THE EFFECT OF SCIENCE NOTEBOOKS ON STUDENT ACHIEVEMENT

by

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July 2011
DEDICATION AND ACKNOWLEDGEMENTS

I would like to show my appreciation to many people that helped guide me through this process. Thank you to my professors at MSU that provided me with excellent learning experiences that further developed me as an educator. Also, thank you to my students that were very willing and excited to help me out by completing many surveys, answering lots of interview questions, and really taking to the whole idea of the science notebook. Finally, thank you to my wife for being patient with me when I was working on homework in the evenings and weekends, I appreciate you!
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INTRODUCTION AND BACKGROUND

Project Background

I teach science to seventh, eighth, ninth, and tenth graders at International School Almere, a very small school located 30 km east of Amsterdam in The Netherlands. Almere is a middle class city of approximately 185,000 people (Statline.cbs.nl, n.d.). Our school is made up of 61 students across the 4 grades. About two thirds of the students are Dutch; however, there are students from countries around the world, including Wales, England, the United States, Korea, China, the Philippines, Spain, France, Germany, Bulgaria, and Brazil. All of the students except three speak English as a second or third language. The students vary in academic ability, but most of the students plan to attend university.

As the school’s only science teacher, I teach general science, biology, chemistry, and introductory physics. Over the past few years, as a strategy to help enhance achievement, I asked my students to record the learning objectives for each lesson in their class notes. The class notes and other handouts were then organized into a binder in a prescribed manner. As a way to check their own understanding, I also asked my students to practice writing questions they should be able to answer if they had mastered the objectives. For example, if the learning objective was Students will be able to compare and contrast the light dependent and light independent reactions of photosynthesis, then, students would devise questions such as What are the light dependent and light independent reactions? How are they the same? How are they different? My intent with these efforts was to promote student ownership of material to facilitate learning, but
unfortunately, this process was not as effective as I hoped it would be. I found that many students did not make the connection between the learning objectives and available resources such as class handouts, textbooks, and lab results. I also had a difficult time checking the questions the students wrote and determining if they were actually using the questions to help them study. My observations were validated when I interviewed my students to learn more about their perceptions. In the Preliminary Interview (Appendix A), many students told me that they either do not study or that they study by reading their notes. One student said, “I just read my notes until they get stuck in my head.” This showed me that he was not making deep connections with the learning objectives, but instead he was trying to memorize everything.

Over the years, I tried a variety of alterations to improve this strategy, but I was not completely satisfied with the results. Based on my observations and interviews, I thought that students would benefit from a more integrative science notebook approach. Klentsch (2005) describes science notebooks as “a central place where language, data, and experience work together to form meaning for the student” (p 24). Using science notebooks was a possible solution to my problem because the notebooks would provide the students one place to organize information in a semi-structured format, and I could formatively assess the notebooks to monitor and guide my students’ use of them.

**Focus Question**

The primary focus for this project was the question: Does the use of science notebooks impact student achievement on summative assessments in science classes? I also wanted to study the following sub-questions:
1. Does the use of science notebooks impact student ability to generate questions?

2. Does the use of science notebooks impact the students’ perceptions of their preparedness for summative assessments?

3. Does the use of science notebooks increase student interest in science?

4. Does the use of science notebooks impact the teacher’s organization in the classroom?

CONCEPTUAL FRAMEWORK

One way to increase student achievement in science courses is to use science notebooks which facilitate learning through several avenues (Klentschy, 2005; Nesbit, Hargrove, Harrelson, & Maxey, 2004). Science notebooks help students understand learning objectives (Klentschy), become self regulated learners (Gilbert & Kotelman, 2005; Roberson & Langford, 2010), and develop their own understanding of content. All three of those characteristics have been shown to increase student achievement (Krajcik, J., McNeill, K., and Reiser, B., 2007; Klentschy, Bruce, 2001; Covington, 2000).

The use of science notebooks help students to understand the objectives of their investigations (Klentschy, 2005), and when learning objectives are clearly identified by the teacher and communicated to the students, student achievement increases for a variety of reasons (Krajcik et al., 2007; Bruce, 2001; Covington, 2000). Students must understand learning objectives in order to understand what is expected of them (Bruce). This understanding gives the students a clear target or goal to shoot for and helps them to create a plan of how to reach the target. Students who used learning goals were more
likely to use self-regulated study techniques, which were shown to increase cognition and student achievement (Covington). Students also benefit from learning objectives because they make the content compelling and understandable, and students are more willing to work toward achieving a learning objective when they find it compelling (Krajcik, et al.).

The aims of a curriculum are often too vague to use as learning objectives because they are written generally enough to cover a variety of situations. For this reason, the aims need to be “unpacked” (Bruce, 2001). For example, an aim of a curriculum may say something like *The students will be able to use scientific vocabulary effectively in a variety of situations.* Unpacking that aim would be to ask questions such as: What scientific vocabulary will be appropriate for this unit? What opportunities will students need to show that they understand the concepts behind the vocabulary? This unbundling of the overall goal creates clear and understandable learning objectives or targets for both the teacher and student (Bruce). Using science notebooks helps students unpack learning objectives or scientific concepts by allowing students to construct their own meaning by asking individual questions about an objective or concept (Gilbert & Kotelman, 2005).

Another factor that leads to student achievement is the ability of a student to self-regulate. Self-regulators are defined as students who use metacognitive strategies to check their own understanding and make judgments about whether they need to continue to study in order to learn an objective (Zimmerman, 1989). Although there are varying degrees to which students self-regulate, self-regulation does have a positive impact on student achievement. Shepard concluded (as cited in McMillan & Hearn, 2008) that students need to self-assess in order to construct their own understanding of material.
Science notebooks help students develop their self-regulation and metacognitive abilities (Gilbert & Kottelman, 2005; Roberson & Langford, 2010). Students record their thoughts and questions about a scientific investigation in their science notebook, and this allows them to construct their own meaning of a concept (Gilbert & Kottelman). The questions the students ask themselves during an investigation or while they are reviewing their peers’ notebooks help them develop their metacognitive abilities (Roberson & Langford). Also, as students use science notebooks, they ask more questions, leading to increased ability in scientific inquiry (Aguiar, Mortimer, & Scott, 2010).

