

HOW DOES THE USE OF DIGITAL PHOTOGRAPHY AFFECT STUDENT
OBSERVATION SKILLS AND DATA COLLECTION DURING OUTDOOR FIELD
STUDIES?

by

Candice M. Lommen

A professional paper submitted in partial fulfillment
of the requirements for the degree of

of

Master of Science

in

Science Education

MONTANA STATE UNIVERSITY
Bozeman, Montana

July 2012

STATEMENT OF PERMISSION TO USE

In presenting this professional paper in partial fulfillment of the requirements for a master's degree at Montana State University, I agree that the MSSE Program shall make it available to borrowers under rules of the program.

Candice M. Lommen

July 2012

TABLE OF CONTENTS

1. INTRODUCTION AND BACKGROUND	1
2. CONCEPTUAL FRAMEWORK	4
3. METHODOLOGY	9
4. DATA AND ANALYSIS	19
5. INTERPRETATION AND CONCLUSION	45
6. VALUE	48
7. REFERENCES CITED	51
8. APPENDICES	53
APPENDIX A: Lessons for Treatment and Non-treatment Study Periods	54
APPENDIX B: Plant Observation Rubric for Drawings and Photos	59
APPENDIX C: Forest Observation Protocol	62
APPENDIX D: Student Behavior Self-Assessment Questionnaires	65
APPENDIX E: Focus Group Interview Questions	70
APPENDIX F: Examples of Student Work	73
APPENDIX G: IRB Exemption Letter	76

LIST OF TABLES

9. Data Collection Matrix.....	13
2. Changes in Students Interest Levels.....	21

LIST OF FIGURES

1. Student Engagement	20
2. Frequency of Student Behaviors.....	27
3. Overall Student Behavior by Activity.....	30
4. Observation Rubric Scores	35

ABSTRACT

The purpose of this project was to determine if adding digital photography as a tool for collecting data during outdoor field study would increase student engagement and also improve the quality of the data students brought back to the classroom. Too often my students would come in from the field with data that focused on surface or irrelevant features. They were unable to use their data to make connections to the ecology concepts we were learning in the classroom. During the non-treatment phase of the study, students recorded all of their data through drawings and written observations. While at their plots, students inventoried the vegetation present and also took specific measurements such as tree circumference, canopy cover and invasive plant cover. Before taking the cameras out to the field, students practiced with the macro settings to take close up pictures of vegetation brought into the classroom. During the treatment phase, students took digital cameras out to their new plots to inventory and measure plants. Student engagement data was measured using a self-assessment questionnaire, outside observer behavior checklist and teacher field journal. Although interest and engagement were high for most students during the entire study, students who were not initially engaged in the field study activities reported higher engagement levels when cameras were used. The outside observer and teacher journal data supported this finding. The quality of student data was measured using both the student self-assessment questionnaire and drawing or photo rubrics. Rubric scores increased when students used photographs, rather than drawings, to write observations. Students felt they had more to write about when looking at their pictures as compared to their drawings. Interestingly, students reported they wrote less while at their plots when they had the camera, relying on their pictures to tell the story of their plot. Using photos only slightly increased students' ability to positively identify their plants. Pictures lacked those complex features that would enable students to easily work their way through a basic key. To increase the complexity of observations, additional content knowledge about plant structure and ecology is needed.

INTRODUCTION AND BACKGROUND

My teaching is grounded in the ideals of relevance and life-long learning. My vehicle for engaging students in authentic science learning is through the use of field studies in our school-yard and community. For years I have enthusiastically traipsed through the woods with my students as they collected data to complete descriptive studies and investigate ecological concepts. The students loved being outside, but I became increasingly frustrated with a “recess” mentality that sidetracked the students with off-task behaviors. Often the data we collected was unusable as evidence for answering our questions or even identifying the plants and animals on our plots. Students were also not applying the information they gathered outside to the bigger concepts we were studying, and I began to wonder if outdoor learning was the most effective use of our time. How can I continue to advocate for the benefits of outdoor study with my peers when my own students don’t understand the difference between research and recess? I decided to research new ways to engage my students during field studies to improve the quality of data collected and improve my teaching practices when using the school yard as my classroom. The idea of using digital photography to engage my students in data collection came from an article I read in the National Science Teachers Association journal *Science Scope* (Walker-Livingston, 2009). Walker-Livingston took her students on a digital scavenger hunt to look for those details about plants that help students identify different plant species.

Purpose

The purpose of this study is to determine if using digital photography during outdoor field studies will increase engagement and improve the quality of data collection and observations. Specifically, I will be investigating the following questions:

- How does the use of digital cameras change the level of student engagement during outdoor field studies?
- How does the use of digital photography affect the quality of student observations during outdoor field studies?
- How will my instructional practice change as I incorporate digital photography into my outdoor field studies?

I hope my research will be significant to seventh grade teachers in my district who have expressed a desire to take their students outside, but are not convinced the level of student learning can be obtained from going outside. In addition, my district has purchased digital cameras for this study with the expectation that I document specific activities that can be done with the cameras during field studies. At the end of seventh grade, students participate in a local field experience to document the health of a forest and make recommendations to the community for improving or maintaining forest health. I hope digital photography will add to the quality of the data we collect and analyze.

Support Team

I have included several colleagues on my support team who seem truly interested in my research. Laurie Harrington is the Language Arts teacher on my team at Cedar River Middle School. Laurie processes information very carefully, asks excellent

clarifying questions and gives constructive feedback. Laurie also has experience with the action research process from her master's work two years ago. She is my proofreader and main sounding board.

My principal, Andy McGrath, has many years of experience working with middle school age students and understands how they think. Andy was an advisor for previous staff member's action research so he is familiar with the process. He has also helped me collect data when I need an extra set of eyes.

Dave Reynoldson is another seventh grade science teacher at my school. He is very familiar with the curriculum I am using during my research project and my teaching philosophy. He shares a love of outdoor field study, and is interested in how the results of my action research will change my instructional approach to our ecology unit. Dave has given me excellent feedback on my data collection instruments developed for the study.

Wendy Whitmer is the Regional Science Coordinator for Educational Service District 101 in Spokane, Washington and is also getting her Masters of Science in Science Education degree from Montana State. Wendy and I once taught together for many years and she is familiar with my teaching style and instructional approach. For the past year we have collaborated regularly on our action research projects. Wendy is able to see many sides of a problem and as a result asks great probing questions. She has helped me to match my research questions with my data collection and offered ideas for analysis.

Last summer I took a wetland ecology class from Joe Bradshaw, and I appreciated his enthusiasm for my study site. He gave me quite a few ideas for methods of studying

my site, so it seemed like a natural fit to ask him to be my science reader for this work. The feedback he has offered thus far has helped me to clarify some of my research methods.

I would be remiss if I didn't mention my husband, Reed, as part of my support team. Reed also teaches seventh grade science and totally "gets" middle school students. He has helped me polish up many papers and was actually instrumental in helping me narrow down my study focus.

CONCEPTUAL FRAMEWORK

What better way to learn about ecology than to take kids outside to experience the environment? However outdoor learning experiences lose their effectiveness if the students are not collecting useable data. I wondered how I could help my students get excited about observing our school grounds and collecting data that adds to their understanding. Using digital cameras to capture detailed pictures of forest plants seemed like a promising approach, however would just putting cameras in my students' hands be enough to make the outdoor experience more meaningful? What are the challenges and benefits of using the school-yard as a learning space and for using technology to collect data? During my literature review, I focused on both the effectiveness of the school yard as a learning environment and also the relationship between developing inquiry skills- such as observation-and more meaningful outdoor learning. I was also interested in how other teachers have used digital photography for data collection in their classrooms and if they found any increase in student engagement with the use of the cameras.

Outdoor learning is commonly thought of as experiential learning, defined as authentic experiences and learning by doing. Broda (2007) breaks it down even further by defining schoolyard-enhanced learning as “an instructional strategy that uses the school site or adjacent areas to teach concepts and process skills from a variety of content areas” (Broda, 2007, p. 12). Educational researcher Linda Cronin-Jones (2000) compared the cognitive gains of 3rd and 4th graders of mixed ability levels during a 10-day ecology unit to determine the effectiveness of outdoor instruction on environmental science content knowledge and attitudes. During the study, half of the students received traditional classroom instructional activities and the other half participated in some of these same activities with an additional component of outdoor lab activities and field observations. Data from pre- and post-lesson assessments found significant cognitive gains in the outdoor groups compared with the indoor only group. Although her hypothesis was supported by the results of her study, she believes more research is needed to determine which types of outdoor activities are more effective than others in promoting cognitive gains, motivating reluctant learners, and increasing student achievement.

Studies of student engagement suggest that students become motivated to learn when they feel the tasks are authentic, relevant and challenging (Broda, 2007; Marks, 2000). Crowder (2010) examined the effectiveness of outdoor learning environments on student engagement. As a high-school principal concerned with retention of students, Crowder followed several different classes of students outside as their teachers taught them math, poetry and science lessons. Her findings suggest that in addition to the cognitive challenge of the task, students were motivated by their positive feelings about

the outdoor environment, and the idea that their work could have implications beyond the classroom walls. Students in Crowder's study also demonstrated an increased understanding of complex concepts because of their engagement during these experiences. Clearly the outdoor learning environment increases student engagement and motivation, but how effective is it for developing a student's ability to be an observer and collect data? If my students were more engaged while outside at their plots, would their science process skills show improvement?

Most people, including classroom teachers, believe that the skill of observation is easy and all children are great observers because they are naturally curious. Eberbach and Crowley (2009) completed an extensive review of science education studies to determine what it means to observe within a science framework. They discovered that a student's ability to observe nature is really a very complex skill that requires careful scaffolding by the teacher. Children tend to observe only surface features because they lack domain knowledge. When students do not receive adequate background knowledge; that is, adequate background knowledge for the task. Without this knowledge and instructional support before beginning the activity, "observation becomes a weak method for collecting data rather than a powerful method for reasoning scientifically" (Eberbach & Crowley, 2009, p. 46). Children also do not use their observations to construct meaning or connect what they observe to the content they are learning in the classroom. The authors believe the reason for this lack of transfer may be due to incomplete or irrelevant data. Eberbach and Crowley go on to say that knowledge in itself is not enough. Children also need supportive learning environments and appropriate tools to help them develop as scientific observers (Trumbull, Bonney & Grudens-Schuck, 2005;

Gunckel, 1999). This has great implications for my teaching. What instructional practices have I used prior to this study and how effective were they at developing student observation skills? A look at best practice when using the outdoor school yard as a learning environment is needed.

Learning in the school yard lends itself naturally to the practice of inquiry. Gathering evidence to support explanations and generating questions is an important part of field studies. Teaching students to be good observers requires instructional scaffolding of not only the content, but also of the processing skills students are expected to practice outside. During an evaluation of the popular Classroom Feeder Watch Program (CFW), researchers found curricular activities needed to more closely align with how a scientist approaches their field study (Trumbell et al., 2005). Lessons should include a blend of acquiring content knowledge and developing science process skills. Eberbach and Crowley (2009) developed an observation framework to help students move from making superficial observations to more scientific observations based on their review of the literature. The framework is a rubric of sorts that breaks down the basic components of observation into noticing, expectations, observation records and productive dispositions, which together comprise the extent to which the students “engage in sustained observations over time and in a variety of contexts” (Eberbach & Crowley, 2009, p. 54). These basic components are then qualified with language that describes specific student behaviors as either novice, intermediate or expert observers. I used this framework in the development of my rubric to evaluate student observation work in my study. Being more deliberate in scaffolding the lessons that teach student science process skills with the content may improve the overall quality of their observations and, in the long run, student

engagement in the task. But how would the use of technology in this activity affect engagement and quality of work? Since I plan to use digital photography during our outdoor field study, it is important to understand how technology is used in the classroom to further engagement and quality of work, and how to structure the lessons to teach this technology to the students.

