

EVALUATING THE EFFECTS OF USING TABLETS ON MOTIVATION AND
ENGAGEMENT IN A SEVENTH GRADE CITIZEN SCIENCE FIELD TRIP

by

Steven O'Neill

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TABLE OF CONTENTS

1. INTRODUCTION AND BACKGROUND1

2. CONCEPTUAL FRAMEWORK4

3. METHODOLOGY8

4. DATA AND ANALYSIS15

5. CONCLUSION24

6. VALUE25

REFERENCES CITED29

APPENDICES32

 APPENDIX A – Entry Ticket33

 APPENDIX B – Exit Ticket35

 APPENDIX C – Student Interview Questions38

 APPENDIX D – Student Interview Responses40

 APPENDIX E – Technology Survey42

 APPENDIX F – Technology Survey Data45

 APPENDIX G – International Review Board Exemption Letter49

LIST OF TABLES

1. Timeline	11
2. Data Collection Matrix	11
3. Northern Middle School Entry/Exit Ticket Surveys.....	18
4. Calvert Middle School Entry/Exit Ticket Surveys	20
5. Southern Middle School Entry/Exit Ticket Surveys.....	21
6. Students Reactions to Using Tablets.....	23

INTRODUCTION AND BACKGROUND

Project Background

This action research project was conducted using a seventh grade unit of Water Quality and Submerged Aquatic Vegetation (S.A.V.). I work with two teachers and one secretary in our department called CHESPAX, which was derived from the “Chesapeake Bay and the Patuxent River”, an environment which surrounds our county in Southern Maryland. CHESPAX is a part of the Calvert County Public School System and works with local and state organizations by developing programs taught by teachers and naturalists throughout our county. The Chesapeake and the Patuxent River become the students’ outdoor classroom focus no matter where they are in the county. Students from kindergarten to high school use the area as an outdoor natural learning environment. I am focused on the Water Quality and S.A.V. project because it is one of the few outdoor environmental education memories that I have from middle school when I attended Calvert County Public Schools.

The role of technology in my generation and during our education has and continues to change the way we work and learn. Technology has grown from typing programs on black and green computers to interactive SMART Boards in the classroom. Today’s students are engaged in technology with cell phones, tablets, computers and even robotics. Teachers, meanwhile, are challenged by the technological advances in the classroom. Some teachers are able keep up with the changes and others are reluctant to learn. Technology is not encouraged by all teachers, especially those involved with outdoor education, who often feels students should connect with nature and “unplug” from electronic devices. Technology is used the most by students when they have free

time. How can a teacher use technology inside and outside of the classroom as a teaching tool instead of a distraction?

In the field, students constantly desire to bring their own devices with them, however, some outdoor educators and teachers feel the devices will be a distraction as the students will be checking social media apps or playing games. The teachers also may not want to be responsible for devices that might be damaged or lost. To engage with students that are always plugged in, it is necessary to create a bridge that connects the students' interest in technology with a tool that creates positive outdoor educational experiences. To create this bridge, the use of tablets during a part of our instruction during the citizen science program would be used to help students connect to the environment in a new and easy way as they use tablets to view an osprey nest. The osprey nest is located on a creek that flows into the Patuxent River in Huntingtown, Maryland. It is located on the same creek that students have been studying and collecting data for over 20 years. The Chesapeake Bay supports one of the largest osprey (*Pandion haliaetus*) breeding populations in the world (Henny 1983). As with many similar populations, Ospreys in the Chesapeake Bay experienced dramatic declines in the post-World War II and later era due to environmental contaminants such as dichlorodiphenyltrichloroethane (DDT) known for its insecticidal properties followed by an equally dramatic recovery (Watts,B). An osprey camera was installed in February 2016, before the ospreys migrated back north and began rebuilding their nest. The pair of ospreys has nested at the site for the past three years and this year is the first time for students to observe the osprey nest via tablet (<http://www.ipcamlive.com/chespaxosprey>).

Support Team

Throughout the action research process there have been several key people that have helped me improve my research. My science reader for my capstone is Dr. David Willey. I met Dr. Willey in the summer of 2015 when I attended his summer Birds of Prey class at Montana State University. I found that the connection of his love for birds and my capstone involving tablets to view ospreys was an appropriate match. Janae Jacob is a friend of mine who loves all things math and has helped me through finding connections in the data analysis stages of my project. The technology department head, Jennifer Sturge, has helped CHESPAX by assisting the implementation of technology in our programs in the schools such as blue bird box cameras to Skyping with scientists. Jen has assisted me in creating my teacher technology survey. Alisha McCoy is another reader of mine who possesses a Masters in Literature and the Environment. She has a background in teaching, the environment, and proofreading papers. This project would also not have been possible without the financial support and labor from Calvert County Natural Resources Division, Spy on A Bird Cameras, Cove Point Natural Heritage Trust, and Environmental Protection Agency.

Focus Questions

The questions that were used in my AR include the primary focus question: “In what ways will the use of tablets increase engagement in a citizen science program?” Sub-questions that I researched included sub-question #1: “How will using tablets out of the classroom affect the student’s motivation and attitude?” Sub-question #2 asks, “How will use of tablets help students to understand how ospreys are connected to the

environment?” and sub-question #3 is stated as, “As an educator how will this action research project affect my approach to teaching?”

CONCEPTUAL FRAMEWORK

Introduction

A citizen science project is where teachers, students, volunteers and scientists meet the education and scientific research needs with and for the community (Zoelick 2012). These needs are constantly changing as scientists find new ways to use and work with technology in the lab and field.

The *Global Environmental Change* journal notes that citizen science engages the public in participatory scientific learning and environmental advocacy (Johnson, 2014). When a participant, or in this case, a student, changes their behavior or attitude this starts to create a new awareness. Throughout my AR this view changed from awareness of what is in the water to deeply caring about the actions families and business can take to improve the health of the surrounding water. This awareness and change of attitude creates environmental advocacy. One of the benefits citizen science creates is an opportunity for the participant to engage with the natural world. In his well-known book, *Last Child in the Woods*, Richard Louv (2008) refers to this disconnect as “Nature Deficit Disorder.” This disconnect causes multiple problems from emotional to educational difficulties (Louv, 2008). Nature-deficit disorder is not a medical term, but rather a term coined by Louv to describe the current disconnect from nature (2008). According to Louv, children need nature for learning and creativity (2008). While there may be many

reasons today's children are not connected with nature, a major contributor is time spent on indoor activities (Holloway, 2012, p. 24).

