

THE EFFECT OF SCIENCE NOTEBOOKS ON ACHIEVEMENT AND ATTITUDE

by

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ABSTRACT

Many students in my high school sophomore level required chemistry course were unmotivated, took little or no pride in their work, failed to see the broad picture of the content and exhibited a lack of organization in their work. Science notebooks utilizing a blended traditional and inquiry based format were used to improve achievement. Elements included guided inquiry investigations, journaling and graphic organizers. Removable constructive feedback, examples and personalization were used to foster a sense of ownership which improved motivation and developed a vision of relevance. Results of the project show that the strategies implemented were effective at increasing achievement and fostering ownership, especially when students invest in the strategies.

INTRODUCTION AND BACKGROUND

For the past year I taught at Camdenton High School in Camdenton, Missouri. Camdenton is a small community that services a large school district in South Central Missouri. Several elementary and intermediate schools feed the high school which had an enrollment of 1,339 in 2011. Ninety five percent of the students are Caucasian, with a 2.6% Hispanic and 1% Black populations. Forty six percent of the student body qualifies for free/reduced lunch (Missouri Department of Elementary and Secondary Education, 2011). I taught six sections of Chemistry in the Environment, a required sophomore level course, which utilizes an American Chemical Society spiral curriculum with an emphasis on how chemistry affects the community and the environment (American Chemical Society, 2006). Two of my six sections were co-taught with an English Language Learner teacher.

Throughout the fall semester I had observed that many of my 149 students were unmotivated by the relevance or content of the curriculum. Little or no pride or sense of accomplishment was observed in student work. Students failed to see the broad picture of the content and maintained a disconnected view of each lesson. Furthermore, a prolific lack of organization in how assignments were completed, submitted and kept by students seemed to synergistically affect motivation and a sense of ownership. Based on personal previous experience using a laboratory notebook, I felt that a science notebook might become a product in which students could take pride and feel a sense of accomplishment, a reference tool that would help students see the relevance of the content, and an organizational system that would keep all students' notes and labs in one location.

The purpose of this study was to examine the effects of the use of classroom science notebooks on student attitude and achievement. The following focus questions informed the primary purpose:

1. How will the use of a blended inquiry-based and traditional notebook format affect learning?
2. Can a sense of ownership be fostered that improves motivation and a vision of relevance?

CONCEPTUAL FRAMEWORK

When used with a carefully developed format, science notebooks become a tool for comprehension by improving students' critical thinking skills and preparing them for future science experiences (Ruiz-Primo, Min, Ayala, & Shavelson, 2004). Proper format of the science notebook is a matter of debate. A notebook format mandated by the teacher maximizes utility, useful longevity, and ease of grading (Lener, 2010). However, a traditional laboratory notebook format containing a title, purpose, procedure, data, and conclusion is less likely to help students learn than an inquiry-based format (Burke, Greenbowe, & Hand, 2006). Notebooks that are organized by the student and personalized in task and appearance help students link personality and emotion to learning, as long as the integrity of the scientific process is maintained (Fulton & Campbell, 2004; Chesrbo, 2006; Clidas, 2010). However, expressive writing, or writing in one's own words, is less effective than expository writing for mastering scientific literacy (Ruiz-Primo, Min, Ayala, & Shavelson, 2004). Ruiz-Primo et al. (2004) also contend that adapting to different scientific writing styles, such as the traditional report, is

critical for teaching scientific communication. Furthermore, the science notebook, though less formal and for a different audience, prepares students for the more difficult task of preparing a formal lab report or scientific paper for publication (Parkinson & Adendorff, 1996). Even Fulton and Campbell (2004) agree that the notebook can be used as a draft for “more formal products” (p. 29).

Notebooks containing carefully constructed prompts in addition to data collection allow students to investigate and inquire about the concepts being learned rather than simply recalling facts and help students find meaning in their results (Esteb, Magers, & McNulty, 2006; Burke, Greenbowe & Hand, 2006; Lener, 2010). Although Parkinson and Adendorff (1996) support a more traditional notebook format, they agree that prompts designed to encourage thinking are superior to the easily graded data or report sheet, which requires no understanding of proper scientific writing style or concepts. Designing different prompts for different purposes is an effective tool to improve motivation, correct misconceptions, and develop understanding. Prompts or entire sections that require independent work outside the classroom foster creativity and a deeper understanding of the content (Esteb, Magers, McNulty, & Wilson, 2006). Pre-assessment prompts before an experiment draw out misconceptions in prior knowledge for scrutiny and clarification (Clidas, 2010). When used for formative assessment, pre-assessment prompts allow teachers to modify their instruction to better re-teach and present concepts (Morrison, 2005). Voluntary portions of the notebook can also be used for enrichment of content understanding. Esteb et al. (2006) showed that organic chemistry students who engaged voluntarily in a content-driven, organized notebook performed better than students who did not use the notebook.

An example of a more traditional approach with an integrated inquiry aspect is the Science Notebook model. Sections are completed by students using guided inquiry, in which the teacher guides the student to develop his or her own investigable question, a plan for solving the question, useful and meaningful observations and diagrams, and finally a conclusion using the student's own observations and data as evidence (Klentschy, 2010). Two models which support expressive writing and allow students to develop meaning and have a greater degree of freedom in completion are the Science Journal and the Science Graphic Organizer models. The Science Journal model provides a platform for students to create meaning in their own words by requiring that students write weekly, three-page entries about what they have learned. It allows students a greater freedom of expression and an opportunity to connect concepts from lessons on different days. Prompts are often used to help students who need support to begin journaling (Fingon, 2008). The Graphic Organizer model is another non-traditional format for representing knowledge. Students develop and evaluate relationships between concepts when they create their own organizers in the form of concept maps, Venn diagrams, flow charts and others (Struble, 2007).

Appropriate teacher feedback is a powerful tool affecting student comprehension and improvement. Ruiz-Primo, Min, Ayala and Shalveson (2004) suggest that the feedback provided by teachers in the margins of the notebook is often unhelpful in suggesting improvements to students' work. Constructive comments containing suggested changes on sticky-notes or other non-permanent marks are superior to permanent marks because they can be removed when the marked work is improved. The

improvement and subsequent removal of the mark fosters a sense of achievement (Mintz & Calhoun, 2004).

