EFFECTS OF A WEB BASED SCIENCE NOTEBOOK
ON METACOGNATIVE KNOWLEDGE AND PROBLEM SOLVING SKILLS

by

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DEDICATION

I dedicate this paper to my dear wife Katie. She has persisted through countless hours of helping me with formatting issues, proof reading and six years of studying almost every day. She also listened to various stories I told of new class material, acted as a sounding board for lessons that I was planning and all without whining or complaining. I am done now and I could not have done it without her love and support.
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ABSTRACT

Science notebooks have always been a staple in the science classroom. Traditionally they have been done with a pencil and paper. As technology and students move into the future, computers and web based learning are rapidly replacing the pencil and paper. This research was designed to measure student’s attitude toward web based learning, how using a web-based notebook increases metaknowledge (how one learns) and does it increase problem solving skills. During the treatment, students made and used a web based notebook in OneNote. In it they could complete assignments and solve problems in their preferred learning style. After the treatment, data showed that today’s students have a favorable attitude toward web based learning. However, only 60% of students completed work in their preferred learning style (N =15). Data also showed that problem solving skills remained the same or slightly decreased as a result of using a web based notebook.
INTRODUCTION AND BACKGROUND

At the top of my white board is a quote, "’I don’t know’ and ‘I can’t’ are not acceptable.” This is because I have a desire for students to keep learning and to never quit. Unfortunately, over the past few years, I have observed student effort declining and as a result test scores are lower and attitudes in the classroom are worse. It seems that when science becomes tough, a majority of students quit, and sit aimlessly staring at their assignments. When I ask them why they have stopped working, they simply say they have no idea what to do next. I know this is not the case for all students, as there are many bright and highly motivated students at my school, but I am speaking of a majority of students who are in the middle of the class.

I have also observed that very few students take notes during the lecture portion of my classes. It is especially true of the ninth graders in physical science. This intrigues me because one of the first lessons I teach is how to take notes in a manner that best fits the individual learning styles. I make note-taking mandatory for the first month and give participation grades for completed note sheets. My hope is that students will begin to see the value of good notes. Sadly, as soon as the month of mandatory note taking ends, so does note taking. If these students are to succeed later on in high school, college and eventually in life, they need to learn to take notes and try to solve problems when they arise.

Another current trend with my students is that they discount their abilities in science. For various reasons, they have convinced themselves that they are not very smart in science, so therefore they will struggle in my class and not do well overall. This
is a major hurdle for me to overcome and sometimes it can be a detriment to the student throughout the whole school year.

In an effort to convince my students that they can be successful, I try to incorporate different modalities to assist the various learning styles. I work with students to give them methods that help them remember the material. For some this would be drawing a picture of the topic, while for others it could be drawing Venn diagrams. When students discover how they learn best they are able to understand and retain information much better. Learning how to learn is just as important as actually learning. Once this metacognition is recognized and understood by the students, they are ready for a lifetime of learning.

Personally, I empathize with the students’ frustration during challenging problem solving activities. I was an auto mechanic for fifteen years before completing a biology degree and becoming a teacher. When cars would come to the shop with a problem, I had to correctly diagnose the problem and determine its cause all in the space of one hour. It was a challenge at first, but the longer I worked as a mechanic, the easier problem solving became. Quitting when it became tough was not an option. I learned to do research and take notes in my toolbox notebook so the next time something similar came in, I had a head start.

I know that students really do try most of the time and none of them desire to fail my class. In order to counter this, I am always looking for different ways to improve my teaching methods to increase student learning, understanding and overall effort. Various
labs, demos and videos help to solidify concepts and reach different learning styles. While all of this helps, it has limited affect.

I currently teach at Cole Valley Christian School. It is the largest Christian school in Idaho with over 800 students K-12. The secondary school has approximately 380 students. Our average class size is 25 or less and one of our main goals is to have a relationship with every student in class. The school is mainly Caucasian, over 95%, and students come mainly from five local communities, Boise, Meridian, Eagle, Nampa and Kuna. Since our school is a private school, most of the students come from wealthy families but a few are on scholarship. There is also a wide range of academic prowess at our school. Twenty percent of students are advanced placement on standardized tests, 70% of the students are proficient in standardized tests and the remaining 10% are below standard. Our graduation rate is 100% and 87-94% of those graduates continue on to college (Cole Valley Snapshot, 2013).

As times change and technology increases, schools must follow in order to properly prepare our students for the future. Our school followed the trend and has recently adopted an online classroom tool called Moodle that was developed by the web based school management software company Renweb. It is similar to the D2L system used by Montana State University. I have spent many hours developing my web pages to have additional learning experiences, test prep help pages, interactive web sites and much more. However, students rarely utilize these pages. This is highly discouraging since I know that there is a wealth of information on the web to help students learn science.
I have been thinking about starting to use science notebooks in my classroom for the past five years. One professional development seminar that I attended had a very intriguing breakout session on science notebooks. I have been gathering material over the years and I have a big folder full of science notebook ideas, templates and methods. The research all states that they greatly help student understanding, but I think I am like many of my students in this case. That is, I desire to succeed at notebooks and yet I just sit and do nothing because I do not know where to start.

