies of soil, sand, and gravel, brown paper bags. Shoulder partners will decide which bean to plant. Students will go to designated table and select four needs from the table. Students will select materials to grow bean inside CD case.

Week 2
Group B: October 22-October 26

2.L.17.1 (MODERATE COMPLEXITY) – See Table 4
Learning Goal: Show the basic needs your bean needs to grow
Materials: Variety of beans, CD cases, soil, images, sand, gravel, tape, rulers, lenses, towels, spray bottles

Monday 30 Minutes 2:20-2:50	Tuesday 30 Minutes 2:20-2:50	Wednesday 30 Minutes 1:20-1:50	Thursday 30 Minutes 2:20-2:50	Friday 30 Minutes 2:20-2:50
Engaging question: What will your chosen bean need to grow?	**Engaging question:** What does your bean need to grow?	**Engaging question:** What will your bean grow to be?	**Engaging question:** What will happen if we take a need away?	**Engaging question:** What is inside a bean when it has all its needs?
Exploration Teacher will pass out all materials to make sure all students are done planting their bean based on their needs. Teacher will label all CD cases with paired student's name (One CD case for every two students). Students will select materials to grow bean inside CD case (2 days of planting).	**Exploration** Teacher will pass out CD cases belonging to each pair of students. Students observe any changes in their bean to verify if their bean has the basic needs to grow. Students will make a picture of the four basic needs of their bean. Students will create a daily chart to begin drawing daily differences.	**Exploration** Students will observe their plants and make a picture of what their bean may look like the following week we meet. On a separate page students will draw a hypothetical picture of what bean will look like next week. Student will make a daily log to observe daily changes in their bean.	**Exploration** Teacher will pass CD cases. Students will write in journal sentences of basic needs of bean explaining: What will happen if one of the needs is taken away? Teacher will take one of the Basic needs away and students will observe outcome. Student will make a daily log to observe daily changes in their bean.	**Exploration** Teacher will pass out presoaked lima beans. Students will take bean apart and draw a picture of what it looks like. Students will be given a diagram as a resource to find all internal parts of the bean. Student will make a daily log to observe daily changes in their bean.

Week 3
Group B: November 5 - November 9

2.N.1.1 (HIGH COMPLEXITY) – See Table 4
Learning Goal: Evidence you explored parts of the bean and the changes of your bean with your teammate.
Materials: Variety of beans, medicine cups, CD cases, soil, images, sand, gravel, tape, rulers, lenses, towels, spray bottles