The science notebook can also be used as a reference tool which fosters a sense of ownership. For this reason, the notebook is superior to a collection of individual assignments containing identical prompts. As the notebook grows to contain more information and is improved upon by the student through reflection and teacher feedback, the student has a product for which he feels proud and a sense of accomplishment (Esteb, Magers, McNulty, & Wilson, 2006). When complete, the student has a chronicle of experience that cannot be obtained by a collection of individual assignments (Fulton & Campbell, 2004). It is not just the sense of accomplishment that makes the notebook superior. When appropriately formatted and maintained with future learning in mind, the notebook becomes a reference tool for future learning. Prior work can be referenced to inform current research. When assignments are not thrown in the trash at the end of a unit, students are taught that knowledge previously gained is important. The ability to access and reference prior work creates connections that improve learning (Lener, 2010). In higher level courses such as organic chemistry, the content-driven notebook can be used in subsequent courses and to study for standardized exams such as the Medical College Admission Test (Esteb, Magers, McNulty, & Wilson, 2006). Examples of especially useful or well-written notebooks from history and litigation can be used to demonstrate the necessity and importance of keeping a detailed notebook, and inspire students that their work is worth keeping (Roberson & Lankford, 2010). In addition to its use as a reference tool in science, the notebook supports retention of other subjects. Writing in notebooks and making measurements undergirds interdisciplinary skills

learned in communication arts and mathematics, respectively (Mintz & Calhoun, 2004; Roberson & Lankford 2010). Reflection is a necessary component for improvement and retention. Reflection allows students to evaluate their learning process from assignment to assignment and over time, which is difficult with a collection of individual assignments (Fulton & Campbell, 2004).

In conclusion, the research presented suggests there are two properties of an effective notebook. First, the traditional notebook format is more effective at preparing students for the professional writing required in more difficult science courses and beyond, but personalization and less traditional formats are more effective for conceptual mastery and a sense of ownership. This suggests that a hybrid of formats will yield the most effective combination of concept comprehension while preparing students for and aiding in future courses requiring a higher degree of scientific literacy. Second, a sense of ownership can be fostered through personalization, developing senses of accomplishment and achievement, and usefulness that improves motivation and a vision of relevance.

METHODOLOGY

The treatment for this study required the use of a composition notebook which was provided to each student at the beginning of the treatment. Treatment occurred from January 3rd to March 30th, 2012. 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. A blended format of traditional and non-traditional components was used. Students were required to maintain titled and

numbered pages and a table of contents. Klentschy's (2010) Science Notebook model was used for six laboratories or classroom investigations (Appendix A). Student work was assessed using the Science Notebook Assessment Rubric (Appendix B). The Science Journal model was used on a weekly basis (Appendix C). Three handwritten pages were required and students wrote in their own words but incorporated vocabulary to describe what they were learning. Prompts were used to help students who needed support to begin journaling. Students were required to write three pages each week (Fingon, 2008). Journal entries were assessed using the Science Journal Assessment Rubric (Appendix D). The Science Graphic Organizer model was used three times throughout treatment (Appendix E). A concept map that students generated with guided instruction was used (Struble, 2007). Graphic flow charts were used in conjunction with the Science Notebook model to help students develop plans for answering their investigable question. Graphic organizers were assessed using the Graphic Organizer Assessment Rubric (Appendix F). The three models were used as assignments of equal value contributing to the students' overall grades during treatment. When assessed, each assignment was examined for themes or trends in students' works. Works which supported themes were selected to be used as artifacts.

A variety of tools were used to foster a sense of ownership through notebook use. Constructive feedback was left on sticky-notes in students' journal entries, on graphic organizers, and in investigations that could be removed when the feedback resulted in improvement. Positive feedback was also left on sticky-notes, which students collected in the notebook cover or left on the page, reminding them of work well-performed. Examples of well-written notebooks from history and notebooks used in litigation were

provided throughout the treatment to demonstrate the importance of a complete and well-organized notebook. Assignments requiring students to look up and use previously recorded information in their notebooks taught students that the notebook is a valuable reference tool. Finally, students were encouraged to personalize their notebooks in any other way they liked. Color pencils were provided for color coding, creative drawing on the covers, and enhancing illustrations, charts, and other graphics.

A variety of techniques were used to collect data during the study (Table 1). The Confidence Survey (Appendix G) was used to collect data before and after treatment. The Confidence Survey asked about all aspects of the treatment and provided substantial data indicating the effectiveness of the methods. Questions focused on how students felt each treatment affected their achievement or motivation on an attitude scale and through open-ended questions. Questions utilizing the attitude scale were assigned numbers to tally quantitatively and open-ended questions were examined for trends and themes.

Table 1
Data Triangulation Matrix

Focus Question	Data Source 1	Data Source 2	Data Source 3
1. How will the use of a blended inquiry-based and traditional notebook format affect learning?	Confidence Survey	Student artifacts	Quarter grades
2. Can a sense of ownership be fostered that improves motivation and a vision of relevance?	Confidence Survey	Interviews	Field notes

Student generated artifacts and the rubrics used to assess them were collected. Student generated artifacts included journal entries, graphic organizers, illustrations, charts and diagrams, and conclusions and reflections from the notebooks. Specific artifacts were selected at intervals throughout the treatment. The number of these artifacts which exhibited improvement and the degree of improvement were collected and used as quantitative measures of achievement.

Quarter grades were used to measure student achievement by comparing them with quarter grades from before treatment. Camdenton High School provides mean grade distributions for each quarter and this data was used for quarter grade comparison. Quarter grades were also compared to those of students taught by another instructor of the same course. This helped remove the variable of material difficulty. For example, if another instructor's students' scores increased by the same factor as my students' scores, the effect was attributed to material difficulty instead of an increase in achievement due to treatment.

Interviews with students were conducted at intervals throughout the treatment as a measure of attitude and students' feelings regarding their achievement. A set of five questions was asked of each student once during and once at the end of the treatment (Appendix H). Three additional questions were asked of students in the second round of interviews. Five students from each period were asked to volunteer for each interview. The first round of interviews occurred individually, while the second round occurred in a focus group setting of five students. Interview results were organized by themes and trends that emerged throughout the course of the treatment.

The final data collection instrument I used was field observations. A composition notebook was kept with dated entries in which I recorded any observations not already included in another data collection instrument. Examples of the types of observations I collected include organization of loose papers in the notebook, personal or supplemental content drawings, general treatment of notebooks such as pages being torn or covers falling off, and any other observation suggesting feelings of ownership or lack thereof.

DATA AND ANALYSIS

The analysis of quarter grades revealed that the use of a blended inquiry-based and traditional notebook resulted in higher achievement ($N = 121$). Treatment occurred throughout third quarter and for four weeks in fourth quarter. Second-quarter grades showed an average decrease of 8.3% from first quarter while third-quarter grades increased 1.8%. Furthermore, when compared to the quarter grades of another instructor of the same course, the reversal of the downward trend from first to second quarter became more substantial evidence of the effectiveness of the treatment (Figure 1). Both instructors used similar instructional strategies, assignments and common assessments. Both instructors' grades exhibited a downward trend from first to second quarter. However, while the other instructor's grades dropped an additional 4.4% during third quarter, the grades of students who underwent treatment increased 1.8%.