Digital camera technology has a proven track record for promoting inquiry practices both inside and outside the classroom in a variety of content areas (Broda, 2007, Leonard, 2003; Leonard, Bassett, Clinger, Edmondson & Horton, 2004; Rivet & Schneider, 2004; Walker-Livingston, 2009). Students use their digital photos as way to collaborate with others and discuss their findings, using their pictures as evidence. In science, digital technology allows students to evaluate the quality of their observations immediately and adjust their data gathering on the spot. Digital photography creates a permanent record of data that can be accessed later as a comparison or to refresh students' memories. Education professor William Leonard (2003) found digital cameras have many possibilities for the biological classroom, especially for data collection. He had students take pictures of their fermentation experiments as evidence of change over time. Students compared their photos along a continuum, and also were able to go back and look for additional evidence once the reaction was complete. While outside studying ecosystems, Leonard's students used the macro setting on cameras to take high resolution pictures of plants, insects, or other species they found in their study area. The detail in the pictures made it easier to identify the species. He frequently hears "this is way cool" from his students because they feel they are participating in "real" science. Rivet and Schneider (2004) studied the use of digital photography during a seventh grade science

stream ecology investigation. There, students used the cameras to document the holistic nature of ecosystems over time. Often their photographs spurred students to investigate new questions. Students also felt the photographs helped them to see details that they had missed while outside at the stream. Rivet and Schneider found digital photography increased the amount of time students spent thinking about their ecosystems, enhanced their desire to participate in the activity, and created feelings of ownership of their study area. The authors felt that the cameras promote student interest and created opportunities for them to share their findings with classmates. Would my students have similar responses to their field experience when using digital photography?

As the studies show, taking the learning outdoors has many positive benefits for students, including increased motivation and cognitive gains. However, teaching students how to observe cannot be overlooked and along with building domain knowledge, needs to become a part of my instructional practice before and during field studies. Digital photography is a helpful way for students to collect data and help them think more deeply about the science concepts they are learning. Students are excited to use this technology.

METHODOLOGY

Research Design

I collected data for this study over a period of seven weeks, beginning in late October and concluding the second week of December. At the beginning of the study, students were assigned an area in the forest behind our school to create a square meter study plot. They visited their plots a total of four times during the study. During the first

two visits (non-treatment) students used paper and pencil only to record the data about their forest plot. The second two visits were the treatment phase of the research cycle during which the students used digital cameras to record data about their plots. Along with trips to the study plots, students participated in classroom lessons and activities that taught them about data collection, observation, and use of digital cameras. This study was designed around adopted district curriculum and included all ability levels of students for the purpose of improving my teaching of district curriculum in an outdoor setting.

Curriculum

The curriculum I used during my research is a Science and Technology Concepts for Middle School (STCM) unit called *Organisms: From Macro to Micro* (National Science Resource Center, 2003). We also used an outdoor study protocol the Seattle Urban Foresters developed to investigate the health of urban forests (Green Seattle Partnership, 2006). This forest protocol has been adopted by our district for use with seventh grade students during field studies, and by using a published curriculum, I helped to insure validity and reliability in my study.

School Demographics

Cedar River Middle School is located in Maple Valley, Washington which is approximately 40 miles southeast of Seattle, Washington. The school has a sixth-seventh grade configuration with about 530 students. Free and reduced lunch is at 16%. There are very few minority students at the school. All three of my seventh grade classes

($N=90$) participated in this study, however absences and incomplete questionnaires from the students resulted in a sample size that fluctuated between $N=67-90$.

Research methodology for this project received an exemption by Montana State University's Institutional Review Board and compliance for working with human subjects was maintained (Appendix G). Before my study started, all students were given an information letter describing the study and the opportunity for their parents to decline student participation in the study. Only one parent asked that their student not be interviewed.

Non-treatment Lessons and Activities

Lessons for this study were developed from the district curriculum materials and activities I discovered while researching digital camera use in the classroom. Specific lessons, activities and materials used during this part of the research cycle are outlined in Appendix A. During their first visit outside, students worked individually using pencil and paper to draw, describe and measure the vegetation in their assigned one-meter square plot. This observation period lasted about 45 minutes. During their second outing, students collected data about canopy cover, invasive plant species and evergreen tree diameters in their plots using the forest protocol to help them assess the health of their plot.

Two weeks after the second outing, students choose their best drawing to evaluate using the plant observation rubric (Appendix B). Students labeled and described the characteristics of the plant or tree that they drew using the highlight comments and captions strategy (BSCS, 2008). A description of this strategy is in the lesson outline.

After labeling their drawings, the students used photo identification cards of Pacific Northwest plants and trees to identify the vegetation they drew. Students handed in their rubrics for me to evaluate.

Treatment Lessons and Activities

Students visited their plots two more times, but for these next outings they used digital photography to collect data on what was in their plot and to document their urban forest protocol work. The students also had the option of using paper and pencil to record additional data if they wished. Students were assigned new forest plots so they would have a fresh perspective on the vegetation found in the plot. Before going to the plots, students learned how to use and care for their camera. A district technology instructor taught students how to upload their images into student online field journals. An outline of these lessons and the materials used are included in Appendix A. Each student worked individually with their own camera and there was no limit to the number of pictures students could take. The time spent outside in the forest was about 10 minutes shorter than the first two rounds of observations because extra time was needed back in the classroom to upload pictures to students' individual electronic journals.

After two weeks, students went back to their electronic photo journals, and used the BSCS highlight comments and captions strategy to explain the identifying characteristics of the plants and trees in their photos. They choose their best photo to evaluate with the same rubric they used during the pre-treatment phase (Appendix B). The photo was inserted into the rubric and then the comments and caption were added. Students evaluated their own work before sending it to me for scoring. All photo rubrics

were initially saved to the public drive and then transferred onto my flash drive for evaluation.

Data Collection Instruments

I used a variety of instruments to collect data during my study. Qualitative data was collected through outside observer anecdotal notes, my field journal, extended responses from student questionnaires, and focus group interviews. I collected quantitative data from Likert-scale student questionnaires, behavior checklists completed by outside observers, and rubric scores from student work. Table 1 correlates the data collection instruments used for each study question.

Table 1
Triangulation Matrix

Primary Research Question: How does the use of digital photography affect student observation skills and data collection during outdoor field study?				
Student Interviews	Outside Observer Behavior Checklist	Student Behavior Self-assessment questionnaire	Drawing/ Photo Rubrics	Teacher Journal
Sub question #1: How does the use of digital cameras change the level of student engagement during outdoor field studies?				
X	X	X		X
Sub question #2: How does the use of digital cameras affect the quality of student observations during outdoor field study?				
X	X		X	X
Sub question #3: How will my instructional practices change as I incorporate digital photography into outdoor field study?				
X	X	X	X	X

Measurement of Student Engagement

To determine how the use of digital cameras effect student engagement during outdoor field studies, I modified data collection tools from studies I read during my literature review and created my own data collection instruments. Crowder (2010) effectively used student interviews and an observation protocol to collect data about how the outdoor learning environment influenced student engagement. I used her observation protocol to collect quantitative data on individual student behaviors out in the forest. Two students each period ($N=6$) were selected to be observed by an outside observer using the Crowder protocol. Students were chosen based on their academic rank in class (one high and one low). Every two minutes, the observer scored the behaviors of two pre-selected students by making tally marks in the appropriate columns indicating the student's level of engagement at that moment as "always", "somewhat", or "not at all". A copy of the protocol can be viewed in Appendix C. The observer also had space to write any field notes they felt were relevant to their scoring. These students were followed for the duration of the study. Although each science class had a different outside observer who came out with us each time we went to our forest plot, all observers were trained on how to use the instrument ahead of time. The observers felt the instrument was very straight forward and easy to use. I field tested the observer protocol instrument last year with a small group of students and found it was an efficient and accurate way to record several students' behaviors at the same time.

To collect engagement data from the students, I modified the observation protocol used by the outside observer to create a companion tool: a Likert-scale student self-assessment questionnaire that was age appropriate and focused on the same

behaviors the observers were watching for. I also included questions from the Science Outdoor Learning Environment Instrument (SOLEI) developed by Nir Orion as a way to measure student's experiences during outdoor field trips (Orion, Hofstein, Tamir & Giddings, 1997). My questionnaire included multiple questions designed to measure two different indicators of student engagement: students' attitudes and specific observable behaviors of students. Students rated their interest and feelings of success on a scale from 1 to 4, with 4 being highly interested or successful. Student behaviors were rated on a frequency scale of 1 to 5, with 5 indicating that the behavior always occurred. Examples of the non-treatment and treatment versions of the questionnaire can be found in Appendix D. Students completed the Likert-scale behavior self-assessment questionnaire each time they returned from their forest plot.

Student engagement was also measured qualitatively using several open-ended responses from the student self-assessment behavior questionnaire. These responses were recorded on notecards and coded to help me find patterns and themes in the students' responses. Unfortunately, I did not field test the entire questionnaire before my first trip into the forest and after the students filled it out I noticed the wording on several questions created an inaccurate picture of some of their behaviors. I made the corrections before our next trip out. Modifying data collection tools used successfully by other researchers increased my confidence in the reliability and validity of the data I collected during this study.

My field journal and the anecdotal notes from the outside observer provided two additional sources of qualitative data. In my journal, I noted to how quickly the class got started and when the group as a whole was beginning to drift off task. While students

were collecting their data I walked around recording their comments and questions about the activity, noting the time these occurred. I also included information about weather and plot conditions. A final source of qualitative data was collected during a focus group interview which included the six students who were observed individually. I field tested the interview questions with two of my focus students shortly after the study began and quickly realized that I had too many questions. I wrote additional probes for some of the questions after observing the students out in the forest several times (Appendix E). The focus group interview was videotaped and took place during one 45-minute homeroom period. Individual student answers were then triangulated with their self- assessments and the information gathered about them by the observer. The majority of the data about student engagement was descriptive by nature, with some quantitative data include from the student questionnaires. Collecting data about the quality of student observations helped me to look for possible correlations between engagement and student performance.

Measuring Quality of Student Observations

Since I began taking students into the forest for plot field studies, I have never been satisfied with the quality of student field observations. Would replacing student drawings with digital photography improve the overall quality of the data? To help me ascertain how the use of digital cameras affects the quality of student observations, I collected quantitative data from student drawings and photos four times during the study. Student drawings and photos were evaluated using a rubric I created based on the Biological Sciences Curriculum Study (BSCS, 2008) method of highlight-comment caption, and the observation framework proposed by Eberbach and Crowley (2009).

Rubrics were scored on a four-point scale. The quality of students' data was defined by the following criteria: realistic drawings or clarity of photos (1 pt.), the number of features highlighted that would help in the identification of the plant or tree (up to 2 pts.), and the ability of the student to correctly identify their plant or tree (1 pt.). Wording on the rubrics was changed to reflect the use of digital cameras on the next two outings. I used practice assignments to determine whether or not the rubric was worded correctly and if I could be consistent when evaluating them. Examples of drawing and photo rubrics are located in Appendix B. I used anecdotal data from the outside observer, student responses from the focus interview and notes from my field journal to look for the underlying causes for low and high rubric scores. What were the behaviors and attitudes of the students who scored high on the rubrics? While students were completing their work on the rubrics, I took notes in my field journal on the difficulties and success students were having using their data to identify the plant or tree. I noted how students used the photo cards and what features of their drawings and photos they felt were the most helpful. Additional notes from the outside observer gave me insight on how the behavior of a student affected the quality of their drawings/photos. Talking with students during the focus interview provided qualitative data from the students' point of view. Did they feel cameras improved the quality of their observations?

