THE EFFECTS OF DIGITAL PORTFOLIOS IN MATH AND SCIENCE IN A FOURTH GRADE CLASSROOM

by

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ABSTRACT

In this investigation digital portfolios were introduced as a means to improve student achievement in a math and science elementary classroom. By introducing digital portfolios, and analyzing data from surveys, questionnaires and assessment scores it was suggested that digital portfolios increase student engagement in math and science through self-monitoring, reflection and having a useful container for tasks in math and science. Portfolios also increase student interest in math and science and scores on unit assessments. Lastly, teacher best practices were also influenced positively through the treatment of digital portfolios in a fourth grade classroom.

INTRODUCTION AND BACKGROUND

Project Background

For 12 years, I have been teaching in a 4th grade classroom at Ophir School in Big Sky, Montana. Big Sky is a rural ski resort area nestled in southwestern Montana, approximately 15 miles from Yellowstone National Park. Because of its close proximity to Yellowstone, three ski resorts, and Montana State University, Big Sky is a unique tourist center that offers both visitor and local community members various outdoor activities throughout the year. Due to its tourism popularity and at one time, increased housing growth, Ophir School District expanded to a K-12 community in July 2008 (Big Sky School District).

The population of this class is centered on a self-contained classroom so the students have the added benefit from being with me throughout the day. The class is made up of 12 girls and 10 boys, ranging from 9-10 years old. The class is culturally similar and made up of 19 Caucasian students, 2 African -American students and 1 Hispanic student. Parent careers range from resort industry related jobs and construction, to business owners that help make the demographics economically diverse (Advameg, Inc., 2012).

Because of the increase in school population and the creation of a K-12 district ways of keeping track of or creating containers for student tasks and assessments were under discussion. Currently Ophir School does not use electronic or paper portfolios in an ordered system. There is a non-structured method of saving a piece of work in writing and art throughout the year, but these folders when passed on to me by the third grade teacher usually sit in the corner and are rarely accessed. When we do look into these paper file containers, they are usually vast and unorganized. After fourth grade, most of these folders become obsolete by being tossed in the trash or recycle bin. Other in-school examples of portfolios or student folders are developmental reading assessments, which are tracked on paper in a folder for each school year starting in kindergarten until fourth grade when I pass them on to the fifth grade teacher. Portfolios are used for art, but are emptied at the end of the year. Otherwise student work is returned, deposited in the recycle bin by students, or kept in a “folder” or “pile of paper” at home. A newly acquired push for using new technology in the classrooms by the district also led me to re-think our student work containers.

My objective with this action research- based project was to start implementing an electronic or digital portfolio in my math and science class to see if they benefited student engagement and teacher practices. Pintrich and De Groot (1990) refer to engagement as a students' use of cognitive, meta-cognitive and self-regulatory strategies to monitor and guide their learning processes. Students do this by exercising various tasks which they choose and by regulating their own learning. From this definition, student engagement is referred to here as a student’s ability to reflect, self-monitor and evaluate tasks in math and science. If desirable results are gained, I plan to continue their use in other curricula areas. The long term goal is to develop a system, using a web-based component, which is manageable by all teachers and students and easily accessed through the internet. The portfolio will be used as a tool for communication between staff, students and parents and connects our newly developed curriculum, adopted core standards, instruction and assessment. Therefore, the end result will be an engaging vehicle that will drive the vital connection between curriculum, instruction and assessment. This was a current staff need that had been recognized for the K-12 school system.

A concern for monitoring student progress and increasing student engagement led me to investigate my focus question: Can student engagement increase as the result of technology being integrated into the classroom? Specifically, what impact do electronic portfolios have on student performance in math and science in a fourth grade classroom? From this focus question I have specifically identified two sub-questions:

Is student interest in math and science impacted?

Is teacher reflection and best practice enhanced?

CONCEPTUAL FRAMEWORK

Portfolios can come in many forms and across curricula. Portfolios can be defined as containers of evidence or a place where we can access the student's learning (Collins, 1992; Grace, 1992). A portfolio is a collection of student work that shows both successes, challenges and ideas moving towards progress. There are portfolios that show the steps towards an end goal, there are portfolios that showcase completed projects and performance portfolios that illustrate a student's scores or grades.

Barrett (2007) notes a more holistic approach that she specifically terms an educational portfolio. Barrett, who is one of the most recognized leaders in electronic portfolios notes:

> An educational portfolio contains work that a learner has collected, reflected upon, selected, and presented to show growth and change over time, work that represents an individual's or an organization's human capital. A critical component of an educational portfolio is the learner's reflection on the individual pieces of work as well as an overall reflection on the story that the portfolio tells about the learner. (p. 436)

An idea put forth by Stiggins (2007) notes that portfolios can serve as vehicles for assessment for learning and contain many benefits that help children in the learning process. He believes that when teachers initially set up an environment where expectations are handed to students in student-friendly language and accompanied with examples of student work, the students can follow their expected learning outcomes without being overwhelmed. He notes, "as students become more proficient, they learn to generate their own feedback and set goals for what comes next in their journey" (p. 23). The portfolio process enhances student learning in a day to day format. When students are invested in their goal setting it becomes more meaningful to them.