As we strive to provide an education that is technologically up-to-date, our administration decided to go to a one-to-one ratio of student to technology. Every student has a lap top computer or tablet device with them all day long to enhance their educational experience. Our staff has participated in many collaboration sessions over the past semesters, learning the various tools available for teacher use on Moodle. As I was thinking of ways to incorporate technology into my classroom, I came up with the purpose of this study, which is to help students develop metacognitive knowledge and skills by creating and using web based notebooks to assist them with scientific problem solving. The sub questions that will be addressed by this study are: Do students know how they learn best? Do today’s students learn better using and creating notes on a computer? Do these notes lead to increased problem solving skills?

CONCEPTUAL FRAMEWORK

A goal of science teachers is to teach using a method that is understood by students and develops metacognitive skills as well as meta-knowledge awareness (Rappolt-Schlichtmann et al.,2013). A common classroom tool used to achieve this goal
is the science notebook or portfolios, and, when properly designed, these tools can easily achieve both of these goals (Waldman & Crippen, 2009; Butler & Nesbit, 2008). In order for the notebook to properly engage the student in metacognitive awareness, it has to be designed as a tool that is used as an assessment for learning. Assessment for learning is defined by the Assessment Reform Group (2002) as “the process of seeking and interpreting evidence for use by learners and their teachers to decide where learners are in their learning, where they need to go and how to best get there” (p. 2). Current research shows that an important aspect of a properly designed notebook is the student’s involvement in the design and purpose. If a notebook is assigned with a strict method of completion, students will feel pressured into producing something the teacher desires. However, if the notebook design is influenced by both the teacher and the student for learning, students will claim ownership and produce a higher quality product that is easily assessed by the teacher to determine students’ learning growth (Barrett, 2007).

Another important result from the use of a science notebook is the student’s increased awareness of their personal level of metacognition and meta-knowledge of science concepts. Metacognition is defined as one’s awareness and understanding of his or her thinking process. When a student is engaged in a for-learning system, they will realize where they are in the learning process and, with correct teacher feedback, they can understand what information needs to be learned or modified in order to reach their learning goals (Barrett, 2007). For learning systems also called the constructionist view of learning, which is building one’s knowledge by adding new facts onto an existing knowledge base. It is how many people learn, and it is easily accomplished by using a
for-learning based notebook. As students learn scientific concepts and share them collaboratively with others in their class, their meta-knowledge increases. As a result of this increase, patterns and relationships begin to emerge. Shortly, students will be able to understand and correctly apply science knowledge to everyday problems and situations (Moshell & Hughes, 2009).

However, as the students build on their knowledge base, it is imperative that valid feedback is quickly offered. A web-based collaborative notebook can provide this valuable feedback through two methods. The first is using peer evaluation, and the second is teacher feedback through rubrics and typed comments placed in students’ work. These comments are a type of formative assessment that lead to increases in summative assessment scores. In most cases, summative assessment scores of students who use science notebooks do increase, but these assessments alone inadequately show complete student growth. However, science notebooks based on for-learning principles coupled with summative assessment scores can easily show complete student growth (Waldman & Crippen, 2009; Butler & Nesbit, 2008; Guzeller, 2012).

As with all paradigm shifts, there are potential technology usage problems that need to be addressed by the instructor. A recent study showed a common fear among instructors that technology will be misused by students who lack self-control. Since these students have not known a time in their life without the internet and social media, many teachers think their students will use technology for social purposes and not educational purposes. However, this is not the case. If the lesson is properly designed, social media and other misuse of technology is generally not an issue. The largest group of students
who misuse technology are college students in large lecture halls. In the secondary school, with much smaller classrooms, the misuse is greatly limited (Jackson, 2012).

Along with technology misuse, initial and continued student usage is also an issue (Edelson, Pea, & Gomez, 1996). If the web-based notebook does not quickly show clear results or is not user-friendly, students will lose interest and stop using the software. Also, if students lose posts in cyber space or have difficulty retrieving recently posted articles, their engagement is likely to be reduced as is their learning (Edelson et al., 1996). Research has also shown that hyperlinking and collaborative work is important to students and is a skill that is required in their future workplace as well (Butler &Nesbit, 2008; Waldman and Crippen, 2009; Edelson et al., 1996).

Instructor attitude plays a significant role in effective use of technology as well (Gebre & Bracewell, 2014). If the instructor believes that technology will enhance the learning and if they are well versed in technology usage, the students will engage with technology at a much higher level. Knowledgeable instructors can quickly fix technology issues and instruct students how to efficiently use various software programs. Other factors that impact technology usage are parental education and income, gender of user and previous exposure to technology. High school boys tend to do well in chat rooms, where the chat sometimes tends to be boisterous and degrading. This is an environment that girls do not find appealing. On the other hand, girls do better with the personalization and theme building components of web based notebooks. Family demographics also have an impact on student’s success with technology. Students of parents with college degrees also tend to do better with technology than students of
parents who stopped their education after high school. Family income is directly related to technology access—those who have been blessed with more have more access to technology and, as a result, feel more comfortable while using it. All of these factors reinforce the need for technology use in the classroom to be well thought out in order to be effective (Fishman, 1999).

While there is little question as to whether or not science notebooks help students, questions still remain as to whether technology is the best teaching tool. Current research has shown that there is a paradigm shift in the modern classroom toward students using more technology. In the past, technology in the classroom was mainly limited to the instructor’s use, such as PowerPoint and videos for instruction purposes. This paradigm shift toward students using technology is being carefully scrutinized by older teachers who were taught in a pencil and paper classroom with very little technology. Regardless of how we feel, common knowledge tells us that today’s students will use technology in every aspect of their future employment and life, so today’s students should become competent in the usage of technology during the school years (Fishman, 1999, Gebre & Bracewell, 2014).

