THE EFFECTS OF TWO-COLUMN NOTES ON SCIENCE ASSESSMENT SCORES

by

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

of

Master of Science

in

Science Education

MONTANA STATE UNIVERSITY
Bozeman, Montana

July 2016

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ABSTRACT

This project examined the effects of two-column, teacher-guided notes on student assessment scores. It also measured the value that students placed on notes and if that value changed as study time and assessment results increased. The fundamental idea was that using notes as an organized study tool would improve both test scores and the value placed on notes.

Two high school science classes were used to conduct this study. All procedures and routines were kept similar between the two classes with the exception of one class using the two-column, teacher-guided note style. Students were led through four units of instruction and given quizzes, and pre and post unit tests. All assessments were in direct correlation with the material covered in the notes regardless of the note style used for each class. After each quiz and unit test students were asked to take surveys to share their opinions on the helpfulness of the notes. The surveys also measured the amount of study time each student used to prepare for assessments.

Calculating the improvement on assessments for each student showed that there was not a strong correlation between the two-column note style and unit assessment scores. Quiz scores throughout the four units were eight percent higher for the Implementation Class and showed that the two-column notes helped keep students current on the unit content. A final survey determined that student motivation and lower semester goals had a significant impact on student performance and preparation for assessments.

INTRODUCTION AND BACKGROUND

There is a great deal of emphasis placed on testing and test scores in academics. The activities, labs and lectures leading up to these assessments are meant to prepare and instruct students in a way that should make them successful at the end of each unit and ultimately each semester. I often observed students producing test scores that did not represent what I believed to be their current level of understanding.

In an attempt to increase understanding of the content and in turn increase assessment scores I looked toward improving study skills through teacher-guided, note-taking strategies to help students prepare for and take assessments. I wanted to determine the effect of this two-column note system on student test performance. In order to do this I implemented a modified-Cornell note-taking style and coached students through using it to prepare for quizzes and tests. I tried to establish a pattern in which students received content information, reviewed that information in condensed study sessions and finally demonstrated mastery of those concepts through summative assessments.

I worked with students from Shawnee Mission West Senior High School. Shawnee Mission West is part of the Shawnee Mission School District and is located in Overland Park, KS. It enrolls students from the cities of Overland Park and Lenexa. The high school was founded in 1962 and had a current student enrollment of 1,847 at the time of this study. The student body was comprised of ninth grade through twelfth grade. The demographics of the area shifted over a five-year period with the most notable change being an increase in the number of students on free and reduced lunch.

That percentage jumped from around 20% in 2008 to over 40% in 2014 according to data generated by SMSD.org and information shared with staff through professional development opportunities.

I worked with 2 classes consisting of 56 total students. Across both classes 66% of the students were male and 34% were female. A majority of the students in the study were Caucasian (52%) with 28% African-American students and 20% Hispanic students. A total of five students had Individual Education Programs providing them with accommodations and modifications to the content and testing procedures of the class. These students did not have a paraprofessional attend class with them; however, all five of them did have access to special education resources upon request. The Implementation Class and the Comparison Class both had a similar distribution of demographics aside from small differences in Special Education students and African-American students (Table 1).

Table 1
Class Demographics (*N*=56).

	Comparison Class	Implementation Class
Male	19	18
Female	9	10
Caucasian	17	12
Hispanic	5	6
African-American	1	8
Multi-Ethnic	5	2
Special Education (IEP)	4	1

I had a great deal of contact with all students during class time. I took advantage of this time by guiding them through the process of effective note-taking. I reviewed their notes periodically to ensure that they were reviewing information that was organized and valid. However, in order to obtain the desired result of increasing test scores and understanding of the material, students needed to assume more responsibility outside of the classroom. They were expected to put in study time at home in the form of chunked and manageable study segments. The primary focus was to determine the effect of two-column notes on student assessment scores. Alongside this question the secondary focus was to measure how closely students followed the prescribed study schedule and if that influenced test and quiz scores. I also measured how assessment results contributed to students' views of the value of their notes.

CONCEPTUAL FRAMEWORK

Rachel White (2012) conducted an action research study that examined the effect of different note-taking styles on student understanding. Her study focused on ninth grade science students. The approach that she chose utilized three different note-taking styles. Students were allowed to generate their own notes with minimal direction from the teacher as to what should be recorded and how it should be organized. White also created partial notes, which consisted of teacher-generated notes printed on paper with portions removed. The understanding was that students would follow along and fill in the missing portions. The third style of notes used in the study was a guided note style. Students created these notes under the direction of the

teacher. The three note styles were implemented in phases and short quizzes were administered to measure the effect of each style. White (2012) discovered that the student generated notes and the partial notes were less effective than the teacher-guided notes when it came to performing well on the quizzes. The guided notes gave the teacher an opportunity to not only convey lesson material, but to help with the organization of written information.

Also to be considered is the effect that note-taking and concept mapping can have on student recall (Arslan, 2006). Notes can be helpful when conveying information in a single class. However, improving recall during test time requires more than simply writing down the notes. Arslan (2006) conducted a study to show that notes served student memory better than concept mapping. Three groups were created to evaluate the effects of both. The first group was a control group, which did not receive any special instruction. The second group was guided in concept mapping, and the third group used a note-taking matrix. The concept mapping and note matrix groups all received teacher input on how to use each respective technique. All three groups were evaluated after four weeks, and the note matrix group outperformed the other groups. These studies indicate that students require teacher interaction not only for content material, but also for the organization of notes and how to use those notes to prepare for tests. These studies also point to the need for a uniform note style as well as teacher-guided implementation.

Donohoo (2010) focused on the implementation of Cornell notes in a science classroom. This two-column note style helps students summarize information, and

focus on key words and questions. According to Donohoo this process is best done through explicit instruction on how to write Cornell notes until students are able to master the technique on their own. He concluded that the involvement of the teacher is crucial during the beginning of this process in the classroom.

Note-taking is simply a means to an end. A true assessment should result in a score that represents what a student knows, and in order for a note-taking style to aid in test preparation it should be organized and clear (Rotter, 2009). The delivery of information to students, as well as their method for recording that information, should be familiar and systematic. Eventually less time should be spent on students figuring out how to write notes, and more time should be afforded to pondering and digesting the presented material. It is a process for students to become comfortable with a unified note-taking strategy. However, as long as it is organized, practiced and methodical it can become useful (Rotter, 2009).

If notes prepare a student for assessments then the assessments should be of the highest quality. There is little benefit in developing and implementing a means by which all students organize and study the material only to assess their understanding using less than stellar assessment methods (Martin & Itter, 2013). The correlation between note-taking style and assessment format are vital. Students must see a direct link between their organized, written notes and the assessment questions. Only then will the assessment truly check a student's level of mastery.

The format of two-column notes supports the structure of the unit assessment. Each question on an assessment should correspond to a specific section in the student

notes. Nothing is recorded on paper without first knowing how and where to apply that knowledge. This provides a clear framework for the major assessment questions. This setup also allows for students to use their notes as a study tool to prepare for formative and summative assessments. Two-column notes contain questions and major topics on the left side of each page. These guiding questions and topics correlate to the major concepts on each assessment (Donohoo, 2010).

Checking for student understanding needs to be a frequent occurrence. It should also be varied enough to accommodate students that demonstrate understanding in various ways (Hunter et al., 2010). There are benefits to using formative assessments during the note-taking process. As students are contemplating a new idea or process a quick check for understanding can guide a teacher in knowing how quickly to move through discussion topics and when to provide additional examples or help. Internet-based clicker systems and software allow for teachers and students alike to receive immediate feedback on how new information is being received (Benfield & Szlemko, 2006). The Internet provides a means by which large amounts of information can be collected and organized automatically. More time can then be spent analyzing data and less on processing and data entry (Benfield & Szlemko, 2006).

King (1992) notes that a student's ability to self-question and analyze their own notes develops from frequent reviews of organized note-taking. Simply reviewing or looking over notes does not promote memory recall as effectively as summarizing lecture notes, and neither method works as well as self-questioning. If students attempt to create questions and answer questions that are directly linked to material in their

notes they are more likely to recall that information in the future (King, 1992).

Socrative.com and Kahoot can be used to collect data on student understanding. Both of these web-based survey sites allow for questions to be quickly administered and answered. They automatically organize the results by class and by student. A breakdown of class performance can be viewed based on a single question or an entire quiz. The results can also be shared with students to help them gain confidence as they master the material (Hunter et al., 2010)

Although the internet-based data collection has many benefits there is a valuable source of qualitative data in body language and word choice that might not show up on a survey (Onwuegbozie et al., 2010). Student interviews provide a chance to reiterate the benefits of the two-column notes and even take a first-hand look at the quality of notes that students are generating (Onwuegbozie et al., 2010).

Bicak (2013) points out that using notes after the initial time of recording will increase a student's ability to perform well on an assessment. Telling students to simply study their notes, but not giving them guidance on how to do that or how often can leave a student overwhelmed and uncertain as to how to proceed. One such form of guidance includes chunking of organized information. These chunks can then be reviewed on a regular basis to help solidify the concepts in a student's mind.

Climenhaga (2011) provides an insight into how at-risk students benefit from teacher-guided notes. Not all students will resist a structured delivery of new information. They actually thrive given the ability to focus on the material and worry less about how their paper looks or how to organize their thoughts.