Similarly, student involvement and engagement are considered valuable components in students developing portfolios. In a study where 13 elementary students in grades K-5 were surveyed through questionnaires, the results showed advance in value placed on the student experience and learning (Hall & Hewitt-Gervais, 2000). The processes of developing portfolios enhance complex learning strategies. Portfolios may not be the answer to all learning problems and there is still a lot of research that needs to be completed, but well thought out and constructed portfolios exemplify important, specific-oriented learning that require different thinking skills and strategies. Some of the complex thinking skills included in portfolio development are problem solving, researching, analyzing and sharing. An integral component of educational portfolios is students being involved in and evaluating their own work and sharing their challenges, improvements and accomplishments. This is considered engagement with one's work or studies, even to the point where students are becoming more involved in parent/teacher conferences by actually leading them or becoming partners with the teacher in communicating their successes and failures (Ellsworth, 2002; Herman & Winters, 1994; Stiggins, 2007; Sweet, 1993). When this student leadership takes place, teacher involvement may also increase which should be reflected in their best practices.

Part of the initiative and focus of portfolios is the elevation of teacher performance or best practices. Schmoker (2006) refers to teacher involvement while observing student samples of saved work that "these samples provide incomparable, ongoing opportunities for leaders to learn- to understand, support instruction and assessment" (p. 131). In several studies, researchers found that teacher practices were drastically improved with the help of student portfolios. The greatest and most valid quantitative studies were the Vermont and Michigan studies performed in the 1990's. Specifically in the Vermont study, which focused on math portfolios, teachers found that through the use of student portfolios, they committed more classroom time to instructing students about better problem solving strategies (Herman & Winters, 1994). The teacher identified a specific need of the students and focused classroom time on it, thus teacher reflection is enhanced and ultimately student engagement and performance increased.

By focusing on individual student needs through evidence in the portfolio, teachers are able to enhance instruction specific to each student. (Hall & Hewitt-Gervais, 2000; Herman & Winters, 1994). Equally important, Ellsworth (2002) notes "portfolios provided a mechanism to see children as learners through different lenses and to recognize the individuality of each student" (p. 348). Teachers recognized that their teaching improved in four areas: enhanced usability of the portfolios, clearer understanding of all their students, new found ability to improve their instruction and ways to ask for and obtain what they need for this instruction to take place (Ellsworth, 2002). The learning becomes more individually specific and needs are met by all students.

Ironically, there are some exceptions made about the effectiveness of student educational portfolios. Criticisms, for the most part, involved a lack of authentic assessment value, time management challenges, and usability of the portfolios for teachers. Just because portfolios exist, doesn't guarantee that they are authentic. Teachers must be careful when scoring content and refer to the specific use of the portfolio. Although portfolios are intended to provide a wealthy, varied, and individual set of performances, portfolios need to be assessed to common standards (Collins, 1992; Dietel, 1992). Herman and Winters (1994) compound this thought by shedding light on the validity across schools and classrooms in that some students may receive more outside help from parents or other teachers when creating their portfolios generating a varying unfairness. They go as far as to recommend that "portfolios may overestimate student performance" (p. 51). At the same time many researchers found that in order for these portfolios to be successful, many hours of teacher training and learning how to use and assess portfolios needs to be practiced. Teachers need time to develop, practice, and learn the technical side of portfolios especially if they are electronic or digital to sharpen their instructional skills (Herman & Winters, 1994). Current technological trends in social media, accessible programs, and web based products can increase teacher usability.

To combat these criticisms some researchers believe that the use of portfolios should be used within all the weaponry of assessment tools (Collins, 1992; Herman &Winters, 1994; Klein, 1995). Portfolios should not stand alone and be the only assessment source or classroom tool. They should be combined with all the other components already occurring in the classroom and school-wide setting that help meet each student's individual needs.

METHODOLOGY

The purpose of this study was to determine if student engagement increased as the result of utilizing digital portfolios in math and science in a fourth grade classroom. The subjects of this study were 22 fourth grade students in my self-contained classroom, including 10 male students and 12 female students. The 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. Units on geometry, fractions and multiplication and division and simple machines were the content area for treatment. The units did not run simultaneously, but spanned the course of the second and third quarters of the school year.

The focal treatment in this research was implementing digital portfolios in the math and science classes. Digital portfolios were created on a web-based internet site called Weebly.com. At Weebly.com students created free web pages which served as their containers for their portfolios. This web-based design was student friendly and easily accessible both at school and home. Students were allotted two hours of instructional time and portfolio development each week during the treatment. This time was spent not only on development of their portfolio, which included creating artifacts from their tasks and assessments, but students also learned to create pod-casts for each other as learning tools, reflecting on artifacts and utilizing other digital media for sharing their work. Presentation skills were also practiced which included and audience of peers, parents and teacher.

First, all students completed the Math and Science Interests Survey (Appendices A and B). The Math and Science Interests Survey is a concise tool to measure interests with elementary students and was limited to 11 questions with only 3 leveled response answers. This instrument was used to gather data about the students' interest and engagement of tasks in math and science pre and post treatment. The data was analyzed using a Likert scale based on their responses: *Not usually (NU)*, *Sometimes (S)*, and *Almost always true (AAT)*. These responses were assigned a numerical value: NU=1, S=2 and AAT=3. After data collection, the scores calculated to determine any change in mode with regards to student interests, communication and containment of tasks. The pretreatment data was compared to post treatment data to analyze any change in math and science interests, communication and containment of tasks with the use of digital portfolios.

Eleven randomly selected students were administered The Digital Portfolio Questionnaire (Appendix C). I video recorded this set of interview responses so that I was able to accurately gather their responses to the questions asked and further ensure validity of their responses. The Digital Portfolios Questionnaire was used to gather similar information about the students' knowledge and interest level of portfolio use pre and post treatment. Transcripts of the student interviews were analyzed, compared and contrasted to the pre and post treatment data and trends were observed. The focus of the analysis was to see what change, if any, occurred in the students' views of the integration of a new technology tool in math and science as a means of a container for their work and to see if math and science interest levels changed.