As the availability of technology in the classroom has increased over the past few years and instructors begin to embrace it, the results on summative assessment have increased in the modern science classroom (Guzeller, 2012; Jackson, 2012). While the pencil and paper method of science notebooks has always been effective, it has also proven to be a hindrance to many students (Rappolt-Schlichtmann et al., 2013). This hindrance was in the form of limited writing and reading skills. While these are
important skills for any student to have, they proved to be a frustration to some students who had a limited ability to clearly express their thought process. With the use of technology, these same students can use many media types to express the same thoughts. Students are now adept at using voice recognition software, videos, or even the webcams that are built into most laptops. These options allow students to express their thoughts verbally instead of in writing. This in turn permits teachers to see exactly where the student is in their science content learning process and where they need to go. Students can also use hyperlinks to link thought processes together. This replaces the old method of taping and stapling pictures into a three ring binder. Technology also allows students to personalize their work with less effort required (Barrett, 2007). If a student wants to explain science using pictures of flowers, it is much easier to find images, and the student can go back and change the images as many times as they desire. This personalization also leads to more involvement and design of the notebook, which increases concept understanding. One other benefit of technology-driven science notebooks is the ease of editing and revising. As student’s metacognition increases, they quite often go back to previous topics and update their entries, a task that is easily accomplished on a computer but not as easily in a pencil and paper version (Waldman & Crippen, 2007; Guzeller, 2012).

As technology rapidly enters the classroom of the 21st century, a teacher can easily embrace and use it for student learning. A willing and knowledgeable teacher can engage science students, increase metacognition, meta-knowledge and meet long range
school requirements for integrating technology in the user-friendly medium of a personal web-based science notebook.

METHODOLOGY

My treatment was done during a ten week period, starting in January 2015 and ending in March of 2015. The treatment was administered to my applied science class which consisted of 16 students, 3 girls and 13 boys, all of them in 11th or 12th grade. To begin the treatment, I had students complete the web based learning style survey, VARK Learning Style Survey, from www.vark-learn.com (Appendix A). Students took a screen shot of the survey results and posted it in their online portfolio, which they shared with me. One of the goals of my research was to increase metacognitive knowledge. This survey informed the students and me of their learning style and potential methods which could increase their content mastery and problem solving skills.

I also administered the Web Based Learning Attitude Survey, a Likert style survey, at the start of the treatment (Appendix B). This survey was intended to measure students’ initial attitudes towards web based work, their perceived skill at solving problems and if students would choose the same learning style as the VARK Learning Style Survey identified. I then compared the results of the VARK Learning Style Survey to the Web Based Learning Attitude Survey to see if learning style data aligned.

Once students had completed the two surveys, they started building an online science notebook. This notebook was based in Google Docs, and the file was shared with me. The notebook had three sections, notes taken during class, completed Problem of the Week and Weekly Summaries. Students completed the two weekly assignments on their
personal device, saved it as a .pdf and submitted it online in ILearnIT, our school’s Moodle-based online learning management tool. I reviewed students’ work, posted comments and graded it. Students then placed their work in the appropriate file and used them for future reference. I also posted photos, articles and resources in a Moodle file which students checked on a weekly basis. The posted documents were then transferred to the notes section of the portfolio and used to help solve the weekly work. Students were encouraged to modify these notes in any manner that they felt would increase their understanding of the content.

The Problem of the Week was a science problem based on current content which students worked through on a weekly basis and it was posted on ILearnIT (Appendix D). To correctly solve the problem of the week, students identified what they knew about the problem, what they needed to know in order to solve the problem and where they found that data. After research, they combined what they knew with what they learned and attempted to correctly solve the problem. While working on the problem of the week, students could complete it and submit it in their preferred learning style. I then graded them with the Problem of the Week Rubric as a guiding tool (Appendix F). I also recorded the manner in which they completed the problem of the week to see if it aligned with their learning style.

Students also completed a Weekly Summary (Appendix C). This was a document the students completed each week in which they restated what they learned that week, how they could apply that knowledge outside the classroom and where they saw that knowledge applied. The goal of this summary was to have students start relating new
content knowledge to their knowledge base, or constructivist learning. As they started to build their knowledge base, they could use that information to correctly solve problems.

During the treatment, students completed two projects, building a bridge and building a scale-model shed. At the end of the projects, students created a report in which they taught the rest of the class what they had learned during the project. Half of the class gave a report on the first project and half on the second project. I gave students a variety of methods in which they could complete their report, and I encouraged them to complete the report in their preferred learning style. I then interviewed four students using the Report Exit Interview to see if they understood the material better because they had created the report in their learning style (Appendix E).

At the end of the treatment, I again administered the Web Based Learning Attitude Survey to measure how students’ attitudes, knowledge and problem solving skills changed during the course of the treatment. I then analyzed the data using a t-test. I also referenced the notes I took in my journal. These notes recorded students’ attitudes toward the treatment work, if they were working in their preferred learning style and any other data I felt was important. As students were working on their notebooks, I was interacting with them by asking questions, listening to comments and noting overall attitude and effort.

The data sources described above are summarized in the Triangulation Matrix in Table 1. The table provides the triangulated data for my research questions regarding students’ attitudes toward using a web-based science notebook, becoming aware of metacognitive knowledge and improving their problem solving skills. 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 (Appendix H).