Evaluation of Instructional Practices

I used several sources of data to help me evaluate the effectiveness of my instructional practices in preparing students for field studies, but none was as important as my field journal. I recorded student behaviors during each trip to the forest, carefully noting what activities seemed to engage students right away and what difficulties students

had with the work we were doing. I wandered by students in my sub groups and wrote down their comments and engagement levels in 10-minute intervals. I noted the tell-tale signs that signaled the start of off-task behaviors such as wandering away from assigned plots and amount of science talk between partners. I also documented my thinking around the development and outcomes of the lessons taught during the study.

My journal observations were triangulated with qualitative data from the student focus group interviews and student extended responses from the questionnaires to evaluating the effectiveness of the lessons taught before going outside and the benefits of adding digital photography as a means to collect data. The outside observer was an extra pair of eyes on my classroom providing formative assessment data on whether or not students were following the instructions they were given or even understood what they were instructed to do while outside.

Quantitative data from the rubrics help me assess student observation skills and what additional lessons might be necessary to help students observe at a deeper level. Additional quantitative data from the student's behavior self-assessment questionnaire was triangulated with rubric scores and my field notes to look for any specific behaviors that impacted quality of work while students were in the forest. These would be the behaviors I would target when developing my expectations for student behaviors while outside.

DATA AND ANALYSIS

The data I collected during my study helped me analyze each of my sub-questions individually, but also provided insight on the connection between student engagement, quality of their work and current instructional practices. I looked first at student engagement data to determine if indeed cameras drew more students into the data collection process. Next, I analyzed the quality of student work both with and without the cameras, searching for any correlations between an increase in quality and the use of digital photography. Finally, I examined the data under the lens of best practices to determine how effective my instructional strategies were when students used cameras to collect data out in the field.

Analysis of Student Engagement Data

Studies on student engagement have demonstrated a correlation between the number and frequency of on-task behaviors to a student's level of engagement both in and out of the classroom (Marks, 2000). The literature also describes a strong correlation between a student's attitude and feelings of success during an activity to their time spent on-task (Broda, 2007; Crowder, 2010; Marks, 2000). I collected both qualitative and quantitative data about student attitudes and behaviors to analyze overall student engagement.

Student Interest and Feelings of Success as a Measure of Engagement

Students' attitudes about the activities were measured using a Likert survey after each visit to their plots. Student ranked the following two statements on a scale from 1(strongly disagree) to 4(strongly agree): *I was interested in the activity*, and *I felt*

successful doing my observations. In general, the majority of students agreed or strongly agreed they were interested in the activities during the non-treatment and the treatment visits to the forest and they felt successful during both treatment and non-treatment visits to the forest (Figure 1).

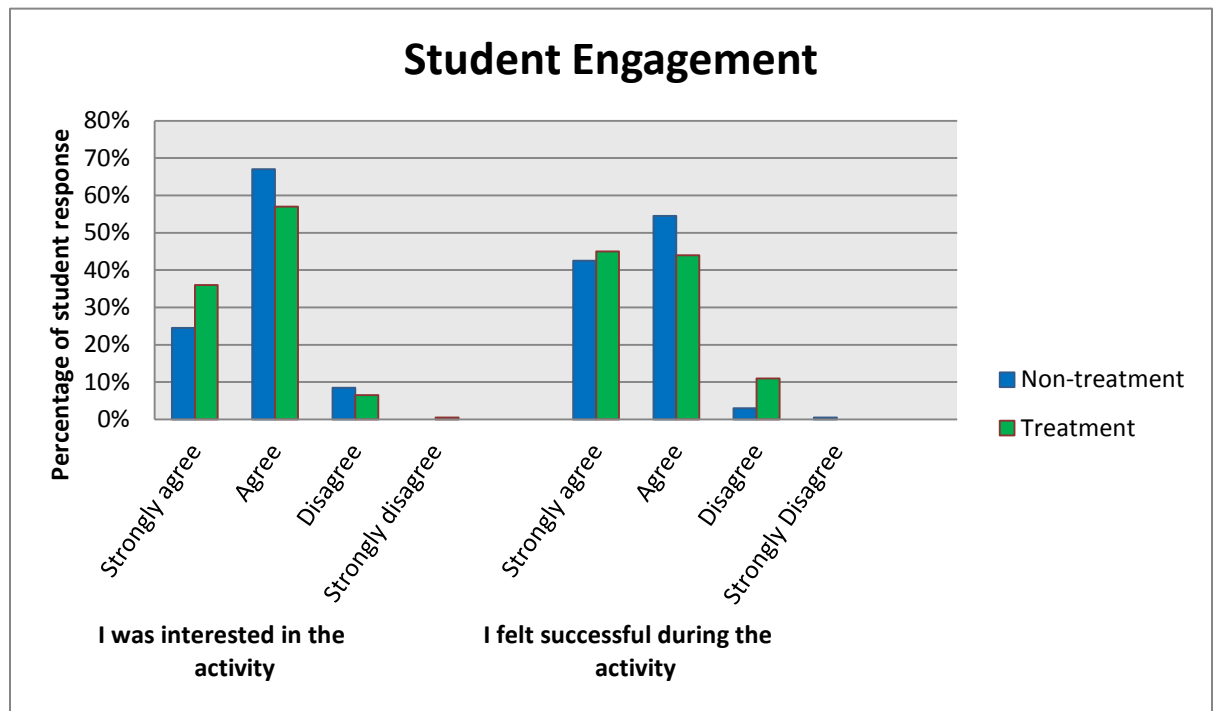


Figure 1. Attitudes about field study activities from student self-assessment behavior questionnaires, (N=78).

Student Interest

When the Likert scores were averaged, the percentage of students who agreed or strongly agreed with the statement: *I was interested in the activity* increased slightly between non-treatment (91%) and treatment visits (92%). 46 of the 78 students (59%) maintained a consistent response of “agree” or “strongly agree” throughout all four visits

to the forest. Students were happy just to be outside and doing something other than sitting in the classroom. “I love being out in nature” and “It’s great to be outside and away from the classroom for a change” were common responses on students’ questionnaires. Thirty-two of the 78 students (41%) reported a change in their interest level at some point during the study.

To identify factors that influenced changes in a student’s interest levels during the study, extended responses from the student self-assessment behavior questionnaires were coded for key words. Table 2 shows the breakdown of those responses.

Table 2

Factors that changed student interest levels over the course of the study as recorded on student self-assessment behavior questionnaires (N=32)

Factors that increased student interest levels				
	Number of student responses by achievement level (% of total)(N=21)			
<u>Themes</u>	High Achieving	Low Achieving	Average Achieving	Totals
Taking pictures/cameras	7 (33%)	9 (43%)	1 (5%)	17 (81%)
Being out in the forest (nature)	1 (5%)	0	0	1 (5%)
Doing something new	0	0	2 (9%)	2 (9%)
Learning about plants	1 (5%)	0	0	1 (5%)
Factors that decreased student interest levels				
	Number of student responses by achievement level (% of total)(N=11)			
<u>Themes</u>	High Achieving	Low Achieving	Average Achieving	Totals
Weather or plot conditions	3 (27%)	0	3 (27%)	6 (54%)
Activity not interesting	2 (18%)	1 (9%)	0	3 (27%)
Do not like being out in nature	0	1 (9%)	0	1 (9%)
Activity too hard/do not understand	0	0	1 (9%)	1 (9%)

Engagement levels increased for 21 of the 78 students (26%) as we moved through the four activities of the study. Two of those students enjoyed learning the Urban Foresters Protocol. Comments included "...it was interesting measuring the trees", and "I felt it was interesting because of how much I learned about my plot". Measuring trees was a novel activity for the students "...because I got to do stuff I hadn't done before". Their interest remained high for the rest of the study. My field notes agree with this finding as I noted more time on task for all students while we were using the Urban Foresters Protocol to evaluate the plots. Being out in the forest and also learning about plants increased two student's interest during the study "It was interesting to find out how many invasive plants were on my plot". Introducing digital photography as a means of data collection raised the interest level for the remaining 17 students (81%) over the course of the study. Their surveys included comments such as "I like taking pictures way more than drawing", "...because it's fun to take close up pictures and see details", and "It was fun learning and taking pictures of my plot." I was encouraged to note that 43% of these students who felt the cameras increased their interest levels were low achieving students "Because I really enjoyed taking pictures and it was a really good activity." Further analysis of the data revealed that all of the students who marked "strongly disagreed" or "disagreed" as their interest level in drawing plants increased to "agree" or "strongly agree" when cameras were used to document their plot plants. Students who originally recorded responses such as "This is boring" and "I wasn't interested because I don't care" mentioned "I like taking pictures of what we observe" and "It was fun using the cameras." I wrote about these same students in my field notes "C worked hard today

and showed me she knew what she was doing”. All but one of these students maintained a high level of interest throughout the study. One student went back to his “disagree” status on the final outing because “It’s too repetitive.” He is a very bright student who is also easily bored in the classroom. His comments and the comments of two other bright students, indicate that I need to consider the cognitive demand of the field tasks as a factor of engagement.

Focus group interview data supports the idea that using cameras were effective in raising the interest level of the students. All of the students interviewed felt the cameras added to their engagement while at the forest plots. Several students mentioned that drawing could be frustrating: “...the drawing is difficult if you are not good at it” and the cameras made the task more enjoyable. Data from the tally sheets of the outside observers confirm that when student interest levels go up, cameras are the reason. Their data indicated that two of the six students observed (33%) showed an increase in their interest levels over the study period. One of the observed students who went up was a special education student. During the two outings without the cameras, her interest level was marked as either “sometimes” or “not at all”. When the cameras were introduced, she had no tally marks lower than “always”. She also moved herself up to “strongly agree” on her data sheet stating: “I am really good with cameras and I love taking pictures”. The other student struggles with the science content and becomes discouraged and disengaged easily in the classroom. On his survey, he notes “It is fun taking pictures of the plants in my plot. I love plants”. The remaining four students’ interest levels stayed the same throughout the activity. These students are high achievers who do excellent work no matter what the task is. It is interesting to note that all four mentioned

the cameras as the reason why they enjoyed the last two outings. Triangulation of the data supports the finding that taking cameras outside definitely increases students' interest levels in field study plot work. There were some students, however, whose interest levels declined during the course of the study.

Eleven students (34%) reported a decline in interest level at some point during the study. Weather and plot conditions were two reasons most frequently cited by six of these students (54%). Weather conditions noted in my field journal supports this finding. The majority of the students who mentioned weather conditions were in my first period class. It was usually still chilly and wet at that time of day and students do not always "dress for success" even though they had advanced warning. Three students did not find the activity interesting. There was no one activity that caused interest to decline.

In summary, the data indicates that if students changed their overall interest level or feelings of success while completing in an activity, 81% of the time it was because of the cameras. I found the interest level inside the classroom was a good predictor for interest outside the classroom. Student who are attentive in class and are interested in science are also attentive outside and interested in the activity. The high and low achieving students, as well as the special education students, were interested in all of the outdoor activities. The students who are most often not engaged in the classroom showed a 100% increase in their interest with the use of the cameras. I am not surprised about this high level of engagement for this year's students. Overall they are a very good group who are attentive in class and are interested in science. This would not have been the case with my students of past years.