In order to gain a better insight and to measure usability of the digital portfolio throughout the treatment, the Digital Portfolio Skills Matrix was used throughout the treatment to all students (Appendix D). This quick formative assessment allowed me to determine if students were using the portfolios with ease so not to increase possible stress or misunderstanding with its use. I was able to find gaps which helped pin-point student usability of this newly introduced technological tool. It also allowed me to monitor where modifications were needed in instruction each week which lead to increased teacher reflection.

I administered three instruments to all students to gather another set of data about student performance. The first set of instruments was a Classroom Assessment Tool (CAT). The Muddiest Point assessment was used after lessons in math and science (Appendix E). I used this instrument as an ongoing tool to gather information about student understanding of daily classroom content in math and science. I prepared the data by making observations on their responses and incorporating them into the next lesson.

Another set of data that was analyzed was unit assessments. The scores were analyzed to show change in test scores throughout the treatment. Scores on teacher made tests can be used to measure achievement and is one of the most common quantitative data collection pieces. The scores on their assessments for specific units in math and science were examined for any trends in change of performance. This is part of the normal classroom procedures and is standard in my classroom. I used the data to justify any noticeable trends in math and science performance particular to the curricular units during the treatment.

Finally, teacher best practices were observed through the use of keeping a journal throughout the treatment. Journal responses were analyzed to notice any trends in personal reflection and if those trends impacted teacher best practice in math and science. Teacher observations were also recorded in the journal to help recognize any change in student interest level. The students' responses to the CAT were also further analyzed for any noticeable increases in pedagogical practices. Lastly the Portfolio Skills Survey was analyzed. The skills matrix showed an increase in usability of the technology component of the portfolios over the course of the treatment. Using a Likert- Scale the responses were coded to assign them a numerical value: *Very unsure how to complete this task* =1, *I can do it most of the time* =2 and, *I feel very comfortable performing this task* =3. These tools are triangulated in Table 1.

Table 1
Data Triangulation Matrix

Research Question	Data Source 1	Data Source 2	Data Source 3
Focus Question: Can student engagement increase as the result of technology being integrated into the classroom?	Pre and Post Student Interest Survey	Pre and Post Student Interviews	Teacher Observations
Secondary Questions: What impact do electronic portfolios have on student performance in math and science in a 4th grade classroom?	CAT	Unit Assessments	_
Is student interest in math and science impacted?	Pre and Post Student Interest Survey	Pre and Post Student Interviews	Teacher Observations
Is teacher reflection enhanced?	Portfolio Skills Survey	CAT	Journal

DATA AND ANALYSIS

The results of the Pre-treatment Math Interest Survey showed that students only *sometimes* had interest in math, and *sometimes* discuss math with friends, family and teachers (*N*=22). Keeping track of math tasks or self-monitoring of math tasks and assessment scores at home and school resulted *almost always true (mode =3).* The overall pre-treatment mode of responses was *sometimes (mode =2)* indicating neither a strong nor weak interest nor engagement in math.

The results of Post-treatment Math Interest Survey showed a positive change in student engagement and interest in math (Figure 1). Students became more aware that math and technology are related and that they could learn math in many places other than math class. After treatment, students responded that they kept track of their math tasks less than before treatment.

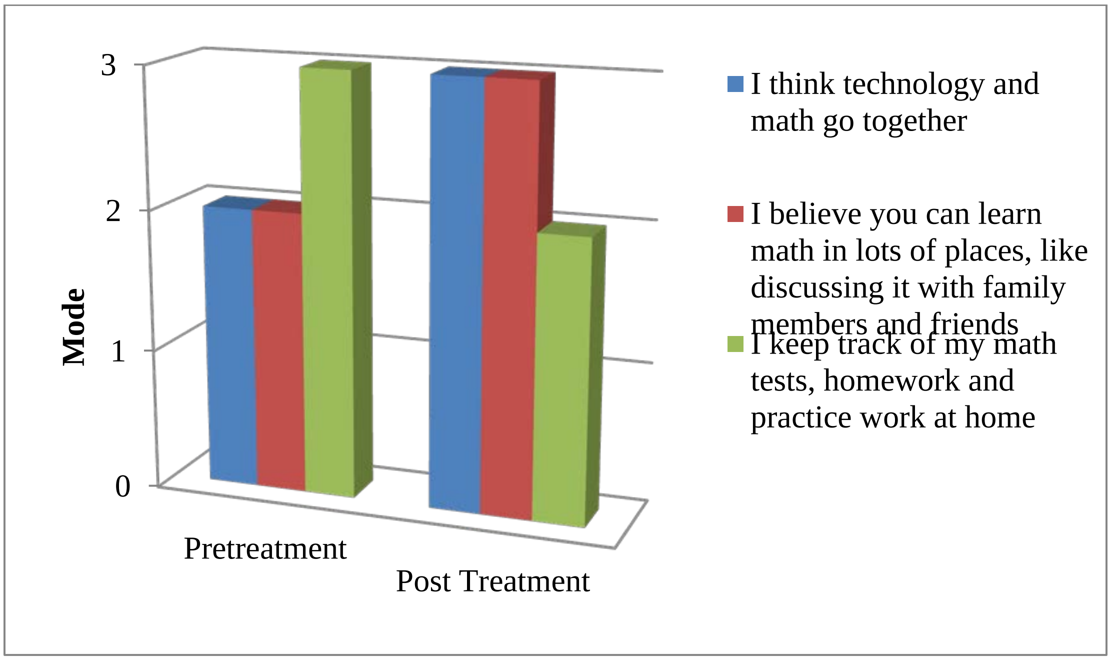

Figure 1. Math Interest Survey, (*N*=22). Legend: *1=Not usually; 2= Sometimes; 3= Almost always true.*

The results of the Pre-treatment Science Interest Survey showed a similar representation. The data showed neither a weak nor strong interests in science. Similar to the math data, the students tended to show evidence of keeping track of science scores and tasks at home and school while communicating science to others was not as evident. One theme presented by the data suggested that students did not want to pursue a science career, nor enjoyed "doing" science in their free time. The overall theme after analyzing the mode was that students responded with *sometimes (mode =2)* having an interest in science.