Table 1

<table>
<thead>
<tr>
<th>Triangulation Matrix</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Questions</td>
</tr>
<tr>
<td>What are students’ attitudes toward web-based learning?</td>
</tr>
<tr>
<td>Did students learn metacognitive knowledge and skills?</td>
</tr>
<tr>
<td>Did student problem solving skills improve?</td>
</tr>
</tbody>
</table>

DATA AND ANALYSIS

During the treatment, the Web Based Attitude Survey data showed a 20% increase in the number of students who viewed online based learning as a beneficial part of their education ($N = 15$). The majority of students were undecided as to whether teacher based lecture style learning is the best method, (53% pre and post treatment).

There was an increase of four students who would choose interactive web based work over a more traditional pencil and paper method of work (Table 2). The survey also showed no change between quality of student work produced with pencil and paper and work produced on the internet. Students were also asked if they produce their best work on a computer or with a pencil and paper. Seven of 15, both pre and post treatment said
they produced their best work with a computer while the remaining 8 students were undecided on the issue.

Table 2

<table>
<thead>
<tr>
<th>Survey question</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Undecided</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre</strong></td>
<td><strong>Post</strong></td>
<td><strong>Pre</strong></td>
<td><strong>Post</strong></td>
<td><strong>Pre</strong></td>
<td><strong>Post</strong></td>
</tr>
<tr>
<td>Internet based learning is beneficial to my educational experience.</td>
<td>1 (6%)</td>
<td>4 (26.6%)</td>
<td>11 (73.3%)</td>
<td>7 (46.6%)</td>
<td>2 (13.3%)</td>
</tr>
<tr>
<td>Teacher based lecture learning is the best method of learning.</td>
<td>0</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>2 (13.3%)</td>
<td>8 (53.3%)</td>
</tr>
<tr>
<td>When given the option, I would choose interactive web based work over pencil and paper work.</td>
<td>1 (6%)</td>
<td>2 (13%)</td>
<td>3 (20%)</td>
<td>5 (13.3%)</td>
<td>7 (46.6%)</td>
</tr>
</tbody>
</table>

*Note.* Numerical digit is the number of responses and the percentage of the sample is in (*). (*N=15*)

These trends were also supported by exit interview statements. One student said, “I did not notice a difference between pencil and paper based work and web based internet work.” Another one said, “It was both helpful and harmful. It is easier to find data and stay organized but it is really easy to get distracted by You-tube videos and other web sites.” However a majority of those interviewed said, “It is a great tool. All of my stuff is in one place, I am really organized and it is easy to jump from one place to another.” My teacher notebook observations also backed up this data as well. Not every student loved internet based work. One student said, “I hate internet based work and
doing stuff on computers.” During the treatment this student’s attitude towards internet based learning did not change.

As I was looking at student’s attitudes toward web based work, I was also looking to see if students would complete assignments in their preferred learning style if they had the ability? While taking the Web Based Attitude Survey before the treatment, 14 of 15 students agreed or strongly agreed they could easily identify their learning style Post treatment evaluation revealed that only 12 of 15 could easily identify their learning style. During the treatment, students had the option of handing in work in their learning styles; audio files for the auditory learner, movies or word documents for the visual learner and pictures of their work for the kinesthetic learners. Two students, one with a multimodal learner and one an aural learner, choose to hand in their work with audio files. Everybody else choose to hand in typed work. One student which the VARK survey showed to be 100% aural choose to do his weekly summaries and problems of the week as a typed Word document. During the exit interview, students were asked if they completed the weekly summary or the problem of the week in their preferred learning style. Of the eight interviews conducted four students said they did and that it helped them understand the material better. The other four said they did not use their learning style because it was faster and easier to type the assignments. One student said “I always tried to do my weekly summaries in my preferred learning style as they always referred back to something we previously learned, so I needed to understand the material in in order to answer the assignment correctly.” The exit interview also asked students if they tried to learn the material in their preferred learning style. Six of the eight students
interviewed said they did. One who was a visual learner watched videos of bridges being built, one kinesthetic learner tried various methods of how to bend wood instead of reading or watching a video. Another student said they tried a variety of learning styles and ended up using their main learning style most of the time. Of the two students who said they did not use their learning style, one said they “forgot” and the other said “it didn’t apply to the project so they never thought of it.” During the treatment, I observed very little evidence of students using their learning style as most of the class time was spent building projects while the weekly summaries and problem of the week were completed at home. Overall, 14 of 15 students could easily identify their preferred learning style and yet only 10 of 15 students used their learning style during the treatment to learn the content better (Figure 1).

**Figure 1.** Identified learning styles compared to the number who actually used it to complete assignments. Vark Survey identified some as multimodal with a strength in one area, but the chart is based on students strongest learning style, (N=15).
The last research questions addressed by my treatment was “Did student problem solving skills increase while using an online science notebook?” The data showed that there were no significant improvements in student’s perceived problem solving skills (Figure 2). While there were increases and decreases, the change was most often less than one value point. However, the data does show an interesting trend between the dark orange line indicating “when stuck solving a problem the first thing I do is Google an answer” and yellow line which indicates “the internet is a good source of answers”. These lines show that after the treatment, more students just googled the answer and did the least amount of work to solve problems. Pre and post treatment data showed that no matter how a problem was solved, all of the students felt very satisfied when they worked through a problem and solved it on their own. Also, 8 students agreed that their problem solving skills would produce the correct answer and this number increased to 12 students post treatment.
Figure 2. Web based attitude survey results for problem solving skills. Data lines show the mean value. A value of 5 represents a strongly agree response, 4 represents agree, 3 represents undecided, 2 represents disagree, (N=15).