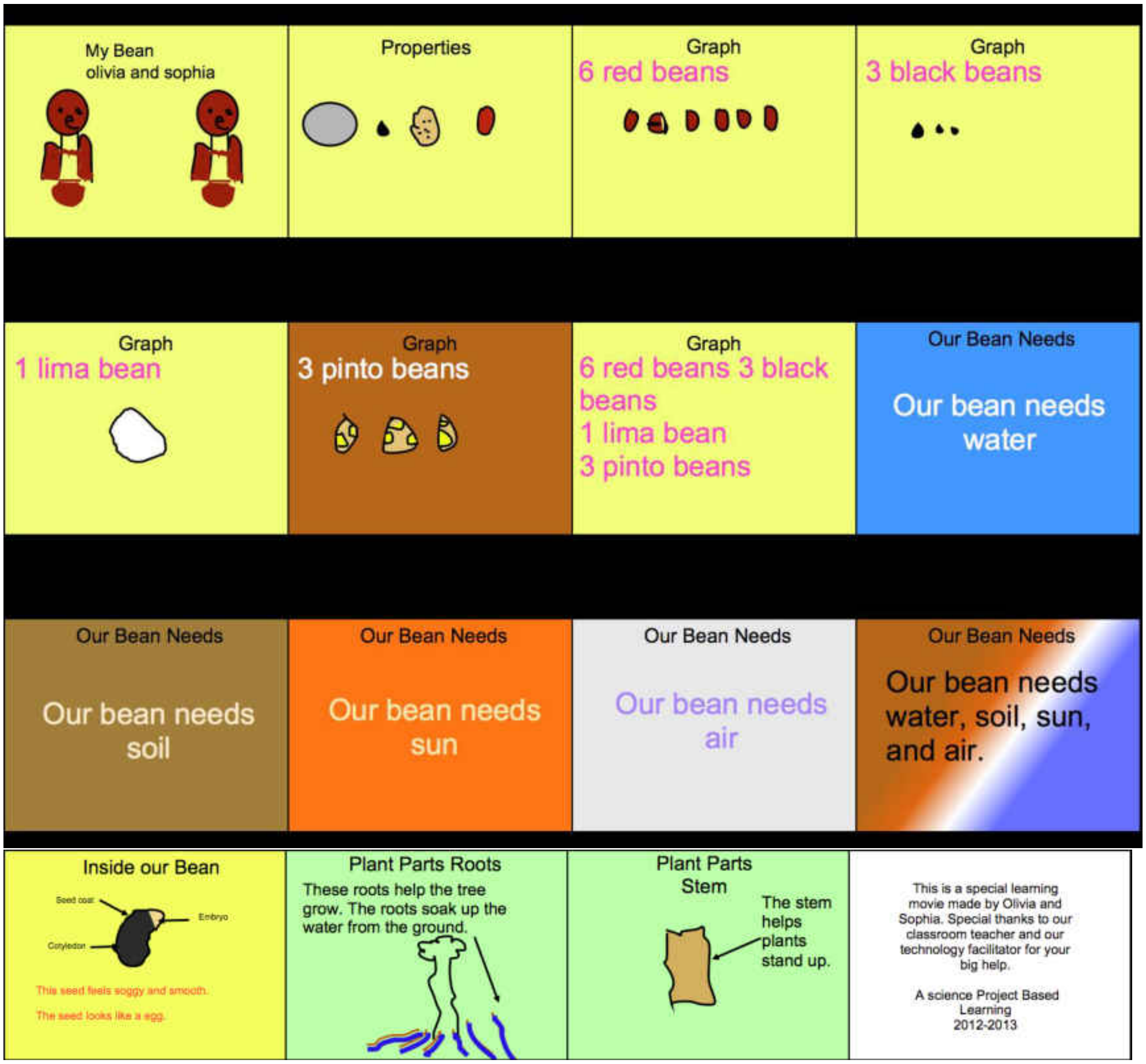
Monday 30 Minutes 2:20-2:50	Tuesday 30 Minutes 2:20-2:50	Wednesday 30 Minutes 1:20-1:50	Thursday 30 Minutes 2:20-2:50	Friday 30 Minutes 2:20-2:50
Engaging question: How can you prove your bean has growing parts?	**Engaging question:** How can you show what we did changed our bean?	**Engaging question:** How can you show what we did changed our bean?	**Engaging question:** How can you show the changes of our growing bean?	**Engaging question:** How can you show the different changes in your plant?
Exploration Teacher will pass out presoaked lima bean. Students will take seed apart and conserve all pieces. Students will tape all of the bean parts inside their science journal and label them using a diagram to guide them. Student will make a daily log to observe daily changes in their bean.	**Exploration** Teacher will pass out CD cases with growing bean. Each team of students will discuss and draw/create the plan of investigation we used to show the steps we took to see the bean change. Student will make a daily log to observe daily changes in their bean.	**Exploration** Teacher will pass out CD cases with growing bean. Each team of students will continue to discuss and finish drawing /creating the plan of investigation we used to show the steps we took to see the bean change. Student will make a daily log to observe daily changes in their bean.	**Exploration** Teacher will pass out CD cases belonging to each pair of students. Students observe and draw changes in their bean. Students will write in their journal how their bean has grown over time. Students will compare the stages to a diagram.	**Exploration** Teacher will pass out CD cases belonging to each pair of students. Students will continue to observe and draw changes in their bean. Students will water their bean and compare it to the bean we took one need away. Student will finalize daily log before transplanting our bean plant in garden.