Steele (2006) suggests that students with disabilities and those who need modifications benefit from having some sort of visual representation of how the material should be laid out. When two-column notes are used a flow chart of information can be quickly generated. Then all written material can be tied back to an initial question. All of these initial questions can be represented in the guided notes. This way students make logical connections between what they already know and what they need to study. This also cuts down on the time required to effectively study before tests and quizzes. By simply folding the notes along the column break students are able to quiz themselves about each essential question and narrow down their focus each night at home.

Ultimately students benefit from the organization and validity of quality information recorded in a way that is easy to review. Teacher-guided notes allow the content to be the focus. This way students spend more time contemplating the material and self-questioning, rather than struggling with how to organize the information from each class. By structuring notes in a way that highlights the major assessment questions and topics, a clear correlation can be drawn between unit information and tests. Not only does student understanding increase, but also the increased understanding is measurable through assessment scores.

METHODOLOGY

My Capstone project focused on the effects of two-column, teacher-guided notes on student assessment scores in Global Issues. I also considered students' attitudes toward note-taking and studying outside of class. I hoped to find out how students' opinions about note-taking were influenced by their unit assessment results.

Class Setup

This study was conducted in the Shawnee Mission School District. I worked with two sections of a one-semester, junior/senior Global Issues class that was offered to students as a science elective. The methodology for this project was in compliance with the standards set forth by the Montana State University's Institutional Review Board and compliance for working with human subjects was maintained (Appendix A).

The project covered an 11-week period of time and consisted of 4 units (Table 1). Unit one was an introductory, baseline section lasting three weeks and consisted of a study of global population growth. The Comparison Class was comprised of students who completed laboratory and written assignments without teacher-guided notes. They were prompted to study for all quizzes and an in-class review was held before the unit one test. All students received a study schedule consisting of small chunks of the material to study each night. The expectation was that five to ten minutes of studying each night would be sufficient time to review the notes and prepare for each quiz. This pattern was consistent with my normal teaching style, procedures and routines. I made an effort to keep this structure the same for all four units. The students in the Implementation Class created teacher-guided notes using a two-column format (Appendix B) linking important information to summary questions and statements. During all four units the only difference between the two classes was the note-taking style.

Table 2
Project Timetable

	Duration	Major Topics	Unique Implementation
Unit 1	3 Weeks	Global Population Growth	Study Schedule
Unit 2	3 Weeks	Agriculture and Food Production	Guided Notes Study Schedule
Unit 3	3 Weeks	Genetic Engineering	Guided Notes Study Schedule
Unit 4	2 Weeks	Cloning	Guided Notes Study Schedule

The second unit also lasted three weeks. The material during this period shifted to the study of food production. Students were expected to learn how agriculture has changed throughout history and how their own food habits influence food production. Classes were instructed in a manner consistent with unit one; however, the Implementation Class was given less time and fewer prompts to create their two-column notes. These same students were expected to use the two-column, note-taking style to organize all content information presented to them. Both classes still received prompts as to when to study for quizzes, and all students were expected to use their class notes as a study tool for these quizzes. During the in-class review session for the unit tests students were able to use their notes in order to draw connections between the notes and the test material. Prior to each quiz and unit test I coached students regarding which sections of the notes to review and approximately how many minutes of studying were recommended. Much of the focus of this unit was on helping students in the Implementation Class to master the note-taking techniques and how to use the notes effectively for independent study.

The third unit followed a similar pattern to the first two units. Students in the Implementation Class were expected to be proficient in the two-column note style by this time, and needed minimal prompts regarding what to study and when to study it. The third unit covered genetic engineering and highlighted the practical and theoretical applications as well as ethical issues that arise from genetic engineering. Both classes began to formulate their own opinions on these issues and gather support for their views. Note-taking during this unit was administered in a manner similar to unit two. However, much less time was devoted to instructing students on the two-column note structure. This afforded me more class time to focus on the delivery of content material.

Unit four was not part of the original implementation plan. I wanted to conclude research after three units, and I felt this would provide enough data to uncover correlations between the note style and assessment scores. Yet, during unit three an illness required me to be absent for six school days. Using substitute teachers and Google Classroom as a digital platform I was able to finish the third unit in a timely manner. I decided to run a fourth unit as a precaution, considering my absence might have an unforeseen effect on unit scores or the quality of notes taken. Unit four covered the topic of cloning. The curriculum focused on types of cloning and showed students the current uses for each technique. Students also learned which theoretical applications are on the horizon. This is consistent with the normal progression of topics for this class, so collecting data for one additional unit was not a significant adjustment for me or for the students.

Using Two-Column Notes

All students in the Implementation Class were encouraged to use the two-column notes regardless of their experience with them from past classes. Each piece of information for these four units was directly tied to a summary question. Each summary question was placed in the left-column of the notes, and the information answering that specific question was written in the right column. This effectively organized the entire unit into manageable chunks that could easily be reviewed and studied in short amounts of time. The summary questions in the left-column coincided with major topics represented on the unit test. Each time a student reviewed the notes they were receiving individual practice on mock test questions. Notes were collected on the day of each quiz and test to assess if students were using the correct format and to gauge the accuracy of their work. These spot checks were quick in order to minimize the amount of time that the notes were in my possession. I filled out a note check sheet (Appendix C) for all students, scoring their notes on a 20-point scale. The criteria for the note check included clearly identified topics, organization, neatness, use of left-column and completeness.

Each summary question contained in the left-column of the two-column notes corresponded to a topic on the quiz. Quizzes were administered online using Socrative.com. This online survey site allowed for students to receive immediate feedback on each response to the quiz. Socrative.com also compiled data results quickly and in an organized manner. Immediately following each quiz I led a discussion on the correct answers and retaught a concept if necessary. I used this discussion time to point out each section of the notes that contained the information connected to the correct answer for each quiz question.

Instruments

All four units started with a pre-test to determine each student's introductory knowledge of the subject matter. These pre-tests were administered using paper answer sheets from ZipGrade.com. Each student quiz was then scanned and an item analysis was created automatically by the ZipGrade app. Each unit test (Appendices D, E, F and G) at the end of a three-week window served as a post-assessment. These unit tests were also administered using the ZipGrade app, and results were compared to the pre-test scores for each student. Hake's method of normalized gain was used to determine the degree of improvement. This method attempts to compare what a student has learned to what that student could have learned. This is accomplished by normalizing the increase from a pre-test to a post-test for all students (Hake, 1998). By keeping as many factors consistent as possible between both classes any differences that were seen in gain scores could be attributed to the use of two-column notes.

At the end of each unit students in both classes received their unit test results and participated in a unit assessment results survey (Appendix H). Each survey consisted of open-ended questions used to capture students' attitudes towards note-taking, two-column notes, and structured study time. These surveys were short and clearly worded to encourage student honesty and participation. A different online survey was given after each quiz and unit test (Appendices I, J). An additional goal of each survey was to estimate how closely each student followed the prescribed study schedule, and how much time was spent studying the two-column notes or normal class notes. I searched the responses for common themes that represented student attitudes.

Similar responses were grouped and summarized using pie charts.

Once the results of the online surveys were compiled and analyzed I conducted student interviews (Appendix K) with a selection of students from both classes. I selected students who represented each of the discovered attitude groups. The goal was to interview enough students to represent those who liked the notes, those who disliked them and those who were impartial. Interview groups for unit three and four included two further subgroups, students who were amiable toward the proposed note style, but performed below expectation on quiz and unit assessments, and students who resisted the proposed note style, and performed well on quiz and unit assessment. Student interviews were held in class and were kept brief. This allowed me to visit with students in person, and to keep a teacher journal of their responses. I played to the strengths of interviewing by paying attention to body language and what a student was communicating through unspoken words (Onwuegbozie et al., 2010). Student responses were audio recorded and reviewed at a later date. The purpose of the online survey was to determine students' attitudes towards the note-taking process and how useful they felt their notes were in preparing for tests.

The interview consisted of open-response questions. This format gave me an opportunity to ask follow up questions for clarification and a deeper understanding of student opinions (Mills, 2014). Following each interview I briefly reflected on the student responses and body language and recorded my initial impressions in a teacher journal (Appendix L). Student responses from each interview were coded and sorted for commonality. I searched for themes between students in relation to their use of the

guided-notes and their opinions as to how useful the notes were on the assessments. The goal was to determine if student responses to interview questions were consistent with patterns found in pre-test and post-test data.

Table 2 provides a summary of the data collection strategies that were used in this project in connection with the research questions that I sought to answer. Using the outlined data collection strategies produced multiple sources of data addressing each research question. I planned for each strategy to overlap with one another in order to balance the strengths and weaknesses of each approach.