However, during the exit interview, students said that using an online notebook reduced time spent problem solving by keeping all of the students notes and materials in one place. Five students said “It kept me more organized and it was easy to find the resources I needed to solve the problems.” Two students said “online notebooks were good resources to solve problems but there was a great temptation to just go online and look it up.”

While I was grading the weekly summaries and problem of the week, two students referred back to what we learned that week. One student said, “this is similar to the picture you posted in the content library” and the other said “this problem is the same
thing that happened to the concrete slab under our shed.” This shows that students were using class notes and observations to increase their problem solving.

**INTERPRETATION AND CONCLUSION**

Overall, the data clearly supported the questions of whether students have a favorable attitude towards web-based learning. It also supported the question of whether online notebooks allow students to recognize and increase metacognitive knowledge and skills. The data also supported, but not as strongly, the question of whether online notebooks increased students' problem-solving skills. I believe that the research findings were properly validated by the data analysis.

Students are deeply involved in all things electronic and their lives seem to revolve around computers and cell phones. It really didn’t surprise me that students had a favorable view of online learning. Two students who didn’t like it had older laptops that did not have the capability to run the latest software required by the school and my treatment, and I believe that if they did, they would have enjoyed the online notebook better. A student’s positive attitude toward online work can be a great asset for teachers as technology use in the classroom changes. Today’s students are fully capable of producing high-quality movies, web pages, and computer-generated graphics. All of this allows students to show content knowledge and mastery in a wide variety of formats, which until recently, were not an option. A great example of this happened in my class just the other day. The group was supposed to make a marketing brochure, but instead they asked if they could make a short marketing video, which I allowed them to do. This resulted in a much better presentation and included a bit of comedy as well. If I had
forced them to make a plain brochure, their ownership of the project and presentation would have suffered.

Although the data showed that students had a positive view of science notebooks, the treatment had a bit of a rough start. I started my treatment in January at the start of the new semester at our school, but in December I decided to switch the notebook software from Renweb’s Moodle to Microsoft’s OneNote. I did this because OneNote is much more user friendly and seamlessly interfaces with all other Microsoft office products. It also allowed students to use multiple modes of completing their assignments. However, according to research, teacher competence in the software is essential to a successful online science notebook. I spent Christmas break working in OneNote but I was not fully capable in this new software when I started my treatment and it caused a few wasted days as I tried to answer questions and solve problems that students were having. I now fully know the software and when I use it again, these issues will arise (Gebre & Bracewell 2014). After it was going smoothly, multiple student’s said “I love this software, it is much easier to use than ILearnIt. The school should all switch over.” In order for the treatment to be a success, a key factor was student friendly software, and I know that OneNote met that requirement easily.

Another interesting aspect of an online notebook is the ability for the teacher to quickly give feedback to the student, which supposedly increases content understand and mastery. During the treatment, I graded all assignments within two day of students submitting them. OneNote allowed me to draw or type comments directly on students work which students could then view to see what mistakes they made and hopefully
increase content mastery (Figure 3). As you can see in the screen shot, I provided some additional prompts for this student and a chance to add to his work and increase his grade. Unfortunately, this student choose not to make the corrections. Providing quick and useful feedback is designed to make the notebook a for learning notebook (Waldman & Crippen, 2009; Butler & Nesbit, 2008; Guzeller, 2012). The OneNote software automatically bolds the tab when a change to the page has been made. The next time students logged on, they would see that I had commented on their work could click on the tab and read the feedback on their work (Figure 4). As you can see in the circled area, this student did not go back and review the comments on Problem of the week #1-4 since they are still bolded. In fact during the treatment only one student regularly checked my feedback. This finding shows that most students in my class are not really concerned
about instructor feedback or using that feedback to improve their knowledge or content mastery. Quite often when I hand papers back students look at the grade and then throw them in the trash, and this would be the online equivalent. I am not sure why students did not go back and read the feedback. I would appear that an online notebook failed in this area of increasing student learning, however, I think more fault lies with the student than with the format.

Another component my conceptual framework research showed to be important is the ability of students to customize their notebooks. The Pre-treatment literature review indicated this would increase student ownership of the notebook and thus increase their use of it. I only observed one time a student personalized their notebook. No students changed the background, font type or color or any other part of their notebook during the
treatment, even after I showed them how and encouraged them too. I am not sure why, the student’s personal laptops were covered with stickers on the outside and the settings were also customized to the user. However, I am not sure if student customization would have increased usage or ownership.