Howard Gardner's (1983) multiple levels of Intelligences of Nature is a useful framework for parents and teachers to allow children to connect with nature using their senses. When Gardner (1983) first proposed multiple intelligences, there were only seven intelligences in his theory. Years later, in 1996, he added naturalistic intelligence which is defined as the ability to distinguish among critical features of the natural environment (Gardner, 1999). According to Gardner, this type of intelligence is marked by the ability to identify different plants and animals and both living and non-living factors within the environment (Gardner, 1983). In other words, naturalistic intelligence is the ability to interact with the surrounding environment.

Richard Louv mentions that Gardner's theory has an immediate application for teachers and parents who might overlook the importance of natural experience to learning and child development. Some other indicators of this intelligence are having keen and heightened sensory skills, noticing patterns, collecting natural objects, and easily learning characteristics about things found in the natural world (Louv, 2008). When students viewed the natural world through technology, such as tablets, they are collecting images and processing new information about their observations.

Direction for Action Research

Citizen science projects are created with the idea that they will educate participants, help scientists gather a larger amount of data, and affect the participants' attitude, which ultimately affects their future behavior (Toomey and Domroese, 2013).

However, Toomey goes on to state that this assumption has been little tested and evidence to support such impacts are lacking. Due to this lack of knowledge, I wanted to dig deeper to test what I was teaching specifically in the 7th grade program. The article goes into further details of explaining theoretical models of behavioral change and informs the reader of Ajzen's Theory of Planned Behavior (Toomey and Domroese, 2013). This theory is used as a framework for understanding influences on behavior and the intention to act on the attitude towards the behavior (Toomey and Domroese, 2013).

A citizen science program incorporating technology would overcome Louv's (2008) disconnection and help participants reconnect to the natural world. The difficult part is creating an atmosphere where seventh grade students can connect with the natural world without disturbing it. Seventh graders can be loud and boisterous, especially in the outdoors. The use of tablets in a citizen science program allows students to remotely view ospreys that are directly connected to the environment the students are surveying on the field trip. Students are already engaged with technology, and teachers want to use that interest to foster outdoor experiences that promote learning (Holloway, 2012).

Although studies show that citizen science programs are beneficial to students, some students do not have the opportunity for an outdoor learning experience. There are limitations preventing students from interacting with the environment that includes a lack of teacher interest, funding, and being close to a park or nature. This is unfortunate since according to Richard Louv (2005), environment-based education dramatically improves standardized test scores and grade point averages and develops skills in problem solving,

critical thinking and decision-making. Allowing children to interact with the environment can change the way they learn.

A key factor in teaching students is to constantly observe, teach, reflect and then teach in a new way. As a classroom teacher, one must be knowledgeable and understanding of the fact that one is not always teaching just one subject matter, but many things at once. Learning activities in the outdoors that are designed to develop greater insight into ecological relationships, and the need for maintaining the quality of the environment should be an integral part of the school curricula (Martin 2003). Researchers have found that students can effectively learn about environmental and science issues in outdoor settings at least as effectively as in the classroom (Martin, 2003). For example, in one study fourth and fifth grade students were tested on four dependent variables: (1) environmental knowledge, (2) environmental attitudes, (3) environmental behaviors, and (4) comfort level in the outdoors (Martin, 2003). These four variables can be woven together and tested in either the classroom or in the outdoors. Just as the variables are interchangeable, they have been adapted for my project in the outdoor classroom setting. The variables I adapted for sub questions are: (1) knowledge of osprey and their habitats, (2) motivation and attitude change, (3) in class behavior during field study and (4) increased engagement due to the use of tablets. Part of the data collection was also based off a scale mentioned in the article called the Likert Scale. A Likert scale is composed of a series of four or more Likert-type items that are combined into a single composite score/variable during the data analysis process (Boone, 2012).

It is vital to acquire information including the different type of survey questions to get a well-rounded view of selected choice answers and the participants' voices heard through the open responses answers. Even in the process of a Likert survey it is wise to ask probing questions to find an understanding of why the person chose their answer. A survey that had thirty-two questions including yes/no, multiple choice, and open response questions about their citizen science project created a format for the participants' voices to be heard throughout (Theobald, 2015). In order to gain a better insight and recognize students' level at the beginning of the citizen science program Entry Tickets (Appendix A) were used as a formal assessment. Similarly, at the end of the program an Exit ticket (Appendix B) was used, using comparable questions to the Entry ticket. This quick formative assessment allowed me to determine the students' prior knowledge.

METHODOLOGY

Treatment

Every seventh grade student in Calvert County Public School system attends the CHESPAX field trip. There are six middle schools in the county that have on average about sixty classes a year that attend the 7th grade Submerged Aquatic Vegetation (S.A.V.) program at Kings Landing Park in the middle of Calvert County, Maryland. Each day in the Fall (September, October) and Spring (April, May) teachers bring their class to participate in a day of citizen science, measuring water quality, identifying fish, and identifying S.A.V.

The water quality instruments were used throughout the day at different times due to the class being in two separate groups (A Group and B Group). Each school group met

us at our site location (Kings Landing Park). They entered the classroom and got a quick summary of the day and review for some prior knowledge. Students were assigned in groups with life vests and paddles. The whole class and the educators walked down to the Patuxent River. Students unloaded canoes and set them up for the class. The class was divided into two groups ranging from three to six canoes per outdoor educator. Next one group (Group A) learned how to canoe using our methods. The other group (Group B) started the day learning with a scope of the day and how to fish with a fifteen-foot seine net while wearing chest waders. Group A headed out on the river and creek first, as Group B stayed on shore to collect fish data. After each student in Group B completed the fishing collection and identification activity, they learned the basics of canoeing. As Group B set out, Group A was at their water quality site. Meanwhile Group A was learning how to take water samples, collect and identify Submerged Aquatic Vegetation (S.A.V.) and learning about the local species, including the ospreys, blue heron, bald eagles, kingfisher, and ducks. Group A ate lunch as Group B heads up the creek to their creek survey site location. Group B learned about water quality and S.A.V. collection.