Student Success

Student interest is only half of the engagement story. A student's feeling of success also increase their engagement level (Marks, 2000). How successful did students feel they were while out at their plots, and how did cameras influence their feelings of success? There was a decrease in the number of students who felt successful when using the cameras to document the plants in their plot during the treatment phase of the study. According to data from the student self-assessment questionnaire, fifty-seven (89%) students indicated that they felt successful or very successful with the cameras as compared to 64 (96%) when students did not use cameras. To determine why students felt less successful with the cameras, extended responses were coded for common responses both with and without camera usage. During the non-treatment period of the study, 95% of the students felt successful while collecting data at their forest plots. The most common reason for students feeling successful was that they understood what to do and finished the task (55%). Students who enjoyed the experience but did not feel successful mentioned not finding many plants in their site or not being a good artist. This last comment came up again during the focus group interview. Several students mentioned they did not feel successful because "the drawing is difficult if you are not good at it" and "If you're not a good artist it can be frustrating." I was surprised at this because I thought there would be more students who didn't feel successful because of their artistic abilities. One student tied feelings of success with the fun factor. "We didn't do anything; you need to make it more fun."

When students worked with the cameras, 44% felt successful because they got their work done and 15% mentioned taking quality pictures as their reason for success:

“My photos look professional” and “I got good photos so it was easy...” The percentage of students who disagreed about feeling successful increased by 14 students (7%) overall when using the cameras. Looking over their responses from the questionnaires, six of the 14 students indicated that they ran out of time. According to my field notes, we were pushed for time that day. Four of the 14 students mentioned camera-related problems, including focus issues. Two students did not feel successful with the cameras because they felt the activity itself wasn’t very interesting.

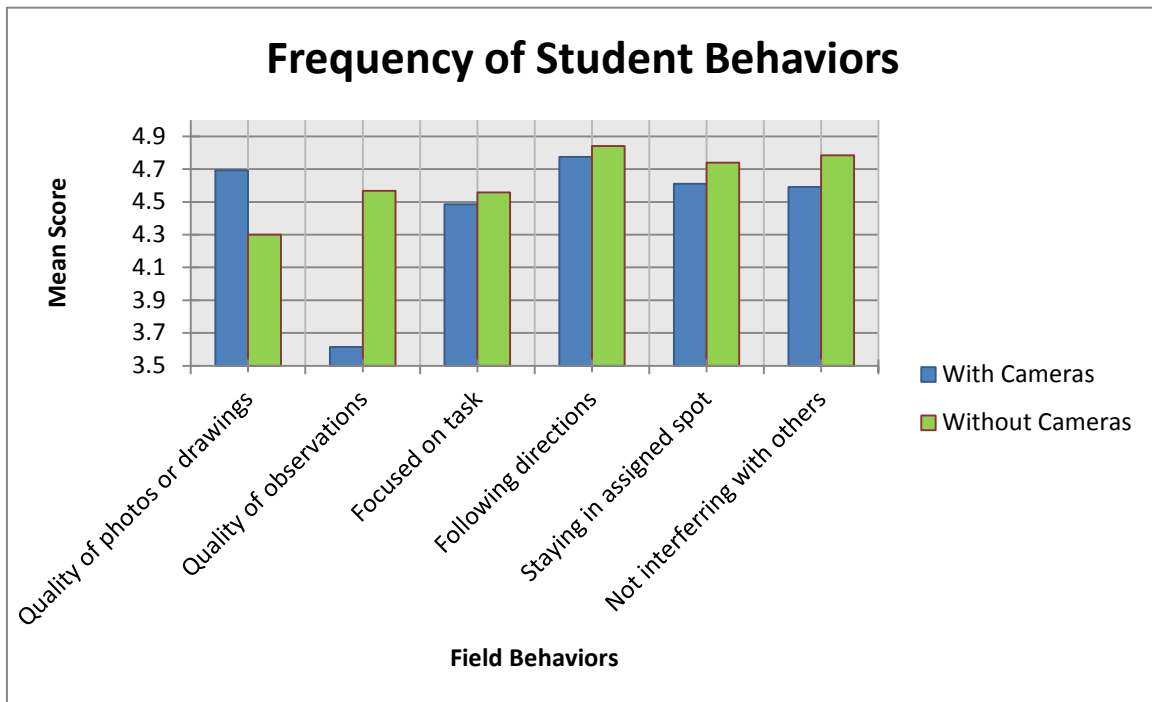
In general, students felt successful while collecting data out in the forest, but mainly because they finished the task. If they were not successful it was due to time constrictions or camera focus issues. The student mindset of just “getting it done” over quality is an area I would like to look into further. I was encouraged to find that 100% of the special education students felt successful outside. They “took their task seriously” and also “stayed on task.”

Student Behavior as a Measure of Engagement

Each time the students returned from their forest plots they filled out a Liker-survey to evaluate their behaviors while out at their plots. Behaviors included staying in assigned spots, following directions, staying focused on the task, making careful observations, and not interfering with the work of others. Student ranked their behaviors on a five-point frequency scale of 5 “always” to 1 “never”. Specific behavior data from questions 6-11 on the student behavior questionnaire was entered into an Excel spreadsheet for each student, and then the mean for each behavior was calculated by student and by class (Figure 2).

Several observations can be made from the data in Figure 2. Overall, students felt they did a better job collecting plant observation data from their plots using a camera than when they had to draw. They also tended to record fewer observations when using a camera and this may affect the quality of their rubric work later in the study. The frequency of remaining on task, following directions, and staying in their assigned spots tended to be higher for the non-treatment outings than for the treatment outings with the exception of quality of photos or drawings. This would seem to indicate the frequency of off-task behaviors was higher while students were using the cameras. This was a surprise to me because I assumed the cameras would raise their behavior levels.

Figure 2. Overall student field behaviors as reported on student self-assessment questionnaires. A mean of 5 indicates students were always engaged in this behavior, (N=67).



I looked over the data for specific behaviors and then triangulated this with my field notes and also the outside observer's data and anecdotal notes. I found the reasons behind the decline in behavior levels were actually positive. For example, my field notes indicated students were straying from their plots on a regular basis and talking a lot with those students in neighboring plots when they had the cameras. Normally I would interpret this as off task behavior, but when I listened in on the conversations, they were sharing and talking about their pictures. Discussions were about what they were seeing on their plots and comparing this to what others had on their plots. In addition, students left their plots when they were finished with the activity to go take pictures of other interesting things they saw on the way up. Several of the outside observers noted this same behavior for the students they were following yet marked the students' overall engagement as "always." For students who had off-task behaviors as noted by myself and the outside observers in the non-treatment phase of the study, bringing cameras to the field plots had mixed results.

One of the students, student D, is a low student who is quiet in the classroom and has difficulty remaining on-task with her work. During our first forest outing she was instrumental in starting a game of forest Marco Polo that dragged several of the students around her off task. The observer marked her as not engaged about 33% of the time we were outside. In addition he commented "A great deal of off task (behavior), shouting to others." But when student D brought a camera outside, her engagement level changed to "always" engaged (100%) and she did not interfere with the work of others. This change in behavior was true for several of the students I observed who were off-task during our first trips to the forest. But for those students who had the most trouble staying on task,

bringing the cameras outside did not change their behavior. I followed these six students very closely. When I looked at their evaluation of their own behaviors, these students indicated they were staying focused on the work about half the time. One of them, student A, was also monitored by the outside observer. His on task behavior decreased with each successive outing. Student A also participated in the focus group interview and when asked what he did well while out gathering data, he said getting all of his work done. Wandering from their plots, standing in groups talking and throwing things at each other were some of the behaviors I noted in my field journal consistently during all four outings for these students. These students are frequently off-task in the classroom as well.

One outlier was the dip in behavior for recording of data during the treatment period of the study. I reviewed student self-assessment sheets and noticed that students marked themselves as “never” more often than during non-treatment because they did not record any additional data when taking pictures. Obviously students felt the pictures were enough, so it will be interesting to see if that is true when the quality of data is analyzed.

Teachers understand that class periods can be wildly different from each other for many reasons, including the two major factors: time of day and class composition. In Figure 3, each class period was analyzed separately to uncover any behavior patterns that were specific to that particular class during the different activities completed in the forest.

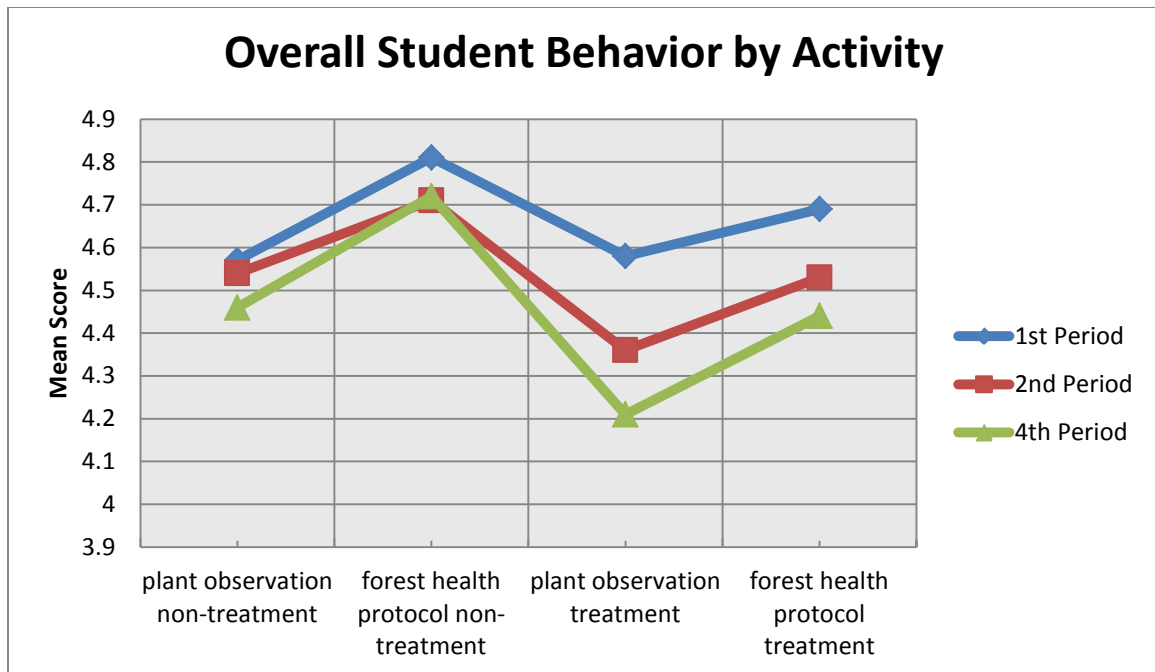


Figure 3. Mean scores for overall behavior during specific field study activities by class period. A high mean indicates a high level of on-task behavior for a specific activity, (N=67).

According to Figure 3, first period has the highest mean scores for behaviors as reported on the student self-assessment questionnaire of the three science periods, with an average of 4.66 out of 5. My field notes indicate students got right to work and carefully completed their tasks each time. The outside observer followed two students over the course of the four outings and rated their overall engagement as ‘always engaged’. These findings are consistent with what I see in the classroom; an on-task group of students who want to do their best. First semester grades for this period averaged 86%. There are no major issues of work completion or behavior for any students in this period.

Period two includes nine special education students in a class of 32. Their mean behavior scores from the student self-assessment questionnaire were 4.54 out of 5.

Students in this class period are generally well-behaved in the classroom, although as a group seem a bit immature. First semester grades for this period averaged 77.7%.

There is a small group of students, both general and special education, who have difficulty focusing on classwork and are very social in class. My field notes indicate that this same group had difficulty focusing on their tasks during the first and second outing when they had to draw plants in their plots, but did better with the cameras. They were still talking, but they were talking about their plots and the plants they wanted to take pictures of. Interestingly, when I looked over individual student's behavior questionnaires for those students who got observed, they rated their behavior frequencies as "always" or "usually" on task, which was what the observer noticed as well.