In order to self-regulate effectively and achieve a learning objective, students need to be able to identify and learn how to use the tools and resources available to them (Jernigan, 2004). Teaching lateral thinking skills helped students determine what was expected from them so they could identify the resources they would need to complete a task (Barak & Doppelt, 1999). Lateral thinking can be thought of as digging lots of small holes, while vertical thinking is digging one deep hole (Feezel, 1993). Alternately stated, lateral thinking is looking at a situation from many perspectives instead of just being focused on one aspect of it and diving deeper into that one perspective. When a problem is investigated from many perspectives (i.e., many holes), then you will begin to think more creatively about the available resources to complete the task. A study found an increase in student achievement in technology classes when the students were taught how to think laterally (Barak and Doppelt). Science notebooks help students to think laterally because they offer students a place to ask many questions about an observation, concept, or investigation (Gilbert & Kotelman, 2005).
Students who are self-regulators tend to benefit from increased deep-cognition, greater motivation, and a more positive attitude toward learning (Rolheiser and Ross, 2003). Self-regulating students evaluated their work, and if they were not satisfied with the results they kept working until they were satisfied, and students who did not evaluate their work tended to turn in work they were not completely satisfied with (Kitsantis et al., 2004). Furthermore, self-regulating students tended to follow mastery goals (Kitsantas et al.), an especially important outcome given Covington’s (2000) claim that setting mastery goals leads to higher academic achievement than setting performance goals.

While some students have the ability to self-regulate, there are many students who do not. Three constraints were identified that influence students’ abilities to use learning objectives and self-regulating skills to achieve in the classroom: schema, metacognitive abilities, and understanding how to interpret the expectations of the learning objective (Wong, 1985; Zimmerman, 1989). These three factors are the exact requirements that McMillan and Hearn (2008) identified as necessary for students to self-regulate.

Students also tended to have difficulty using self-regulation while they were trying to master less structured tasks, such as sentence writing, than they did with structured tasks that follow a set of procedures (Rosenshine, Meister, & Chapman, 1996).

Although there can be constraints to students’ abilities to self-regulate, self-regulation is a skill that can be taught just like any other. One behavior that self-regulators have in common is inquiry (Chin, 2002). Therefore, if students are taught how to properly ask questions, they will gain part of the skill-set necessary to become a self-regulator. When teachers modeled self-regulation in their lessons, it showed students how to become self-regulators (Rosenshine et al., 1996; Chin). Also, students in a
primary school science class achieved better when they were given question stems to help them form questions to ask about the science lessons than when they were asked to form questions on their own (King, 2004). In order to guide their own question writing, students were provided with question stems such as "How are ... and ... alike? What is the main idea of ... ?", and "What are the strengths and weaknesses of...?" (King, p. 187).

Another strategy King (2004) found to be beneficial, although not as beneficial as question stems, was providing the students with signal words when they were asked to generate questions. Providing signal words is a similar strategy to providing students with question stems, but in this strategy, the students are only given the first word of a question such as who, what, when why, where, etc. Also, students learn how to ask questions to become better self-regulators in the science classroom when they hear their peers asking questions and inquiring (Aguiar, et al., 2010). In alignment with these findings, science notebooks are an effective way for students to ask questions in the science classroom (Gilbert & Kotelman, 2005).

The use of science notebooks is a form of scaffolding because they allow students to work at their own pace, delve as deep as they can into a concept, and construct their own meaning of concepts (Gilbert & Kotelman, 2005). Scaffolding is a general term describing any strategy that provides extra support to the students during instruction, and it has been shown to improve students’ abilities to self regulate. One example of a scaffolding technique was the use of procedural prompts to help students complete certain tasks (Rosenshine et al.). Procedural prompts are steps for the students to follow that remind them how to complete a task until students can internalize the process. Science teachers can use procedural prompts to help students write complete scientific
explanations in their notebooks by instructing them to first make a claim, then support that claim with evidence, and finally to explain that evidence with a scientific explanation (Ruiz-Primo et al., 2010).

Ruiz-Primo et al. (2010) studied students’ explanations in their science notebooks to determine if there was a connection between the explanations and the scores on summative assessments. The study showed evidence that students performed higher on summative assessments when the explanations in their science notebooks contained a claim, evidence to support that claim, and scientific reasoning to explain the claim than when the students’ explanations were missing one or more of those parts (Ruiz-Primo et al.).

There are a variety of factors that affect student achievement, but three of them are student ability to use a learning objective to guide their understanding, student ability to become a self-regulator, and student ability to develop their own understanding of content (Krajcik, 2007; Klentschy, 2005, Bruce, 2001; Covington, 2000). The implementation of science notebooks is one strategy that helps to develop students’ abilities in all three of those areas (Klentschy, 2005; Nesbit, Hargrove, Harrelson, & Maxey, 2004).

METHODOLOGY

Treatment

The treatment for my capstone project was the use of science notebooks in four classes: seventh, eighth, and ninth grade general science and tenth grade biology. With the exception of students new to our school and the incoming seventh graders, I taught
the same students for the 2009-2010 (Year 1) and 2010-2011 (Year 2) school years. I started the treatment at the beginning of Year 2 and compared student achievement under treatment with the student achievement from Year 1. All of the students’ parents signed a consent form to participate in the study (Appendix B). 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.

I introduced science notebooks by showing the students examples of notebooks, discussing their purpose, and emphasizing their importance. I gave my students photocopies of science notebooks, and they recorded lists of items they observed in each notebook (Figure 1). From these lists we created an agreement about the content to be included in their notebooks. The students decided to include the date, titles, data tables, graphs, labeled pictures, observations, purposes, and notes in their science notebooks. I also had the students include page numbers and a table of contents at the beginning of their notebook. Some examples from student notebooks can be seen in Figure 2.

Figure 1. List from a student notebook about items observed in example notebooks.
Figure 2. Example of student notebooks that show a table of contents, graphs, pictures, data tables and observations.

During the first six weeks of the school year, I focused on helping my students use the science notebooks to collect and organize data and to record questions they had during investigations (Figure 3). Before we started an investigation, I led a brainstorming session to help my students identify data they should collect and possible ways to organize those data. I tried not to dictate a form for their data tables because I wanted my students to make them their own. Before my students started an investigation, I reminded them to record questions they had during the investigation. During the investigation when a student asked me a question I said something like, “That’s a great question. You should write it down in your notebook so you can use it in your conclusion.”

After the first six weeks of the school year, I had my students practice writing explanations in their science notebooks. I taught my students to write their explanations in three parts: they made a claim to answer their purpose question, supported their claim
with a direct reference to the data they collected, and finally explained the scientific concept behind their claim and evidence.

*Figure 3.* Observations and questions recorded in a student notebook.