Next, students were introduced to the new part of our program, which is the focus of my action research study. An osprey camera was installed in February 2016, before the ospreys migrated back north and began rebuilding their nest. The pair of ospreys has nested at the site for the past three years and this year is the first time for students to observe the osprey nest via tablet. They used the tablets to learn about the local birds of prey species and their connection to the environment. The teacher asked students about prior knowledge of ospreys and where they nest. Students asked questions about the

ospreys as they were viewed and displayed via tablet by the teacher. Both groups completed this activity, using different tablets at different times throughout the day. The tablets were used to view the ospreys. Group A used the tablets when the students just finished their lunch on the canoes. This location was usually within sight distance of the actual osprey nest. Students had been canoeing for most of the day and were comfortable in the canoes. Group A teacher told students about the process of building the camera setup, and the various parts of the camera. Then students learned characteristics of the ospreys as they passed the tablet from one canoe to the next as the canoes were rafted together. Group B was similar, however, they used the tablets earlier at the entrance of the creek where a mini lecture was given on how the plants along the shoreline hold in the soil to prevent less erosion into the creek and river. Students viewed the tablet while talking about other animals living in the area. Students also asked questions about the ospreys and other birds they had seen so far during their trip.

Timeline

The time line shows the progression of my project. Due to deadlines, I observed five middle schools of the six total that occur in the Calvert County Public Schools System. This time line changed a few times due to technology challenges approval from the Board of Education. This slowed the start date and changed the number of schools that were included in the action research data project. Another problem was that there was a state testing day that was changed and we had to reschedule another school. This made the group size small with a total of three schools.

Table 1

Timeline

December, 2015	All treatments to be finalized
January, 2016	Collect Teacher Technology Surveys
February, 2016	Osprey Camera Installation
April, 2016	Osprey Camera Public Link (Proposed)
April 7, 2016	Trial Run with Calvert Middle School (Proposed)
April 8, 2016	Plum Point Middle School (Cancelled)
April 11, 2016	Osprey Camera is Online
April 11, 2016	Windy Hill Middle School(Cancelled)
April 12, 2016	Northern Middle School
April 13, 2016	Calvert Middle School
April 14, 2016	Southern Middle School – Finish Treatment
April 15 – April 30, 2016	Analyze Data

Data Collection

Testing my AR questions required a great deal of data collection. Table 2 summarizes the data collection methodologies that were used for each study question.

Table 2

Data Triangulation Matrix

Research Questions	Data Collection Methodologies				
	Entry/Exit tickets	Teacher Surveys	Field Notes	Student Interviews	Reflective Journal
Primary: In what ways will the use of tablets outside increase engagement in a citizen science program?	X	X	X	X	X
Secondary: How will using tablets out of the classroom affect the student's motivation and attitude?		X	X	X	X

Research Questions	Date Collection Methodologies				
	Entry/Exit tickets	Teacher Surveys	Field Notes	Student Interviews	Reflective Journals
Secondary: How will using tablets to view ospreys help students to understand how ospreys are connected to the environment?	X		X	X	
Secondary: As an educator how will this action research project affect my approach to my teaching?			X		X

Data Collection Instruments

The process of collecting data is best when the instruments are diverse. The data that was collected varied from students, teachers and me as an educator. Students in Group B were given a 10 question entry ticket once they were divided into groups. Students answered questions about ospreys, technology, attitude and motivation. The exit tickets at the end of the field trip program covered the same topics and aligned closely to the same questions from the Entry Ticket. The entry/exit tickets provided a baseline quantitative data set that allowed me to investigate how students improved and how their ideas changed throughout the day. Students were also interviewed in a randomly selected group. The interview happened after students used tablets to view the osprey habitat. The interview (Appendix C) took place while canoeing. Two or three students were randomly assigned to my canoe. The process of having a random group assignment helped to create

an authentic and genuine response from students. Creating a group that was randomly selected helped to create well-balanced data that that was hopefully valid and reliable. The interview was recorded using a hand held recorder and quotes from the students were used to reinforce the qualitative data. The interview data was paired with the themes outlined in the Student Survey Table (Appendix D).

Before the spring session of trips started, I handed out technology surveys to a group of 16 middle school teachers at professional development training. These teachers have been a part of the program from one to 20 years. The teachers completed the technology survey (Appendix E) and returned it to me. Their answers were compiled into a table (Appendix F) Technology Survey. The Likert survey addressed the sub questions, “In what ways will teachers gain insight of using technology to increase student’s engagement?” and “How will using technology out of the classroom affect the student’s motivation and attitude” The Likert survey was given to 15 teachers from 6 different middle schools in the Calvert County School District.

As an educator on the citizen science field trips I took observations to see if students were engaged in the process of using the tablets. I counted the number of hands raised to see who else wanted a turn. I watched the students’ body language to see if they were more interested in other classmates than in what we were teaching. I took these notes in my observation journal for the day. The last qualitative data instrument would be the use of a journal. At the end of each day I wrote down my thoughts. I wrote what was good, what could have been better, what wasn’t good and where I saw growth, in either myself as an educator, or the students of the day. The research methodology for

this project received an exemption by Montana State University's Institutional Review Board (Appendix G), and compliance for working with human subjects was maintained.