The field behavior scores from 4th period's student self-assessment questionnaire for period four were the lowest of all three periods: 4.45 out of 5. This group comes to science right after lunch and they are still in the social mode. This class also has more students who have problems staying in their seats, remaining on task and completing their work. It was these same students who responded on their self-assessment questionnaires that the field experiences were boring or they did not enjoy being out in nature. My field notes indicate these students were off-task during all trips to the forest. In fact, their own self-assessment of their behavior shows a decline in the frequency of acceptable behaviors during the treatment phase of the study. They most often marked themselves lower than the rest of the class when it came to focusing on the task, staying in their areas, and not interfering with the work of others. It does not seem like the cameras made any difference in the overall on-task behavior for this group of students while out in the forest. First semester grades for 4th period averaged 79.6%.

The data suggests that there are no overall gains in on-task behavior frequencies when cameras are introduced into the field activities for the general student population. In fact, data in Figure 2 indicates some on-task behaviors decreased with cameras. My field notes and the outside observer's notes contradict this data. Those students who tend to be off-task increased the frequency of their on-task behaviors when cameras were added. Students also felt that the quality of their plant observation data improved with use of the cameras. This is a significant finding to me and I am wondering if this will be demonstrated when analyzing the quality of student observations. There is a slight difference in student behavior between the different periods. The most off-task behavior happens during the period I have right after lunch. This may be because they are still in the "recess" mentality when they come to the forest. This finding certainly has implications for my teaching and will need to be addressed in my instructional approach.

Analysis of Quality of Student Observation Data

Over the past few years, my students have not done a spectacular job collecting quality data from the forest that can be used back in the classroom. While researching the topic for my action research project, I came across studies that examined the science process skill of "observation" and how students acquire this skill. I discovered that most teachers, including myself, assume our students already know how to observe, *what could be so difficult?* But in fact, there is a difference between observing in everyday life and observing scientifically. Eberbach and Crowley (2009) point out those students need to learn how to use a variety of observational tools. Also, they need to have adequate background knowledge and instructional support to help them go beyond observing surface features and begin to observe scientifically. I know I have much room for

improvement in this area, but as I began to plan my action research project, I decided to use this study to gather data on the quality of their observations with the aid of digital cameras based on my current instructional practice to discover how the use of digital photography affects the quality of student observations.

To help me determine how the use of digital cameras affects the quality of student observations, I collected quantitative data from students' drawing and photo rubrics and from the outside observers' observation sheets. Rubrics were scored on a four-point scale. For the purposes of this study, the quality of students' data is defined by the following criteria: realistic drawings or clarity of photos (1 pt.), the number of features highlighted that would help in the identification of the plant or tree (up to 2 pts.), and the ability of the student to correctly identify their plant or tree (1 pt.). Wording on the rubrics was changed to reflect the use of digital cameras on the next outing. Examples of drawing and photo rubrics are located in Appendix C. Students used sets of photo identification cards that I have in my classroom to identify their plants. These sets include species of plants that are commonly found in the Pacific Northwest. To help me describe any patterns or trends in the data, I also collected qualitative data from multiple sources including my field journal, outside observers' field notes, focus group interviews and extended responses from students' behavior self-assessment.

On our first visit to the forest plots, students were instructed to choose three plants or trees from their plots and draw them with as much detail as they could. They could also add written observations about their plants on the side of their drawings. I did not give students any instruction on what features to look for and draw. One month later, students chose their best drawing of the three to use to complete their drawing rubric.

Students attached the drawing to the rubric and used the BSCS strategy of *highlight-comment* to describe and identify their plant. This procedure was repeated on our third trip to the forest plots. On this trip each student had a digital camera to photograph the plants that were in their new forest plots. Students were told they could take as many pictures as they wanted, and I did not specify what plant features they should include in their shots. Students were also encouraged to take additional notes. Once back in the classroom they uploaded all their pictures to their flash drives and the next day went through and selected the best pictures to save in the online field journals. One month later, students chose one plant to upload to their photo rubric. Students could put any number of pictures on the rubric, as long as they were of the same plant. Once again, students used the *highlight-comment* technique to add descriptions around the edges of their photos. I waited a month in between data gathering and completing the rubrics because I did not want students to identify their plant based on the visual memory of their plot. I then averaged student photo and drawing rubric scores for all students and further broke this down into the four subgroups of special education, low and high achievement and students who generally are off-task in class (Figure 4).

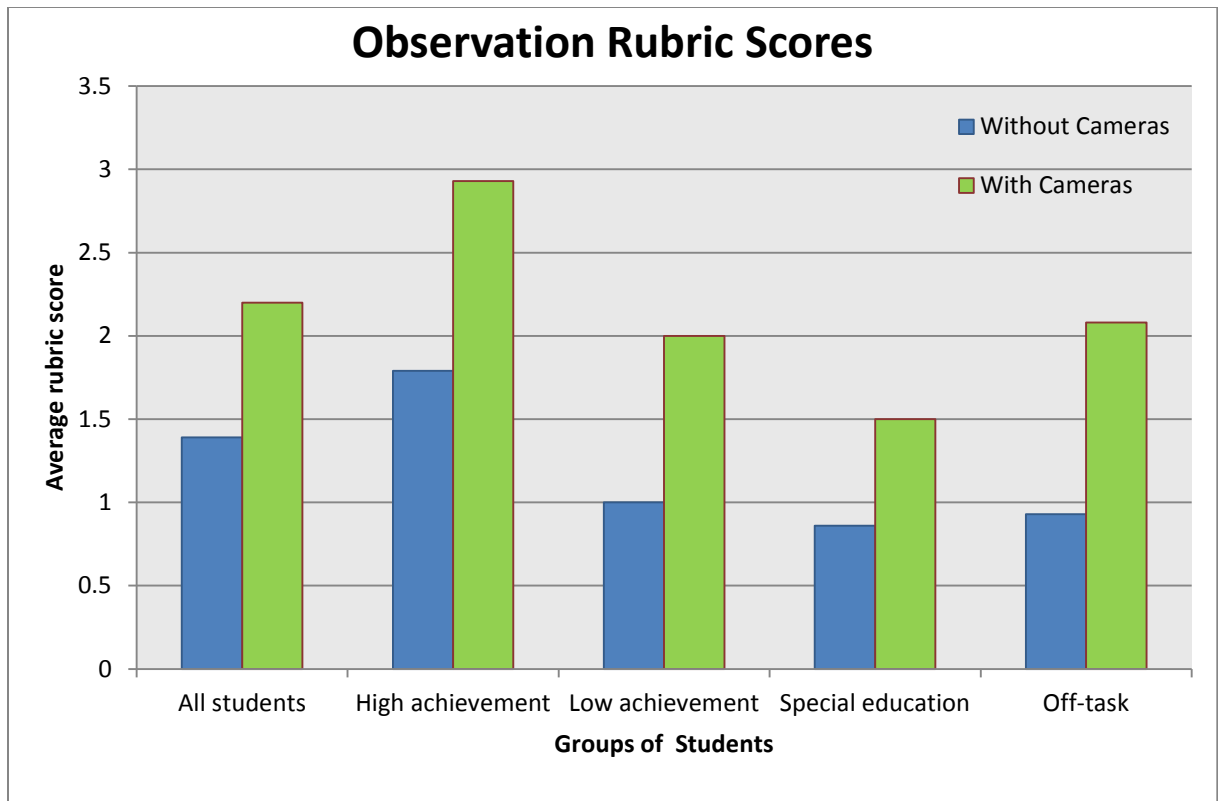


Figure 4. Quality of observational data by student group. This graph shows the average scores for drawing (non-treatment) and photo (treatment) observation rubrics, ($N= 67-79$).

All subgroups of students improved their rubric scores when using the cameras. In addition, 37% of all students were able to successfully identify their plants on their photo rubrics while 13% could do so from their drawing rubrics. To understand why students were more successful with the cameras, I looked at some of the differences between student photo rubrics (treatment) and drawings rubrics (non-treatment).

Drawing Rubrics

What effect, if any, did student drawings have on their rubric scores and ability to successfully identify their plants? Thirteen percent of the students were successful at identifying their plants from their drawings and additional notes. I wrote notes while the students were working on the rubric in the classroom. I heard lots of comments like “Wow, I was a bad draw-er”, “I should have added more to my drawing” or “I don’t even know what this is”. Rarely did I hear a student say they did a good job on their drawings. I got a sense that students were not working that hard on this rubric assignment. I could see that they really had no idea what plant characteristics they should have included in their drawings. One student in my focus group commented “The drawings are difficult if you are not good at it”. When I probed further and asked what would have helped her with her drawings, she replied “...knowing what things should have been in your drawings, things to pay attention to”. Another student agreed “...we would be more detailed with our drawings and be able to tell what it actually is”. Additional data they recorded on their sheets was vague at best with words such a green, round and pointy to describe a leaf. Very few students included measurement data, even though they had a meter stick with them. Most struggled to find four highlights to comment about and most struggled to identify their plants. An example of a typical student drawing rubric can be viewed in Appendix F.

Photo Rubrics

Thirty-seven percent of all students successfully identified the species of their plant or tree with the combination of photos and highlight-comments. This is a 24% increase of the number of students who could successfully identify their plant or tree with just their drawings and highlight-comments. The majority of these students took additional notes to go along with their photos. Even though the data shows that students did improve their rubric scores when they used photos of their plants, there were still problems. When students were working with their photo rubrics, they continued to struggle with identification. Some wanted to skip right to the identification cards and compare their picture with the pictures on the cards and make “close enough” identification. Many students indicated on their behavior self-assessment questionnaires that they did not record any additional observations about the plant they were photographing. They did not want to take the time to put the *highlight-comments* around their pictures or they didn’t have enough data to add. A closer look at the differences between the drawing and photo rubrics of all the students in the subgroups revealed 17 students (61%) did increase the number of highlight-comments around their plant photo. This was true for all of the students in the high achievement group and six of the seven students in the special education group. The other groups had a two out of the seven with increased highlight-comments on their drawing rubrics. However adding more details was not enough for these students to successfully identify their plant. Only about a third of those students who increased the number of *highlight-comments* were successful at identifying their plant. I wondered why so many students were still having trouble

identifying their plants from the photo rubrics even with when they were adding more observational details?

Quality of Descriptions

The rubric scores only tell part of the data quality story. Even if students made a realistic drawing and wrote several descriptors of their plant or tree, this observation data did not always translate into a successful identification. Why were 87% of the students unsuccessful at identifying the plants in their drawings? I believe the key was the type of descriptors that students recorded about their plant. Students who successfully identified their plants included more complex descriptors such as how many leaves were grouped together or how they were arranged on the stem, the size of the plant, if it was low growing or not and what the leaves looked like. They wrote descriptions that included information about stems and leaves or, in the case of the trees, bark and needles. These types of descriptors were similar to those used in identification keys and therefore much more helpful for the identification of the plants and trees. I randomly pulled nine drawing rubrics from the unsuccessful pile and counted the number of descriptive terms (comments) they wrote that would actually help them when using the photo cards to identify their plant. I compared this number to the same information from the nine successful students. Successful students had an average of 4.25 complex descriptors per rubric whereas the students who had difficulty identifying their plant had an average of 1.44 complex descriptors per rubric. The high and low achieving students had an average of 2.17 and 1.17 complex descriptors per rubric respectively. The off-task group's work was obviously lacking in detail with an average of 0.38 complex descriptors included in

their rubrics. According to my field notes, the majority of the off-task students were done with their drawings very early. Their comments about the task included “I liked it only because we got to leave the classroom” and “We just looked at the ground and drew”. Three of the seven students indicated on their behavior assessments that they were “seldom” or “never” careful when doing their drawings. In contrast to this, all of the special education students ranked their behavior as “always” or “almost always” careful when drawing their plant or tree. Comments included “I felt like I was taking my job seriously” and “I was drawing the best that I could”. They recorded an average of 1.43 complex descriptors per rubric. Students who had difficulty identifying the plant from their drawing included only a well-drawn single leaf or possibly a detailed cluster of leaves. Very few students drew leaves coming off the stems or how their plant grew out of the ground. Only one student included any data on size, even though students brought meter sticks out with them. Complex descriptors, such as how leaves are arranged on the stem, size measurements, needle groupings, leaf vein patterns and leaf edges, when included with realistic drawings, were the best indicators for student success in identifying their plant or tree. Did these complex descriptors also play a part in student success when using the cameras?