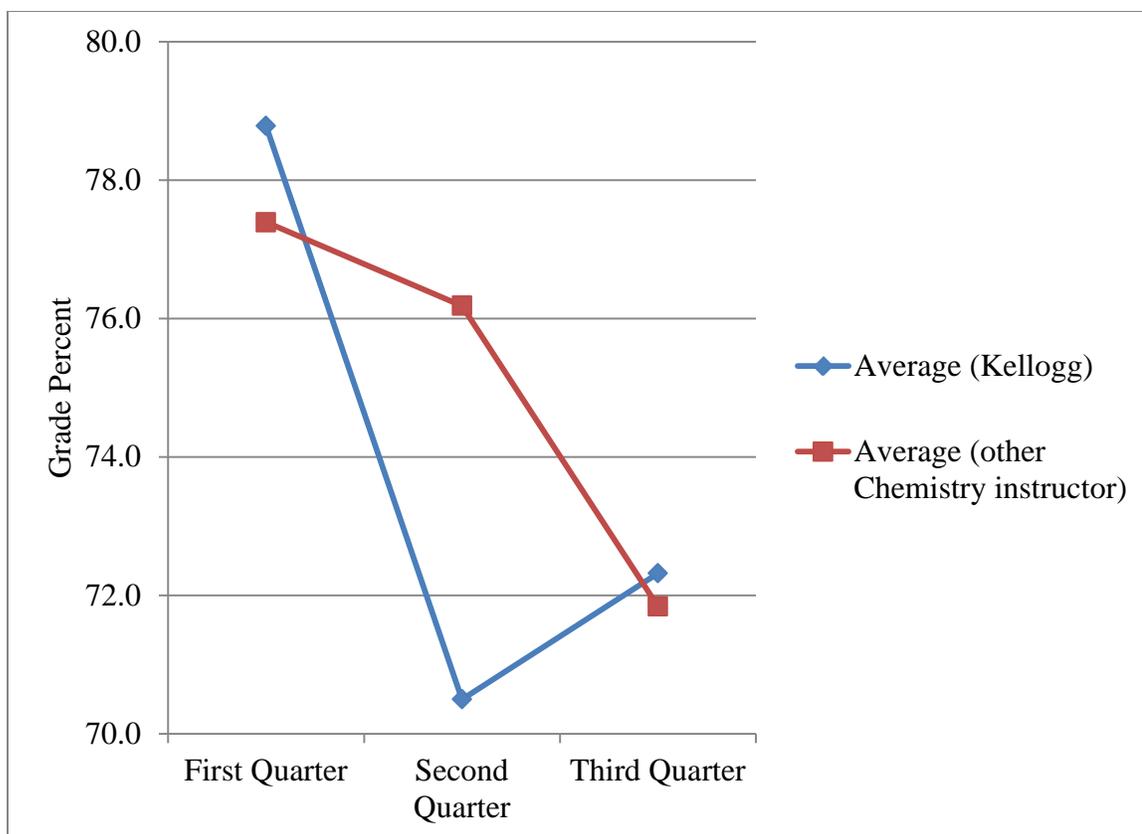


Figure 1. The effect of notebook use on student achievement in third quarter, ($N = 121$).

The results of the Confidence Survey showed that students were almost equally confident using their notebooks to learn both before and after treatment. When asked if students felt like their notebooks helped them learn, the number of students who responded that their notebooks definitely helped them learn increased 4%, but those who responded *maybe some* decreased 8% revealing an overall decrease in positive feelings about the effectiveness of their notebooks. However, many individuals shared positive comments about their notebooks in their journals and interviews. One student commented, “I am glad we keep notebooks because it gives me a reliable reference to look back on when I know I learned something before.” Another student stated, “I believe that keeping a notebook is essential to the education of a student.... In my

personal experience this notebook has been important for receiving notes in class and studying for tests. IT HELPS.”

After using Klentschy’s (2010) Science Notebook model, students felt that the model helped them understand what they were trying to discover in the laboratory. When asked if writing their own question, prediction and plan helped them understand what they were trying to discover, the number of positive responses increased from 41% to 57% (Figure 2).

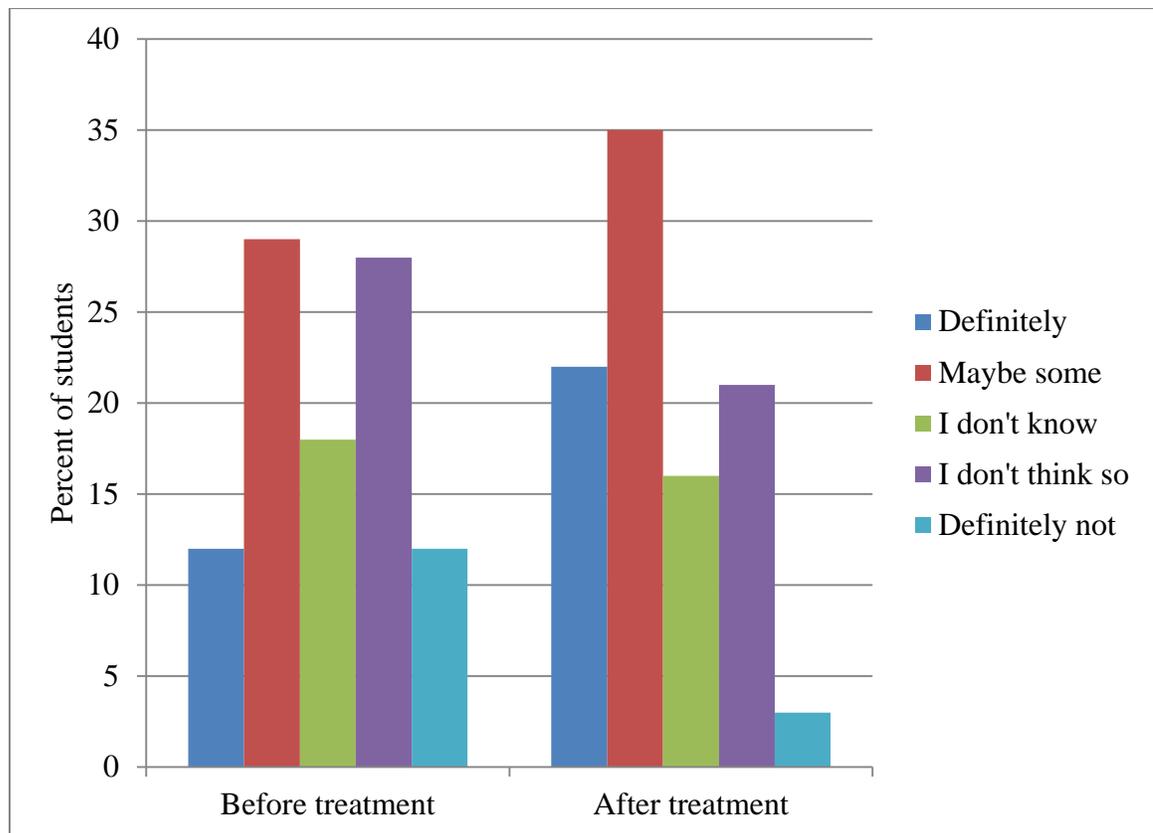


Figure 2. Response to question, *Writing my own question, prediction and plan helps me understand what I am trying to discover*, ($N = 121$).