There is one other item that reduced the overall effectiveness of the notebooks. I am a visual learner and can easily look at an object in a picture and then go and build it. I tended to try and teach this building class in the same way. I would simply post images as examples and not written text or videos for the other learning styles. I think this was a simple oversight on my part but it could have caused problems for students with other learning styles. However, they had the ability to go and search for the same information in their learning style, and if they did, I was not aware of it as they did not post it into their notebooks as they were encouraged to. Each student had a tab in their notebook for class notes, a place where they were supposed to place typed notes, images that helped them understand the assignment better or links to videos. At the end of the treatment, all but one of the class notes pages were blank. A reasonable explanation of this is that we only used the notebooks for a short time. If students had used them all year long, I believe they would have started posting more material on their own. I also need to back off and post less. If I posted the images, the students just used my work and didn’t see any need to do more. I need to make an assignment for them to do research and post the material. This way it is their work, done in a method they understand and in a format that increases their learning.
While analyzing the data, the item that disturbed me the most was the lack of a significant increase in student problem solving. Research showed that technology misuse is a major concern among educators who are bringing technology into the classroom (Jackson, 2012). While I did observe a small amount of student misusing their class time to view social media, the bigger concern is students treating the internet like a big book of answers. Instead of students searching for and compiling information that could be used to solve problems, they simply searched for the answer on the internet and put in the least amount of effort possible. One can easily type a problem into the search engine and multiple sites with solutions show up. Almost every question in modern school text books has been searched for on the internet and most of them have been answered. This is an alarming issue, and it most certainly does not enhance a student’s learning or problem solving skill and speaks volumes about the work ethic of today’s high school students. As a teacher, I will have to start reworking my questions so that the upper level of Blooms taxonomy is used more. Instead of just giving a problem for them to solve, I need to give data that students will have to analyze, interpret and then synthesize a reasonable answer. This would force students to use the internet as a resource for learning instead of an answer bank.

While the current trend in schools is to increase the use of technology in the classroom, it can have some undesirable side effects. A trend has been documented in research which showed that too much screen time, both at home and school, results in lazier children who read less and took less time on homework. Their research went on to show that by limiting screen time academic scores went up as well as their level of
energy (Robinson & Borzekowski, 2006). I have seen evidence of this trend in my classroom. I have juniors in high school who brag about not reading any books outside of classroom reading, and what reading is done is done with spark notes. I have also seen students who cannot write papers or interpret written text, all indications that those students do not read. And the data in this treatment validated this trend as well, students admitted to just searching for the answer instead of trying to solve the problem. Since our school implemented a one to one technology program last year, most every day high school kids are having part of each class hour engaged in screen time and who know how much more at home. As a school, we might need to readdress this issue and see if limiting screen time and learning to solve problems the old fashioned way, logic with trial and error increases problem solving skills.

VALUE

This project and the MSSE program as a whole were valuable in many different areas, especially in my assessment of student work. I has forced me to critically analyze what I am looking for in order to measure student growth. I have learned to use formative assessments of a variety of styles in order to guide my teaching towards unit goals. I have seen evidence of this with increased student content mastery and decreased test stress.

I have also learned a great deal about learning styles and how important they are to use in a classroom. If a teacher does not use all styles or allow student to work in all styles, they are limiting the students’ ability to prove to the teacher what they know. Many times I have resisted giving a drawing project because it takes a greater amount of
time to grade them. However, I learned that with OneNote software, I can allow students to submit work in a variety of learning styles and it is not any harder to grade.

This project also lead me to question students’ view towards technology. Students will Google the answer and not really try to solve it. The internet is viewed as a giant cloud based answer key and not as a huge resource of information that can be used to solve problems. A few of my students were recently telling me about a new app called Photomath. In this app, one clearly writes out the math problem, snaps a picture of it and then the app solves it and sends you back the answer with the steps used to solve it in case you need to show your work. As a teacher, I need to be careful of how I use technology in my class and how I monitor students. I realize I cannot control what students do at home, but while in the classroom I need to teach them to use the internet as a resource of data and not just answers.

As I teach I also realize that I need to design assignments that don’t have easily searchable answers. Instead, I should generate questions that require the student to gather data, analyze it and produce an answer, tasks that are on the top of Bloom’s taxonomy. However, as I am doing this I also need to somehow teach students to love learning and not to just do the least amount possible. One method I could use to meet this goal is inquiry based learning. Our school has incorporated the Next Generation Science Standards (NGSS) as our science standards. These standards are heavily weighted with inquiry based activities which will help accomplish this goal. I know that I do not have to change all of my lessons at once. Instead, I can slowly but surely change to inquiry
based, and thus reduce the chances for students to look up the answer. This way they just might discover that they love science.

Overall, the whole MSSE program has been a great asset to my teaching. I took an alternative route to earning a teaching credential (ABCTE). As soon as I started in the classroom on my own, I quickly realized that I needed many more classes on teaching. This program has easily filled those knowledge gaps and I now feel that I am qualified to properly teach science. I also feel qualified to participate in department improvement programs, and I will start this fall by sharing the results of this treatment.
REFERENCES CITED


APPENDICES
APPENDIX A

VARK LEARNING STYLE SURVEY
Choose the answer which best explains your preference and tick the box next to it. **Please tick more than one** if a single answer does not match your perception. Leave blank any question that does not apply.

Other than price, what would most influence your decision to buy a new non-fiction book?

- [ ] A friend talks about it and recommends it.
- [ ] It has real-life stories, experiences and examples.
- [ ] Quickly reading parts of it.
- [ ] The way it looks is appealing.

You are helping someone who wants to go to your airport, the center of town or railway station. You would:

- [ ] tell her the directions.
- [ ] write down the directions.
- [ ] go with her.
- [ ] draw, or show her a map, or give her a map.

A group of tourists wants to learn about the parks or wildlife reserves in your area. You would:

- [ ] talk about, or arrange a talk for them about parks or wildlife reserves.
- [ ] take them to a park or wildlife reserve and walk with them.
- [ ] give them a book or pamphlets about the parks or wildlife reserves.
- [ ] show them maps and internet pictures.