Table 3
Data Triangulation Matrix

Focus Question	Data Source 1	Data Source 2	Data Source 3
Primary Question Effect of Two-column, Guided Notes on Assessment Scores	Pre- and Post Unit Assessments Normalized Gains	Weekly Online Quizzes	Weekly Note Checks
Sub-Question 1 Effect of Structured Study Schedule on Assessment Scores	Post Quiz Survey	Weekly Online Quizzes	Unit Assessment Results Survey
Sub-Question 2 How Assessment Results Influence Student Attitudes Toward Notes	Unit Assessment Results Survey Post Quiz Survey	Student Interviews	Teacher Journal

DATA AND ANALYSIS

Collecting data on both the Comparison Class and the Implementation Class produced a vast amount of data. Certain data collection instruments were designed to grasp information intended to address multiple research questions. For example, a Unit Assessment Results Survey asked students to comment on the total amount of time spent

studying their class notes for a given unit and also on the likelihood of them using similar class notes in another class. The information from these surveys was broken down and organized based on the research question to which it applied. The primary focus was still to determine what effect, if any, the two-column note style had on quiz and unit test scores. Most of the information used to examine this possible correlation came in the form of quantitative data, which was relatively simple to manipulate and analyze.

Sub-question one was an attempt to measure if the structured study time with class notes had any effect on assessment scores as well. I used student quiz scores and Post Quiz Surveys to try and find a connection between these two variables. My initial work with these data consisted of looking for trends in student quiz scores from unit to unit that might match the trends in the amount of time spent studying their notes. Student responses were initially color-coded depending on an increase, decrease, consistent, or varied amount of study time. The same color coding and descriptive themes were used to analyze the trends in quiz and assessment scores.

Sub-question two was not as quantifiable as the other data sets. The focus for this question was to measure how students' attitudes toward their notes might be connected to their assessment scores. After each quiz and unit test students were asked to comment on how valuable their notes were in preparing them for the assessments. My aim was to watch for changes in their opinions toward the notes and to try and find a reason for those changes. Given the nature of this type of data I used the surveys as a starting-off point and followed up with student interviews and comments in a teacher journal to try and capture an accurate assessment of each student's attitude about the value of the notes.

Primary Question – Effect of Guided-Notes on Assessment Scores

My main source of data for this primary question came from pre-test and post-test data. Each student was given a pre-test on the first day of each of the four units prior to the delivery of any of the subject matter. Completion of the pre-tests was relatively high throughout the semester with 95% participation in the Comparison Class and 86% participation in the Implementation Class. Student data were omitted from an individual unit if either the pre-test or the post-test was not completed for that section. I calculated percent normalized gains for each student and compared class averages between the two classes.

The Comparison Class showed a drastic increase in average percent normalized gains from the unit one test to the unit two test (Figure 1). There was a noticeable drop in performance for units three and four with the highest average percent normalized gains (74.3%) coming from the unit two test. The Implementation Class showed a similar increase in gains from unit one to unit two. However, after a drop in class average for unit three the highest average percent normalized gain was reached on the unit four test with 78.5%. A comparison of the gains from the Comparison Class to those of the Implementation Class showed that gains were consistently higher in the Comparison Class. Both classes followed the same trend in average percent normalized gain scores across all four units represented by an increase after unit test one, a decrease on unit test three and a rebound on unit test four. The Comparison Class (20%, 73%, 59%, 69%) also demonstrated average percent normalized gain scores with smaller standard deviations and left-skewed data. The Implementation Class (20%, 69%, 55%, 78%) produced

average percent normalized gain scores with much larger standard deviations and went well below the origin on unit test one and unit test three.

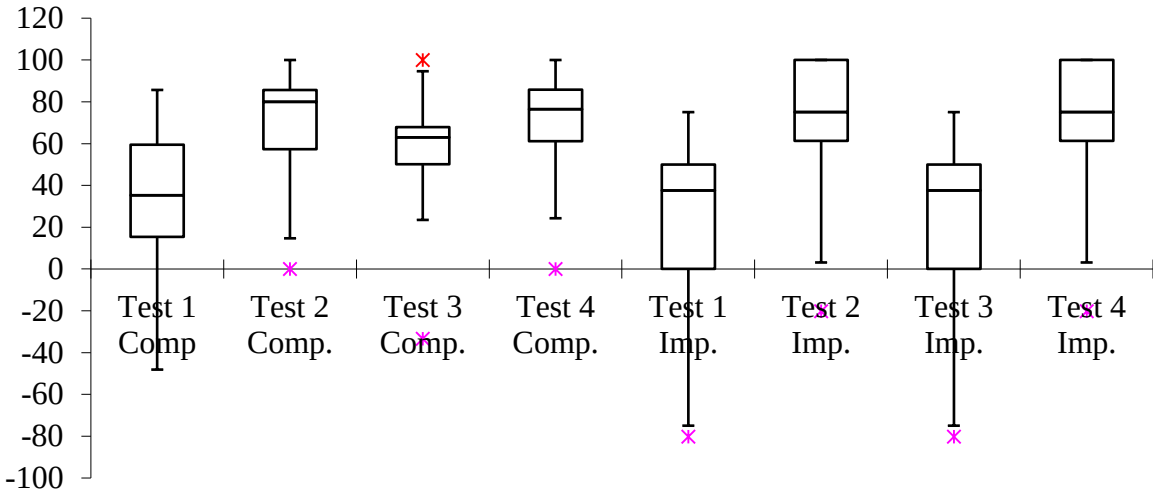


Figure 1. Percent normalized gains for Comparison and Implementation classes, (*N*=55). *Note*. Minimum score of -300 removed from Test 1 Comp.

The unit quizzes were meant to be a formative assessment to give some indication of what could be expected for the unit assessment. My biggest interest in an individual's quiz scores was to see if there was a discernable trend throughout the semester and if the quiz scores improved due to the type of notes taken and how much time was spent studying those notes. The first indicator between the two classes was the fact that the class average quiz score was quite different with an average of 67% for the Comparison Class and 80% for the Implementation Class. I then looked at the collective quiz scores for each individual student and determined if they demonstrated an increasing, decreasing, consistent, or varied trend (Figure 2).

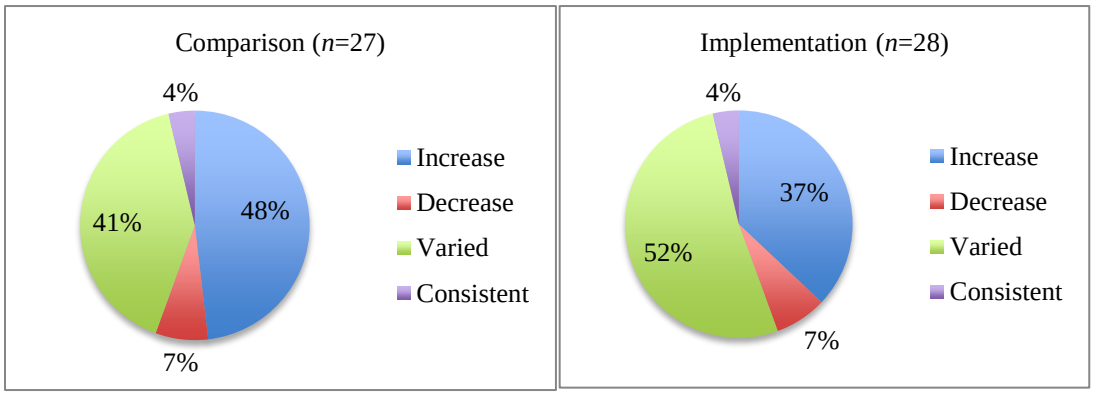


Figure 2. Semester quiz score trends, (*N*=55).

The third piece to the puzzle for this primary question had to do with the quality of notes for each student. Every time a quiz was given or a unit test administered I collected student notes. Each set of notes was scored on a 20-point scale. For the Implementation Class the scale consisted of points for a clearly identified topic, implementation of the left-column, summary statement and completeness. Since the Comparison Class was not expected to use a two-column note format the 20-point scale consisted of points for identified topic, organization, neatness and completeness. The students in the Comparison Class turned in notes for note checks 55.2% of the time compared to 82.6% of the time for the Implementation Class. The average score for student notes in the Implementation Class was 14.2 on the 20-point scale and for the Comparison Class it was 11.5 on the same scale.

Figure 3 and Figure 4 show scatter plots for both classes, which incorporate the average quiz score for each student compared to each student's score from note checks. The Implementation Class shows data with less spread and a stronger grouping towards the upper right of the scatter plot representing a stronger connection between students' quiz scores and note scores. Student data were removed if either the average quiz score or

average note score was a zero due not participating. There was one student in the Comparison Class who never turned in notes, but did score zero on the quizzes taken.