One student captured the opinions of many during an interview when he stated, “The lab format is much easier to use when they’re in an order like that because you just do step-by-step, like this is my question, *now* what do I think is going to happen, and *now* how

am I going to get there.” Several students shared that when they developed their own question they were more invested in the lab, as expressed by one student, “It adds a sense of individuality to the lab, so you’re not doing an entire class of 30 students researching the same question.” Another student shared, “I think it makes it a lot more interesting when he’s got a different question than I do, because I’m obviously more interested in the question that I asked because I get to pick a question I actually care about.”

Two-thirds of students had positive feelings about the Science Graphic Organizer model both before and after developing concept maps (Struble, 2007). However, students generally agreed that the concept maps helped if they had to look up definitions to words, but it was difficult to make connections and the map was not used as a reference tool once complete. “The actual doing of the mind maps helps me think about how everything’s connected. So doing it helps but to review with it, that doesn’t help much,” stated one student. Another student shared that he didn’t “buy in” to the assignment, just worked to complete it without internalizing its value. Other students in the focus group agreed with both of these statements. Students in the interviews were split regarding the value of the concept maps. Many felt that reviewing the definitions of words was the only value, while others appreciated how the topics were interrelated. “One thing in particular we have learned is how everything connects. We used mind maps to teach us how everything throughout the week relates to each other. That was helpful to me.” While this student’s work received *passing* marks on the Science Graphic Organizer Rubric because the connections are incomplete and the content is somewhat thorough, it demonstrates how the student developed connections between concepts he had been learning (Figure 3).

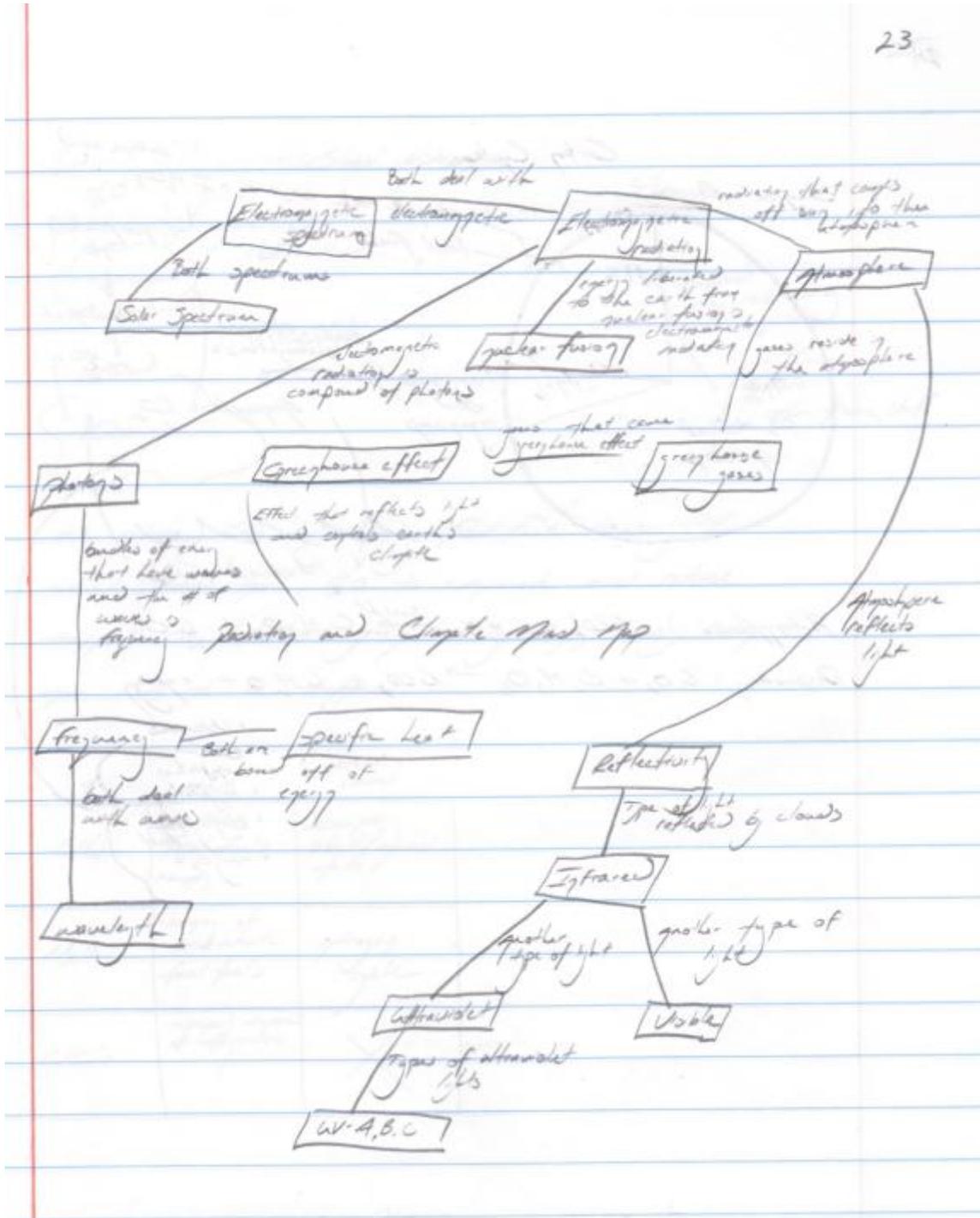


Figure 3. A student-generated concept map.

The results of the Confidence Survey showed that students completed the treatment with strong negative feelings about the effectiveness of the Science Journal

model (Fingon, 2008). Before treatment, 25% of students responded negatively when asked if journaling in their notebooks helps them learn. After treatment, 48% of students responded negatively to the same statement (Figure 4). When asked what students would change about the way they used their notebooks, 21 students replied that they would have had fewer or no journals, and when asked if there was anything else they would have liked me to know, a different 21 students responded that journals were pointless, unlikable or too long. “They take a lot of time and effort,” explained one student. Another student shared, “I think writing three pages was too much. I started to get off-topic and ramble.” One student captured the feelings of many when he said, “I’ve never written a journal longer than one and three quarters of a page. Just thinking and putting it onto a page, I can’t do it. I’ve tried but I can’t. I stop and then think, ‘What do I write now?’”