Demographics

Calvert County is one of 24 counties in Maryland. It is located on the western shore of the Chesapeake Bay in southern Maryland. Calvert County is a peninsula that has the Patuxent River on one side and the Chesapeake Bay on the other. There are six middle schools in Calvert County. Three out of the six middle schools were studied in this action research project. A school was selected from the northern (Northern Middle School), middle (Calvert Middle School) and southern (Southern Middle School) parts of the county. Each part or pocket of the county has a diverse of population ranging from social economic and race. In total, there are 716 students in Northern Middle School (NMS) with the majority of students being white (83%). The African American culture is second with 8%, then mixed (two or more races), Asian and Hispanic. Northern Middle School is a feeder school from upper middle class families. Calvert Middle school(CMS), located 12 miles south of Northern Middle School, is more diverse than Northern. There are a total of 558 students at CMS. About one third of the students are on Free and Reduced Meal (FARMS) program at the school. This is accounted in for the citizen science field trip when the teacher arrives with extra lunches from the cafeteria. CMS is majority white but twenty percent less than NMS, at 62% white, 27% African American, 5% Hispanic and 2% Asian. Southern Middle School is 15 miles south of Calvert Middle School and near the end of our county, five miles before the bridge to enter St. Mary's County. Southern Middle School has around 562 students. They are mostly white at 71%,

and includes 18% African Americans, 6% Hispanic, 4% two or more races and 1% Asian.

DATA AND ANALYSIS

Interpretation of Results

I took each question from the Likert survey in a category that matched to a theme, which included: Engagement, Motivation, Accessibility and Teachers' Knowledge. The Likert survey helped answer "In what ways will the use of tablets increase engagement in a citizen science program?" and "How will using tablets outside of the classroom affect student's motivations and attitude?" Appendix F has explanations from teachers that gave insight into the probing question of why they answered the way that they did. Not all teachers answered the probes when they were asked. Overall, teachers seem to be comfortable using technology in the classroom. Every teacher has a smartphone or tablet; even though most of the teachers have been teaching for over 10 years they have kept up with technology in the classroom and outside of their classroom on their personal time. Fourteen out of sixteen teachers use technology on a weekly basis; while, only eleven of those use it on a daily basis. Thirteen percent of the teachers overall did not incorporate technology in their weekly lessons, and when asked why, some said "The Attention deficit hyperactivity disorder (ADHD) kids are unable to focus on the changes in the classroom". This is surprising because the average number of teachers mentioned how "the generation of today is so screen focused" but they still do not use technology with the ADHD students

In the Likert survey, teachers were asked to define technology in the classroom. Collectively the teachers defined technology as any tools beyond paper, pencils, and books used to aid in instruction, simplify and enhance students' educational experience, help students do work, or allow students to see and learn in a new way and listed such tools as the internet, computers, video cameras, tablets and smartphones. Over ninety percent of teachers were confident using multiple forms of technology ranging from computers to smart phones. When comparing question five (about teachers being confident with multiple forms of technology) to question thirteen, which concerned students' engagement and motivation increasing when students collaborated together, I observed in my analysis a strong correlation of .97. This correlation was observed when students worked together on projects in the computer lab or using online simulations. I also observed that there was an equal amount of teacher confidence and student engagement with technology. The combination of teacher confidence and student engagement is very promising for the future use of technology in the classroom. Teachers are willing not only to teach students with technology, but learn the different types of technology. I feel technology will have to be mainstreamed across schools so it is easier for students, parents, teachers and administration to facilitate and troubleshoot with everyone that is involved in using the technology. This process of mainstreaming would help students to have a good foundation with technology in the future to use one proficiently, and yet allow them to use the tools to use programs like Microsoft Office on more than one operating system.

I have used both the teacher technology survey and the interview to help answer such questions as “In what ways will technology increase engagement” and “How will using tablets out of the classroom affect students’ motivation and attitude?” Student engagement begins with the teacher, i.e., first they have to be engaged to begin engage the students. The use of technology is a natural attraction and interesting to the students in the first place, but the teacher needs to know how to use technology devices efficiently, and to show confidence in the students while they are using it. One teacher noted that technology’s effectiveness is short-lived once the novelty wears off. The student interview data is displayed in appendix D. A student in the interview mentioned “for the most part we only use phones or technology to look up a definition” another student mentioned “sometimes we use an app called Kahoot! ... it is a fun multiple choice game to play”. All of the students agreed that class would be more interesting when using their cell phone or tablet in the classroom along with their labs and day to day activities. Most students complained how they wanted to use Snapchat or other apps in the class when they aren’t supposed to use it within the school property.

There is a positive feeling towards technology from the students and teachers, even when the teachers do not feel confident working with Apple (Apple, Inc., Cupertino, CA) and Android (Google, Inc.) devices. Most students feel that teachers are not fully capable of using new technology in the classroom. However, in comparison according to the survey only fourteen percent of the teachers are fearful of using technology in the classroom because they may be unfamiliar with it. Over eighty percent of teachers say

that they use technology on a weekly basis. This technology could vary from a Smart Board to a television.

The data collected from the Entry and Exit tickets helped to answer the primary question, in what ways will the use of tablets outside increase engagement in a citizen science program, and the secondary question, how will using tablets to view ospreys help students to understand how ospreys are connected to the environment? The resulting data showed a variety of interesting patterns (Tables 3-6). There was an increase in understanding of osprey biology for all three schools from the Entry Ticket to the Exit Ticket. The Entry Ticket was a probe to see what students knew already from class or other outdoor experiences with ospreys. The Exit Ticket was used to measure what was learned during the lesson of ospreys while using the tablets.

Table 3 displays these increases from each individual at Northern Middle School. Each question that was answered correctly they received a point of 1. If it was answered incorrectly, or answered “I don’t know” no points were given. On average there was a 33% change their before and after knowledge. Twelve percent of the students scored exactly the same, while the other eighty-eight percent increased their scores on average of one point, which is a twenty percent increase.