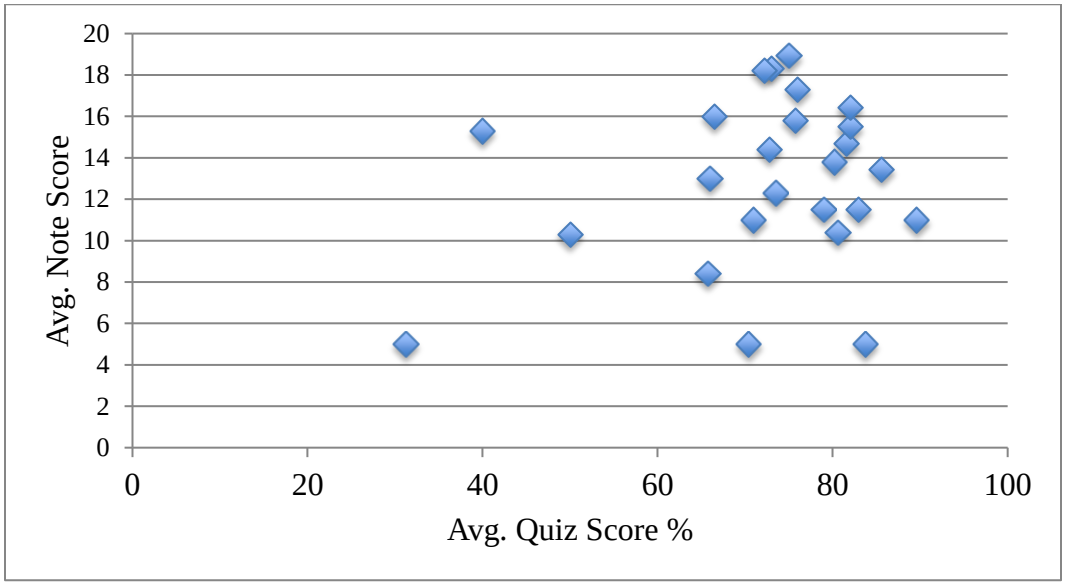


Figure 3. Average quiz score vs. average note score for Comparison Class, (*n*=25).

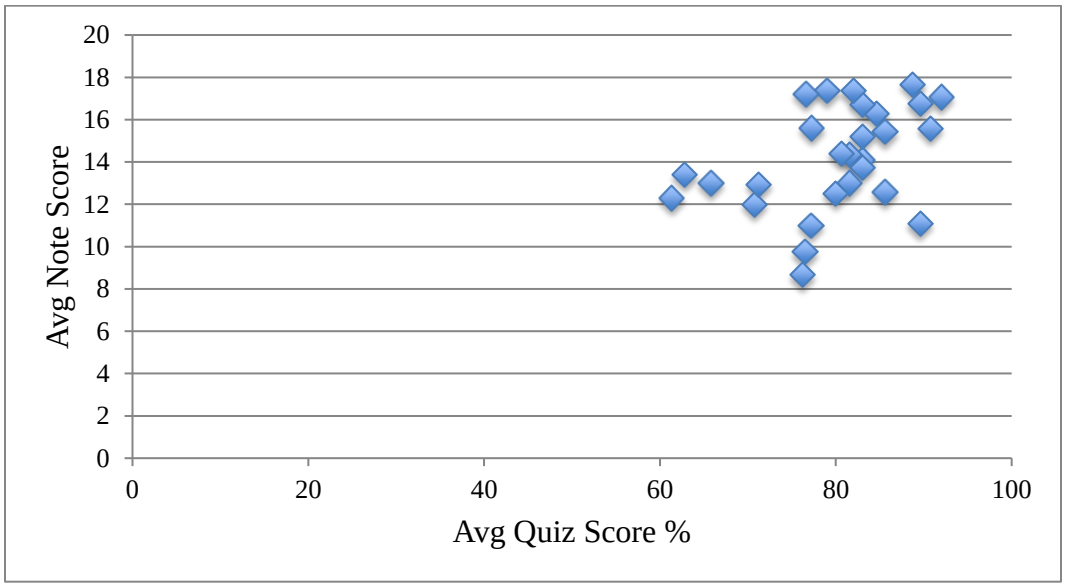


Figure 4. Average quiz score vs. average note score for Implementation Class, (*n*=28).

Sub-Question 1 - Effect of Structured Study Schedule on Assessment Scores

Once I examined the quality of students' notes I wanted to determine if there was a connection between the amounts of time spent studying the notes and the quiz scores. I used the same quiz score data collected for the primary research question and compared it to information gathered from Post Quiz and Post Unit Surveys. Each of these online surveys was given immediately following each quiz and test. Students were asked to reflect on how many minutes they spent studying their notes in preparation for the assessments. They were encouraged to spend five to ten minutes studying their notes outside of class each time we took notes in class. This would equate to about 10 to 20 minutes of studying each week and 30 to 60 minutes of studying for each unit. For the Comparison Class there did not seem to be many connections between the trend of study time throughout the semester and the trend in quiz scores, so I compared each student's average quiz score with their total amount of study time. Figure 5 shows this information with no strong correlation, as the line of best fit is almost perfectly horizontal. The scatter plot for the Implementation Class shows a very slightly positive correlation, which is not statistically significant (Figure 6).

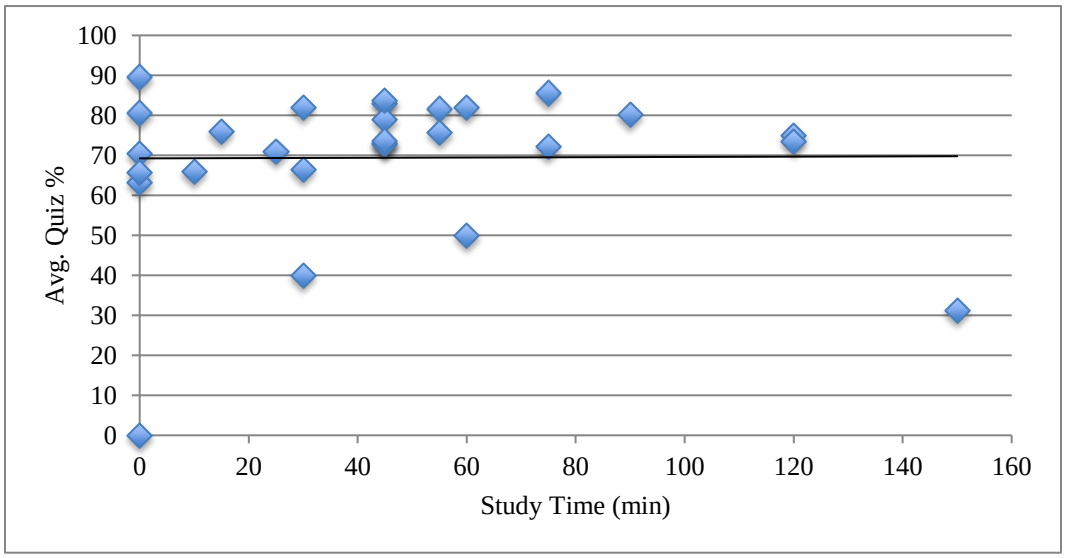


Figure 5. Average quiz score percentage vs. study time in minutes for Comparison Class, (*n*=25).

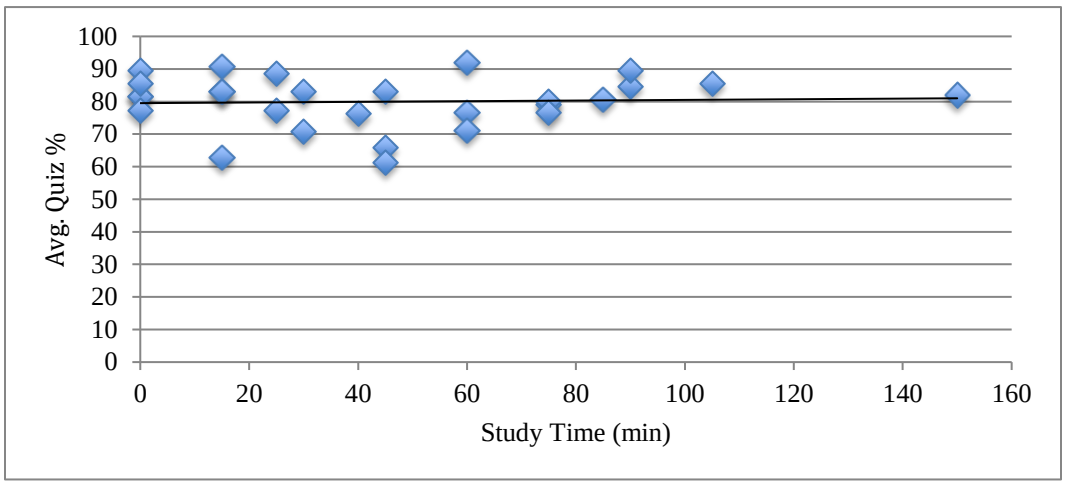


Figure 6. Average quiz score % vs. study time in minutes for Implementation Class, (*n*=27).

Neither class shows a strong positive correlation between quiz scores and study time. The correlation coefficient for the Comparison Class and the Implementation Class was 0.008 and 0.05 respectively. I then tested the correlation between study time and

average percent normalized gain scores from the pretest/posttest analysis for each student. Figure 7 and Figure 8 show that both classes demonstrate a positive correlation, however the correlation coefficient for the Comparison Class was 0.39 and the Implementation Class was 0.22.