You have finished a competition or test and would like some feedback. You would like to have feedback:

- [ ] using graphs showing what you had achieved.
- [ ] using examples from what you have done.
- [ ] using a written description of your results.
- [ ] from somebody who talks it through with you.

You are using a book, CD or website to learn how to take photos with your new digital camera. You would like to have:

- [ ] many examples of good and poor photos and how to improve them.
- [ ] clear written instructions with lists and bullet points about what to do.
diagrams showing the camera and what each part does.

a chance to ask questions and talk about the camera and its features.

You want to learn a new program, skill or game on a computer. You would:

- read the written instructions that came with the program.
- use the controls or keyboard.
- talk with people who know about the program.
- follow the diagrams in the book that came with it.

You are about to purchase a digital camera or mobile phone. Other than price, what would most influence your decision?

- Trying or testing it
- Reading the details or checking its features online.
- It is a modern design and looks good.
- The salesperson telling me about its features.

You are planning a vacation for a group. You want some feedback from them about the plan. You would:

- phone, text or email them.
- describe some of the highlights they will experience.
- give them a copy of the printed itinerary.
- use a map to show them the places.

You have a problem with your heart. You would prefer that the doctor:

- used a plastic model to show what was wrong.
- gave you something to read to explain what was wrong.
- showed you a diagram of what was wrong.
- described what was wrong.

You are going to cook something as a special treat. You would:

- use a good recipe.
- ask friends for suggestions.
cook something you know without the need for instructions.
look on the Internet or in some cookbooks for ideas from the pictures.

Do you prefer a teacher or a presenter who uses:
- diagrams, charts or graphs.
- demonstrations, models or practical sessions.
- question and answer, talk, group discussion, or guest speakers.
- handouts, books, or readings.

Remember a time when you learned how to do something new. Avoid choosing a physical skill, eg. riding a bike. You learned best by:
- written instructions – e.g. a manual or book.
- diagrams, maps, and charts - visual clues.
- listening to somebody explaining it and asking questions.
- watching a demonstration.

I like websites that have:
- interesting written descriptions, lists and explanations.
- things I can click on, shift or try.
- interesting design and visual features.
- audio channels where I can hear music, radio programs or interviews.

A website has a video showing how to make a special graph. There is a person speaking, some lists and words describing what to do and some diagrams. You would learn most from:
- reading the words.
- watching the actions.
- listening.
- seeing the diagrams.

You are going to choose food at a restaurant or cafe. You would:
- listen to the waiter or ask friends to recommend choices.
- choose from the descriptions in the menu.
choose something that you have had there before.

look at what others are eating or look at pictures of each dish.

You have to make an important speech at a conference or special occasion. You would:

write a few key words and practice saying your speech over and over.

make diagrams or get graphs to help explain things.

write out your speech and learn from reading it over several times.

gather many examples and stories to make the talk real and practical.

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APPENDIX B

WEB BASED LEARNING ATTITUDE SURVEY
# Web Based Attitude Survey

Thank you for taking the time to complete the following survey regarding the use of a web based science notebook, problem solving skills and learning styles. Your responses are confidential and will not be used against you in any way. The feedback you provide will be used to help make an informed decision about how to improve your learning environment and the curriculum. Please be honest in your answers. I need you to put your name on this survey to match data throughout the treatment. Please clearly circle the position indicator under each question.

1. Internet based learning is beneficial to my educational experience.

<table>
<thead>
<tr>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Undecided</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
</table>

2. I can easily identify the method in which I learn best.

<table>
<thead>
<tr>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Undecided</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
</table>

3. I like the challenge of solving problems

<table>
<thead>
<tr>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Undecided</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
</table>

4. Teacher based lecture learning is the best method of learning

<table>
<thead>
<tr>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Undecided</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
</table>

5. When given the option, I would choose interactive web based work over pencil and paper work.

<table>
<thead>
<tr>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Undecided</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
</table>

6. When I get stuck solving a problem, the first thing I do is Google the answer.

<table>
<thead>
<tr>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Undecided</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
</table>

7. When I solve a problem, I am confident of my answer.

<table>
<thead>
<tr>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Undecided</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
</table>

8. I routinely use class notes as a resource to solve problems.

<table>
<thead>
<tr>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Undecided</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
</table>

9. If I had a choice, I would rather watch a video describing how to solve a problem, rather than read an article.

<table>
<thead>
<tr>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Undecided</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
</table>
10. I get easily discourage when doing work with the traditional method of pencil and paper.  

<table>
<thead>
<tr>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Undecided</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
</table>

11. I get easily discourage when doing work on the internet.  

<table>
<thead>
<tr>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Undecided</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
</table>

12. My best work is produced while working on my device (laptop, iPod, etc.)  

<table>
<thead>
<tr>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Undecided</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
</table>

13. My best work is produced while using pencil and paper.  

<table>
<thead>
<tr>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Undecided</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
</table>

14. I am confident that my problem solving skills will produce the correct answer.  

<table>
<thead>
<tr>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Undecided</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
</table>

15. When a teacher posts online learning resources on iLearnIT, I use them to increase my knowledge and skill.  

<table>
<thead>
<tr>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Undecided</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
</table>

16. When I am stuck on a problem, I use online resources to try and figure out how to correctly solve the problem rather than just looking up the answer.  