When I average the number of complex descriptors from the student photo rubric sheets, I found that students who successfully identified their plant averaged 2.48 complex descriptors per rubric. This average is lower than the 4.25 complex descriptors that helped students to successfully identify plants from their drawing rubric. The pictures themselves definitely made a difference as students compared their picture to the photo ID cards. In contrast, students who were not able to identify their plant had 1.28

complex descriptors, which is consistent with the same data from the drawing rubrics. Their photos were not helpful in many cases because they were either unfocused, too far away, or included too little of the plant to make a positive identification possible. It seemed there were additional factors that contributed quality data collection. Students who included more than one photo on their rubric also tended to be more successful in identifying their plant. They took pictures of the entire plant, the stems, and in some cases the top and bottom of the leaves. Entire plant photos showed how the plant grew out of the ground or how the branches hung from the tree. They photographed the complex descriptors, but did not always comment about them on their rubric. They let the pictures speak for themselves. An example of this level of student work can be viewed in Appendix F. A few of the students did attempt to use rulers as scale in their pictures, but they did not use them in a way that would add helpful details to their data. During the focus group interview, students indicated that they preferred trying to identify their plant with a picture rather than a drawing because “a picture captures all the details, when you look back at your pictures you can find stuff that you didn’t notice before in person” and “there is more time to really look at the plant when you have a picture”. My favorite comment was “You’re not just taking a picture with a camera, but you are taking a picture with your mind and then when you see the picture again you say, like, oh, I remember that plant now”.

Only three of the nine students who could identify their plant from their drawings were again able to identify their plant from their photos. These students are high-achieving students who pay attention to detail in their classroom work as well. They

included many details in their drawings and took pictures with characteristics that were helpful in identifying their plant. One of these students wants to be a graphic artist!

Even though there was an increase in the number of students who successfully identified their plant when they used a camera, the quality of written student observations did not improve overall. Students tended to write more around the edges of their pictures, but their observations were still only surface deep and not that helpful for identification purposes (the leaf has a brown spot, or the leaf is dark green). Only when students took multiple pictures that included important plant identification characteristics, or used several complex descriptors to describe the plant were they successful at identifying the plant. Students need more instructional scaffolding to help them become scientific observers of nature and to ensure that all students are able to collect useful data to describe and identify the plants in their forest plots.

Analysis of Current Field Science Instructional Practices

Teachers should not make the assumption that all students know how and what they should observe when they go outside and study nature. The Cornell Classroom Feeder Watch program made this mistake with their initial attempts to work with students to collect data about the number and species of birds that visit schoolyard birdfeeders. Eberbach and Crowley (2009) found that not only were students unsure what to record, but teachers were struggling with the lack of direction the observations should take. To teach students how to observe like true scientists, lessons should include a blend of acquiring content knowledge and developing science process skills (Trumbell, Bonney, & Grudens-Schuck, 2005). How was I preparing my students to go out and observe?

In our first outing, students were instructed to go out and choose three plants to draw with as much detail as possible. I have come to realize that “with as much detail as possible” was just as vague as the unsuccessful birdfeeder directions were. The only instruction I did around observation was to have students describe a leaf with as many adjectives as they could think of. I encouraged them to get creative and stretch themselves. This type of descriptive writing is not always included in plant identification keys. As a consequence of this approach, most students were lost when it came to knowing what to record. In my focus interview with several students this point was made by several students who felt their drawings would have been better if they would have known what to include. I sent my students out without essential background knowledge on how to identify plants, more specifically, what characteristics to observe and record.

When we went out the second time, students were using the Seattle Urban Foresters protocol for determining the health of a forest. The students and I went outside my classroom and practiced making the plots, assessing canopy cover and using tools to measure tree diameters before we went to the forest. Inside the classroom, we also learned what it meant to have a healthy forest and we set a purpose for why we were going out to do this measuring. According to the data from student behavior self-assessment questionnaires, students felt successful when out taking these measurements and recording the data. They responded with “I like measuring the trees, it was fun” or “I completed the task because I knew what to do.” Figure 3 shows that on-task behavior frequencies were higher for the times we went out and did this protocol then when we just went out and drew or photographed plants in our plot. This may be due to the

novelty of the work, or possibly because students had more support to help them understand what they were doing and why they were doing it.

According to student questionnaire data, students felt successful when we went out with the cameras. Before we went outside, we spent several days practicing with the macro focus of the camera, using materials that I brought in from the forest. My notes from this day of practice were full of positives as students helped each other get the best possible quality of picture and also to seamlessly upload pictures to their online field journals. But when we got out to our forest plots, the data they collected was not helpful for plant identification. In fact, 63% of the students still could not identify their plant even when they compared their photo to the photo ID cards in the classroom. There were issues with photos being out of focus and not including enough of the plant to help with identification. I tried to give them a few tips while we were out there such as taking a picture of the entire plant and also of the leaves and stems, but I don't think many students followed my field advice. I think it was too late to try and change their approach while out in the field. Also, students who are normally off-task in the classroom continued this behavior even with a camera in hand. My field notes indicate that they took all of their pictures in the first few minutes, and then headed off to join other students. Clearly the cameras alone do not engage the students. When students are not challenged by the work, it doesn't matter if the classroom is inside or out. Students want challenging and authentic opportunities to study science. I can see that I need to be thinking about differentiating the study plot tasks to increase student engagement and decrease off-task behavior. I will also need to modify my expectations and procedures when going outside to reflect the time of day that students have science. Since students

tended to be more off-task after lunch, my approach with this class will certainly need to be different. They have been sitting in classes all morning and then coming into my class after social time with friends. How will I compete for their attention now? How will I redirect their energy to learning science?

I have discovered through trial and error that the best instructional approach is to spend more time learning those characteristics of plants that are needed to make positive identifications. Along with learning these characteristics, I think students need more exposure to nature journaling so that it would be second nature to them to always take appropriate notes about the plants and their plot in general. Many students did not record additional data while outside that might have helped them identify their plant. Student behavior data has shown me that when they understand their job and how to use the tools, as with the Urban Forester protocol, they really do want to do the best job possible. Students also need additional practice learning how to evaluate their pictures while out in the field and to troubleshoot focus issues on their own. I think this would result in less down time while out in the forest and higher quality data to bring back to the classroom.

Some students still have the “recess” mentality when going outside, but I believe this can be minimized by giving students the content knowledge and skills they need to be successful forest observers.

INTERPRETATION AND CONCLUSION

The action research process has caused me to look deeply at the relationship between student engagement and quality data collection while outside. I thought it would be a straight-forward study to determine if cameras affected student engagement and data collection. However the further I went into the data, the more I realize the process is like peeling an onion: there are many layers under the surface! It is not just about putting cameras into the hands of students, it is about discovering what motivates students to learn when they are outside, and what skills and knowledge students need to be truly good observers and successful data collectors.

I included the sub question *“How does the use of digital cameras change the level of student engagement during outdoor field studies”* as part of my Action Research study because I was looking for an instructional tool that would make data collecting more interesting and productive for the students. I discovered that overall; students enjoyed using the cameras to collect data. Students whose engagement levels increased during the treatment period of the study, (81%) cited the cameras as the reason they were more engaged. Almost half of these students were low achieving students (43%). These low achieving students felt successful because of the quality of their pictures and they also enjoyed collecting data with the cameras. There were no overall gains in on-task behavior frequencies when cameras were introduced into the field activities. Behavior issues were minimal throughout the study, but I had a really great group of students to begin with. For those students who had focus issues or are very social in the classroom, using cameras gave them a legitimate reason for getting together and talking. My field notes describe how students would run over to their friends to show their pictures and

discuss the difference in the plots. I was encouraged with this educational talk between students! A few students who had a decline in their engagement levels during the study, but it was often due to the weather or plot conditions (54%) or a general lack of interest in the activity (27%).

I assumed that more students would mention difficulty in drawing as a reason they were not engaged and might prefer using cameras, but this was only true for a few students. What frustrated students when collecting data was not so much their lack of artistic ability, but rather their lack of understanding about what to include in their drawings. This finding agreed with student comments from the focus group interview.

In addressing my second sub question “*How does the use of digital photography affect the quality of student observations during outdoor field studies*”, I found that in general, students did not draw or photograph important features that would increase the quality of their data and aid them in identifying their plants once they returned to the classroom. Although students tended to write more descriptors about their photos, there was only a 24% increase in the number of students who could identify their plants with their photos as compared to students who could identify plants with their drawings. This was due to either a lucky match with the photo cards, taking multiple pictures of the same plant, or including additional details of the plant on their rubrics. The types of descriptions written by students were very basic, looking only at surface features such as color or shape of leaf and were lacking the complexity that most identification keys require. Based on these findings I have come to the conclusion that instructional changes will be the most effective way to improve the quality of student observations and data collection during field studies.

My final study sub question focused on *“how would my instructional practice change with the use of digital photography as a student data collection tool?”* Three areas that I will be focusing improvement on are: establishing clear student behavior and quality of work expectations, scaffolding of lessons to provide students the content necessary to be scientific observers, and differentiating the field experience to account for student interests and abilities. I have gathered data about student interest levels and behaviors while they are out at their study plots and according to common themes found in their responses to the student questionnaire, the majority of the students (73%) indicated they were interested in data collection and learning about the forest. This means 73% of my students are engaged in field studies! I was surprised by this because in the past I had been interpreting off-task behavior as being uninterested and I now realize that my focus was only on misbehavior. As I mentioned earlier, my own data collection has shed some light on student behavior. What appears to be off-task behavior doesn’t always mean a student is not engaged. Middle school students are social. Talking to each other about the data is motivating to them. It’s not easy for me to give up control in this area, but I believe I will feel more confident that learning is happening outside if I am more structured in my approach to teaching behavior expectations while in the field. I need to teach these expectations same way I teach my classroom expectations: lots of repetition! Going outside more often at the start of the school year and establishing those expectations while engaging students in partial field studies will establish the outdoors as a time of learning rather than recess. Training students did pay off when we learned how to do the Urban Foresters Protocol. Several practice sessions out on the playfield preceded the trip to the forest to collect this data and it paid off with an increase in

student on-task behavior. Quality of work is a part of on-task behavior as well. Students overwhelming indicated that they felt successful when they understood what to do and finished the assignment, yet some students finished early and did the bare minimum. I want to collect some exemplary examples of student work to show students what the expectations are for gathering data. Several pieces of student work from this study will start me down this path. Also, giving students the option to use a camera instead of drawing alone may also cut down on off-task behavior. Students who indicated on their surveys that they did not feel they were good at drawing (19%) only felt only somewhat successful while outside and when students lost interest in the drawing, off-task behaviors began. Setting clear expectations is important for improving student behavior, but providing good instruction is just as important.