Table 3
Student Data from Northern Middle School

Northern Middle School n=15				
Student No.	Entry Ticket	Exit Ticket	Difference	% Change
1	4	5	1	25%
2	3	4	1	33%
Northern Middle School n=15				

Student No.	Entry Ticket	Exit Ticket	Difference	% Change
3	4	5	1	25%
4	3	5	2	67%
5	4	4	0	0%
6	2	4	2	100%
7	4	4	0	0%
8	3	5	2	67%
9	4	5	1	25%
10	3	4	1	33%
11	4	5	1	25%
12	2	5	3	150%
13	3	4	1	33%
14	4	5	1	25%
15	5	5	0	0%
AVERAGES:	3.4	4.6	1.1	33%

Calvert Middle School data varied from Northern Middle School by having a larger increase of change from the Entry to Exit Surveys (Table 4). Some students come in with prior knowledge, resulting in lower percentage knowledge gain. Some students come in with fairly weak environmental knowledge and were engaged with the use of tablets, resulting in a higher percentage of knowledge gain. Most students from CMS scored poorly on the Entry Ticket with an average of 54% grade, however once shown the tablet along with the information students increased their scores to the 84%. The difference of thirty percent could be from a few factors such as lack of exposure, school atmosphere, and teachers in the school. Students having a lack of exposure would be the greatest of these factors, an assumption which was backed up in the interview when students did not know the river they were paddling on and hadn't ever been on the river before. For example, when asked about our location, many students answered "the

Chesapeake Bay,” although we were on the Patuxent River. Access to the river in the county is limited to a few parks and mostly private communities. Parents of students in the central and southern end of the county have less time to take off from work. Most of them work jobs that do not allow for much personal leave. The majority of the parents in the northern end of the county work for the Federal Government in Washington, D.C.

Table 4
Student Data from Calvert Middle School

Calvert Middle School n=15				
Student No.	Entry Ticket	Exit Ticket	Difference	% Change
1	2	4	2	100%
2	3	4	1	33%
3	2	4	2	100%
4	2	4	2	100%
5	3	4	1	33%
6	4	5	1	25%
7	3	4	1	33%
8	3	4	1	33%
9	4	5	1	25%
10	2	4	2	100%
11	2	4	2	100%
12	4	5	1	25%
13	3	4	1	33%
14	2	4	2	100%
15	2	4	2	100%
AVERAGES:	2.7	4.2	1.47	54%

Southern Middle School is Calvert County’s Middle School second closest to Patuxent River Naval Air Base. Most students’ parents in this area commute across the county bridge for work. In comparison, the northern part of the county around Northern Middle School has families working in the Anne Arundel and Washington D.C. area.

Southern Middle school ranges in different family classes. These family classes vary from low income housing, employment through at Patuxent Naval Air Base, retiree's and the upscale neighborhoods of Solomon's Island. The students scored the highest on the Entry Ticket with a total of 4.6 on average scored per student. This school's students seemed to be coming in with higher amount of previous knowledge. This entry ticket high score created 23% change of score. This shows that even for schools that have students with more local environmental exposure the use of tablets helps to increase overall understanding, although at a lower percentage than for school's with students that attended the program with little prior knowledge. All students in every school increased their score or remained the same. Students either had 4 or 5 correct answers on the exit ticket. The lowest score on the entry ticket was 2.

Table 5
Student Data from Southern Middle School

Southern Middle School n=15				
Student No.	Entry Ticket	Exit Ticket	Difference	% Change
1	4	5	1	25%
2	4	4	0	0%
3	3	4	1	33%
4	4	5	1	25%
5	5	5	0	0%
6	3	5	2	67%
7	4	4	0	0%
8	3	5	2	67%
9	4	4	0	0%
10	4	4	0	0%
Southern Middle School n=15				
Student No.	Entry Ticket	Exit Ticket	Difference	% Change
11	3	4	1	33%

12	4	5	1	25%
13	3	4	1	33%
14	2	3	1	50%
15	3	4	1	33%
AVERAGES:	3.5	4.3	0.8	23%

Question 2 (Appendix D) on the Exit ticket was created to find what students' reactions were to using tablets to view the ospreys. This question gave a chance to get reactions from all students, as some I could not see and question during our lesson on ospreys in the nest using the tablets while we were in multiple canoes. This question was a multiple choice emoticon question. Students were asked to circle which emoticon met their reactions the best. The emoticons were Like, Love, Meh, Yay, Wow, Sad, and Angry. The options were both given a matching emoticon similar to one you would find on a social media website like Facebook. All students circled more than one. All students either circled the like or love option in Table 5. In addition to their first reaction, students also circle one or two more. The most common one was the Yay or Wow reaction with 77 percent of the students. Students would often say during our trips while using the tablets, "WOW! I have never seen an osprey eating a fish so close before" and they would ask things such as "What kind of fish is he eating?" or "Do osprey ever eat S.A.V?" These types of questions both showed students' enthusiasm for viewing the osprey via tablet and opened up further discussion of the surrounding environment. The other third of students circled sad or angry. Which implied that students thought it was interesting to see and use a tablet, but an osprey was not viewed on the tablet. On the day an osprey was not on the nest I noted it on my journal. Students learned that the ospreys

were not there due to us being on the creek, eagles in the area, or even possibly predators like the Great Horned Owl. Students were still excited to see and pass around the tablet in the canoes, which are represented in Table 6 of students’ reactions of all students loving and liking the tablet.

Table 6
Students Reactions to Tablet Use (n=45)

Category	 Like	 Love	 Meh	 Yay	 Wow	 Sad	 Angry
Total Circled	26	19	0	15	15	12	3
Percent	58 %	42 %	0 %	33 %	33 %	27 %	7 %
Total	100 % 45 responses		100 % 45 responses				

Note. All students chose 2 responses each. Each student chose either a Like or Love, and also one of the face emoticon equaling a total of 90 responses overall.

Two main themes were found in my journal: Attention and Interest and Connections through Understanding and Comprehension. Students increased their attention to all birds in the surrounding environment. Students paid more attention to ospreys for the rest of the trip and noticed other birds flying in the sky. One student even saw an osprey dive bomb a bald eagle because it was near its nest. Connections were made leading to a greater interest in the food cycle. Most students are invested in the seafood industry from fishing for Rockfish (Striped Bass) on the weekends or eating crabs. Students connect how Ospreys are connected to the fish they eat, and how those fish live in the Submerged Aquatic Vegetation. This connection directly meets with the

lesson of water quality of the creek and surrounding watershed. Students see how if the water quality is low, the fish will not breed and be safe in the SAV, and ultimately Ospreys and other birds will not stay around in an unhealthy habitat. Journaling at the end of the day helped to sort out the ways Group A and B were using each tablet. Giving students personal time with tablets during a non-instructional time with a discussion afterwards was more effective than lecturing on osprey characteristics while the tablet being passed around.