<table>
<thead>
<tr>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Undecided</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
</table>

17. When solving problems, I do the least amount of work necessary to solve it.  

<table>
<thead>
<tr>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Undecided</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
</table>

18. The internet is a good source of problem solving resources.  

<table>
<thead>
<tr>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Undecided</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
</table>

19. The internet is a good source of answers to my homework problems.  

<table>
<thead>
<tr>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Undecided</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
</table>

20. I feel very satisfied when I work through a problem and correctly solve it on my own.  

<table>
<thead>
<tr>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Undecided</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
</table>
21. When solving a problem, I can easily identify what I know, what I need to know and where to find that information.

<table>
<thead>
<tr>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Undecided</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
</table>

22. I would prefer to read the directions rather than listen to somebody explain them.

<table>
<thead>
<tr>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Undecided</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
</table>

23. If I had a choice, I would rather read an article on how to solve a problem I am working on, rather than watch a video of how to solve it.

<table>
<thead>
<tr>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Undecided</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
</table>
APPENDIX C

WEEKLY SUMMARY
Please answer the following questions. You need to give specific details and examples in your answers. I expect you to write a short paragraph per question. These are to be submitted by Sunday night, midnight in OneNote, in the weekly summary tab. They are automatically date stamped so be aware.

Question 1
What did you learn this week?

Question 2
How can you apply this knowledge outside of the classroom?

Question 3
Where have you seen this knowledge applied outside the classroom?
APPENDIX D

PROBLEM OF THE WEEK
My Border Collie, Scout, needs a new house. You are going to estimate the materials for me. Thanks in advance from both Scout and myself.

By using the diagram above and the parameters on the right, please tell me how much lumber I am going to need. This will include both dimensions, linear feet and amount.

For example, if you type 100 2x4s, this would be translated as 100 2ft long 4in wide, quite a bit for a simple dog house. I do believe you can do a whole lot better. I would suggest inserting a table to record your data, but as long as it is neat and readable, that is fine.
APPENDIX E

REPORT EXIT INTERVIEW
Report Exit Interview

1. Did you complete the report in your preferred learning style?

   If the answer to question 1 is yes,

2. Do you think it helped you remember the material better?

   If the answer to question 1 is no

3. Why did you choose to not use your preferred learning style?

4. Did another person or group present a report in your preferred learning style?

5. If so, do you think it helped you understand the material better?

6. Is there anything else about this report that you want me to know?
APPENDIX F

PROBLEM OF THE WEEK GRADING RUBRIC
Problem of the Week Grading Rubric

Intended outcome: students will use inquiry, quantitative & analytical reasoning to solve problems.

<table>
<thead>
<tr>
<th>Performance Area</th>
<th>Rating = 4</th>
<th>Rating = 3</th>
<th>Rating = 2</th>
<th>Rating = 1</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defining the problem</td>
<td>Student states the problem clearly and identifies the underlying issues</td>
<td>Student adequately defines the problem</td>
<td>Student fails to define the problem adequately</td>
<td>Student does not identify the problem</td>
<td></td>
</tr>
<tr>
<td>Developing a Plan to Solve the Problem</td>
<td>Student develops a clear and concise plan to solve the problem with alternative strategies and follows the plan to conclusion</td>
<td>Student develops an adequate plan and follows it to conclusion.</td>
<td>Student develops a marginal plan and does not follow it to conclusion.</td>
<td>Student does not develop a coherent plan to solve the problem.</td>
<td></td>
</tr>
<tr>
<td>Collecting and Analyzing Information</td>
<td>Student collects information from multiple sources and analyzes the information in-depth.</td>
<td>Student collects adequate information and performs basic analysis</td>
<td>Student collects inadequate information to perform meaningful analyses.</td>
<td>Student collects no viable information</td>
<td></td>
</tr>
<tr>
<td>Interpreting Findings and Solving the Problem</td>
<td>Student provides a logical interpretation of the findings and clearly solves the problem, offering alternative solutions.</td>
<td>Student provides an adequate interpretation of the findings and solves the problem, but fails to provide alternatives.</td>
<td>Student provides an inadequate interpretation of the findings and does not derive a logical solution to the problem.</td>
<td>Student does not interpret the findings or reach a conclusion.</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX G

POST TREATMENT INTERVIEW
Post treatment interview questions

1. In your opinion, is a science notebook a valuable learning tool? Why do you believe this?

2. In your opinion, is web based learning a valuable learning method? Why do you believe this?

3. Do you think your problem solving skills have improved during this treatment?

4. Did you complete the weekly summary or problem of the week in your learning style?

5. If the answer to question 4 was no, why?
   If the answer to question 4 was yes, do you think it helped you learn the content better?

6. Did you try to learn the material during the treatment in your learning style?

7. Is there anything else you would like to tell me or anything else you think I need to know?
APPENDIX H

IRB EXEMPTION
MEMORANDUM

TO:        Jerald Touchstone and John Graves
FROM:      Mark Quinn, Chair
DATE:      November 13, 2014
RE:        "Effects of Using a Web-based Science Notebook on Metacognitive Knowledge and Problem Solving Skills" [IT111014-EX]

The above research, described in your submission of November 17, 2014, 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:

_ X _ (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.

_ X _ (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 collected 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) positive 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) Tests and food quality evaluation and consumer acceptability studies, if wholesome food without additives are consumed, or 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.