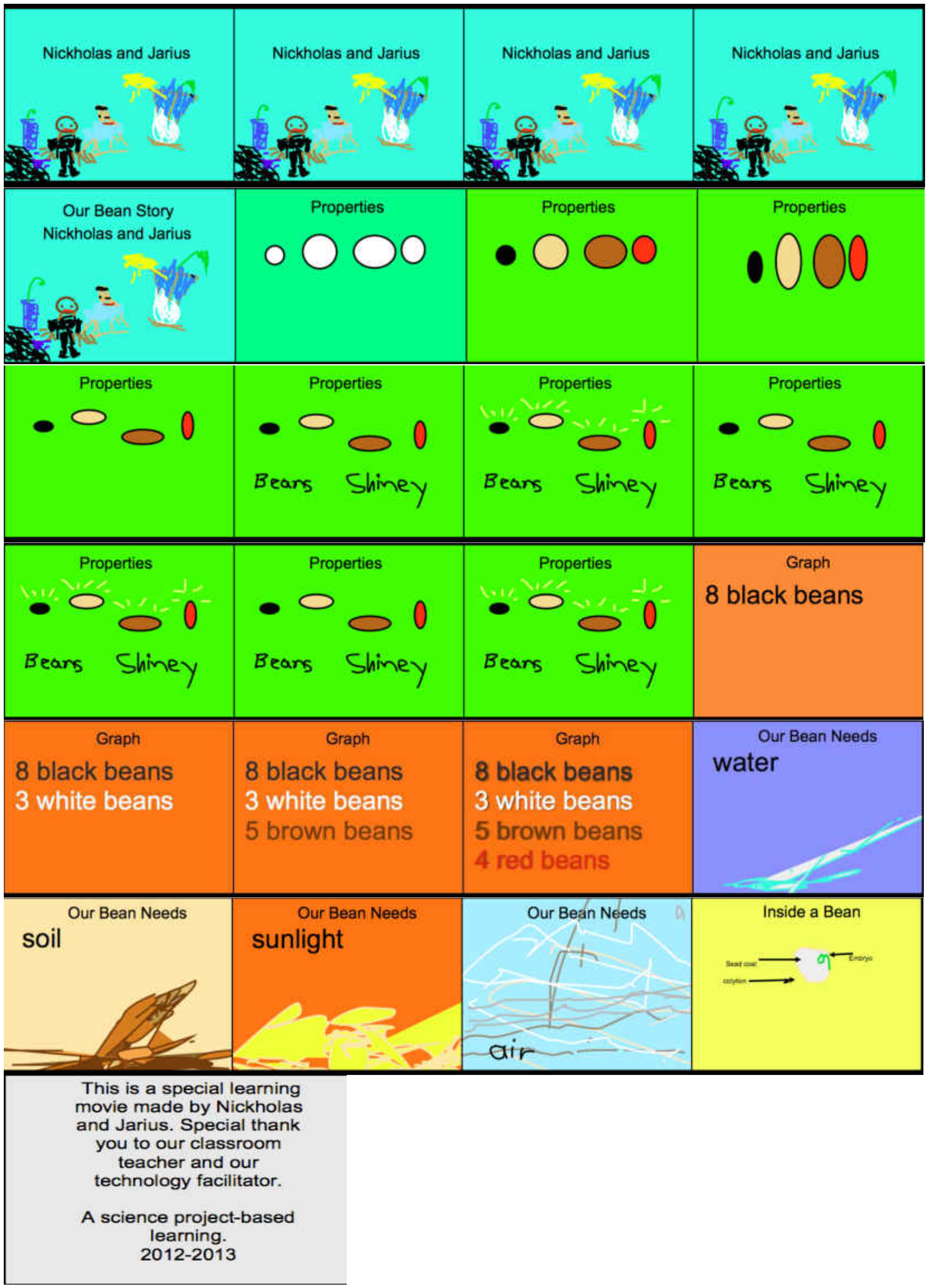
Week 4
Group B: November 26 - November 30

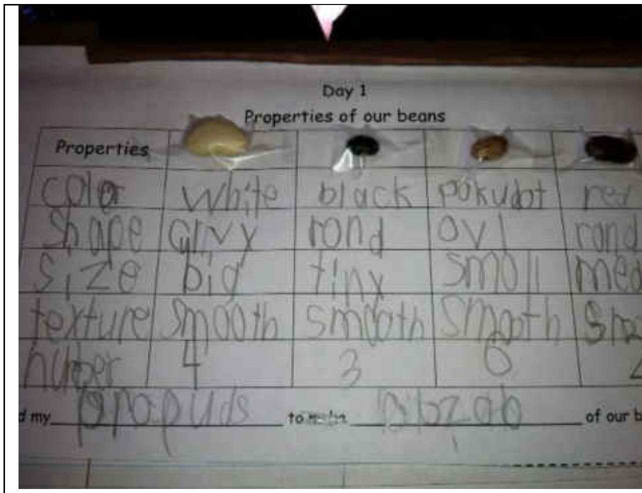
2.L.16.1 (MODERATE COMPLEXITY)
Learning Goal: Describe the life cycle of the bean and show its steps
Materials: Variety of beans, CD cases, soil, images, sand, gravel, tape, rulers, lenses, towels, spray bottles