The results of the Post-treatment Science Interest Survey showed a more positive change in student engagement and interest in science than that of the math survey (Figure 2). The overall mode changed from *sometimes (mode =2)* to *almost always true (mode=3)* for student interest and engagement in science. Students responded with a more positive statement that showed an interest in choosing a career that involved science. Also students responded with further engagement with keeping track of their tasks and scores and communicating science to others as *almost always true (mode=3).*

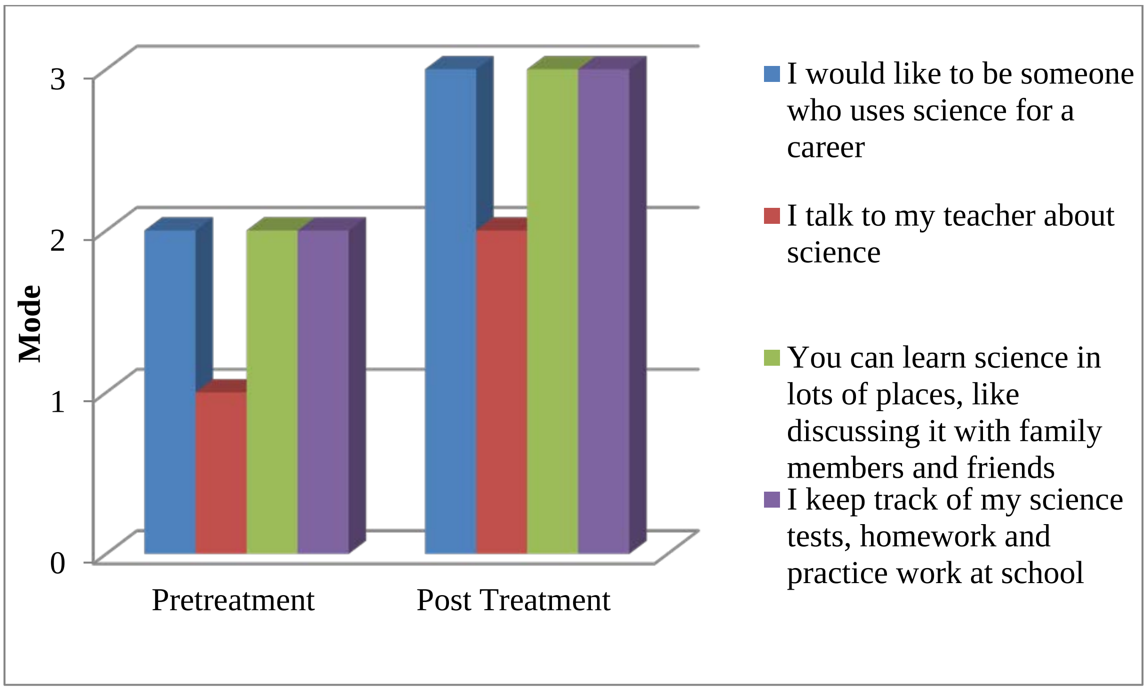

Figure 2. Science Interest Survey, (*N*=22). Legend: *1=Not usually; 2= Sometimes; 3= Almost always true.*

A second set of data used to help determine students' knowledge and interest level of portfolio use in math and science was the Digital Portfolio Questionnaire (Appendix C). Before treatment many students reported that portfolios were a place to keep their stuff and usually this container was a box or pile of papers at home. This data changed after the treatment. Most student responses suggested that they could now create a new page on my portfolio, and insert or scan a test into their portfolio to keep track of their work. One student suggested that "Portfolios are easy to work with and you don't have to carry a package, they [portfolios] are reusable." Another trend presented before treatment was that students *sometimes* communicated their challenges or successes in math and science with friends, family and teachers. One student went so far as to say, "I usually don't discuss it much, I basically tell them how I'm doing based on my opinion." After treatment, a majority of student responses showed increased communication. "Now I can show them about my progress, failures and successes, I even talk to my grandmother about my portfolio," one student responded. Lastly, student engagement and interest in science and math increased in recorded responses. One student concluded "I can recalculate my mistakes on a test." While many students reported that they used their portfolio to help them learn concepts like multiplication better. One student stated "I can now put stuff on my website so I can keep track of what I learned, I never knew about them (portfolios) but now I like working with them."

In multiplication and division, scores increased from 76% to 89%, geometry 81% to 86% and fractions 73% to 86%. With regards to science scores, only the unit on simple machines was assessed pre and post -treatment. Simple machines assessment scores increased from 72% to 86% after working with their portfolios (Figure 3).