CONCLUSION

My action research has been a series of trails. At first, it went in the direction of looking at one of the many citizen science programs within the CHESPAX department. This trail ended with a focus on the 7th grade program. It was the program I was part of 20 years ago when I was in 7th grade. Eventually, the path led to a grant to install a camera at an osprey nesting platform. Students would be able to use tablets to view the ospreys. This helped me with my main question: In what ways will the uses of tablets outside increase engagement in a citizen science program? With technology bridging the gap to viewing the natural environment of ospreys, students encountered these birds of prey as they had never seen them before. I have learned that students can connect better to the natural environment using tablets, especially those students who think all bugs are out to get them and dirt is yucky. Exposure to the environment is less overall as sports are increasing year round and fewer opportunities are geared towards the environment. Most students would rather play lacrosse, basketball, or other sports instead of spending time outdoors. During the field trip experiences students had a more intimate, up-close view of

the osprey and nest using the tablet. The tablet created a connection that 7th graders felt comfortable with, especially those who were initially uneasy and unfamiliar with nature.

Incorporating technology further in the program is possible in other areas of the field trip. I would like to acquire more tablets for students to share. Students could have more one to one time with the tablets increasing the time they are able to watch ospreys. However, I found that when teachers showed students the camera website in the class prior to the field trip it created a less interested audience during the program. It was best for students to see the osprey via tablets for the first time in the field. It could be beneficial to continue viewing the osprey in class after the field trip, but not before. After the field experience, students could also view the ospreys on their own devices and share screenshots through twitter of the bird when they see them with fish or a funny look on their face. A future change to the program would be to include a fish identification part of the program while using tablets. I want to see the same students who think fish are disgusting become interested in their world. This would happen by collecting fish with water in plastic bags. Students can hold the bag, not the fish, and identify them using a fish identification app through the Maryland Department of Natural Resources.

VALUES

Through action research I have become a more reflective teacher. I have paid careful attention to my daily teaching and students' responses. My action research project has connected me closer to my coworkers and created a healthy working relationship allowing technology in the outdoor classroom to increase engagement and close up observation of the natural environment. For example, after the first few days of the

treatment my coworkers and I discussed how to troubleshoot problems with technology while out on the water. This note was recorded in my journal of how things were changing while using the tablets. I was able to share with them ways to live stream in the field and refresh the video rather than being stuck with a frozen image.

Because of this project I am working more closely toward my values as a teacher. When I graduated with my undergraduate degree in elementary education, engagement was a part of my philosophy of education. It is great to come full circle and still be focused on my value of engagement with students. I have gained satisfaction to connect the engagement value to technology where students have a prior safety feeling with tablets.

Action research has given me a systematic approach to looking at something new and challenging to a level where I can facilitate something new and analyze it throughout the process. I will continue to pursue action research with my coworkers no matter if I am working in a classroom or a future office. This project will help me in the future to write up Student Learned Outcomes (SLO) which are highly data driven. I have talked to many teachers who have trouble with that area. This project is giving me a confidence to go in those areas knowing I will be able to exceed expectations. In the future years, the program will evolve in a more technological citizen science experience. I know next in the making is working with an application on the tablet to help identify fish. As the budget expands for technology, the number of tablets will increase too, and students will record their data on the tablet instead of paper.

Things have changed throughout my experience with the capstone action research project. There are some things I would do again and others I wouldn't. First of all, I would have planned for a project that I could implement sooner in the school year allowing me more time for data analysis. It was a hard timeline to keep when some things were out of my control. For example, the camera was installed later than expected and the tablets arrived on time but were not fully up and running till the end of the S.A.V. program for the season. Teachers and students are involved with the S.A.V. program through the use of an incorporated multi-week unit where students look at data from previous years. Due to the low averages in the data, it may be helpful to create a lesson or two about ospreys and other animals of how they depend on the S.A.V. This lesson would help students to bring a larger background knowledge with them to the field trip.

At the end of the project I was left with some unanswered questions. These questions are from my outside view of the relationship of students to teachers on their view of technology. According to the surveys teachers are using and implementing technology, but students only mentioned technology in the classroom as Smartboards, projectors, and the use of hand held technology mainly limited to the same app(Kahoot) and the use of it as an encyclopedia. I keep asking myself, why isn't more technology involved in learning, not just instruction? Is there not enough time or resources? How can we grow with technology in curriculum while still keeping students engaged?

The use of a journal and recording my interview with the student groups has given me a lot to reflect about. I have paid close attention to the way I speak to students. I will continue to record myself in the future so I can listen closely to how I speak to the class

and to individual students. The observation journal during the program helped me to formulate my thoughts to students' responses later in the day. The daily reflection helped me to see how things worked out and a reminder of what to do differently. For example, the first day it was difficult for me to read the interview questions with the wind blowing while out in the canoe in the creek. I journal about this and corrected it for the next day and wrote them down on my write in the rain notebook. I do not think I would have easily corrected this problem without the use of the reflecting at the end of the day.

Implementing in the lesson inside or outside in the classroom is essential for today's students. The technology has to have a purpose for the classroom and fit the needs of the students. If the novelty is wearing off, the teacher needs to use it less or find something new to incorporate in the lesson. Technology helps to bridge the gap of engagement for the students who would rather be connected to their device than to the learning in the classroom. Creating an atmosphere of using technology can create for students a foundation of digital responsibility.