Next, I taught my students how to use the questions they generated during investigations to guide their analysis of the validity of the investigation and to identify other paths of inquiry. In order to determine the validity of their investigations, I had my students use a flow chart (Appendix C) to determine the relevance of the questions they asked during their investigations. The flow chart categorized questions that identified variables that could have impacted the results of their investigations and questions that led to other paths of inquiry. The flow chart then guided the students about how to discuss the impact of the questions in a lab report.
Data Collection Techniques

I used seven data collection tools to gather information regarding the impact of the science notebooks in class: Preliminary Interview, Preparation Rating Scale, Notebook Data Sheet, Student Opinion Survey, Student Perception Interview, Historical Assessment Data, and Field Notes. The treatment period ran from September 1, 2010 through March 31, 2011. Data was collected in three phases: pre-treatment, during treatment, and post-treatment. The purpose of each data collection tool, how each data collection tool was used, and the plan for data analysis is described below.

I administered the 10-question Preliminary Interview to 10 students to gather information about their note-taking, studying, and questioning habits in order to establish a baseline of how students organized information and prepared for assessments in science and other courses (Appendix A). I analyzed the responses of the students for all questions and divided the responses into categories based on common themes. The purpose behind the Preliminary Interview was to help me understand how my students prepared for assessments because the use of science notebooks would be a new experience for them, and I needed to know how my students functioned previously in order to help them implement the new system.

The first half of the Preparation Rating Scale was administered to the students at the beginning of each unit (Appendix D) as a pre-assessment to determine the students’ levels of understanding of each vocabulary term and learning objective for the unit. The second half of the Preparation Rating Scale (Appendix E) was administered along with the summative assessments so the students could reassess their level of understanding for
each vocabulary term and learning objective. On the second half of the Preparation Rating Scale, the students also predicted their expected level of achievement, answered questions about how they prepared for the assessment, and rated how useful the science notebook was in preparation for the assessment.

This tool aimed to collect data to determine if the use of the notebooks helped students prepare and feel prepared for summative assessments. The percentage of responses for the students’ levels of understanding for the first half and the second half of the Preparation Rating Scale was compared between each round of data collection to determine if the students felt they knew the vocabulary and learning objectives better at the end of the unit than they did at the beginning of the unit.

Next, the percentage of responses for the students’ expected levels of achievement for the summative assessment was compared to the percentage of their actual level of achievement on the summative assessment. This determined whether the students’ perceptions of how well they would perform aligned with their actual performance on the assessment.

The percentage of the students’ ratings of usefulness of the notebook was compared to the percentage of the students’ expected levels of achievement to determine if there was a correlation between the two pieces of data. Finally, the percentage of the students’ ratings of usefulness for the science notebooks was compared with their actual levels of achievement on the summative assessment. This was compared to determine how the students perceived the usefulness of the science notebooks with the students’ actual performance.
The Student Opinion Survey was administered before the treatment period, after the students’ second unit using science notebooks, and at the end of the data collection period (Appendix F). The Student Opinion Survey was designed to gather information regarding the students’ opinions about their overall level of preparedness for class, ability to achieve in science, interest in science, and their teacher’s level of organization. The percentage of each of the responses on the Student Opinion Survey was compared to determine if there was a change in student opinion throughout the implementation of science notebooks. The percentage of agreement and disagreement was calculated and compared as well to determine if there was a change of opinion through the course of the project.

Student Perception Interviews were used throughout the study to gather information on the students’ perceptions about their ability to achieve in science, their interest in science, their opinion on the structure and organization of their science class, and their preferences on how structured or organized they liked a classroom to be (Appendix G). The Student Perception Interviews were administered toward the beginning of the treatment period, at the end of the first term of the school year, and at the end of the data collection period. The responses from each round of Student Perception Interviews were analyzed by grouping answers into common themes and counting the number of student responses that fit into each theme. Outlying responses were also recorded. The analyses from each round of interviews were compared with each other to determine if the students’ perceptions about achievement changed throughout the course of the study.
Historical Assessment Data from Year 1 was collected and analyzed (Appendix H). The Historical Assessment Data was analyzed at a mid-point during Year 1 and at an end point during Year 1. That data was compared with the during-treatment data from Year 2 and post-treatment data from Year 2 respectively. The percentage of students who earned each level of achievement within the assessment criteria was calculated as well as the percentage of the students’ final grades.

Our school follows the Middle Years Program (MYP) of the International Baccalaureate Organization (IBO) which uses criterion related assessment. There are six criteria in science used to evaluate our students: A- One World, B- Communication, C- Knowledge and Understanding, D- Inquiry, E- Data Processing, and F- Attitudes. One world assesses the students’ ability to relate topics and concepts in science to the real world. Communication assesses the students’ ability to communicate scientific ideas in a variety of ways while using appropriate documentation. Knowledge and Understanding assesses student ability to apply science concepts. Inquiry assesses student ability to design, implement, and evaluate experiments while Data Processing assesses ability collect and analyze data. Finally, Attitudes assesses student ability to work safely, cooperatively, and accurately in the lab.

The assessment data collected was grouped into three categories. The data from One World (Criterion A) and Communication (Criterion B) were grouped together, the data from Knowledge and Understanding (Criterion C) were collected by themselves, and the data from Inquiry (Criteria D) and Data Processing (Criteria E) were grouped together. I chose not to include Attitudes (Criterion F). The data were grouped like this because One World and Communication were always assessed together, Knowledge and
Understanding was always assessed independently, and Inquiry and Data Processing were also always assessed together. The Historical Assessment Data from Year 1 were compared with the comparable assessment data for Year 2 to determine if there was a difference in student achievement during the treatment period. The Year 1 midpoint assessment data were compared with the Year 2 during treatment assessment data, and the Year 1 end point assessment data were compared with the Year 2 post-treatment assessment data.

Each criterion is assessed on a scale of 1-6 where a 6 represents the highest level of achievement and a 1 represents the lowest level of achievement. At the end of each term a Final Grade is awarded based on a sum of the levels of achievement from the six criteria. The Final Grade is on a scale from 1-7 where a 7 represents the highest grade.

Each student completed a Notebook Data Sheet three times during the data collection period (Appendix I). The seventh graders filled in a Notebook Data Sheet for the Bread Mold Lab, Polymer Lab, and Weather Lab. The eighth graders filled in a Notebook Data Sheet for the Solubility Lab, Unknown Solutions Lab, and Gears Lab. The ninth graders filled in a Notebook Data Sheet for Percent Composition Lab, Cellular Transport Lab, and Anaerobic Respiration Lab. Lastly, the tenth graders filled in a Notebook Data Sheet for the Mitosis Lab, Genetics Lab I, and Genetics Lab II.