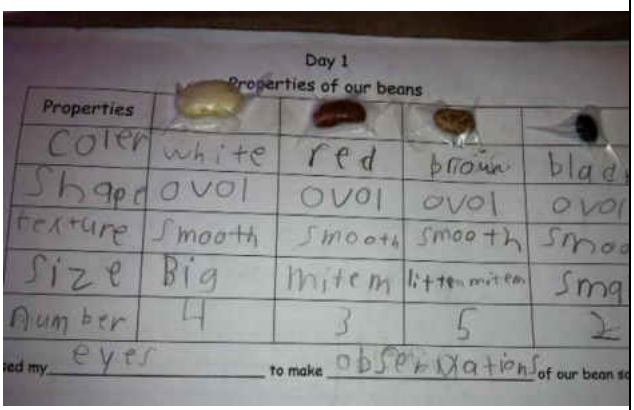
Monday 30 Minutes 2:20-2:50	Tuesday 30 Minutes 2:20-2:50	Wednesday 30 Minutes 1:20-1:50	Thursday 30 Minutes 2:20-2:50	Friday 30 Minutes 2:20-2:50
Engaging question: How can you show the different changes in your plant?	**Engaging question:** How can you show the different changes in your plant?	**Engaging question:** How can you show the different changes in your plant?	**Engaging question:** How can you show the different changes in your plant?	• Fusion Posttest
Exploration Teacher will pass out CD cases belonging to each pair of students. Students will see different pictures of life cycles. Students will try to use diagram to draw the first stage of the life cycle of their bean.	**Exploration** Teacher will pass out CD cases belonging to each pair of students. Students will see different pictures of life cycles. Students will try to use diagram to draw the second stage of the life cycle of their bean.	**Exploration** Teacher will pass out CD cases belonging to each pair of students. Students will see different pictures of life cycles. Students will try to use diagram to draw the third stage of the life cycle of their bean.	**Exploration** Teacher will pass out CD cases belonging to each pair of students. Students will see different pictures of life cycles. Students will try to use diagram to draw the fourth stage of the life cycle of their bean.	