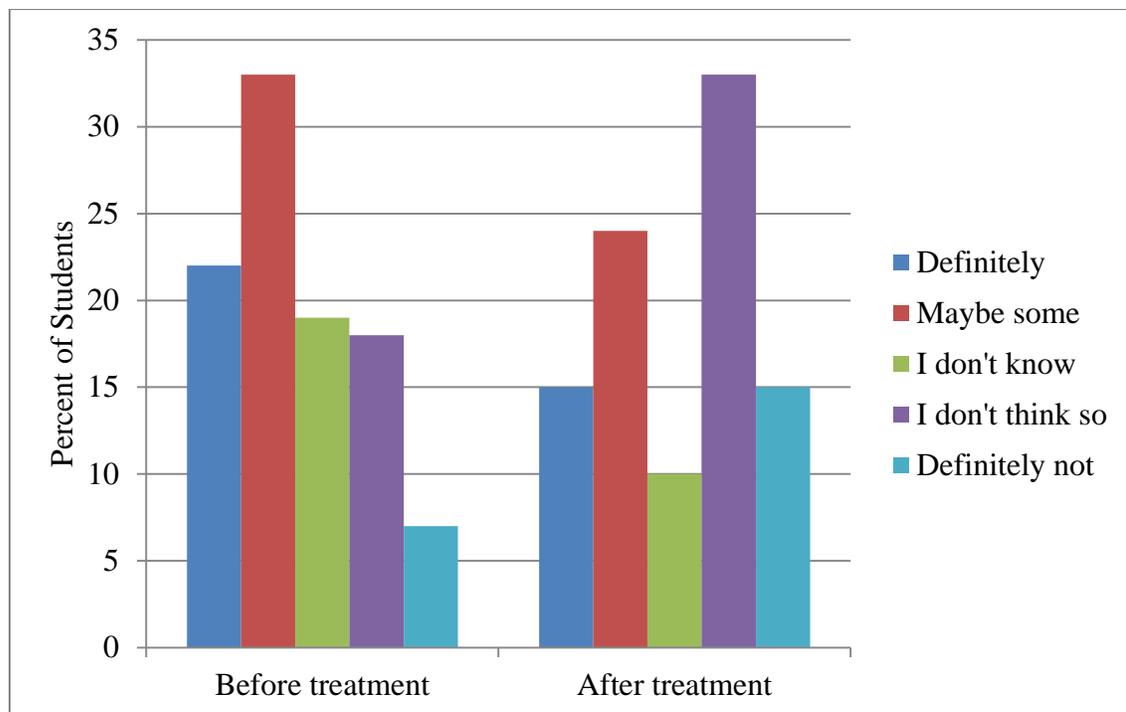


Figure 4. Responses to question, *Journaling in my notebook about what I have learned helps me remember more*, ($N = 121$).

When analyzing third-quarter grade data it was discovered that only 25% of students completed 80% or more journal entries and 56% of students completed fewer than 50% of the journal entries. The large percent of students who did not complete most entries called into question the validity of the Confidence Survey data. To determine the effect journal completion on achievement, the third quarter grades were adjusted to no longer reflect journal completion, as if the assignment had been voluntary. Furthermore, students were grouped by second-quarter grades to reflect similar pre-treatment status. The results are inconclusive. A comparison of quarter grades among these students revealed that the higher the student's pre-treatment achievement, the more journals improved achievement (Figure 5). While A-students who completed journals increased their grades 4.5%, grades of A-students who completed fewer than 50% of journals increased only 2.5%. B-students adjusted third-quarter grades increased almost identical amounts of 3.5% and 3.8%, while C-students who completed 80% or more journals exhibited a decrease of 0.3%.

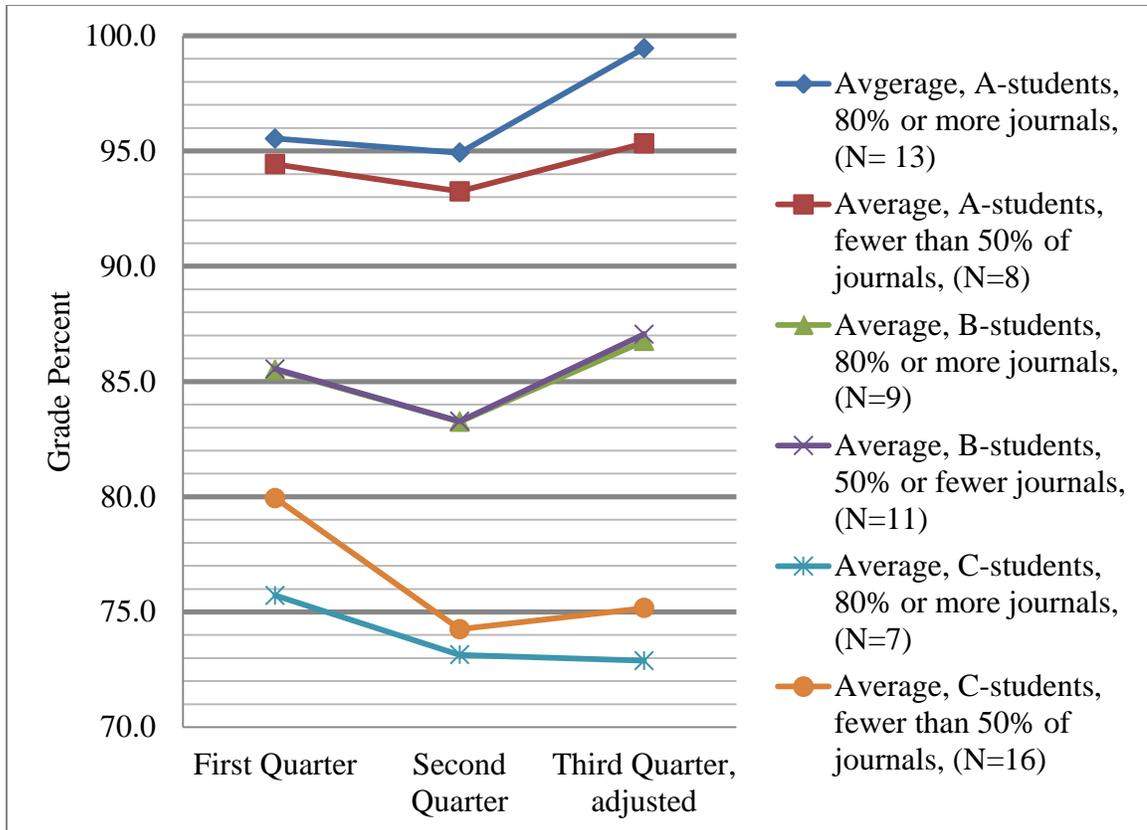


Figure 5. A comparison of students who completed journals.

Many students who frequently completed their journal entries stated that journaling had helped them learn in many ways. When asked to share in their journals how journaling about what they have learned helped them, many students replied with answers that exceeded half a page. One student succinctly captured the opinions of many when he stated, “I feel like writing in my journal helps me in lots of ways. By writing it down after I’ve learned, it helps me understand everything much better than I did before.” “I think that since we started writing these journals I have improved in this class and done better on the tests,” shared another student. A third student replied with a theme that emerged among many of the students that writing in their own words helped them digest the material, “Writing journals has helped me a lot because writing what we learned the past

weeks helped me to remember and also putting them in my own words helped me to understand it better.”

The results of the Confidence Survey revealed that the percent of students who felt proud of the work in their notebooks decreased from 64% to 60%. The number of students who *definitely* felt proud of the work in their notebooks increased 5%, but the number of those who responded *maybe some* dropped 9%. It was also observed that while a few students took care of the covers and pages in their notebooks, many students tossed their notebooks into the paper boxes in which they were stored without regard for how they landed. However, students whose pride increased in their notebooks often had positive and insightful comments about the notebooks’ roles in their learning processes.