VALUE

I have been assuming, as most teachers do, that the skill of observation did not require much extra instruction and that most kids were natural observers of nature when given the opportunity. However there is a difference between the type of data that is gathered by just looking on the surface, and the type of data that is gathered scientifically. Eberbach and Crowley (2009) determined that without adequate background domain knowledge, student will remain surface observers, describing only what they actually see and instead of ascribing meaning to their observations. This makes sense to me and is the missing link between the quality of data I have been expecting from my students and what my students have been producing. As I completed the conceptual framework for this study, I set aside many articles on instructional practice suggestions from teachers

who have successfully engaged in the same type of work with their students. I will need to do more scaffolding of the content to help my students become better observers, including more nature journaling and plant identification. Students need more instruction on framing shots and using scale to improve the usefulness of the data they capture in their pictures. I realize now that I did not provide enough time for students to become skillful with the cameras and to systematically experiment with the macro settings. I think bringing people into the classroom who are more knowledgeable about these skills than I will be a necessity. Having cameras in their hands certainly motivated the students to spend time collecting data at their plots, but is this the only means to increasing student engagement and quality of work during field studies?

The answer of course is no. Having fun using a camera for the sake of using a camera will eventually become tiresome for students, especially those students who are bored with class and want more of a challenge. I have two different types of bright students: those who do well, take school seriously and have excellent impulse control, and those who can't seem to stay in their seats and often lose interest in whatever we are doing quickly. How am I meeting their needs when we go outside? I have discovered that capable students who don't feel challenged by the field study tasks are only somewhat interested in collecting data. One student rated their interest in the drawing observations as high because "I got to set up my own plot and decide what I wanted to draw", but then rated her next time out as only somewhat interesting because the data collection was too easy. Another capable student had his interest piqued when the cameras were brought out initially, but then downgraded his interest level the next time out because taking pictures had become "too repetitive". The key is finding the correct

cognitive demand and relevancy that creates a need to learn and places more control and responsibility on the student. The scope of the field study may be too simplistic for some students and I'd like to find ways to challenge the more capable students, possibly including more open-ended inquiry into field studies. What about the students on the other end of the spectrum who have difficulty with the science content? If I increase the amount of domain knowledge to raise the level of observation quality, will I lose them in the process? In general, the students who had difficulty with the written content in my classroom were very interested in the field work. Providing these students with some sort of step-by-step checklist that they can take out in the field with them and use as a reminder of what data to collect and how to collect it would give them the support they need as they make decisions about their data collection while out in the field. Looking for more developmentally appropriate identification keys that also contain sufficient content is always difficult and I have had limited success so far. This study has taught me that differentiation is not just for inside the classroom.

Because of this study I have a better understanding of how my students view data collection while out at our forest plots. I have learned that poor data collection does not equate with poor behavior, and the skill of observation can only improve if students understand the science behind it. These are the lessons I am ready to share with my science colleagues. I am hoping I can find another teacher who will share my passion for outdoor education and help me take the next steps.

REFERENCES CITED

- Broda, H. (2007). *Schoolyard-Enhanced Learning. Using the Outdoors as an Instructional Tool, K-8*. Portland, ME. Stenhouse Publishers.
- Cronin-Jones, L. (2000). The effectiveness of schoolyards as sites for elementary science instruction. *School Science and Mathematics*, 100(4), 203-211.
- Crowder, P. (2010). The influence of the outdoor learning environment on student engagement. Unpublished doctoral Dissertation. San Diego State University.
- Eberbach, C. & Crowley, K. (2009). From every day to scientific observation: how children learn to observe the biologist's world. 79(1), 39-68. Retrieved March 12, 2001, from MSU-Bozeman Library.
- Finley, F.N., & Pocovi, M.C. (2000). Considering the scientific method of inquiry. In J. Minstrell & E.H. van Zee (Eds), *Inquiring into inquiry learning and teaching in science* (47-62). Washington, DC: American Association for the Advancement of Science.
- Green Seattle Partnership (2006). "20 Year Strategic Plan" Urban Forestry Project. <http://greenseattle.org>.
- Gunckel, K. (1999). Ecosystem: Connecting an ecology field experience to the classroom. *Science and Children*, 37(1), 18-23.
- Marks, H. (2000). Student engagement in instructional activity: Patterns in the elementary, middle, and high school years. *American Educational Research Journal*, 37(1), 153-184.
- Leonard, W. (2003). Using the digital camera as a classroom data collector. *The American Biology Teacher*, 65(3), 210-215.
- Leonard, W., Bassett, R., Clinger, A., Edmondson, E. & Horton, R. (2004). Making connections with digital data. *The Science Teacher*, 71(1), 34-39.
- Orion, N., Hofstein, A., Tamir, P. and Giddings, G.J. (1997). Development and validation of an instrument for assessing the learning environment of outdoor science activities. *Science Education*, 81, 161-171.
- Project Learning Tree (2010) *Global Connections: Forests of the World*. Project Learning Tree in Partnership with the World Forestry Center. Washington, D.C.
- Rivet, A., & Schneider, R. (2004). Exploring the role of digital photography to enhance student inquiry in a local ecosystem. *Journal of Computers in Mathematics and Science Teaching*, 23(19), p.47. Retrieved April 02, 2011, from General OneFile

Trumbull, D. J., Bonney, R. and Grudens-Schuck, N. (2005). Developing materials to promote inquiry: Lessons learned. *Science Education*, 89, 879–900.
doi: 10.1002/sce.20081.

Walker-Livingston, W. (2009), Botanical scavenger hunt. *Science Scope*, 32(6), 31-34.

APPENDICES

APPENDIX A

NON-TREATMENT AND TREATMENT LESSONS AND ACTIVITIES

Non-treatment Lessons

Lesson 1: Tale of the tape

Objective: Students will practice the process skills of observing and describing.

Materials: adding machine tape, one leaf per student, tape

Description of lesson: Each student is given a leaf and a 3-foot long piece of adding machine tape. All students in the same period should have the same type of leaf so they will have something to contribute to the discussion. Students write as many words or phrases as possible to describe their leaf. Allow enough time for students to struggle because that's when they get creative. To debrief the lesson, a student volunteers to read their list to the class to create a master list and others cross off similar terms from their lists. Additional terms are added to the list. Adapted from: *Schoolyard-Enhanced Learning. Using the Outdoors as an Instructional Tool, K-8*. Steinhouse Publishing.

Lesson 2: Scientific Drawings

Objective: Students will observe live and prepared insect specimens to practice using criteria for scientific drawings.

Materials: Microscopes, prepared slides of WOWBug© insects, live WOWBugs© and drawing guidelines.

Description of lesson: Students draw a WOWBug© under 100x magnification to the best of their ability. They will measure and label specific features of the specimen following the scientific drawing guidelines provided. Adapted from: *Organisms: From Macro to Micro*. STCM curriculum, Smithsonian/The National Academies .

Lesson 3: Classification Using Dichotomous Keys

Objectives: Students use external and internal structures to classify an organism using a dichotomous key.

Materials: Several published dichotomous keys for classifying insects and trees, an assortment of specimens, microscopes and hand lens.

Description of lesson: This lesson stretches out over several days. Students start by making bio glyphs based on seen and unseen characteristics of themselves. Then, move to classifying silly creatures with a host of unusual features. Different dichotomous keys are presented in order of complexity as students become more comfortable using this classification system.

Lesson 4: Creating study plots

Objective: Students learn how to accurately measure and mark study plots and apply this learning to their forest plots.

Materials: Fluorescent flags and measuring tape on reels.

Description of lesson: Before we go into the forest to set up our study plots, students practice using the equipment on the play field. Students are divided into groups of four to create a similar size plot as they will have in the forest.

Lesson 5: What makes a Forest Healthy?

Objective: Students will use criteria to distinguish between a healthy forest and an unhealthy forest.

Materials: Seattle Green Partnership power point presentation, finding evidence graphic organizer.

Description of lesson: The criteria used to determine the health of a forest is explored. Case studies of different forests around the world are presented and students use the criteria to evaluate the health of the forest. Adapted from: Global Connections: Forests of the World, Project Learning Tree, 2010.

Lesson 6: Learning the Urban Foresters Protocol for studying the health of forests

Objective: Students will practice the step-by-step procedures for forest investigations to become more accurate in their data collection.

Materials: Flags, measuring tape, PVC pipe meter squares, plant and tree photo ID cards (The Starflower Foundation).

Description of lesson: Students practice the procedures for investigating a healthy forest. They will learn how to measure forest canopy cover, identify, count and map invasive species, identify trees and measure their circumference to collect data on the health of their forests. We practice using the equipment on the field before going up to the forest. Adapted from: Urban Forestry Project, Green Seattle Partnership.

Lesson 7: Highlight comment and caption

Objective: Student will use the highlight comments and captions technique to practice communicating scientific information from their drawings.

Materials: Drawing rubric and a variety of materials from the forest, and hand lens.

Description of lesson: Highlight comments link observations from their drawings to interpretations of what the observation may mean. After comments are arranged around the picture, students put them into sentences to form a paragraph that tells the story of their drawing. Students will draw and describe several natural items of their choice to practice this learning strategy on the rubric we will be using during the study. Adapted from: *BSCS Science: An Inquiry Approach*. Kendall/Hunt Publishing Company.

After this series of lessons, students will go to the forest to set up their plots and collect data. Students will visit the plots twice over a period of two weeks.

Treatment Lessons

Lesson 8: Getting to Know the Digital Cameras

Objective: Establishing guidelines for the use and care of the digital cameras.

Materials: Cannon Power Shot© A800 cameras, various forest materials,

Description of Lesson: Many students are familiar with digital photography and because of this may feel that they can manipulate the cameras to various settings but not really understand what features will help them to take the best pictures. Also, since many students will be using the same camera, students must observe protocol for changing the settings and deleting their pictures when done.

Lesson 9: Using the Macro Setting on the Camera

Objective: Students will compare and contrast the quality of their photos when using the macro versus general setting on the camera. Students will record their observations so they can systematically determine the best settings for different situations in the forest.

Materials: Cannon Power Shot© A800 cameras, photo log, various forest materials.

Description of Lesson: Today students will use the vegetation from the forest to practice using the different settings on the camera, particularly the macro setting. As students take their pictures, they will record the setting, distance, and quality of the shot. After taking several pictures at several different settings, students will review their logs and determine when it is appropriate and necessary to use the macro setting on the camera.

Lesson 10: Uploading Photos to Student Online Journals

Objective: Students will create an online field journal using Microsoft Power Point format. Students will become skilled at uploading their pictures into their field journals.

Materials: Netbooks, cannon Power Shot© A800 cameras.

Description of Lesson: All students will be creating and adding to an online field journal throughout this school year. Because time is a factor when going out into the forest, it is important that students are able to quickly evaluate the photos they took that day and then efficiently upload them into their power points. Storage of extra pictures and public drive space will be discussed.

Lesson 11: Review of Highlight Comments and Captions Strategy (Lesson 7).

Objective: Students will apply what they have learned about the strategy to describing the digital photos in their online field journal.

APPENDIX B

PLANT OBSERVATION DRAWING AND PHOTO RUBRICS

Plant Observation Drawing Rubric

Name: _____ Date: _____

Objectives:

- I can explain the appearance of a plant using descriptive language
- I can create a realistic drawing of a plant in my plot
- I can use the drawing and description to correctly identify the plant

This is a drawing of a _____

I know this because _____

Criteria	Self score	Teacher score
1. The drawing is realistic and looks like the object	Y / N	Y / N
2. The drawing above highlights at least four identifying features including: size, color, texture and shape	____ / 4	____ / 4
3. There were enough details recorded to allow for identification of the plant, tree, or shrub	Y / N	Y / N

Plant Observation Photo Rubric

Name: _____ Date: _____

Objectives:

- I can explain the appearance of a plant using descriptive language
- I can use the digital camera to take detailed pictures of my plant
- I can use the picture and description to correctly identify the plant



This is a photo of a _____

I know this because _____

Criteria	Self score	Teacher score
4. The photo is focused and clearly shows details of the plant	Y / N	Y / N
5. The captions I added to my picture highlights at least four identifying features including: size, color, texture and shape	____ / 4	____ / 4
6. The photo and captions have enough detail to allow me to identify the plant, tree, or shrub	Y / N	Y / N

APPENDIX C

FOREST OBSERVATION PROTOCOL

Forest Observation Protocol

Student: _____ Date: _____ Time: _____

Length of observation: _____ Observer: _____

This is the _____ observation of this student.