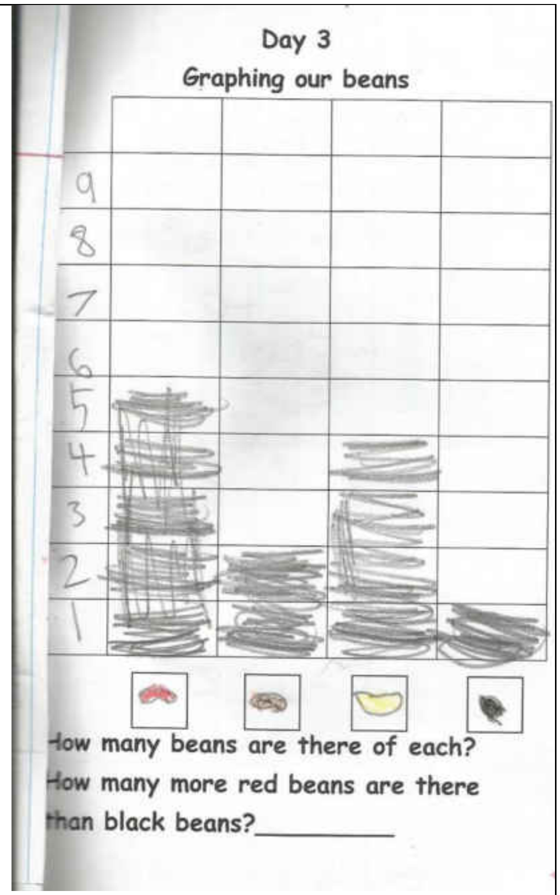
APPENDIX F:
STUDENT PROJECT SAMPLES

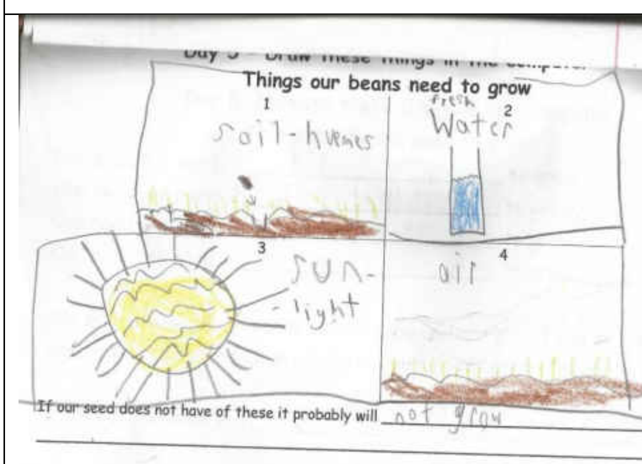

My Bean
olivia and sophia
Properties
Graph
6 red beans
Graph
3 black beans
Graph
1 lima bean
Graph
3 pinto beans
Graph
6 red beans 3 black beans
1 lima bean
3 pinto beans
Our Bean Needs
Our bean needs water
Our Bean Needs
Our bean needs soil
Our Bean Needs
Our bean needs sun
Our Bean Needs
Our bean needs air
Our Bean Needs
Our bean needs water, soil, sun, and air.
Inside our Bean
Seed coat
Embryo
Cotyledon
This seed feels soggy and smooth.
The seed looks like a egg.
Plant Parts Roots
These roots help the tree grow. The roots soak up the water from the ground.
Plant Parts Stem
The stem helps plants stand up.
This is a special learning movie made by Olivia and Sophia. Special thanks to our classroom teacher and our technology facilitator for your big help.
A science Project Based Learning
2012-2013

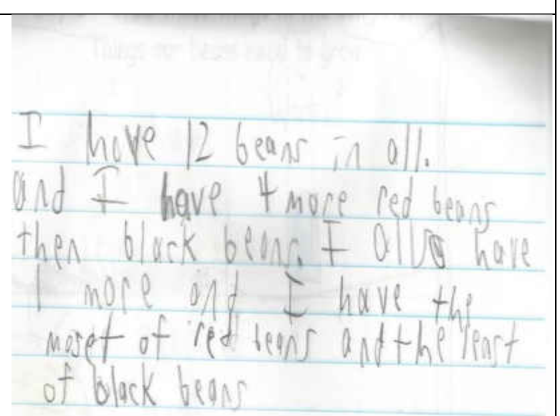

Nickholas and Jarius
Nickholas and Jarius
Nickholas and Jarius
Nickholas and Jarius
Our Bean Story
Nickholas and Jarius
Properties
Properties
Properties
Properties
Properties
Beans Shiney
Properties
Beans Shiney
Properties
Beans Shiney
Properties
Beans Shiney
Properties
Beans Shiney
Properties
Beans Shiney
Graph
8 black beans
Graph
8 black beans
3 white beans
Graph
8 black beans
3 white beans
5 brown beans
Graph
8 black beans
3 white beans
5 brown beans
4 red beans
Our Bean Needs
water
Our Bean Needs
soil
Our Bean Needs
sunlight
Our Bean Needs
air
Inside a Bean
This is a special learning movie made by Nickholas and Jarius. Special thank you to our classroom teacher and our technology facilitator.
A science project-based learning.
2012-2013

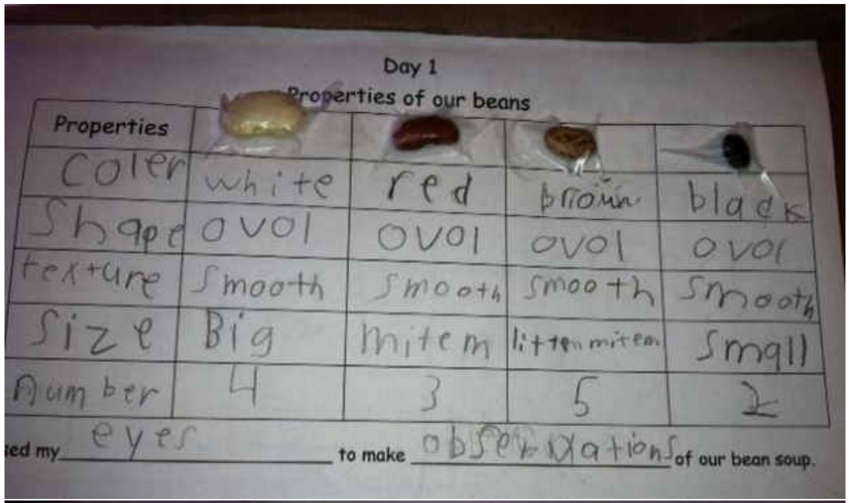

Day 1
Properties of our beans
Properties
color white black red
texture smooth smooth
of our b


Day 1
Properties of our beans
Properties
coler white red brown
Shape ovol ovol ovol
texture Smooth Smooth Smooth
Size Big
number 4 3 5
ed my eyes to make observations of our bean


Day 3
Graphing our beans
9
8
7
6
5
4
3
2
1
How many beans are there of each?
How many more red beans are there than black beans?