The first ten questions of the Notebook Data Sheet collected information to determine the level to which the students met the agreed upon requirements for the notebook. These were yes/no questions and the percentage of yes’s and no’s was
calculated for each question and an overall percentage of yes’s and no’s was calculated to determine how well the students used the notebooks.

The last part of the Notebook Data Sheet was used to record data about the quantity and types of questions the students asked during investigations. The mean number of questions asked during the investigations was calculated and the percentage of testable, researchable, and other types of questions was also calculated. These numbers were compared for each unit to determine if the number of questions asked changed throughout the course of the study.

I kept Field Notes of observations (Appendix J), reflections, and feelings throughout the project. I recorded notes during lessons of observations in a notebook and at the end of each week I transcribed my observations into an electronic journal. I used the observations in this notebook to make adjustments throughout the project, identify trends in the students’ performances and behaviors, and help draw conclusions about the effectiveness of science notebooks in general. A summary of the data collection techniques and the research questions is presented as a triangulation matrix in Table 1.
Table 1
*Data Triangulation Matrix*

Focus Question: Does the implementation of science notebooks impact student achievement on summative assessments?

<table>
<thead>
<tr>
<th>Sub Focus Questions</th>
<th>PI</th>
<th>PRS</th>
<th>SOS</th>
<th>SPI</th>
<th>HAD</th>
<th>NDS</th>
<th>Field Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does the implementation of science notebooks impact student ability to generate questions?</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Does the implementation of science notebooks impact the student’s perception of their preparedness for summative assessments?</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Does the implementation of science notebooks increase student interest in science?</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Does the implementation of science notebooks impact the teacher’s organization in the classroom?</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

*Note: The following key defines each data source: Preliminary Interview (PI), Preparedness Rating Scale (PRS), Student Opinion Survey (SOS), Student Perceptions Interview (SPI), Historical Assessment Data (HAD), and Notebook Data Sheet (NDS)*
DATA AND ANALYSIS

The data collected during the study was divided into five themes: student achievement, student preparation, student ability to generate questions, student interest in science, and teacher organization.

Student Achievement

More students achieved at least a passing final grade of 4 during the treatment of Year 2 than they did at the midpoint during Year 1 (Figure 4). During Year 1, 32% of the students earned a final grade of 4, 26% earned a 3, 25% earned a 5, 11% earned a 6, 6% earned a 7, and 0% earned a 1 or 2 (N=54). During Year 2, 49% of the students earned a final grade of 4, 23% earned a 5, 17% earned a 3, 11% earned a 6, and 0% of the students earned 1, 2, or 7 (N= 61). At the midpoint of Year 1, 68% of the students earned a 4 or above and 83% of the students earned a 4 or above during treatment in Year 2.

Figure 4. Percent of students earning a Final Grade of at least 4 at the midpoint of Year 1, (N=54) and during treatment of Year 2, (N=61).
By the post-treatment data analysis, more students achieved at least a passing final grade of 4 with the use of science notebooks than without (Figure 5). At the end point of data collection during Year 1, 43% of the students earned a 4, 23% of the students earned a 3, 17% of the students earned a 5, 15% of the students earned a 6, 2% of the students earned a 7 and 0% of the students earned a 1 or 2 ($N=54$). At the post-treatment data collection point of Year 2, 45% of the students earned a 4, 27% of the students earned a 5, 18% of the students earned a 6, 8% of the students earned a 3, 2% of the students earned a 7, and 0% of the students earned a 1 or 2 ($N=61$). Seventy-seven percent of the students earned a 4 or higher at the end point of data collection during Year 1 and 92% of the students earned a 4 or above during Year 2 at the post-treatment data collection.

![Figure 5](image_url)

*Figure 5*. Percent of Students earning a Final Grade of at least 4 in at the end point of Year 1, ($N=54$) and post-treatment of Year 2, ($N=61$).

Student achievement in One World (Criterion A) and Communication (Criterion B) was higher at the post-treatment data collection of Year 2 than at the end point of data collection.
collection of Year 1 (Figure 6). In Year 1, 81% of students achieved a satisfactory level of achievement ($N=54$) and in Year 2, 92% of the students achieved a satisfactory level of achievement ($N=61$). Student achievement also increased more between the during-treatment and the post-treatment data collections in Year 2 than in Year 1 for these two criteria. The percent of students earning fives and sixes in these criteria increased from 26% to 36% between the two data collection points of Year 2 and during same time period in Year 1 the students earning fives and sixes decreased from 39% to 28%. On the other end of the spectrum, the students who earned a one or two decreased from 21% to 7% during the data collection period of Year 2, but during Year 1, it increased from 15% to 19%.

![Figure 6](image.png)

*Figure 6.* The percent of students meeting satisfactory performance in Criteria A and B during Year 1, ($N=54$), and Year 2, ($N=61$).

A larger percent of students met a satisfactory level of achievement in the post-treatment analysis of Knowledge and Understanding (Criteria C) during Year 2 than they did during Year 1 (Figure 7). In Year 1, 64% of the students reached a satisfactory level
and 36% of the students did not (N=54). In Year 2, 76% of the students had reached a satisfactory level and 24% of the students had not (N=61). Twelve percent more students were achieving at a satisfactory level in Knowledge and Understanding (Criterion C) at post-treatment of Year 2 than during Year 1.

![Bar chart showing percentage of students meeting satisfactory performance in Knowledge and Understanding (Criterion C) during Year 1 and Year 2.](chart.png)

*Figure 7.* The percent of students meeting satisfactory performance in Knowledge and Understanding (Criterion C) during Year 1, (N=54), and Year 2, (N=61).

More students achieved a satisfactory level in Inquiry (Criteria D) and Data Processing (Criteria E) by post-treatment of Year 2 than they did during Year 1 (Figure 8). At the end of Year 1, 44% of the students achieved at a satisfactory level while 56% of the students did not (N=54) and during Year 2, 57% of the students achieved at a satisfactory level and 43% of the students did not (N=61).
Figure 8. Percent of students that met a satisfactory level in Criteria D, Scientific Inquiry, and E, Processing Data, in Year 1, (N=54), and Year 2, (N = 61).

When asked about their ability to earn a high final grade in science, 75% of the students interviewed near the end of the study indicated they could earn at least a 6 out of 7 compared to only 38% that said they could earn a 6 or 7 when asked at the beginning of the study (N=8). For example one student said, “It’s my preparation for tests and behavior that holds me back from getting a seven. I could probably do it, but it’d be really hard and I just don’t think I would.” During the first Student Perception Interview students tended say that science is very complicated and that is why they could not achieve a high grade. One student stated, “Science has a lot of hard words and I have a hard time explaining it all.”