Level of Engagement in Activity	Always	Sometimes	Not at all
Student is interested in the activity Comments:			
Student conversation is focused on the activity and/or the science content Comments:			
Student works carefully Comments:			
Student stays focused on the activity Comments:			
Student completes observation task in the allotted time Comments:			
Student stays at their assigned spot during the activity Comments:			
Student interferes with the work of others Comments:			

Description of activity:

How would you rate this student on their **overall** level of engagement for the duration of this activity? (Circle one)

Not engaged at all Somewhat engaged Mostly engaged Always engaged

What behavior or set of behaviors stands out in your mind as you were rating this student's overall level of engagement?

Additional comments:

APPENDIX D

STUDENT OUTDOOR OBSERVATION BEHAVIOR SELF-ASSESSMENT
WITH AND WITHOUT CAMERAS

Student Outdoor Observation Behavior Self-Assessment Without Cameras

Name: _____ Period: _____ Date: _____

Your participation in this research is voluntary and participation or non-participating will not affect your grade in this class or your class standing in any way.

Directions: Please read the following behavior descriptions and draw a circle around the response that most closely matches your impression of **your own** behavior today at your study site.

Behavior Descriptions

1. I was interested in the activity

Strongly agree

Agree

Disagree

Strongly disagree

Please explain why you felt the activity was interesting or not interesting

2. I felt successful when I was outside doing my observations

Strongly agree

Agree

Disagree

Strongly disagree

Please explain what made you feel successful or not successful outside today?

3. I completed the activity

Strongly agree

Agree

Disagree

Strongly disagree

If you did not complete the activity, please tell me the reason(s) why you did not finished.

4. If I talked with another student while out at the plot, my conversation was about the observations I was making

Always

Usually

About half the time

Seldom

Never

5. If I talked with another student while out at the plot, my conversation was about what we are learning in the classroom

Always

Usually

About half the time

Seldom

Never

- | | | | | | |
|---|--------|---------|---------------------|--------|-------|
| 6. I worked carefully on my drawing | Always | Usually | About half the time | Seldom | Never |
| 7. I worked carefully recording observations | Always | Usually | About half the time | Seldom | Never |
| 8. I stayed focused on the activity | Always | Usually | About half the time | Seldom | Never |
| 9. I followed my teacher's directions for the activity | Always | Usually | About half the time | Seldom | Never |
| 10. I stayed at my assigned spot during the activity | Always | Usually | About half the time | Seldom | Never |
| 11. I did not interfere with the work of others around me | Always | Usually | About half the time | Seldom | Never |

Thank you for your honest evaluation of your behavior while outside today.

Is there anything else you want me to know?

Student Outdoor Observation Behavior Self-Assessment With Cameras

Name: _____ Period: _____ Date: _____

Your participation in this research is voluntary and participation or non-participating will not affect your grade in this class or your class standing in any way.

Directions: Please read the following behavior descriptions and draw a circle around the response that most closely matches your impression of **your own** behavior today at your study site.

Behavior Descriptions

1. I was interested in the activity

Strongly agree

Agree

Disagree

Strongly disagree

Please explain why you felt the activity was interesting or not interesting

2. I felt successful when I was outside doing my observations

Strongly agree

Agree

Disagree

Strongly disagree

Please explain what made you feel successful or not successful outside today?

3. I completed the activity

Strongly agree

Agree

Disagree

Strongly disagree

If you did not complete the activity, please tell me the reason(s) why you did not finished.

4. If I spoke with other students while out at the plot, my conversation was about the observations I was making.

Always

Usually

About half the time

Seldom

Never

5. If I spoke with other students while out at the plot, my conversation was about what we are learning in the classroom

Always Usually About half the time Seldom Never

6. I worked carefully taking pictures in my plot

Always Usually About half the time Seldom Never

7. I worked carefully recording observations

Always Usually About half the time Seldom Never

If you answered seldom or never, please explain: _____

8. I stayed focused on the activity

Always Usually About half the time Seldom Never

9. I followed my teacher's directions for the activity

Always Usually About half the time Seldom Never

10. I stayed at my assigned spot during the activity

Always Usually About half the time Seldom Never

11. I did not interfere with the work of others around me

Always Usually About half the time Seldom Never

12. I was able to take pictures that were in focus

Always Usually About half the time Seldom Never

Why do you think your pictures were not in focus? _____

Thank you, as always, for your honest evaluation of your work. I appreciate your help with my project.

APPENDIX E

FOCUS GROUP INTERVIEW QUESTIONS

Interview Questions

Focus Group Interview Questions

I'd like to talk with you about the time you spent in the forest drawing your study plot. I will be recording your answers so that I can go back and take notes about what you've told me. After I am done with the notes I will be erasing the tape. Is it ok that I tape your responses?

1. What types of activities do you do outside on your own time?
2. About how much time to you spend outside doing these activities each week?
3. Were you familiar with how to use a digital camera before we used them in class? Probe: Tell me about your experiences using digital cameras.
4. You have all had the experience of recording what was in your forest plot by drawing and writing out observations about the plants. What was good about this activity? What was bad about this activity?
5. Do you feel the data you collected, the drawings and written observations, helped you to identify the plants or trees in your plot? Why or why not?
6. On our third and fourth visits to the forest plots we used digital cameras. What was good about this activity? What was bad?
7. Do you feel the pictures you took helped you to identify the plants or trees in your plot? Probe: Why do you feel the pictures were better? Why not? What specifically was helpful to you when you used the cameras?
8. Our goal was to record what was growing in our forest plots and all of you indicated on your questionnaires that you felt successful when you were outside each time. Why did you feel successful? Probe: did you understand the directions?

Probe: did you do quality work? Probe: did you finish the assignment? Probe: did you stay on task?

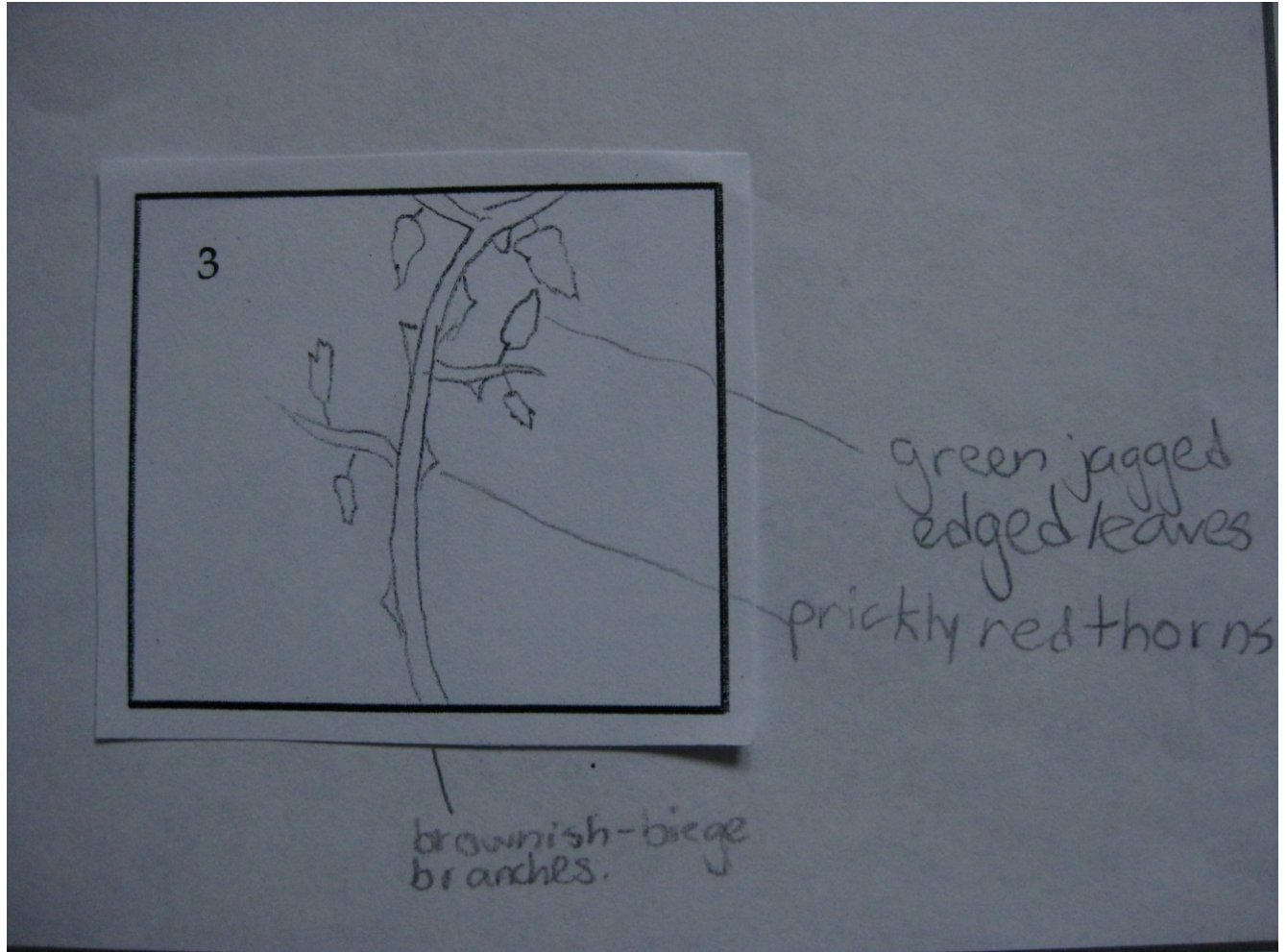
9. What do you like about learning in the outdoors? Probe: Please give specific examples.

10. What would have made this whole field study better for you?

APPENDIX F

EXAMPLES OF STUDENT WORK

Examples of Student Work



Objectives:

- I can explain the appearance of a plant using descriptive language
- I can use the digital camera to take detailed pictures of my plant
- I can use the picture and description to correctly identify the plant



The stems of the plant come out like a fountain

This plant is almost 10x larger than my clipboard in width.

This plant is rough, bumpy underneath. And a little sharp on the edges.

Lime green color with light brown stems

This is a photo of a: Sword Fern

I know this because: The frond reaches outward from the middle like a fountain, and is about 6' wide.

Criteria

Self-score

Teacher score

APPENDIX G

IRB EXEMPTION LETTER



INSTITUTIONAL REVIEW BOARD
For the Protection of Human Subjects
FWA 00000165

960 Technology Blvd. Room 127
 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
 406-994-4707
 mquinn@montana.edu
Administrator:
 Cheryl Johnson
 406-994-4706 or 6783
 cherylj@montana.edu

MEMORANDUM

TO: Candice Lommen

FROM: Mark Quinn, Ph.D. Chair *Mark Quinn Chf*
 Institutional Review Board for the Protection of Human Subjects

DATE: October 19, 2011

SUBJECT: "Using Digital Photography to Improve Student Observation Skills and Data Collection During Outdoor Field Studies" [CL101911-EX]

The above research, described in your submission of October 19, 2011, 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.