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APPENDICES

APPENDIX A
ENTRY TICKET

Date: _____

Initials: _____

ENTRY TICKET – OSPREYS

- 1. Have you ever seen an Osprey before?**
(A) Yes
(B) No

- 2. What does it look like?**
(A) White head, white tail
(B) looks like a hawk
(C) looks like a vulture
(D) I don't know

- 3. What is the primary food source Ospreys?**
(A)Plants
(B)Fish
(C) Plants and Fish
(D) I don't Know

- 4. What is the habitat of the Osprey?**
(A) They nest on the ground
(B) They nest near and around the water
(C) In a bird box
(D) I don't know

- 5. In what ways are Ospreys directly connected to Submerged Aquatic Vegetation (S.A.V.)?**
(A)They eat the S.A.V.
(B)They eat the fish the live in the S.A.V.
(C) If the water is clear, they can't drink it
(D) I don't know

- 6. What chemical nearly wiped out Ospreys and other birds of prey 25 years ago?**
(A)DDT
(B)Pesticide
(C)Fertilizer
(D) I don't know

APPENDIX B

EXIT TICKET

Date: _____

Initials: _____

EXIT TICKET – OSPREYS**1. Did you see an Osprey on the tablet?**

- (A) Yes
- (B) No

2. What was your reaction? Circle two that best fits your reaction.

Like Love Meh Yay Wow Sad Angry

3. Will you log on again to see the Ospreys?

- (A) Yes, on the phone/tablet
- (B) Yes, on the computer
- (C) Yes, in the classroom
- (D) No

4. What does it look like?

- (A) White head, white tail
- (B) Black band over the eyes with white and mostly black on the wings like a hawk
- (C) All black like a vulture
- (D) I don't know

5. What is the primary food source Ospreys?

- (A) Plants
- (B) Fish
- (C) Plants and Fish
- (D) I don't Know

6. What is the habitat of the Osprey?

- (A) They nest on the ground
- (B) They nest near and around the water
- (C) In a bird box
- (D) I don't know

7. In what ways are Ospreys directly connected to Submerged Aquatic Vegetation(S.A.V.)?

- (A) They eat the S.A.V.
- (B) They eat the fish that live in the S.A.V.
- (C) If the water is clear, they can't drink it
- (D) I don't know

8. What chemical nearly wiped out Ospreys and other birds of prey 25 years ago?

- (A) DDT
- (B) Pesticide
- (C) Fertilizer
- (D) I don't know

APPENDIX C
STUDENT INTERVIEW QUESTIONS

1. What Body of water are we on right now? When did you first learn that?
2. Have you been on this river or the Chesapeake Bay before? Can you tell me when?
3. What are you learning in Science right now??
4. Do you have a cell phone or tablet? What kind do you have?
5. Are you able to use your cell phone, tablet in the classroom?
Probe - Why or why not?
6. Did you have to sign an agreement or contract to use it in the classroom?
7. Do you complete your homework on your device?
Probe – Why do you do that instead of a computer?
8. Do you find class more interesting when you can use your technology?
Probe – Give me an example how you have used it in class?
9. Do you feel that everyone has access to technology in the classroom?
Probe – What about home?
10. Do you feel like you are learning in science class?
Probe – Do you feel you could learn more if more technology is involved like tablets?
11. How could you use an app on this trip?
12. Have you used your device besides writing homework in school?
13. “Do you have any additional thoughts you would like to share?”

APPENDIX D

STUDENT INTERVIEW RESPONSES

Student Interviews n = 17				
Question	Brief Summary	Student's Answers and Quotes	Agree/Yes	Disagree/No
1	Location on water	Most students said the Chesapeake Bay	4	13
2	Been here previously	Fishing with my dad, tubing on the water	6	11
3	Learning in Science now	Cells, genetics, adaptations, I don't know	n/a	n/a
4	Own cell phone or tablet	Most students have them and have had them for at least a year. "I have one and its broken, but my mom is going to fix it"	17	0
5	Use cell phone in the classroom	"We use Kahoot in a lot of my classes" "yes, Kahoot!, but most people log on and get bored and start playing madden"	17	0
6	Required to sign an agreement	No, most people don't sign it, but still use their phone in class. "I did sign the form to describe your phone, in case you lost it"	17	0
7	Complete HW on Device	"I will use it for an Edmodo assignment, but not for writing papers"	7	10
8	Class is more interesting with device	"I wish we could use other apps in class...there are so many and its boring to use Kahoot now"	17	0
9	Everyone has access to technology	"All of my friends have a phone or IPod...friends can still text on an IPod"	13	4
10	Remember with technology	"I remember more when using technology and working on group projects"	10	7
11	Cool apps / for this trip?	Instagram (but a photo of Hydrilla wouldn't get a lot o likes), twitter, snapchat, make a video.	10	7
12	Other use of your cellphone/tablet	"mostly play games"	n/a	n/a

APPENDIX E
TECHNOLOGY SURVEY

Teacher Survey**Initials:**Circle the level that you agree or disagree with the following statements**1. How would you define technology in the classroom?**What technology is available to you and your students?**2. Do you own a smartphone?**

{ Yes ----- No }

3. Do you own a tablet?

{ Yes ----- No }

If answered yes (Question 2 or 3), what type of smart phone or tablet do you have?**4. Students are more engaged when technology is involved in the classroom**

{ Strongly Agree ----- Agree ----- Disagree ----- Strongly Disagree }

Why did you answer the way you did?**5. Technology drives student's motivation**

{ Strongly Agree ----- Agree ----- Disagree ----- Strongly Disagree }

6. The use of technology encourages collaboration among students

{ Strongly Agree ----- Agree ----- Disagree ----- Strongly Disagree }

Give an example of collaboration among students using technology.**7. Technology today tends to distract students from schoolwork rather than to help them academically**

{ Strongly Agree ----- Agree ----- Disagree ----- Strongly Disagree }

Explain your answer:**8. Students complete their homework using a tablet or phone**

{ Strongly Agree ----- Agree ----- Disagree ----- Strongly Disagree }

- 9. I am fearful of students using personal devices because I am unfamiliar with them**
 { *Strongly Agree* ----- *Agree* ----- *Disagree* ----- *Strongly Disagree* }
- 10. The use of technology on field trips would encourage student engagement**
 { *Strongly Agree* ----- *Agree* ----- *Disagree* ----- *Strongly Disagree* }
- 11. Most students have access to personal tablets or cell phones**
 { *Strongly Agree* ----- *Agree* ----- *Disagree* ----- *Strongly Disagree* }
- 12. The use of technology in the classroom changes the student attitude towards learning**
 { *Strongly Agree* ----- *Agree* ----- *Disagree* ----- *Strongly Disagree* }
- 13. I use technology with my students on a weekly basis**
 { *Strongly Agree* ----- *Agree* ----- *Disagree* ----- *Strongly Disagree* }
What type of technology do you use with your students?
- 14. I feel I am confident in using multiple forms of technology with students**
 { *Strongly Agree* ----- *Agree* ----- *Disagree* ----- *Strongly Disagree* }
- 15. Tablets/Smartphones in the outdoor classroom will increase engagement on field trips**
 { *Strongly Agree* ----- *Agree* ----- *Disagree* ----- *Strongly Disagree* }