In February 2011, I wrote in the Teacher Field Notes, “The students seem to have a much stronger grasp of the chemical reactions that make up cellular respiration and are using the proper vocabulary much more than they did in the past.” I also noted at various times that all of my students had begun to write scientific explanations by making a
claim, supporting the claim with evidence, and then explaining the related scientific
concepts. By early winter my students were able to use this format without much
prompting from me, but many students in all grade levels had difficulty explaining the
scientific concept behind the evidence.

Although the data up to this point showed evidence the students did achieve
higher in science, there was one item from the Student Opinion Survey that showed a
different trend (Figure 9). When asked if the students had the ability to earn a high grade
in science, 42% of the students agreed with that statement at the beginning of the study,
then in the middle of the study 60% of the students agreed with it, and by the end of the
study the percent agreement dropped back down to 42% ($N = 61$). Also, the percent of
the students that disagreed with that statement increased throughout the data collection
period from 11% to 20%.

Figure 9. The percent agreement to the statement *I have the ability to earn a high grade in science*, ($N=61$).
Student Preparation

The second theme analyzed was students’ perception of their preparation for summative assessments. The results of the Preliminary Interview and the Student Perception Interviews showed that more students began to use self-regulation techniques at the end of lessons and at the end of assignments as the study progressed. During the Preliminary Interview many students commented about how they just read their notes to study for a test. One student said, “I don’t really study for tests. I just mostly remember stuff from the board.” However, during the Student Perception Interview more students stated that they asked themselves questions, wrote summaries of lessons, or compared ideas with their friends. One student said, “I highlight the important parts in my notebook and give it to my parents for them to ask me questions. I also talk about interpretations with my friends to see if we think the same things.” Another student said, “During the lesson I will ask myself what the teacher is saying.”

The students’ use of their notebooks was also used to help identify if their level of preparation increased throughout the study. Their use of their scientific notebooks improved slightly throughout the course of the study, but remained relatively constant (Figure 10). After analyzing the first Notebook Data Sheet it was discovered that students included 68% of the items they were supposed to include in their entries and during the second and third times collecting data it was found that the students included 76% of the items ($N=61$).
Figure 10. The percent of items included in the science notebooks from the Notebook Data Sheet (NDS), ($N=61$).

The students’ use of their science notebooks showed the most improvement in the inclusion of appropriate units, pictures, and quantitative data. The inclusion of units showed the greatest percent increase moving from 43% to 92% and back down to 87% during the three rounds of data collection ($N=61$). The inclusion of pictures showed the next greatest gain during the study. The students improved their inclusion of pictures by increasing from 24% to 40% throughout the study. Finally, the students improved their inclusion of quantitative data from 72% to 94% ($N=61$).

By the end of the study the students were not able to predict their level of achievement on a summative assessment any better than they were at the beginning of the study. After the first round of data collection the mean predicted level of achievement was 0.25 points higher than the mean of the earned level of achievement, during the second round of data collection the mean predicted level of achievement was 0.09 points higher than the mean of the earned level of achievement, and after the third round of data
The mean predicted level of achievement was 0.41 points below mean earned level of achievement.

The observations from my Field Notes showed evidence that students were better able to anticipate the general expectations of a summative assessment by the end of the data collection period than they could in the beginning. For example, most of my tenth graders did not include sources for a research assignment about cancer they completed in September, but 100% of the students did include sources for a genetic disease research assignment completed in March. Also, before we began the genetic disease research assignment I had my students brainstorm what they thought they would have to include in the final product and each group mentioned citing their sources.

The same trend of being better prepared for summative assessments was observed in my seventh, eighth, and ninth graders’ lab reports. At the beginning of the study I observed that all of my students, except one or two in each class, did not draw conclusions based on the data they collected, but by the end of the study all of the students, except one or two in each class, drew conclusions based on the data they collected. The connection they made was not always accurate, but there was evidence that the students knew the data and conclusions should be connected to each other. Also, as I mentioned earlier, my students were able to anticipate using the claim, evidence, explain format of writing scientific explanations in all four grade levels at the end of the study.

Analysis of the Preparedness Rating Scale showed that students’ believed their science notebooks were more useful by the end of the study than they did at the
beginning of the study. After the first round of data collection 71% of the students rated their science notebooks as useful or very useful and by the end of the study 88% of the students rated the notebooks as useful or very useful.

**Ability to Generate Questions**

Another theme that was analyzed was the students’ ability to generate questions. Data from the Student Perception Interview, Assessment Data, and Field Notes contained information related to this theme.

The students showed more self-regulation through asking questions when I interviewed them for the last time during the Student Perception Interview than on the previous interviews. All eight of the students I interviewed made a comment about how they asked themselves questions, asked their friends questions, or had someone ask them questions to make sure they understood a topic. Most of the students did not say they used self-regulation techniques before they used science notebooks when I interviewed them during the Preliminary Interview.

I also observed many eighth and ninth grade students asking questions during their investigations. At the beginning of the study my students did not ask many questions about the data they collected. For example, during the percent composition lab my ninth graders completed in September the students did not ask any questions regarding the validity of their data, but during a lab about osmosis in January each of the four lab groups had at least one question regarding the data they collected.
Lastly, as mentioned earlier in the data and analysis, the students’ level of achievement increased in Inquiry (Criterion D) and Data Processing (Criterion E) which are two areas that require the ability to ask questions (Figure 8).

**Student Interest in Science**

There was mixed data in regards to whether student interest in science changed throughout the course of the study. The Student Perception Interview showed that the majority of the students enjoyed watching science-related television shows and about half of the students were interested in “how things work” and “why stuff happens.” One student said, “For example, I want to know why it rains more in one place than in another. Also technical stuff, like how does a walkie-talkie or a stop watch work.” These results remained constant throughout the course of the study.

My field notes also showed that about half of the students seemed to be very interested in lab activities. While I observed my seventh graders recording observations for their weather journal I noticed that in each lab group of four students there was always at least one student that appeared to be very interested in recording data, one or two students that seemed semi-interested, and one student that was disinterested. I observed the same pattern that about 25% of the students in any given activity seemed very interested 50% of the students were on task but not completely interested, and 25% of the students were not completely engaged or off task. I also noticed that the longer the students worked without direction from me, the greater the number of students that seemed disinterested became.
The Student Opinion Survey was also used to determine student interest in science (Figure 11). When asked if science generally interests the students percent agreement decreased from 86% to 70% to 56% over the course of the study \((N=61)\). The same trend was observed when the students responded to a question about their plan to study sciences at the university level. Their percent agreement decreased from 60% to 36%. However, the students’ responses showed a slightly different trend when asked if they would consider science-related career. Their level of agreement decreased from 45% to 27% between the first and second round of data collection, but then it rose to 39% after the third round of data collection.