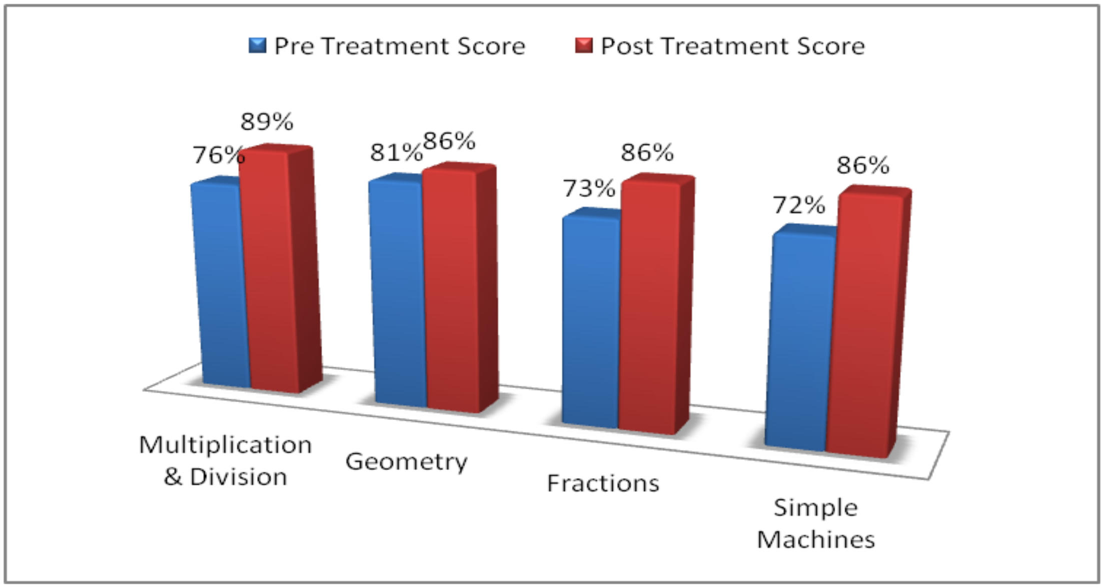

Figure 3. Average assessment scores pre and post treatment, (*N*=22).

The Skills Matrix showed an increase in usability of the technology component of the portfolios over the course of the treatment based on student self-assessment. A change in mode from 1= *very unsure how to complete this task,* to 3= *I feel very comfortable performing this task,* was recorded from pre to post treatment with all task questions. Students had an overwhelmingly positive response to learning the tasks that accompany developing the digital portfolio such as creating content specific pages, using Flip Videos and, PowerPoint instructional slide shows (Figures 4 and 5).

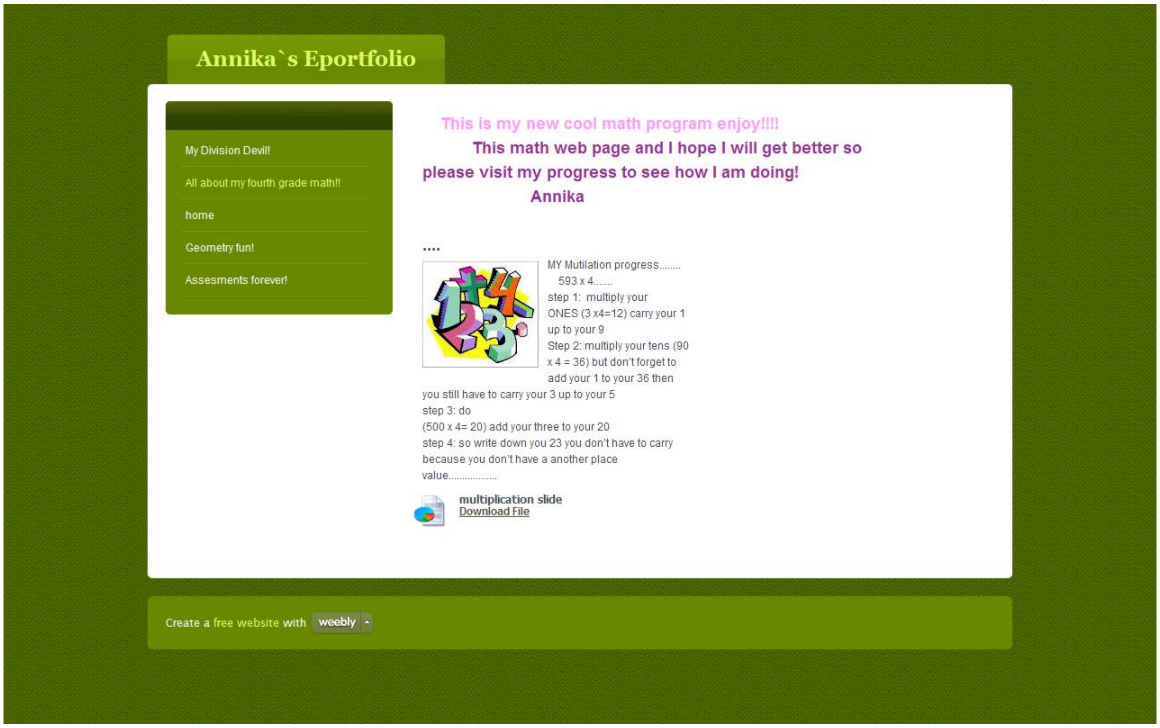

Figure 4. Student digital portfolio example- with PowerPoint lesson.