Students felt generally positive about feedback left by the instructor on sticky notes to improve work. Before treatment, 79% of students responded either *definitely* or *maybe some* when asked if feedback left on sticky notes helped them improve their work. After treatment 76% of students still responded positively to this statement. Although the Confidence Survey showed little change during treatment, student comments revealed that they appreciated feedback to improve work and responses to journal entries. “I like the feedback from the labs, because even if we get it wrong you put a note in there and make sure we know what we did wrong. That’s good because we are able to fix it.” To one student “it was definitely a little surprising” that the instructor “read them all,” referring to the journal entries. Another student who kept all her feedback in the back cover of her notebook wrote, “Thanks for taking the patience and time to listen/read what we have to say in our journals” (Figure 6).

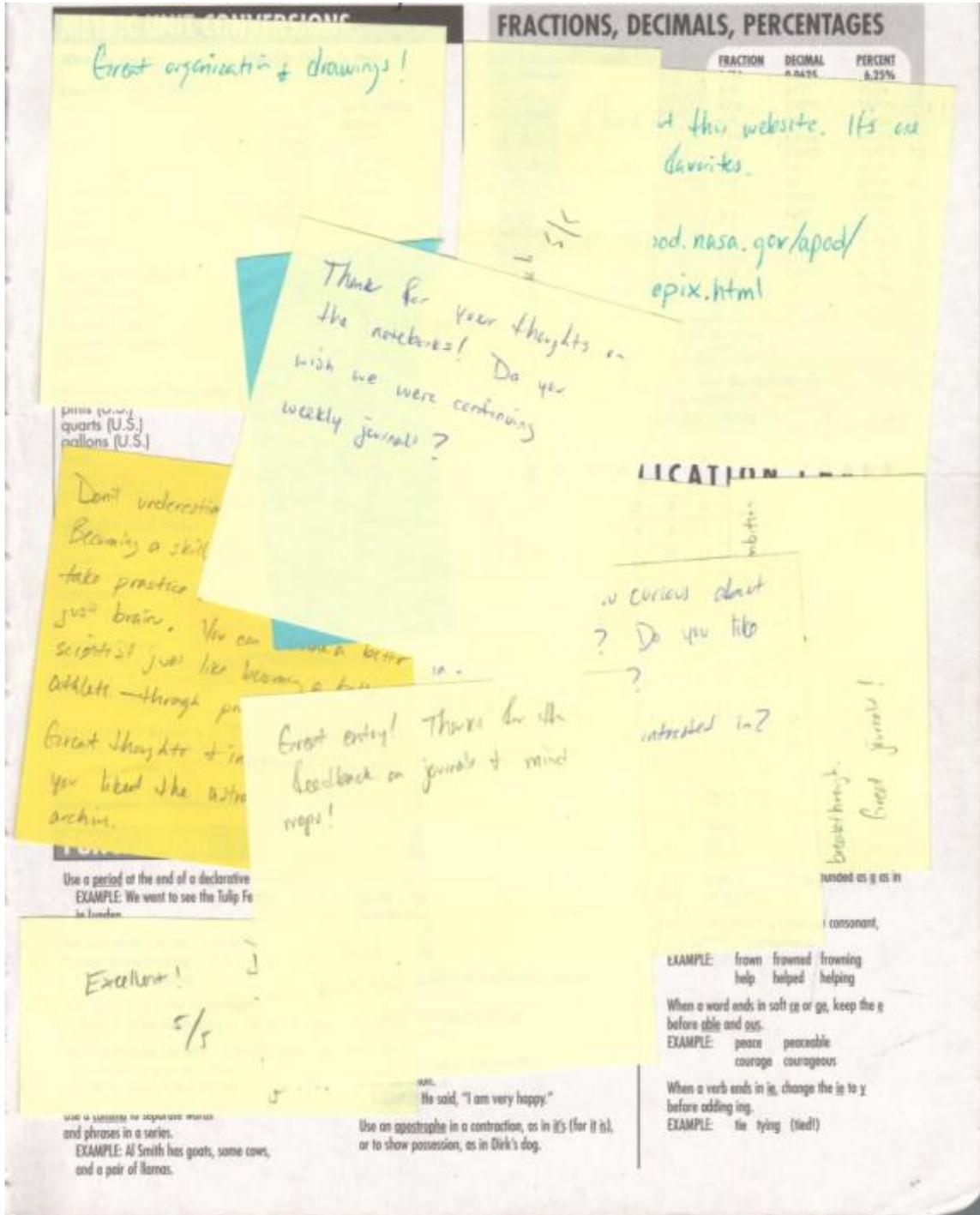


Figure 6. Collected feedback in a student notebook.

Most students (79%) responded that they *definitely* or *sometimes* used their notebook as a reference before treatment. An increase of 5% in positive responses followed treatment.

When asked how students used their notebooks to help them learn, 3 times as many

students (8 before to 24 after treatment) replied that they used it as a reference tool to look up information. It was observed that students often attempted to follow examples they had copied into their notebooks but many were unable to do so. Furthermore, when asked if students used their notebooks to study for tests, 12% of students who replied *maybe some* before treatment replied that they *didn't know* or *didn't think so* after treatment, indicating that fewer students used their notebooks to study after treatment. However, students who were interviewed frequently mentioned using their notebooks to help them learn by using them to study for tests and as a reference.

The use of color pencils increased 28% during treatment and 13% more students responded *definitely* when asked if enhancing their work with color made them feel proud of their work. Students who mentioned color as a way to personalize their notebooks increased from 17 to 30 after treatment. Furthermore, when asked to display a page of their notebooks that they were proud of, many students selected a page of their notes that had been enhanced with color. "I like these [notes], because they have color... and are easy to visualize," one student shared. Organization was another reason students stated they were proud of their work. Students were generally proud of organized works which utilized color and were useful after the page was complete (Figure 7).