![Figure 11](image.png)

*Figure 11. Percent agreement to the statement Science in general interests me.*

**Teacher Organization**

The last theme analyzed in the data was whether or not my level of organization changed throughout the course of the study. Based on my Field Notes I felt that I was
more prepared during the first four months of the school year, but during the next two months I did not feel as prepared. For example, my organization regarding tasks such as how I stacked papers to grade, when I washed glassware, etc., did not change from before the implementation of science notebooks, but my organization regarding the planning of what demonstrations, exploration activities, teaching strategies, and formative assessments I used did change.

At the beginning of the year I made sure to prepare all of my materials for demonstrations, exploration activities, formative assessments, etc., at least one day in advance and during January and February I did not prepare all of my materials in advance. After February, I got back in the habit of preparing in advance again. During the Student Perception Interview two of my students made comments that supported this claim. One student said, “Sometimes you forget photocopies or materials and have to go get them in class.” I also observed that my level of organization was typically high for one or two classes, but low for the other classes. Then, I would have a pendulum swing and the level of organization and disorganization would switch so the classes I did not feel well organized would become organized and vice-a-versa.

Based off of the Student Opinion Survey, my students felt that I was organized. Over 90% of the students agreed with the statements the science teacher has a plan for what to complete each day, the science teacher uses the entire hour on science-related activities, and the science teacher appears to be prepared for the lesson each day.
INTERPRETATION AND CONCLUSION

Based on the data, I conclude that the implementation of science notebooks improved my students’ achievement on summative assessments and their ability to do valid science. However, my students’ interest in science did not increase and may have actually decreased. Finally, my level of organization did not necessarily get better, but I did become better at identifying what I wanted my students to do, what successful completion of that task would look like, and how I would evaluate it.

The students showed higher achievement in all five assessment criteria when they used science notebooks as opposed the year before they used science notebooks. This supports the claims made that student achievement in science increases when students use science notebooks (Klentschy, 2005; Nesbit, Hargrove, Harrelson, & Maxey, 2004). Although my sample size was relatively low I believe this conclusion is valid. I used the same or very similar assessments for both years and most of the students were the same from one year to the next. However, I believe that since I started using science notebooks many aspects of my teaching changed that may have had a positive influence on student achievement. Two specific items that changed since last year are that I learned how to implement formative assessment and inquiry much more effectively through two graduate courses I took.

I also believe my students are now better at some scientific skills like using data to support claims and overall scientific inquiry. Prior research showed evidence that when students included a claim, evidence to support the claim, and an explanation in a notebook that they tended to do better on summative assessments (Ruiz-Primo et al.,
2010). I taught my students that three-step process for writing scientific explanations and throughout the study I observed that my students were eventually able to do this process individually and they knew that every explanation was required to include all three parts (Figure 12). My students still needed to work on explaining the scientific concept behind the data, but they are now much more aware of the importance and expectation that all claims need to be supported by evidence. This observation has led me to a future line of inquiry I would like to explore. I would like to complete a project to determine how to best help my students write clear and accurate explanations.

![Figure 12](image)

*Figure 12.* The claim, evidence, and explain portion of a scientific explanation from a student’s notebook.

The use of science notebooks also made it easier for me to transition into an inquiry-based classroom. The use of notebooks allowed us to develop our skills much more than I had in the past because everyone could look back into their notebooks to remember prior experiences and students could look at their peers’ notebooks to see what questions other students tried to answer, the data they felt was important to collect, and
different ways of organizing data. My findings supported the claim that science notebooks help students to become better inquirers (Aguiar et al., 2010).

Through the course of the study my level of organization improved and I was able to connect the students’ learning experiences in class more closely with the learning objectives. By looking back in the notebooks I could see what we did during other units, what lab experiences worked well, and then try to recreate similar experiences. The use of science notebooks specifically helped me to incorporate inquiry into my lessons and I believe because I was more organized I was able to do this more effectively than I did in the past. However, because I was new to using inquiry as a central part to my teaching I often struggled with finding appropriate activities and implementing the activities with skill. But, I know becoming an inquiry-based teacher takes time (Llewellyn, 2005).

The last conclusion I made was that the use of science notebooks did not increase my students’ interest in science. Based off conversations I had with students I think they have a natural curiosity for how the world works, but I did not do an effective job of fostering this curiosity. I did not take enough time to allow students to wonder and I did not do an effective job of showing real world applications of many of the topics they learned about. This observation has lead me to a future research question in how can I continue to help my students to improve their achievement while also increasing their interest in science?

VALUE

The participation in this process was invaluable to me as an educator. I was not aware of action research before this process began and previous changes I made in the
classroom were rarely long term or beneficial. I have always been an educator that wants
to improve and wants his students to learn, but I did not have a clear way of
implementing change. Learning about action research and being able to complete this
project has given me a tool that I plan to continue to use independently and I also hope to
have the opportunity to be in a leadership position to help other educators learn how to
use it as well. I am now a teacher that can confidently help himself, his colleagues, and
his school to implement change and evaluate the effectiveness of the changes.

This specific project has helped me to become a more effective science teacher
because I am better at connecting science concepts with the process of science. In the
past I tried to stay away from cookie-cutter labs, but I still found there was a
disconnection between the lab experiments we did and the content knowledge my
students learned. Through reflecting on what I’m doing and using science notebooks to
organize our class I can see a much closer connection between the two aspects of science.
Without the action research process I would not have collected as much data as I did and
I think I would have stopped making the notebooks central to our class early in the year.

Finally, I believe my students benefited from participation in this study because
they had the opportunity to make more independent connections with the content and
learned the importance of using data to support their claims. I will leave my school at the
end of this year and I am confident that the students will be able to write scientific
explanations for their new teacher. I believe that the participation in this study resulted in
my students having to meet a higher standard of quality in their work and that will benefit
them in their future studies.
REFERENCES CITED


APPENDICES
APPENDIX A

PRELIMINARY INTERVIEW
Preliminary Interview

1. How do you organize your notes and other handouts you receive in your classes?

2. Tell me the process of how you study for a test… where do you study, how long do you spend, how soon before a test do you start, what resources do you use, etc?