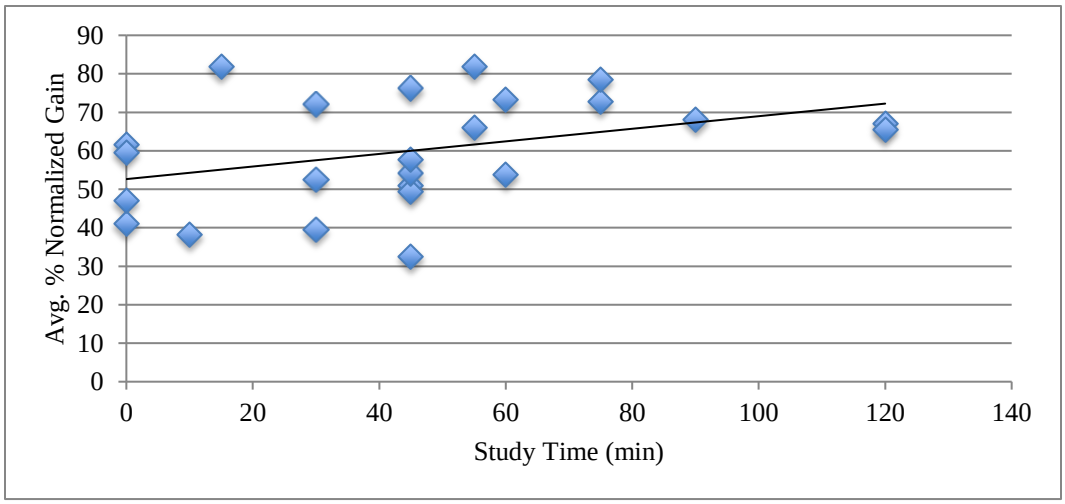


Figure 7. Average pretest/posttest percent normalized gains vs. study time in minutes for Comparison Class, (*n*=24).

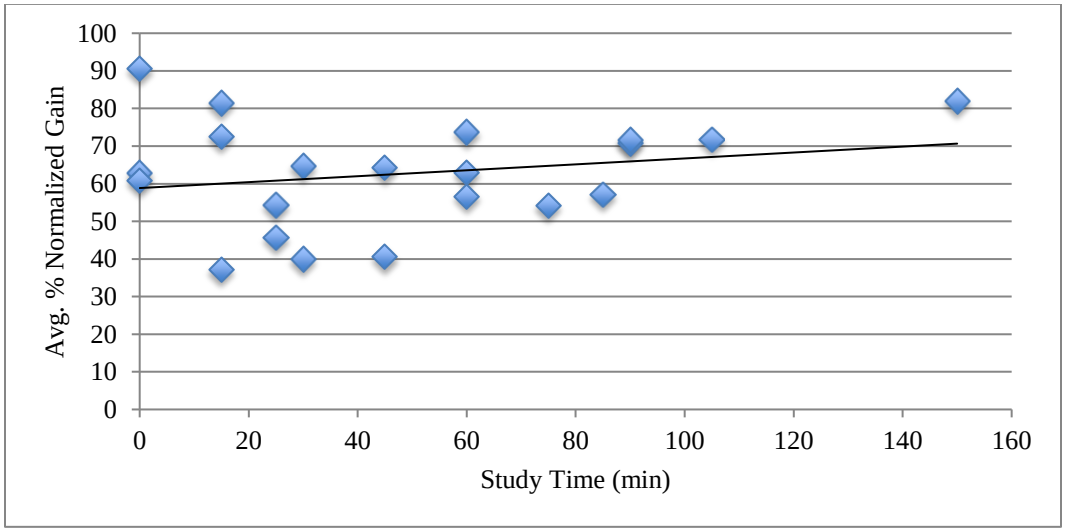


Figure 8. Average pretest/posttest percent normalized gains vs. study time in minutes for Implementation Class, (*n*=21).

Sub-Question 2 - How Assessment Results Influence Student Attitudes Toward Notes

Sub-question two posed a trickier challenge than the previous two research questions. There is always the challenge of getting accurate reporting from students even when they want to be honest and participate. However, the Post Unit Online Student Survey and the Unit Assessment Results Survey both attempted to capture students' attitudes toward their notes. More importantly I wanted to see if students would place different value on their notes based on how well they did on quizzes and tests. In order to accomplish that I administered these surveys immediately following a unit test and immediately following the class period when assessment results were made known to students. Across all four units I tried to identify students that had a discernable trend in how they viewed their notes. Figure 9 shows how the comparison class fell across themes of improving value, decreasing value, consistent value and varied. The Implementation Class showed a much more even distribution of opinion in the categories of improving, declining and varied with a similar percentage of consistent value placed on notes.

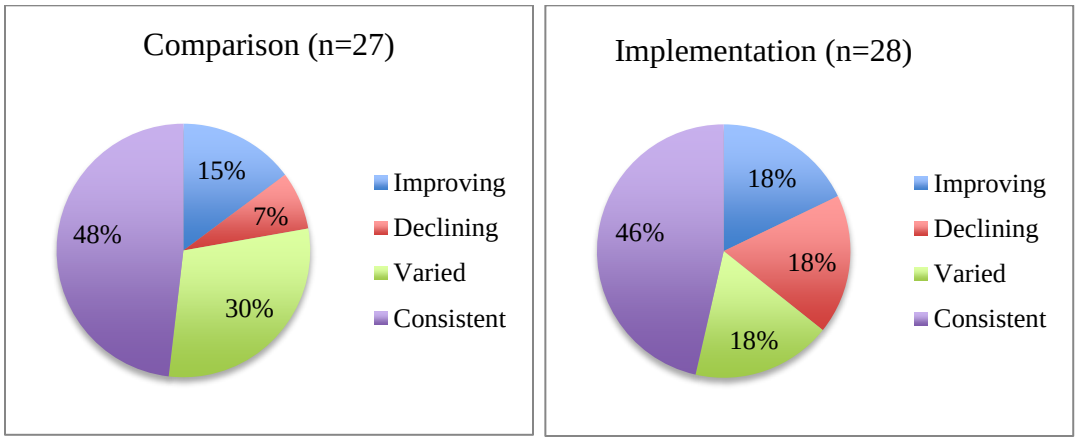


Figure 9. Trend in student attitudes toward notes, (*N*=55).

Student interviews were conducted in a way that would allow both classes to expound on their survey results. None of the students in either class reached a study time equal to that expected for all four units. However, student interviews relevealed that very few students were willing to voice an open dislike for note taking. From a sample of 57 students only 5 of them communicated any statement suggesting they found notes generally unhelpful. One student in the Implementation Class let me know on the first official day of research that she would not do two-column notes beause, “they just don’t work for me and I don’t learn that way.” Even in Unit Assessment Results Surveys students were given a chance to provide open-ended feedback and it was common to find statements that reflected a desire to be better about taking notes rather than a claim that their notes failed them.

There were some differences in how I conducted interviews between the two classes. For example the Comparison Class was not taught how to take two-column notes, so my line of questioning referred to notes in general. The students interviewed did express appreciation for the strong connection between the information provided for notes and the quiz and test questions. In the Implementation Class I was able to ask interview questions specifically about the two-column note style. By the conclusion of the fourth unit 59% of the students in the Implementation Class stated that they would be willing to use this note style in other classes. This percentage dropped from earlier in the semester when 70% of students in this class expressed a willingness to use two-column notes in other classes.

The individuals in the Comparison Class were asked in interviews to comment on how helpful their notes were. From those that participated in the last interview 65% found their notes to be at least a little helpful in preparing for the unit test. This percentage did not vary much from the first unit when 67% of those interviewed said their notes were a helpful study tool.

In the interview I was able to ask all students what they found most difficult about the two-column note style. There were two common threads throughout most of the responses. The first was a concern with the summary statements at the bottom of the notes. Very few students (11%) of the implementation class would take the time to go back and write a summary statement from the main topics of the day. Even those who completed the summary were not completely convinced of its usefulness. The second concern was the time and effort it took to go back and formulate the prompts and questions for the left-column. The left-column was one of the fundamental differences between two-column notes and many other note styles. It was also an essential element to using the notes as an effective study tool. Forming these questions and prompts was a difficulty for 46% of those interviewed.

INTERPRETATION AND CONCLUSION

I will admit that prior to starting this research project I made the assumption that any teacher-guided note system would benefit students in the form of elevated test scores. I also considered that a two-column note style would cut down on study time and be a motivation for students to study more frequently, albeit for shorter periods of time. Looking at the data and the trends that emerged there are patterns and answers to the

primary and secondary research questions, however, these answers are not what I initially expected.

Primary Question – Effect of Guided-Notes on Assessment Scores

I was surprised and a little disappointed that there was not a greater difference in the percent normalized gains between both classes. I made every effort to keep class procedures and routines perfectly similar, but there are always some uncontrollable factors. The Comparison Class had consistently higher percent normalized gain scores throughout the first three units when compared to the Implementation Class. It was not until unit four that the Implementation Class finally had higher percent normalized gains. Even class average scores on unit tests were higher for the Comparison Class. This left me with two of many new questions: *Do two-column notes have a negative effect on assessment scores? Could it be that requiring students to take notes in a new or more structured way actually turns them off to learning and hinders performance on assessments?* The trend of percent normalized gains suggests otherwise. During the third unit of instruction I became very ill, and was forced to use internet resources such as Google Classroom to maintain a flow of material for students. I left extensive instructions for the substitute teachers, but my absence of six school days clearly had an effect on student learning. Percent normalized gain scores dropped from the 70s for unit two down into the 50s. I do feel that I regained momentum in unit four and with an uninterrupted routine percent normalized gain scores increased once again.