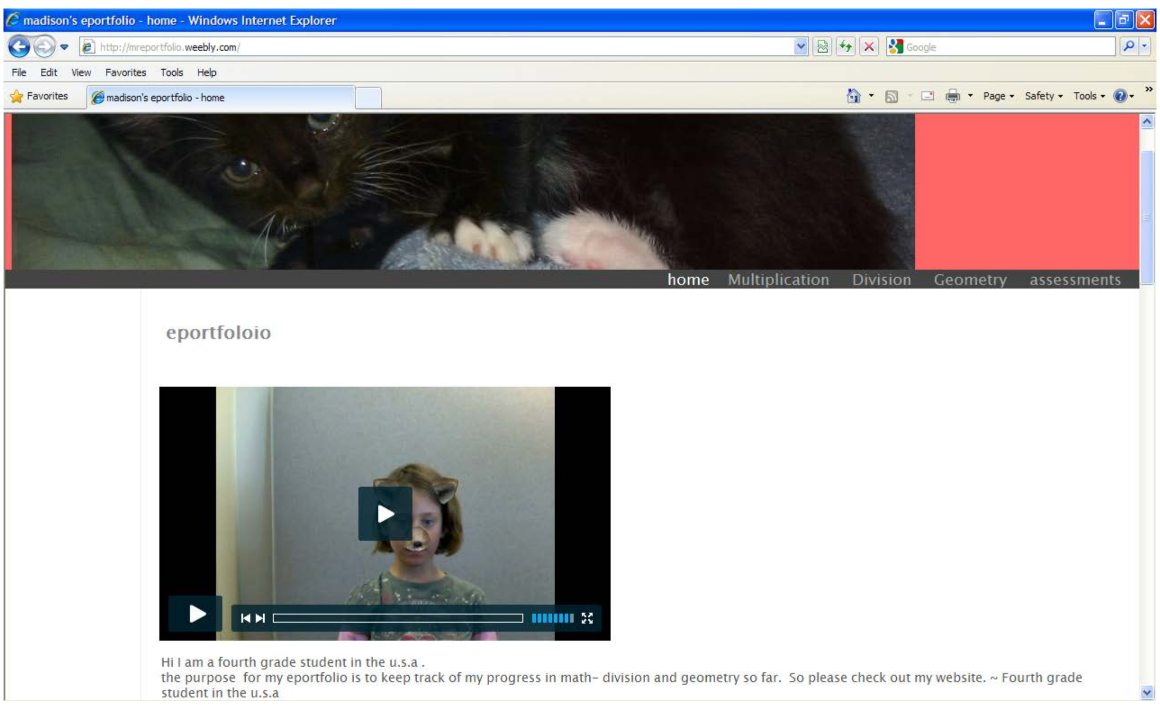

Figure 5. Student digital portfolio example- with Flip Video.

Another assessment tool, the Muddiest Point, was used for weekly concept understanding and to help determine teacher best practices. A journal kept by the teacher was also recorded and looked at for trends in teacher responses. The trends represented consisted of comments that helped guide teacher practice to fit student usability with their work on digital portfolios. One journal comment stated that “with continued practice at these multi-media components students are catching on.” While another entry reported that “Students have an overwhelming desire to work with portfolios asking me every day if we have time to work on them [portfolios]” were recorded. Many student responses on the Muddiest Point assessment were recorded with a theme of students wishing they had more time for portfolio work. One student responded, “ I couldn’t do things like division until I started making slide shows for my portfolio.” Many students responded throughout the treatment with comments that showed a change in understanding and an ability to complete technology-based tasks. One student specifically stated “Some of the multi-media stuff was hard but now I’m getting it.”

INTERPRETATION AND CONCLUSION

The data were analyzed to help determine if student engagement increased as the result of technology being integrated into the classroom and if there was an impact on student performance in math and science with the use of electronic portfolios. Interpretation of the data suggests that electronic portfolios improved student engagement and performance in math and science. Through the triangulation of data collected this trend is further documented.

The results of the Math Interest Survey showed a positive change in student engagement and interest in math. Most notably, students recognized that they could learn math in places other than math class. As well, the Science Interest Survey showed a positive change in mode from *sometimes* to *almost always* in their overall responses from pre to post treatment. Moreover, students responded with further engagement by keeping track of their tasks and scores and communicating science to others. During the exposure to the treatment, math and science interests increased. An additional piece of data that shows a positive change in interest and engagement in math and science was the Digital Portfolio Questionnaire. Positive change was evident in their responses after the eight-week treatment period. This questionnaire also showed an increase in student communication of math and science through the use of their digital portfolios.

An increase in student performance was evident through the average scores of the unit assessments in math and science. The final piece of data that supports student performance and the use of digital portfolios were their responses to the Digital Portfolio Matrix. Students had an overwhelmingly positive response to learning the tasks that accompany developing the digital portfolio from *Very unsure how to complete this task*, to *I feel very comfortable performing this task.*

Of course, some of this improvement and enhanced engagement could be related to other components outside the technology lab and the time spent developing the portfolios. Classroom instruction, possible student research outside of class, or further discussions between student and teacher could help accommodate these increases in assessment scores. I would expect more exposure of the math and science content alone could help bring about these trends in student interest and engagement which could have played a part in the apparent increase. Working with technology also seems to be a school-wide theme with students gaining extra interest in technology related activities. Coincidently, I was hoping for more of a change in mode responses with the Interest Surveys, but like many tasks in school I found that some students became fond of the portfolio work after time while some struggled with it. The few that struggled with it also demonstrated less technological skills in other tasks not related to the portfolio process.

A secondary research question asked if teacher best practices were enhanced and improved through the digital portfolio treatment. During the treatment, a trend showed more individual attention being paid to students, increased communication, and more specific and guided instruction for developing and maintaining a digital portfolio. Part of this increased attention paid to students was due to the fact that we started from nothing and fully developed these portfolios together. I had little experience with portfolios and so we learned how to create, contain reflective information and build the portfolio from actual experience with me along side of the students trying new strategies. This may have also lead to increased student engagement and even student performance. I would think that when learning something new and using new tools might help activate the young mind and help increase engagement. Anytime a teacher spends more time and walks carefully through the steps to any activity with students one would think student interest and performance would increase alongside teacher best practices improving. I think, like many tasks we initiate with students, some catch on quickly and run with it and some struggle with the practices. It would be beneficial to track the results throughout an entire school year. My prediction would be that eventually some fourth graders might lose interest after their initial curiosity waned.