3. What would make it easier to study for a test or to complete a big assignment at home?

4. In what class do you write the most complete sentences?

5. How is writing in science similar or different than writing in other classes?

6. If you have a question in a class, how do you ask it (one-on-one with the teacher, in front of others, to another student, etc)?

7. Tell me if you agree with this statement and why, “Good students are usually more organized than weak students.”

8. How about this one, “Weak students ask more questions than good students.”

9. Would you like a teacher to look through your notebook? Why or why not?

10. What do you like, dislike, find easy, or hard about using your drama notebook?

11. Is there anything else you would like to add or would like me to know?
APPENDIX B

INFORMED CONSENT
The purpose of this research project entitled "The Effect of Science Notebooks on Student Achievement," examines the impact of using notebooks as the main resource for students to construct their own understanding of science concepts and the scientific process. For this project, students will be asked to complete surveys, interviews, knowledge rating scales, and regular classroom tests. All of these data collection instruments fall within the area of common classroom assessment practices.

Identification of all students involved will be kept strictly confidential. Most of the students involved in the research will remain unidentified in any way, and their levels of environmental interaction will be assessed and noted. However, three (3) students per grade level will be selected for interviews three (3) times during the project. The students will be chosen based on their performance on a test or other graded assignment. Participation in the interview is voluntary and there will be no consequence if a student does not want to participate in the interview. Nowhere in any report or listing will students’ name or any other identifying information be listed.

There are no foreseeable risks or ill effects from participating in this study. All treatment and data collection falls within what is considered normal classroom instructional practice. Furthermore, participation in the study can in no way affect grades for this or any course, nor can it affect academic or personal standing in any fashion whatsoever.

There are several benefits to be expected from participation in this study. First of all, students will be able to reflect on what they are doing to prepare for tests, lab reports, and other assignments. Secondly, students will be able to offer me feedback on what techniques are helping them learn and what techniques are not as beneficial. Finally, the data collected from this project will help me as a teacher identify what helps the students learn the most so I can continue to develop those strategies and in turn better help my students.

Participation in this study is voluntary, and students are free to withdraw consent and to discontinue participation in this study at any time without prejudice from the investigator.

Please feel free to ask any questions of Mr. DeLuca via e-mail, phone, or in person before signing the Informed Consent form and beginning the study, and at any time during the study.

Parent signature: ___________________________

Date: ______________________
APPENDIX C

FLOW CHART FOR CATEGORIZING QUESTIONS
Is your question testable?

**YES**

Could the answer to the question affect your results?

- **YES**
  - This question has identified a variable that needed to be controlled. If you did control it, then you should discuss how you controlled it in the METHOD section of your lab report. If you did not control this variable, then you need to explain how it may have affected your results in the CONCLUSION section.

- **NO**
  - This question has identified a further line of inquiry. It is an idea for another possible experiment. You should discuss this question in your CONCLUSION. Some possible things you could discuss would be how you would test the question and why the question is important.

**NO**

Could the answer to the question affect your results?

- **YES**
  - This question has identified a variable that needed to be controlled. If you did control it, then you should discuss how you controlled it in the METHOD section of your lab report. If you did not control this variable, then you need to explain how it may have affected your results in the CONCLUSION section.

- **NO**
  - This question is a RESEARCHABLE question. You could look up this answer using a resource like a book or the internet. Once you know the answer, you may see that it leads to other lines of inquiry or it may actually affect the results of the lab. Discuss this question in your CONCLUSION.
APPENDIX D

FIRST HALF OF PREPAREDNESS RATING SCALE
# SIMPLE MACHINES

Rate the learning objectives for this unit with the following scale. Do this once at the beginning of the unit and again at the end of the unit.

1 = I don’t understand what I am expected to do from this learning objective.
2 = I understand what I am supposed to do, but I have no prior knowledge about it.
3 = I understand what I am supposed to do, and I have a little prior knowledge about it.
4 = I understand what I am supposed to do, and think I can do it pretty well.
5 = I understand what I am supposed to do, and I am confident that I have mastered it.

<table>
<thead>
<tr>
<th>Learning Objectives</th>
<th>Pre-Unit Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Define and calculate force, work, and power in example problems and lab experiences.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>2. Discuss the benefits and limitations of simple machines on everyday life.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>3. Define, compare, and contrast ideal mechanical advantage (IMA) and actual mechanical advantage (AMA)</td>
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</tr>
<tr>
<td>4. List, label the parts (if applicable), describe the function and give examples of six different types of simple machines</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>5. Calculate the ideal mechanical advantage (IMA) and actual mechanical advantage (AMA) for four simple machines in example problems and lab experiences.</td>
<td>1 2 3 4 5</td>
</tr>
</tbody>
</table>

Rate the vocabulary words for this unit with the following scale. Do this once at the beginning of the unit and again at the end of the unit.

1 = never heard of the word
2 = heard the word but not sure of the meaning
3 = heard the word and think you know the meaning
4 = heard the word and pretty sure you know the meaning
5 = know the word and can use it accurately in science

<table>
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<td>1 2 3 4 5</td>
</tr>
<tr>
<td>3. Force</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>4. Distance</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>5. Simple Machine</td>
<td>1 2 3 4 5</td>
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<tr>
<td>6.</td>
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<td>7.</td>
<td>Wedge</td>
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<tr>
<td>8.</td>
<td>Screw</td>
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<tr>
<td>9.</td>
<td>Pulley</td>
</tr>
<tr>
<td>10.</td>
<td>Wheel and Axle</td>
</tr>
<tr>
<td>11.</td>
<td>Lever</td>
</tr>
<tr>
<td>12.</td>
<td>first class lever</td>
</tr>
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</tr>
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<td>14.</td>
<td>third class lever</td>
</tr>
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<td>15.</td>
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</tr>
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</tr>
<tr>
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</tr>
<tr>
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<td>Power</td>
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<td>21.</td>
<td>Watt</td>
</tr>
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APPENDIX E
SECOND HALF OF PREPAREDNESS RATING SCALE
Rate the learning objectives for this unit with the following scale. Do this once at the beginning of the unit and again at the end of the unit.
1 = I don’t understand what I am expected to do from this learning objective.
2 = I understand what I am supposed to do, but I have no prior knowledge about it.
3 = I understand what I am supposed to do, and I have a little prior knowledge about it.
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11. Lever | 1 2 3 4 5
12. first class lever | 1 2 3 4 5
13. second class lever | 1 2 3 4 5
14. third class lever | 1 2 3 4 5
15. Fixed Pulley | 1 2 3 4 5
16. Moveable Pulley | 1 2 3 4 5
17. Mechanical Advantage | 1 2 3 4 5
18. Ideal Mechanical Advantage | 1 2 3 4 5
19. Actual Mechanical Advantage | 1 2 3 4 5
20. Power | 1 2 3 4 5
21. Watt | 1 2 3 4 5

End of Unit Questions

1. Use the rubric provided to predict what you think you will earn on the assessment.  
   __________  What did you earn? __________

2. What resources did you find most useful in preparing for the assessment? If you did not prepare for it, please, be honest because your response will not impact your performance in any way!