Perhaps the most telling effect of the two-column notes on assessment scores showed up in quiz scores. By chunking information in manageable segments students that

use two-column notes seem to benefit simply by writing down the information. The average quiz score in the Implementation Class was nearly 13% higher than the average quiz score in the Comparison Class. Perhaps students in the comparison class were not looking at their notes as frequently, but put in the time to learn the material before the unit test. Again, the elevated quiz scores for the Implementation Class is encouraging, but not a strong enough argument to conclusively say that the note style alone had a significant effect on assessment scores.

Sub-Question 1 - Effect of Structured Study Schedule on Assessment Scores

The optimist in me assumed that if students were provided with a study tool that was aligned with quizzes and tests they would almost instinctively put time and effort into studying their notes. As seen from the data section there was not a single student from either class who followed the prescribed study prompts for any of the four units. Some expressed that simply taking notes in class is enough for them to retain the unit information. These students had the lowest study times, and even showed a decreasing trend in study time across all four units. However, these same students also demonstrated proficient unit tests scores. Many of these types of students have learned how to process and retain information at a level sufficient for success in high school. I did have a few of these students in the implementation class who still took two-column notes simply because they wanted to please the teacher and because the notes were being collected and scored. I explained to all students that the scores on note checks would not affect their academic grade, but some are pleasers and did not want any low score associated with their name.

Once again the quiz scores were the only real support that the two-column notes had a positive effect on assessment scores. Although none of the students studied as much as the study schedule recommended, the study time must have been more useful for the Implementation Class given their higher quiz scores. On a related note, the online quizzes were setup to review the correct answer for each question immediately after a student submitted a response. This might explain why some students in the comparison class scored lower on quizzes, but higher on unit tests. They could have been using the quizzes as a learning tool and a review strategy for tests, rather than treating them as individual formative assessments.

In general I still recommend that my students study for shorter periods of time, but more frequently than I suspect they do now. Large amounts of information can be challenging to retain long-term if crammed in at the last minute. Perhaps the next set of data to collect will be how well these students do on the final exam. If the Comparison Class scored well on unit tests by cramming information at the last minute and the Implementation Class studied in smaller, more frequent chunks then the results of the final should be very telling.

Sub-Question 2 - How Assessment Results Influence Student Attitudes Toward Notes

This was by far the most challenging question for me to answer through this research. I found it difficult to cut through a student's desire to tell me what I wanted to hear. I worried every time I sent out a survey that by asking students to reveal their names with their responses I would receive biased responses. However, a student interview also presents a similar challenge by putting a student face-to-face with a teacher. I could sense

from time to time that students were searching out a response that they thought I wanted to hear. I tried to explain over and over that I was not jumping on board with two-column notes until I saw data that supported it, but many interviews still consisted of genuine admiration for how we were using the notes in class. One factor that I discovered on the last two note checks was that only about 10% of the notes submitted had a crease down the column line, signifying that the notes had been folded and used as a study tool like I had suggested. I suppose that some might have simply covered up the right-column of the notes rather than fold them, but I could not tell that from just a glance at the paper.

I was pleasantly surprised that the note check scores were considerably higher for the Implementation Class. Note scores on average were 15% higher for the Implementation Class suggesting that regardless of how they planned on using the two-column notes they took pride in writing them down and sticking to the format rather closely. Without giving any instruction in the Comparison Class regarding how to take notes the most common result was a stream of bullet points with no organization or structure. When I interviewed these students I asked them how they used their notes to study and many of them said something similar to, “I just look over them.” What choice does a student have when they have simply recorded facts without any essential questions or organization?

Ultimately I determined that teaching how to take notes and showing students that it doesn’t take much extra time to organize instructional information in a useful way results in higher quality notes. Perhaps these students did not see the effects of their notes

in their unit test scores, but in general they did continue to use the two-column format throughout all four units.

VALUE

It was important to me going into this research that I stay unbiased. I did not wish to do research on a teacher technique that I already used in the classroom. I feared that my preconceived notions might cause me to steer the results one way or the other. I had made up my mind that if the data did not conclusively support the use of two-column notes I would be willing to abandon the idea or at the very least start over with a new research focus. At the end of the fourth unit I still found myself a little discouraged that my efforts to teach two-column note taking was not showing up as a strong benefit to assessment scores for my students. I then realized that there was yet another factor that I had overlooked. Many of the students in my Global Issues classes are enrolled simply for the science credit needed for graduation and are less concerned with the actual grade earned for the semester. Almost as an afterthought I offered students one last chance to weigh in using yet another voluntary, online survey tool. However, this time I left the survey anonymous in hopes that I would get higher participation and a greater level of honesty in their responses. I received 70% participation on this final survey, which I called the Desire Survey (Appendix M). Like the other surveys I kept it short and to the point. I first asked if this was a class needed for graduation. I asked this to determine which students might be motivated to do well based on a desire to get credit for the class and 74% claimed that they in fact needed to pass to graduate. There were also 6 other students (16%) that responded that they were not sure if they needed the class for

graduation. Then perhaps the most telling question of all was which letter grade they were trying to obtain by the end of the semester. I was startled to discover that 45% of those who responded admitted that they were fine with a semester grade of a C or lower as long as they passed the class and got credit.

I was not exactly sure how to process these results, however it did explain why some students were willing to participate in class, show interest in the information, but would not put in the time or effort to study their notes or even take effective notes in the first place. My attention and desire to conduct more research was turned to questions of student motivation and effort. The current administration at Shawnee Mission West is shifting our professional development towards teaching students how to demonstrate effort and how to accomplish hard tasks. It is too easy for me to claim that students who do not perform well carry most of the blame on their shoulders because of a lack of motivation. However, it is a considerable stumbling block when a teacher functions under the assumption that a student wants to attain the highest grade possible and the student is simply there not to get an F.

An underlying theme throughout my research has been the use of technology in a science classroom. All Shawnee Mission High Schools went to a one-to-one student to laptop ratio starting in the 2014-2015 school year. I did not shy away from the technology in any of my classes, but I do see the concern with technology being a distraction. During my absence in the third unit of implementation I went almost exclusively to assignments being given and turned in through digital pathways using the laptops. Not only did the normalized gain scores drop for both classes during this time, but the percentage of

assignments turned in dropped drastically as well. Almost every student had multiple missing assignments. My third and final question on the Desire Survey asked students to comment on how much of a distraction their laptops were to learning. More than 68% of students surveyed admitted to the laptops being at least a little distracting to their learning. I estimate that this percentage is still conservatively low considering some students might not have taken the voluntary survey. I would love to make technology a focus for further research.

Outside of my classroom and even outside of the science department note-taking is a needed skill. As reading and comprehension continue to find footing in our school goals and district directives, two-column notes could very easily be used across many curricula to record, reflect and respond to all types of information. Two-column notes can be adapted to break down a novel, and can just as easily be used to dissect the technical writing found in science textbooks. My main focus was on notes taken in class discussion and lecture settings, but information is presented to students in multiple ways. How powerful it would be to have a unified school note technique that would be taught and reinforced in each classroom, by each teacher.

I began this study with an optimism similar to what I had as a new teacher. I fully expected students to respond well to an opportunity to achieve higher assessment scores and many students did. Some students regularly inquired about their 20-point note score and if the results for the class supported the two-column note style. I even had a small group of students who decided to use the two-column note style in other classes on a regular basis based on their success in my class.

I was also intrigued with students who professed that the notes were valuable and helpful, but who did not regularly turn in high-quality notes. It seemed that some students were content with passing the class rather than using all of the tools available to them to achieve higher assessment scores and a better semester grade. Motivating students has always been a necessary task as a teacher, so when higher test scores and an efficient study tool are not enough to give rise to extra effort then I have to dig deeper. I noticed that when students were attempting to make up work at the end of the semester they would gravitate towards one or two types of assignments that played to their strengths. For example one student might choose to make up labs and video worksheets, while another might choose to work on book assignments and articles. Perhaps differentiating my methods of assessing mastery on a student-to-student basis would help motivate all students to demonstrate understanding though methods they prefer. There must be more than one way to lead students to their academic goals.

REFERENCES CITED

Arslan, M. (2006). The Influence of Teaching Note-Taking and Information Mapping on Learning and Recalling in Science. *The Turkish Online Journal of Educational Technology, 5*, 56-63.

Benfield, J.A., Szlemko, W.J. (2006). Internet Based Data Collection. *Journal of Research Practice, 2*, 1-15.

Bicak, B. (2013). Scale for Test Preparation and Test Taking Strategies. *Educational Sciences: Theory & Practice, 13*, 279-289.

Climenhaga, S.J. (2011). *The Effect of Using Guided Notes for At Risk High School Science Students.* (Unpublished Professional Paper). Montana State University, Bozeman, Montana.

Donohoo, J. (2010). Learning How to Learn: Cornell Notes as an Example. *Journal of Adolescent & Adult Literacy, 54*, 224-227.

Hake, R. (1998). Interactive-engagement versus traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses. *American Journal of Physics, 66, 64-74.*

Hunter, A., Rulfs, J., Caron, J.M, & Buckholt, M.A. (2010). Response System for Real-Time Data Display and Analysis in Introductory Biology Labs. *Journal of College Science Teaching, 40*, 19-25.

King, A. (1992). Comparison of Self-Questioning, Summarizing, and Notetaking-Review as Strategies for Learning From Lectures. *American Educational Research Journal, 29*, 303-323.