VALUE

I am a teacher, who since starting teaching 12 years ago, has been committed to taking students outdoors to learn from the wonders of the natural world. I pride myself at Ophir School as the one who started many of the outdoor learning opportunities here, the one who continues to use outdoor education and year-long service learning projects based around scientific inquiry. It was rather ironic that my action research was focused around an indoor teaching and learning style and that it was centered on technology, something I was avoiding for some time. This research and science program at Montana State University has changed my practices. I am no longer afraid to try new things. I follow through with topics I wasn't confident about and research them to better my instruction. I instruct differently. I pay more attention to student needs, I look as assessments differently and I combine many different ways for students to learn than I did before this program and especially this action research. I remember reading back in one of the earlier classes about action research being a continuing process that helps all stakeholders. That, with further reflection, more emphasis on assessment and gathering information we can change our schools to be more effective and improve student learning (Mills 2007).

I can see where my students, my school and I can improve with this research and these new practices. I have become a more involved teacher, a teacher with more confidence and a teacher who looks at scores and performance differently. I can also share these data and conclusions with my co-workers. I can now help them create action research projects and can help them share data differently. Recently I was asked to lead our new Response to Intervention (RtI) program started this year as the data manager. I believe this happened because of my new data acquiring skills I gained through this action research and a new ability to present information differently. One of the components lacking at Ophir, and the reason this research was prompted, is that of a constant and easily manageable container for student work. We recently adopted a new grading program, but we still are lacking a portfolio-type container to keep track of student work. This treatment serves as an option which I will share with co-workers this summer. The may use our class examples as a means to set up with their students to see if they are something they want to start next year.

My students now have a new tool to monitor their progresses and challenges of their tasks in school. The web-based portfolios are available for students to continue to develop and work on, if they so desire. My students now have an array of multi-media practice and skills can take into middle school and beyond. They also have an increased love for math and science, something we have been battling for years at Ophir. Science interest was never a concern in my class, but students in the past were afraid of math, I feel like my students this year for the first time are leaving fourth grade with less fear of math.

After reflection, I am left with some concerns for other classes beginning digital portfolios or students continuing them after fourth grade. The first concern which was also addressed in the conceptual framework was that the portfolios can create more work for some students and teachers. I could imagine this to be the case with some co-workers who do not feel confident with starting new programs and feel like this might be just another added new craze in education. Time is always an issue, where do we find the time to develop these new activities among the classroom, school and district needs. Our treatment took away from some critical classroom and textbook time to develop the digital portfolios. During the eight weeks, the portfolios seemed to take up a considerable amount of valuable time, especially in the beginning, but as time went on and we became more practiced at our technology skills, this feeling faded away. Another concern for others may be obtaining tech room time is difficult. With six classes sharing a technology room and only one scanner and one video web camera present, resources are limited. Again, not all students feel that technology is an easy component, but with practice, many of those students started to more comfortable with the tasks as the Digital Portfolio Skills Matrix pointed out. More often than not, I find that some students who are challenged to remain on task in the classroom are also the ones who have a difficult time sitting at a computer and completing tasks. Added practice in patience and simple scaffolding on the part of the teacher could help reduce this conflict with some students.

As teachers, we need to recognize that combining a variety of ways of instruction is the best way to invite increased engagement and performance with students and best practices with teachers. This sometimes referred to as differentiated instruction. Like many other initiatives and varied instructional practices, some students found success with the portfolios and some struggled with the treatment. Ironically, it was interesting to watch students who sometimes have a difficult time finding success in the classroom or outdoors found the portfolios as a means to demonstrate something they were good at. At the same time, students who often find success outdoors or in the classroom found this to be a difficult task. Logically, there is no one component that can save or fix education, although portfolios can help assist some students as we have seen through this research study and maybe bring up assessment scores when coupled with increased student-teacher interaction, communication, interest and engagement. If anything, portfolios serve as an added bonus for monitoring student and teacher performance in the classroom. Not only can they build self-confidence and enhance reflection and engagement with both parties, but they also may benefit teaching global technology, reflection and presentation skills that will be essential in the 21st century. That, coupled with new interest in technology, a new tool for communicating their learning, and teacher practices enhanced, suggests this action research served its intention.

Personally I changed my thoughts on technology and education. Before this research, I often found myself shying away from such daunting technology tasks. I asked myself if this is really where the global society was moving towards. I skirted around technology in the classroom as just another quick trend in education that would soon fizzle out. I continued to ignore it and used increased individualized instruction in the classroom and outdoor education as my go to. I found through this research that ignoring things don't make them go away. I embraced this and found a new appreciation and value integrating technology into the curriculum. My classroom environment has changed to where there are daily slide shows welcoming the students every morning, I use Teacher Tube and You Tube to show different perspectives about content material, I allow students more opportunities to complete tasks using components like Flip Videos, pod casts, Prezi presentations and recently ordered a SmartBoard. I think the last element that will make a considerable difference in my effectiveness as a teacher is that I am currently working on the Common Core State Standards (CCSS) for my district and trying to incorporate not only my portfolios but other technology into the new curricular strands. With these new acquired skills I can continue to reflect on my classroom, accommodate and create more individualized instruction, and make changes that are necessary for student learning and school improvement.

Some questions still remain and may not be easily answered. Where will we keep all these gigabytes that we acquire with using tools like this? It has to be stored somewhere, where is this tremendous cloud of social, educational and personal data to be kept? Another question about data and technology is will the programs we use today be here tomorrow? The technology world is so dynamic and moves at such great speeds that it almost topples over itself with new components being introduced each month. Are we able to manage these constant changes in the technology world? These are questions we will need to consider.