Things our beans need to grow
1
2
Water
3
4
sun-light
air
If our seed does not have of these it probably will not grow


I have 12 beans in all.

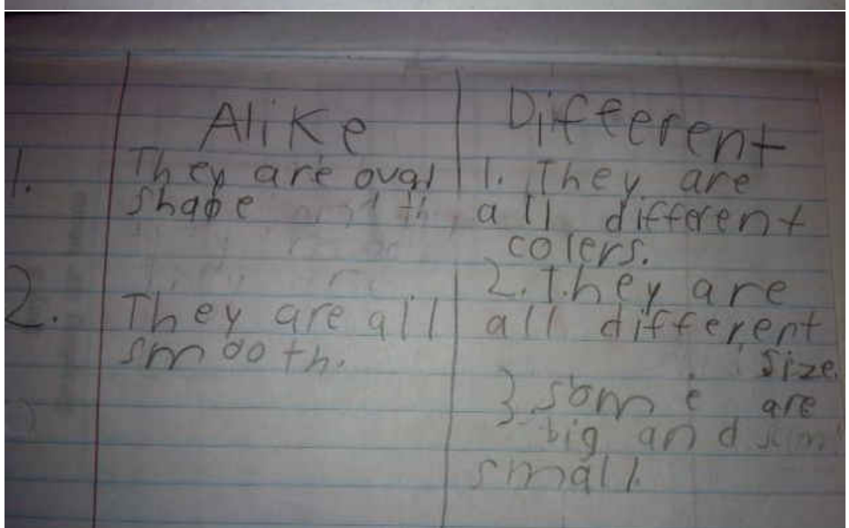


Day 1

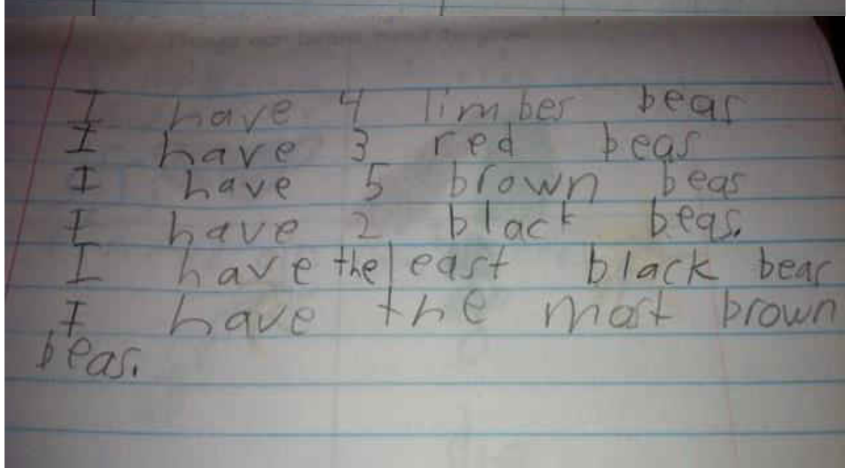
Properties of our beans

Properties				
coler	white	red	brown	black
Shape	ovol	ovol	ovol	ovol
texture	Smooth	Smooth	Smooth	Smooth
Size	Big	mitem	litten mitem	Small
number	4	3	5	2

[u]sed my eyes to make obsevations of our bean soup.



Alike	Different
1. They are oval shape	1. They are all different colers.
2. They are all smooth.	2. They are all different size.
	3. some are big and small.



I have 4 limber beas
I have 3 red beas
I have 5 brown beas
I have 2 black beas.
I have the least black bear
I have the most brown beas.

APPENDIX G:
STANDARDS

Nature of Science – Big Idea 1: The Practice of Science
• **SC.2N.1.1 (High Complexity)** Raise questions about the natural world, investigate them in teams through free exploration and systematic observations, and generate appropriate explanations based on those explorations. **(C-PALMS, 2010)**
Life Science – Big Idea 16: Hereditary and Reproduction
• **SC.2.L.16.1 (Moderate Complexity)** Observe and describe major stages in the life cycles of plants and animals, including beans and butterflies. • **SC.2.L.17.1 (Moderate Complexity)** Compare and contrast the basic needs that all living things, including humans, have for survival. **(C-PALMS, 2010)**
MACC.2.MD.4.10– Math Common Core Standard
Draw a picture graph and a bar graph (with single unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph. **(C-PALMS, 2010)**

LIST OF REFERENCES

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