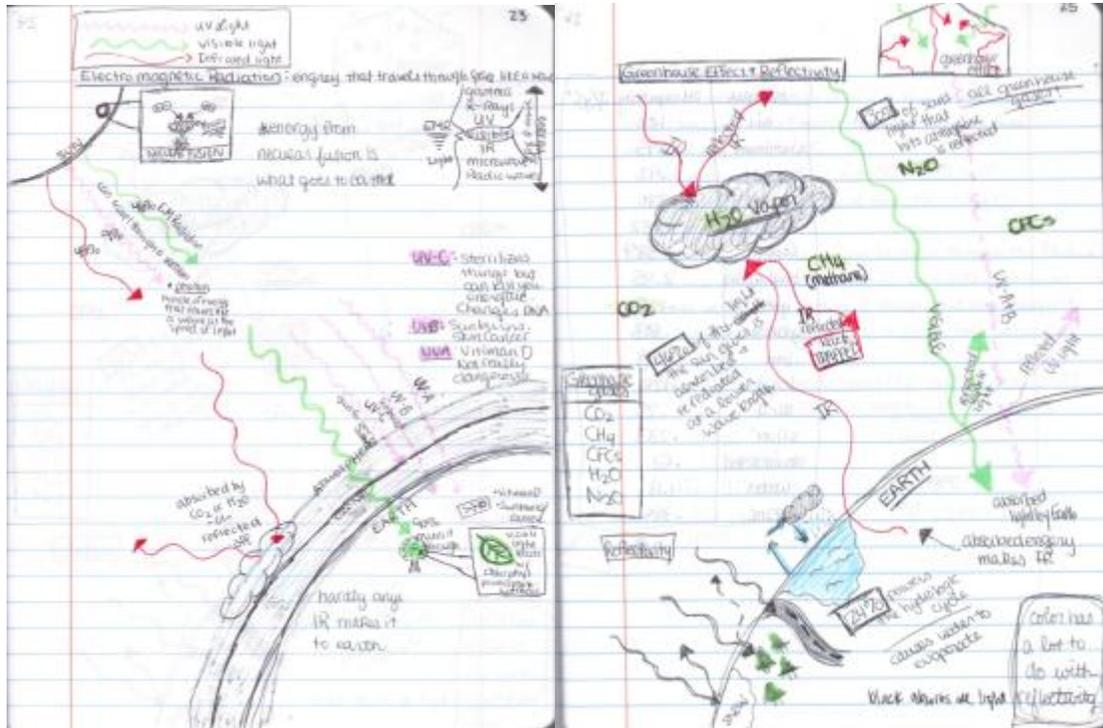


Figure 7. A student's pictorial notes, organized and enhanced with color.

When asked to display a page of which students were not proud, students often selected a page they considered disorganized. After treatment, 6% fewer students felt their organization made their notebooks useful to them. However, when asked how students would change their notebooks, the number of responses calling for greater organization dropped from 32 to 18. "These [notebooks] are more organized than the ones we used first quarter... and I didn't know how to use it [before].... My first quarter one was a wreck," stated one student. Another student shared how the organization in his notebook improved his organization in other classes, "It made me more organized, not only in this class but in other classes too."

INTERPRETATION AND CONCLUSION

After reviewing the data I concluded that the use of a blended inquiry-based and traditional notebook format positively affects learning. Furthermore, a sense of ownership that improves motivation and a vision of relevance can be fostered through these strategies. Improvement in the third-quarter grades in combination with the positive feedback during the interview process indicate that achievement did increase during treatment. The discrepancies from the confidence survey I believe are a result of students' greater sense of awareness of their own learning and the role of notebooks in that process. Before treatment students marked how they expected certain strategies to work. After treatment students know how effective each strategy was for them and many students *liked* their notebooks less but used them to learn more effectively. A key to using notebooks effectively is for students to invest in the process and strategies. One reason the interviews may have been so positive is that the kind of students who volunteered to share their feelings about the notebooks are the same students who had been using their notebooks correctly. The Science Journal model provides an example in which the raw data indicated that performance and attitude suffered, but the validity of the data was in question when so few students completed a majority of the entries. The students who did complete the entries recognized the value of the journals and their quarter grades reflected their increased performance.

While strategies to increase ownership did not affect every student, many students completed the treatment with an increased sense of ownership in their own learning through using the notebooks. Many students learned to organize their own work into a

personal product that has utility. Furthermore, I was able to develop many excellent relationships with students through my replies in their journals. A topic of further research would be the effect of teacher-student relationships on achievement through journaling. In conclusion, the strategies implemented in this study proved effective for both increasing achievement and fostering ownership for many students.

An unexpected theme which emerged as a result of this study that merits further research was the popularity of pictorial notes. Throughout the school year I had increasingly used class notes in which concepts were represented graphically with illustrations, color and phrases of explanation. A large number of comments in the journals, interviews and confidence survey revealed that students found pictorial notes more engaging and effective than worded notes.

VALUE

The value of this study is certainly in what it accomplished for the students. While not every strategy is effective for every student, many students completed the treatment with an entire tool kit that they can implement in future academic endeavors. The Science Graphic Organizer model, the Science Journal model, use of color, pictorial notes and strategies for organization are all methods that students can use to improve their personal achievement in the future.

I found the weekly journals to be the most challenging and rewarding part of this research. While replying on a sticky note to each student each week I was able to develop many fantastic relationships with students through which I was able to support them in their personal lives and current academic circumstances as well as give advice on

future opportunities. Through discussions of students' personal interests I was able to motivate many students to perform their own research in areas of science interest and share in their journals what they discovered. Other students initiated science-related questions to help them find compatibilities between their spiritual faith and science. One student used the journal to vent as a close uncle died of lung cancer from a lifetime of smoking. While she often strayed from academic topics, she was able to use the journal to meet a need and we developed mutual trust as she shared what she was going through in her family situation. These opportunities would never have been available to me on this scale outside of the journals. Students' responses to my feedback provided me with the insight that students still want to be cared for by their teachers even though they may never admit it verbally. It was an excellent experience which allowed me to develop real trust and rapport with many of my students.

Because of this project I have developed a much greater awareness of how students' backgrounds and personalities shape their learning experience. This has allowed me to practice greater sensitivity to students' learning preferences to help them enjoy learning. I am also more willing to try new instructional strategies after implementing several in this project. I enjoy that I have the confidence to try a new strategy and evaluate its effectiveness. The entire process has helped me realize that teaching is not something I work on until I perfect it and then it is complete, but that it is continually changing, adapting to new surroundings. Through this action research I have learned that there are many strategies in which one must invest to see their value and that that value cannot always be measured in terms of academic achievement.

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APPENDICES

APPENDIX A

SCIENCE NOTEBOOK MODEL

- I. Question, Problem or Purpose: An investigable “how” or “what” question relating to the investigation.
- II. Prediction: A prediction about what will happen when answering the primary question.
- III. Plan: A student-developed method for answering the primary question and testing the prediction.
- IV. Observations in the form of Graphics, Charts or Illustrations: These form the foundation for drawing conclusions about whether the primary question was answered.
- V. Conclusion: The result of claim-based evidence answering the primary question.
- VI. Reflection: Investigable questions that arose during the investigation (Klentschy, 2010).

APPENDIX B

SCIENCE NOTEBOOK ASSESSMENT RUBRIC

Elements and Criteria	N/A	Not Present	Lacking	Meets	Exceeds
Question/Purpose					
Student generated, in own words, relates to purpose, investigable.	Comments:				
Prediction					
Possible answer to question, gives an explanation for response.	Comments:				
Plan					
Relates to question, has clear sequence and logical order, identifies variables.	Comments:				
Data/Observations					
Accurate, organized, includes student-generated graphs, drawings, or charts.	Comments:				
Conclusion					
Answers question, uses data and observations as evidence, uses evidence logically.	Comments:				
Reflection					
Student generated thoughts on further investigable questions.	Comments:				
Total					

(Klentschy, 2010, p. 195)

APPENDIX C

SCIENCE JOURNAL MODEL

1. Write two dated and titled entries in your notebook this week answering the following question: In chemistry in the environment this week, I learned...
2. Write one dated and titled entry in your notebook this week answering the following question: In chemistry, I am curious about...