3. Rate the usefulness of your science notebook during this unit on a scale from 1-5. Using the following scale:

   1=useless  2=barely useful  3=somewhat useful  4=useful  5=very useful
APPENDIX F

STUDENT OPINION SURVEY
Student Opinion Survey

Directions: Please answer the following questions as honestly as possible using the scale below. Your responses will not impact your performance in science class in any way.

1 = Strongly Disagree   2 = Disagree   3 = Neutral   4 = Agree   5 = Strongly Agree

1. I have the ability to earn a passing grade (4 or higher) in science.
   1 2 3 4 5

2. I have the ability to earn a high grade (6 or 7) in science.
   1 2 3 4 5

3. I always study on my own time for tests and quizzes.
   1 2 3 4 5

4. I am good at studying and preparing for assessments in general.
   1 2 3 4 5

5. I am good at studying and preparing for assessments in science class.
   1 2 3 4 5

6. I understand which is expected of me on assessments in science class.
   1 2 3 4 5

7. Science in general interests me.
   1 2 3 4 5

8. I would consider studying science at the university level.
   1 2 3 4 5

9. I would consider a career in the sciences.
   1 2 3 4 5

10. The science teacher has a plan for what to complete each lesson.
11. The science teacher explains what is expected of me in a way that I understand.

12. The science teacher uses the entire class period to work on science related activities.

13. The science teacher appears to be prepared for the lesson each day.
APPENDIX G

STUDENT PERCEPTION INTERVIEW
Student Perception Interview

1. What are some strategies that you use to check your understanding of something that you read or study? For example, if you had to read a section in your book, how would you know if you understand it? Or, if you sat through a lesson, how do you know at the end of the hour if you understood the material?

2. Do you find science easy, medium or hard? What makes it so?

3. What do you think is the highest possible score you could earn in science? What is holding you back from a ______? Or, what skills do you possess that allow you to earn a 7?

4. What do you find difficult about tests in science?

5. What do you find difficult about lab reports?

6. What do you find difficult about projects in science?

7. Are you interested in science topics? Why or why not?

8. How structured and organized do you like a classroom to be? Think about use of time, arrangement of the desks, time doing activities, etc.

9. What about science class is organized well?

10. What about science class is not organized well?

11. Is there anything else you’d like me to know?
APPENDIX H

HISTORICAL ASSESSMENT DATA
Historical Assessment Data

<table>
<thead>
<tr>
<th>Criteria A and B</th>
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APPENDIX I

NOTEBOOK DATA SHEET
Notebook Data Sheet

Does the investigation __________________ have

1. The Date........................................................................................................Yes  No
2. A Title........................................................................................................Yes  No
3. A purpose question or statement..............................................................Yes  No
4. Data table(s)............................................................................................Yes  No
5. Labels for the columns and row (only fill out if # 4 is a Yes)...........Yes  No
6. Units for data collected when appropriate.............................................Yes  No
7. Quantitative Data....................................................................................Yes  No
8. Qualitative Data......................................................................................Yes  No
9. Pictures....................................................................................................Yes  No
10. Labels on the pictures (only fill out if #9 is YES).........................Yes  No

Count the number of questions you recorded during the investigation.

How many testable questions did you record?

How many researchable questions did you record?

How many other questions did you record? List the questions below and/or on the back.
APPENDIX J

EXAMPLE ENTRY FROM REFLECTION JOURNAL
Week of Oct 18

This week I have started a new tactic in how I’m recording information in my reflection journal at school. I was beginning to feel like I was recording similar things day after day and it was getting difficult for me to make good use out of my reflections. So now I am dividing my journal into quadrants based on the sub questions I’m trying to collect data on. For example, there is a section about my organization and another section on the questions my kids ask. I just started doing this midweek, but so far I like the organization of it. Now, I will be able to look at my reflections in a better way in terms of my capstone project instead of just reflecting on what I’m doing each day. It is helping me to focus my reflections and in turn it will hopefully help me focus my use of the notebooks.

Some of the big things I’ve noticed this week... My organization improved at the beginning of the year, but over the past 3 weeks I have not done a very good job keeping up with my science notebook (the one I keep for each class that plans what investigations my kids are doing). I was keeping a notebook with general examples of what my kids were doing, but I’ve let myself get lazy about it. I really like keeping these notebooks and I am going to get back to that. It helps me to think about what I want my kids to do and what they are doing.

My kids seem to be asking better questions in their notebooks, but I need to devise a better data collection tool to quantify this. My original plan was not going to work very well, so now I’m thinking of a new way. Originally, I was going to record information about the level of questions my kids asked based of Bloom’s taxonomy, but that would require a ton of prep work on my kids if I wanted them to tally that info themselves or a lot of time if I would tally it myself. Now, I think I am going to just record the number of testable and researchable questions they ask. I am going to choose 2ish investigations per unit to collect data on. My goal/hope is that the students begin to use these questions to improve their ability to design and analyze experiments. Most of my students have just completed their first formal lab write ups and now I am going to show my students how they can use the questions they’ve asked to help evaluate their investigations. For example, one class just did an experiment on the percent composition of sugar in chewing gum. The kids design their own experiment and write their own testable question and do the experiment. Most kids do the same thing which is to mass gum, chew it, and remass it to calculate the percent composition of the gum. Well, I give the kids two types of gum- a sugar-free gum and a regular gum. A lot of the kids ask questions like, why did the sugar-free gum lose mass? However, they do not use that question to evaluate their method... does the experiment really test the amount of sugar in the gum?

I feel like right now I’m at a definitive crossroads in my capstone project. My treatment started out great, but right now I’m at a point when it could go two ways. Either, the notebooks could become just another thing we’re doing in class, or they could continue to develop my students’ ability in science class. I’m going to work to continue formally planning how my students will use their notebooks and reorganize the data I’m going to collect to determine if the notebooks are beneficial.