Equally as important and relevant is the use of technology and the time it may take away from other more traditional ways of education. How do we blend new technology and continue to get students to explore the outdoors? How do I balance my classroom so students still pick up and flip through the pages of a book or learn to write using manuscript or cursive? These are some of the questions that need to be addressed as we move into a technology enhanced schooling system. I don’t have the answers to these questions but I do believe we must find a way to use the tools that will address individual student needs, allow teachers to inspire all students, and make sure we are competitive in global education and prepare our students for a global market.

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APPENDICES

APPENDIX A

MATH INTEREST SURVEY

Math Interest Survey

Check whether you are: A boy ______ or a girl ________

We're interested in finding out what you think about Math. Read each statement, and then circle the response that best describes how true the statement is for you. **Participation in this research is voluntary and participation or non-participation will not affect a student's grades or class standing in any way.**

1. Math is one of my favorite classes.	Not usually	Sometimes	Almost always true
2. I enjoy talking to my friends and family about what I'm learning in my math lessons.	Not usually	Sometimes	Almost always true
3. I would like to be someone who uses math for a career.	Not usually	Sometimes	Almost always true
4. I enjoy "doing" math, even during my free time.	Not usually	Sometimes	Almost always true
5. I talk to my teacher about math.	Not usually	Sometimes	Almost always true
6. I know my math scores.	Not usually	Sometimes	Almost always true
7. I think technology and math go together.	Not usually	Sometimes	Almost always true
8. I'm good at math.	Not usually	Sometimes	Almost always true
9. I believe you can learn math in lots of places, like discussing it with family members and friends.	Not usually	Sometimes	Almost always true
10. I keep track of my math tests, homework and practice work at school.	Not usually	Sometimes	Almost always true
11. I keep track of my math tests, homework and practice work at home.	Not usually	Sometimes	Almost always true

APPENDIX B

SCIENCE INTEREST SURVEY

Science Interest Survey

Check whether you are: A boy ______ or a girl ________

We're interested in finding out what you think about Science. Read each statement, and then circle the response that best describes how true the statement is for you. **Participation in this research is voluntary and participation or non-participation will not affect a student's grades or class standing in any way.**

1. Science is one of my favorite classes.	Not usually	Sometimes	Almost always true
2. I enjoy talking to my friends and family about what I'm learning in my science class.	Not usually	Sometimes	Almost always true
3. I would like to be someone who uses science for a career.	Not usually	Sometimes	Almost always true
4. I enjoy "doing" science, even during my free time.	Not usually	Sometimes	Almost always true
5. I talk to my teacher about science.	Not usually	Sometimes	Almost always true
6. I know my science scores.	Not usually	Sometimes	Almost always true
7. I think technology and science go together.	Not usually	Sometimes	Almost always true
8. I'm good at science.	Not usually	Sometimes	Almost always true
9. I believe you can learn science in lots of places, like discussing it with family members and friends.	Not usually	Sometimes	Almost always true
10. I keep track of my science tests, homework and practice work at school.	Not usually	Sometimes	Almost always true
11. I keep track of my science tests, homework and practice work at home.	Not usually	Sometimes	Almost always true

APPENDIX C

DIGITAL PORTFOLIO QUESTIONAIRE

Participation in this research is voluntary and participation or non-participation will not affect a student's grades or class standing in any way.

Prompt: I am going to record this interview so that I will be able to correctly understand your answers to the questions I asked you about on the Digital Portfolios Questionnaire. For each question, I will read the question, if you need me to re-read the question I can, and then explain to me your answer using as many details as possible.

1) How do you keep track of your school work, like grades and what you learn?

2) Do you communicate your progress and challenges in school with your teacher? If so how?

3) Do you communicate your progress and challenges in school with your parents? If so how?

4) Do you communicate your progress and challenges in school with your friends? If so how?

5) How do you think your teacher keeps records of your school work?

6) How would you prove to a teacher, parent or other student that you deserve a better grade?

7) If we used something in class that could help contribute to your own success would you like to use it?

Why or Why not?

8) Do you like working with technology?

9) What do you know about portfolios?

Have you ever used them in other grades or schools?

10) Is there anything else you want me to know about portfolios, keeping track of your work, math or science?

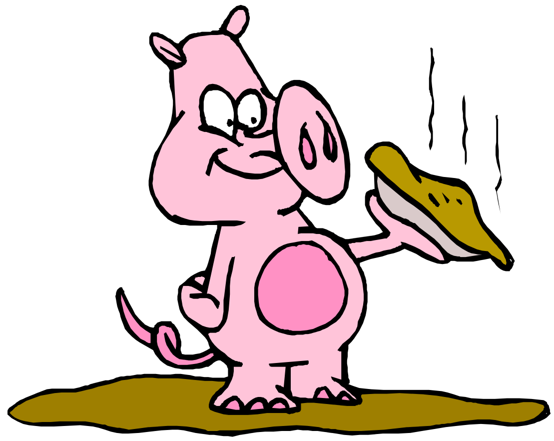
APPENDIX D

DIGITAL PORTFOLIO SKILLS SURVEY

First and last Initials:			
Portfolio skills	*Very unsure how to complete this task*	*I can do it most of the time*	*I feel very comfortable performing this task*
Create an artifact (file)			
Save an artifact in the correct place			
Find an artifact after I saved it			
Place an artifact into my portfolio			
Insert pictures			
Insert video			
Scan a picture			
Insert a scanned picture			
Insert a response to an artifact			
Save a response to an artifact in the correct place			

APPENDIX E

MUDDIEST POINT



Muddiest point…

After today's lesson I'm still "stuck" or confused about…