APPENDIX D

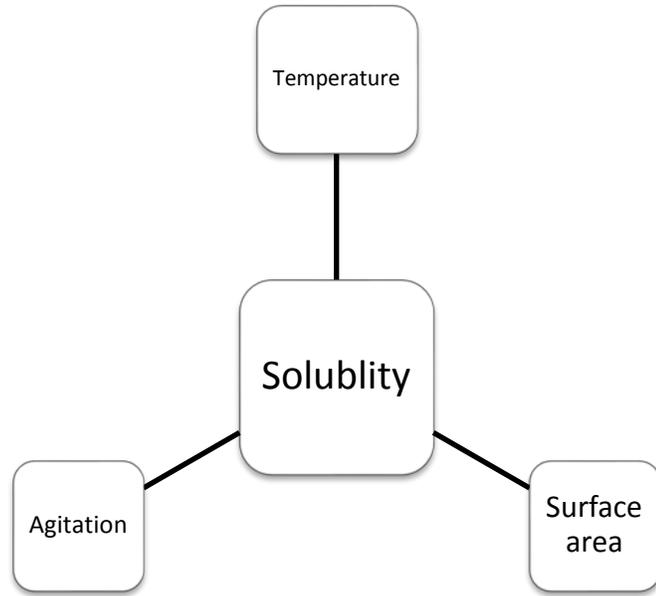
SCIENCE JOURNAL ASSESSMENT RUBRIC

Needs improvement	Passing	Very good	Exceptional
Fewer than three dated entries, or entries that are less than one page each, or writing doesn't make sense.			Three dated entries, at least one page each, with titles, neatly written.
Ideas not related to science or off-topic.	At least one idea related to science, classroom discussion or labs.	Few ideas all related to science, classroom discussion or labs.	Several ideas all related to science, classroom discussion or labs.
No vocabulary used, or not in the context of student's own words, or used incorrectly.	Some vocabulary terms from content used correctly in a context of student's own words.	Many vocabulary terms from content used correctly in a context of student's own words.	Wide variety of vocabulary from content used correctly and in a context of student's own words.
No response to prompts.	Response to prompts shows limited curiosity, thought, ideas or research.	Response to prompts is detailed, shows some curiosity, thought, ideas or research.	Response to prompts highly detailed, shows additional curiosity, thought, ideas or research.
Total:			

(Fingon, 2008, p. 42)

APPENDIX E

SCIENCE GRAPHIC ORGANIZER MODEL



APPENDIX F

SCIENCE GRAPHIC ORGANIZER ASSESSMENT RUBRIC

Needs improvement	Passing	Very good	Exceptional
Relationships between concepts inaccurate and incomplete.	Relationships between concepts accurate but incomplete.	Relationships between concepts accurate and complete.	Relationships between concepts accurate and complete. Organizer shows exceptional effort, organization and mastery of concepts.
Content does not contain all appropriate terms and ideas or are presented without thoroughness.	Content contains most appropriate terms and ideas with some degree of thoroughness.	Content contains all appropriate terms and ideas with thoroughness.	Content contains all appropriate terms and ideas with thoroughness including links to previous knowledge.
Total:			

APPENDIX G

CONFIDENCE SURVEY

1. I am confident using my notebook to learn.
 - a. Definitely
 - b. Maybe some
 - c. I don't know
 - d. I don't think so
 - e. Definitely not
2. I feel like my notebook is a tool to help me rather than an assignment for the teacher.
 - a. Definitely
 - b. Maybe some
 - c. I don't know
 - d. I don't think so
 - e. Definitely not
3. The way I organize my notebook makes it useful to me.
 - a. Definitely
 - b. Maybe some
 - c. I don't know
 - d. I don't think so
 - e. Definitely not
4. I enjoy writing in my notebook.
 - a. Definitely
 - b. Maybe some
 - c. I don't know
 - d. I don't think so
 - e. Definitely not
5. I enjoy drawing in my notebook.
 - a. Definitely
 - b. Maybe some
 - c. I don't know
 - d. I don't think so
 - e. Definitely not
6. Journaling in my notebook about what I have learned helps me remember more.
 - a. Definitely
 - b. Maybe some
 - c. I don't know
 - d. Not really
 - e. I don't ever do this.
7. Graphic organizers help me understand what we talk about in class.
 - a. Definitely
 - b. Maybe some
 - c. I don't know
 - d. I don't think so
 - e. Definitely not

8. Writing my own question, prediction and plan helps me understand what I am trying to discover.
 - a. Definitely
 - b. Maybe some
 - c. I don't know
 - d. Not really
 - e. I don't do this.
9. Feedback left by the teacher in my notebook helps me improve my work.
 - a. Definitely
 - b. Maybe some
 - c. I don't know
 - d. I don't think so
 - e. Definitely not
10. Using suggestions from the teacher in my notebook to correct work makes me feel like I am improving or have performed well.
 - a. Definitely
 - b. Maybe some
 - c. I don't know
 - d. I don't think so
 - e. Definitely not
11. I use my notebook to look up things we have already learned about when I need to.
 - a. Definitely
 - b. Maybe some
 - c. I don't know
 - d. I don't think so
 - e. Definitely not
12. I use my notebook to study for tests.
 - a. Definitely
 - b. Maybe some
 - c. I don't know
 - d. I don't think so
 - e. Definitely not
13. When I hear stories about important notebooks are, it motivates me to keep a detailed, organized notebook.
 - a. Definitely
 - b. Maybe some
 - c. I don't know
 - d. I don't think so
 - e. Definitely not
14. I use the colored pencils in my notebook.
 - a. Very often
 - b. Sometimes
 - c. Rarely
 - d. Never

15. Enhancing my work with colored pencils makes me feel proud of my diagrams.
 - a. Definitely
 - b. Maybe some
 - c. I don't know
 - d. Not really
 - e. I don't use color pencils
16. Overall I feel proud of the work I have accomplished in my notebook.
 - a. Definitely
 - b. Maybe some
 - c. I don't know
 - d. I don't think so
 - e. Definitely not
17. Overall I feel like my notebook helps me learn.
 - a. Definitely
 - b. Maybe some
 - c. I don't know
 - d. I don't think so
 - e. Definitely not
18. How do you use your notebook to help you learn?
19. What would you change about the way you use your notebook if you could?
20. In what ways do you personalize or enhance it to make it your own?
21. Is there anything else you would like me to know?

APPENDIX H

INTERVIEW QUESTIONS

Interview questions asked during the third week of treatment

1. How does your notebook help you learn?
2. How confident are you using your notebook to help you learn and why?
3. How does your notebook motivate you to work?
4. Can you show me a notebook page of which you are especially proud and share why? One that you are not pleased with and why?
5. Is there anything else you want me to know?

Interview questions asked at the end of treatment

1. How does your notebook help you learn?
2. How confident are you using your notebook to help you learn and why?
3. Can you show me a notebook page of which you are especially proud and share why? One that you are not pleased with and why?
4. How do the mind maps help you learn?
5. How does the lab format help you learn?
6. How do the journals help you learn?
7. Is there anything else you want me to know?