Martin, D.L., Itter, D. (2013). Valuing Assessment in Teacher Education – Multiple-Choice Competency Testing. *Australian Journal of Teacher Education, 39*, 1-14.

Mills, G.E. (2014). *Action Research: A Guide for the Teacher Researcher.* Upper Saddle River:Pearson

Onwuegbuzie, A.J., Leech, N.L., Collins, K.M.T. (2010). Innovative Data Collection Strategies. *The Qualitative Report, 15*, 696-726.

Rotter, K.M. (2009). Enhancing Memory in Your Students: Compose Yourself. *TEACHING Exceptional Children Plus, 5*, 2-16.

Steele, M.M. (2006). Helping Middle School Students with Learning Disabilities Pass the Federally Mandated Science Tests. *Science Scope. NSTA WebNews Digest*, 74-80.

White, R.M. (2012). *The Impact of Note Taking Strategies in a Ninth Grade Earth Science Course.* (Unpublished professional paper). Montana State University, Bozeman, Montana.

APPENDICES

APPENDIX A

INSTITUTIONAL REVIEW BOARD APPROVAL

MONTANA
STATE UNIVERSITY

INSTITUTIONAL REVIEW BOARD
For the Protection of Human Subjects
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MEMORANDUM

TO: Ryan Call and Peggy Taylor

FROM: Mark Quinn, Chair Mark Quinn CTJ

DATE: November 9, 2015

RE: *"The Effects of Guided Notes on Science Unit Test Scores"* [RC110915-EX]

The above research, described in your submission of November 9, 2015, is exempt from the requirement of review by the Institutional Review Board in accordance with the Code of Federal regulations, Part 46, section 101. The specific paragraph which applies to your research is:

_X_ (b) (1) Research conducted in established or commonly accepted educational settings, involving normal educational practices such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.

_X_ (b) (2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability, or be damaging to the subjects' financial standing, employability, or reputation.

____ (b) (3) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under paragraph (b)(2) of this section, if: (i) the human subjects are elected or appointed public officials or candidates for public office; or (ii) federal statute(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.

____ (b) (4) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available, or if the information is recorded by the investigator in such a manner that the subjects cannot be identified, directly or through identifiers linked to the subjects.

____ (b) (5) Research and demonstration projects, which are conducted by or subject to the approval of department or agency heads, and which are designed to study, evaluate, or otherwise examine: (i) public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in or alternatives to those programs or procedures; or (iv) possible changes in methods or levels of payment for benefits or services under those programs.

_____ (b) (6) Taste and food quality evaluation and consumer acceptance studies, (i) if wholesome foods without additives are consumed, or (ii) if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the FDA, or approved by the EPA, or the Food Safety and Inspection Service of the USDA.

Although review by the Institutional Review Board is not required for the above research, the Committee will be glad to review it. If you wish a review and committee approval, please submit 3 copies of the usual application form and it will be processed by expedited review.

APPENDIX B

TWO-COLUMN NOTE TEMPLATE

Topic: Date:

Essential Question:

Questions:	Notes:

Summary:

APPENDIX C

WEEKLY NOTE CHECKS

Student Name _____
Block _____ Date _____

	1	2	3	4	5
Topic Clearly Identified					
Essential Question Clearly Stated					
Format Follows Teacher Guidelines					
Summary Statement Represents Concepts					
Total					

APPENDIX D

UNIT ONE POST TEST

Directions: Answer all questions by selecting the BEST answer available. Show your work when necessary. Bring your test forward when you are finished.

1. When did the global population first reach 1 billion people? #1
    a. 1800
    b. 1930
    c. 1960
    d. 1974
2. The current global population is closest to which number? #1

. 5 billion
a. 7 billion
b. 15 billion
c. 30 billion

3. Which of the following statements is TRUE regarding the world's use of energy? #1

. Most people in the world use about the same amount of energy per person
a. We are using less energy globally than ever before
b. A small percentage of the world's population uses a big chunk of the world's energy
c. Energy consumption has not changed much over the last 100 years

4. If human population growth were to be summed up in one word it would be… #4

. exponential
a. linear
b. decreasing
c. unknown

5. In order for any population to increase…#7

. The death rate must be larger than the birth rate
a. The death rate must be equal to the birth rate
b. The death rate must be smaller than the birth rate
c. The death rate must be to times smaller than the birth rate

6. The carrying capacity of the earth is currently limited by how much space we have for people to live in. #9a

. True
a. False

7. As a region becomes more modern the growth rate of that region decreases. Which of the following is NOT a reason why this happens? #7

. It creates more career opportunities for women
a. Availability and use of birth control increase
b. Less economic value for having children
c. Available technology educates more people about population growth

8. "Replacement-level fertility," means the average couple has how many children? #7

a. 1 child
b. 2 chilren

c. Zero children
d. 3 or more children

9) There are many Americans age 65 and older that live with grown children or other extended family members. #8
a. True
b. False

10) Over the next twenty years what will happen to the number of working adults available to support those in retirement?
a. There will be plenty of working adults to support the retired
b. There will be no change in the current ratio or working to retired
c. There will be a lot less working adults to support the growing number of retired
d. The age that a person is considered an adult will get higher

11) According to the population article by Anup Shaw that we read in class the population size is not the source of our problems, but we struggle with: #9a
a. How we use resources
b. Finding land to build houses
c. Being nice to each other
d. Winning wars

12) According to the article mentioned above who does get wrongly blamed for over consumption of earth's resources? #9a
a. The wealthy
b. The poor
c. Politicians
d. The US

13) Which regions of the world have the highest growth rate? #7
a. Developed countries
b. Developing countries
c. Europe
d. China

14) What has China tried to do to reduce the number of hungry people?
a. Using more land for farming
b. Lowering food prices
c. Sending people out of the country
d. Limiting families to 1 child

15) All of the following statements describe characteristics of exponential growth except
a. Exponential growth plots as a straight line

b. Exponential growth plots as a “J” curve
c. Exponential growth starts slowly, but is capable of generating large numbers very quickly
d. Exponential growth is characterized by doubling in a fixed amount of time

16) If families had just enough children to meet “replacement level fertility” how long would it take before the population would stabilize? #7
a. Immediately
b. 20 - 30 years
c. 50-70 years
d. 100-150 years

17) In nature exponential growth is a normal experience.
a. True
b. False

18) The carrying capacity of Earth is estimated to be 10-12 billion.
a. True
b. False

19) In the beginning the world’s population was growing at a very slow rate because women were choosing to have few children.

a. True
b. False

APPENDIX E

UNIT TWO POST TEST

Directions: Choose the BEST answer for the following questions. Circle the letter next to your response.

1. The number of Calories you need each day is based on your

a. age.
b. gender.
c. size.
d. activities.
e. all of these are factors.

2. The major reason so many people on Earth go hungry is

a. poor distribution of food due to political conflict.
b. lack of meat in developing countries.
c. the Earth's inability to grow enough food.
d. low literacy means people can't plan good diets.

3. What is happening to small farms compared to big farms in the U.S.?

a. Nothing, the size of the farms is the only difference
b. Small farms are getting bigger and big farms are getting smaller
c. Small farms are disappearing and big farms are getting bigger
d. Small farms grow corn and big farms grow wheat

4. What is available to farmers today that helps them grow four times as much corn as their ancestors?

a. More tillable land
b. Ammonia fertilizer
c. Stronger cattle
d. More farmers

5. Iowa and many other midwestern states grow a lot of corn. Which little known fact describes most of this corn?

a. It is all actually brown
b. It is hard and inedible
c. It has a sweet taste to it
d. It has a salty taste to it

6. There many cattle ranches across the country that grow acres of corn, but what is all of this corn used for ?

a. Growing more corn
b. To make corn products
c. To feed the cattle on the farm

d. For antibiotics

7. What percentage of antibiotics in the US are consumed by livestock?

a. 10%
b. 25%
c. 50%
d. 70%

8. What is one advantage to feeding cattle a grass-based diet?

a. It keeps the meat fattier
b. It makes the cows ready for production faster
c. It is a healthier diet
d. It makes the cows crave antibiotics

9. In 1970 Earl Butz changed the way farming was done in the US. What was that major change?

a. He no longer wanted to pay farmers for not farming
b. He pushed to have farmers grow more food
c. He allowed farmers to expand the amount of land used to grow food
d. All of the above

10. Corn farmers make a profit from the money that the government pays them, not from the money made from selling their crops.

a. True
b. False

11. What is pink slime?

a. A pasty food mainly consumed by astronauts
b. A new kind of play doe
c. A waste product from eating corn
d. A meat filler made from cow trimmings

12. The official name for pink slime is

a. Lean Finely Textured Beef (LFTB)
b. Genetically Modified Organisms (GMO)
c. Bovine Filler Derivative (BFD)
d. Strategic Homeland Intervention, Enforcement and Logistics Division (SHIELD)

13. In the production of pink slime it is treated with ammonia gas. What is the purpose of this step?

a. To kill the E. coli bacteria in the meat
b. To flavor the meat before it is shipped out
c. To provide the meat with its reddish, pink color
d. To preserve the meat for a longer period of time

14. Monsanto is a large corporation in the food industry that was the first company to:

a. Genetically modify seeds
b. Grow corn and soybeans in the same field
c. Patent a genetically modified seed
d. Clean seeds for planting the following season

15. Our current food system skews our choices and cravings towards which type of products?

a. Fatty and sugary foods
b. Foods that contain government subsidized products
c. Salty foods
d. All of the above
e. None of the above

16. How many food inspectors does the US have that are devoted to inspecting imported food?

a. 1,500
b. 15,000
c. 150,000
d. 1,500,000

17. The best defense against all of the toxins and pesticides in food is:

a. Eat a balanced diet and wash foods before eating
b. Find a few healthy foods and only eat them
c. Eat as little as possible to avoid exposure to harmful chemicals
d. Take a multivitamin each day.