APPENDIX F
TECHNOLOGY SURVEY DATA

Likert Survey Question	Theme	Survey Sub Category	Average Score n=16	Comments
1	Teachers Knowledge / Accessibility in the classroom	Teachers Knowledge	N/A	Smartboard, Teacher and Students Computers, BYOD Policy, Stream Books, Nooks, Personal smartphones, Flip Cameras, Document Cameras, Wi-Fi, Internet, Microscopes
2	Cell Phone Ownership	Accessibility / Teachers Knowledge		Yes: 15 / No: 1
3	Tablet Ownership	Accessibility / Teachers Knowledge		Yes: 8 / No: 8
Explanation	Ownership Types	Teachers Knowledge		Apple: 6 / Android: 9 / None:1
4	Teachers Fearful Using Technology	Teachers Knowledge	3.31	N/A
5	Confidence using Multiple Forms	Teachers Knowledge	1.75	N/A
6	Students' Access to Handheld technology	Accessibility	1.87	N/A
7	Completion of HW using Technology	Accessibility	2.68	N/A
8	Teaching with Technology on Weekly Basis	Engagement	1.81	They are a screen focused generation, Only when the technology is current, listen to music during CW,(Focus), The effectiveness is short-lived once the novelty wears off, Without technology of some sort, students are not engaged much at all, Students are very motivated by electronic devices and they enjoy the challenges that technology can provide, They relate to technology better than just printed info, They can be more engaged but it depends on the task, This is a class to class, kid to kid basis. I see lots of distraction when using, Sometimes they use the device for personal fun - not the assignment, Can Sometimes be distracting

9	Teaching with Technology on Daily Basis	Engagement	2.13	N/A
Likert Survey Question	Theme	Survey Sub Category	Average Score n=16	Comments
10	Students are more engaged with Technology in the classroom	Engagement	2.13	Students are very motivated by electronic devices and they enjoy the challenges that technology can provide...They are also more distracted.....They love it...They relate to technology better than just printed info...They can be more engaged but it depends on the task...This is a class to class, kid to kid basis. I see lots of distraction when using... Can Sometimes be distracting...Without technology of some sort students are not engaged much at all...They are a screen focused generation...Only when the technology is current...The effectiveness is short-lived once the novelty wears off...Listen to music during CW to help them Focus
11	Technology Drives Student's Motivation	Motivation	2.4	N/A
12	Use of Technology encourages Collaboration	Collaboration	2.2	Students become absorb in technology, that they resent working in groups, working together in computer lab with Online Lab Stimulations, Technology speeds collaboration...not enhancing collaboration, Personally, I have noticed less "meaningful" collaboration since using technology more, Students will show each other different things on the website or search additional information, Students working on a group assignment on their own personal laptop, Working Together to solve a task, Flip cameras to create a PSA on a topic, Share and Discuss their research

13	Technology distracts Students from Productive work	Engagement	2.2	10 years ago technology could have been distraction, now it is so common place, students are not likely to be distracted, when it helps students understand or make a connection to what we are learning it is a great tool, , When not given a focus, games or other apps are used more frequently, Technology allows students to engage in many types of activities, some of which are more interesting than schoolwork, Since I have incorporated daily use of smart phones in class, I have many distractions that lead to arguments
14	Technology changes Student's Attitude of Learning	Attitude	2.33	N/A
Likert Survey Question	Theme	Survey Sub Category	Average Score n=16	Comments
15	Technology outside increases Engagement	Engagement	2.33	N/A
Additional Comments				Always need a back up plan, Technology is a tool, my fear is from students engaging in inappropriate websites or use cell phones inappropriately.

APPENDIX G
IRB EXEMPTION LETTER



INSTITUTIONAL REVIEW BOARD
For the Protection of Human Subjects
FWA 0000165

960 Technology Blvd. Room 127
 c/o Immunology & Infectious Diseases
 Montana State University
 Bozeman, MT 59718
 Telephone: 406-994-6783
 FAX: 406-994-4303
 E-mail: cherylj@montana.edu

Chair: Mark Quinn
 406-994-5721
 mquinn@montana.edu
Administrator:
 Cheryl Johnson
 406-994-6783
 cherylj@montana.edu

MEMORANDUM

TO: Steven O'Neill and Walt Woolbaugh
FROM: Mark Quinn, Chair *Mark Quinn Ch.*
DATE: January 4, 2016
RE: "In What Ways Will the Use of Tablets Outside Increase Engagement in a Citizen Science Program?"
 [SO010116 EX]

The above research, described in your submission of January 4, 2016, is exempt from the requirement of review by the Institutional Review Board in accordance with the Code of Federal regulations, Part 46, section 101. The specific paragraph which applies to your research is:

- (b) (1) Research conducted in established or commonly accepted educational settings, involving normal educational practices such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.
- (b) (2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability, or be damaging to the subjects' financial standing, employability, or reputation.
- (b) (3) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under paragraph (b)(2) of this section, if: (i) the human subjects are elected or appointed public officials or candidates for public office; or (ii) federal statute(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.
- (b) (4) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available, or if the information is recorded by the investigator in such a manner that the subjects cannot be identified, directly or through identifiers linked to the subjects.
- (b) (5) Research and demonstration projects, which are conducted by or subject to the approval of department or agency heads, and which are designed to study, evaluate, or otherwise examine: (i) public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in or alternatives to those programs or procedures; or (iv) possible changes in methods or levels of payment for benefits or services under those programs.
- (b) (6) Taste and food quality evaluation and consumer acceptance studies, (i) if wholesome foods without additives are consumed, or (ii) if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the FDA, or approved by the EPA, or the Food Safety and Inspection Service of the USDA.

Although review by the Institutional Review Board is not required for the above research, the Committee will be glad to review it. If you wish a review and committee approval, please submit 3 copies of the usual application form and it will be processed by expedited review.