18. What percentage of the soybeans grown in the US come from Monsanto?

a. 30%
b. 50%
c. 70%
d. More than 90%

19. If you are a farmer which of the following legal issues might you be involved with regarding Monsanto's seeds?

a. Cleaning and reusing Monsanto seeds for multiple growing seasons

b. Encouraging others to reuse Monsanto seeds by owning and operating a seed cleaning machine
c. Growing Monsanto product on your land from cross pollination of a neighboring field
d. All of the above

20. Harmful algal blooms (HAB) also known as the Red Tide are a direct result of:

a. Extreme cold weather
b. Genetically modified foods
c. Fertilizer run-off from farms
d. Disposal of plastic bottles

21. Adding antibiotics to chicken feed and turkey feed is supposed to promote growth. Which of the following is a negative result of the added antibiotics?

a. The chickens die earlier
b. The chickens never get sick
c. The chickens are all dark meat
d. The chickens have stronger strains of E. coli

22. BPA is a chemical found in can linings and hard plastics. Which of the following is ***NOT*** a side effect of BPA?

a. Depression

b. Anxiety

c. Obesity

d. Cancer

23. Which of the following reasons is responsible for the decreasing bee population over the last 70 years?

a. Parasites

b. Disease

c. Poor nutrition

d. Pesticide exposure

e. All of the above

f. None of the above

24. According to our Food Radar article the best defense against all of the toxins and pesticides out there is:

a. Eat a balanced diet and wash foods before eating

b. Find a few healthy foods and only eat them

c. Eat as little as possible to avoid exposure to harmful chemicals

d. Take a multivitamin each day.

Big Ideas, Small World Episode

25. Local Burger (the fast food restaurant in Lawrence, KS) provides food products that are only treated with one kind of pesticide.

a. True
b. False

26. The man that ate Local Burger food for 30 days lost weight, but his blood pressure increased.

a. True
b. False

27. Blue Velvet is a gourmet restaurant that serves food made from organic produce.

a. True
b. False

APPENDIX F

UNIT THREE POST TEST

1. Which of the following is not an advantage to genetically modified foods/crops?
   a. Resistance to bugs and pests
   b. Resistance to pesticides
   c. Faster growth rate
   d. All of the above are possible advantages
2. Genetically modified tomatoes can contain vaccines that would replace the need for needle injections in some countries.
   a. True
   b. False
3. Which of the following is a disadvantage to genetically modified crops?
   a. They could result in super bugs
   b. They always take longer to grow than ordinary crops
   c. The idea is nice, but not yet a reality
   d. GM crops no longer require pesticides
4. DNA could be taken from an individual using which of the following materials?
   i. Blood
   ii. Urine
   iii. Saliva
   iv. Breath
   a. i, iii, and iv
   b. just i, and ii
   c. i, ii, iii
   d. i, ii, iii, and iv
5. What is the major problem with modified transgenic super salmon?
   a. They grow too big
   b. They grow too quickly
   c. They are too aggressive
   d. Their offspring don't survive well
6. Why do some people fear the release of the transgenic super salmon into the wild?
   a. They could lead to the extinction of multiple salmon species
   b. They could take over and be the only kind of salmon to survive
   c. The super salmon might kill other types of fish
   d. They were too big for the ocean
7. Which of the following is not an advantage for athletes from gene therapy?
   a.Increases red blood cell count
   b.Widening of blood vessels
   c.Increased muscle mass
   d.Better overall performance
8. Why doesn't gene doping show up on normal drug tests?
   a.The tests were given too long after the gene therapy
   b.Other drugs masked the substances
   c.Gene therapy increases the amounts of naturally occurring substances
   d.The tests actually did catch the gene doping, but no one really cared about it

9. Which of the following is NOT a barrier that would normally keep two species from mating?
   a. Behavioral – species might not understand the others mating language
   b. Genetic – species have different genes
   c. Immunological – immune system recognizes DNA from the other as foreign and kills it
   d. Nutritional – different species eat different foods
10. Although sterile what is one advantage to mating a horse and a donkey to make a mule?
   a. Increased intelligence
   b. Longer life span
   c. Very fertile offspring
   d. Increased strength
11. Which of the following is not an advantage to using bacteria as a storage device?
   a. The storage capacity of bacteria is enormous
   b. Bacteria can tolerate high temperatures
   c. The bacteria can withstand high levels of radiation
   d. The bacteria are too small to see
12. Which of the following is not a letter used to represent bases of DNA?
   a. A
   b. T
   c. G
   d. U
13. The beginning and end of each genetic message contains
   a. Punctuation
   b. A period
   c. A sentinel
   d. A question mark
14. What percentage of human DNA matches that of a primate?
   a. 25%
   b. 53%
   c. 98%
   d. 100%
15. Every cell in the human body contains a copy of that person's DNA.
   a. True
   b. False

APPENDIX G

UNIT FOUR POST TEST

Directions: Answer the following questions by choosing the best answer. Place your answers on your answer sheet.

1. Woolly mammoths died relatively recently compared to dinosaurs. What other factor makes them good candidates for regeneration?

a. They are big
b. Their remains are frozen
c. They are tame animals
d. They consume a lot of food in a day

2. Although the frozen remains are well preserved the cold temperatures also damage the DNA that would be used for the cloning process.

a. True
b. False

3. Once a mammoth embryo has been created it needs to be implanted into the womb of which animal?

A Rhino
B Dinosaur
C Elephant
D Hippo

4. Teruhiko Wakayama is the scientist that discovered he could extract frozen DNA with success from which animal?

A Rhino
B Mouse
C Cat
D Elephant

5. If I go down to my local cloning store and have an exact copy of myself made, which type of cloning will be used?

A Reproductive
B Embryo
C Therapeutic
D Redundant

6. Bill is in a terrible accident, but his DNA is taken and a new heart is grown, not a new Bill, but just a heart. What type of cloning is this?

A Reproductive
B Embryo
C Therapeutic
D Redundant

7. Somatic cell nuclear transfer is a specific technique for which type of cloning?

A Reproductive
B Embryo
C Therapeutic
D Redundant

8. During the process of cloning a mouse which type of cell needed to be taken from the original mouse?
A Egg cell
B Skin cell
C Blood cell
D Somatic cell

9. A grouping or ball of cells is known as the:
A Nucleus
B Morula
C Somatic cell ball
D Mitosis

10. What is the term for removing the nucleus from a cell?
A Enucleation
B Nucleation
C Somatic cell nuclear transfer
D Cloning

11. Which of the following are NOT considered somatic cells?
A Skin cells
B Brain cells
C Nerve cells
D Reproductive cells

12. It is suggested that the first disease that will most likely be treated by therapeutic cloning will be:
A Diabetes
B Multiple sclerosis
C Alzheimer's
D Meningitis

13. What was the suggested benefit to cloning a panda?
a. Keep them from going extinct
b. To make spider silk
c. To study AIDS
d. All of the above
14. What was the suggested benefit to cloning a goat?
a. Keep them from going extinct

b. To make spider silk
c. To study AIDS
d. All of the above

15. What was the suggested benefit to cloning a cat?
a. Keep them from going extinct
b. To make spider silk
c. To study AIDS
d. All of the above

APPENDIX H

UNIT ASSESSMNET RESULTS SURVEY

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

Socrative.com

1) Now that you have seen your unit test score did you get the grade you were expecting to get?
    a. Yes, I got the score I expected to get
    b. No, I scored higher than I expected
    c. No, I scored lower than I expected

2) How helpful do you think your CLASS NOTES were in preparing you for the Unit Test?
    a. Very helpful
    b. Somewhat helpful
    c. No opinion
    d. Not very helpful
    e. Not helpful at all

3) How likely are you to study your CLASS NOTES for quizzes and the next unit test?
    a. Very likely
    b. Likely
    c. No opinion
    d. Not very likely
    e. Not likely at all

APPENDIX I

POST QUIZ SURVEY

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

1) How much time did you spend this week studying your notes outside of class?
    a. 0 minutes
    b. 1-10 minutes
    c. 11-20 minutes
    d. 21-30 minutes
    e. More than 30 minutes

2) How valuable do you think the notes are as a study tool for the weekly quiz?
    a. Not very valuable
    b. Somewhat valuable
    c. Valuable
    d. Very valuable

APPENDIX J

POST ASSESSMENT ONLINE SURVEY

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

1) How much time did you stand outside of class studying for the UNIT 2 TEST?
    a. 0-15 minutes
    b. 15-30 minutes
    c. 30-45 minutes
    d. 45-60 minutes
    e. More than 60 minutes

2) How much time did you spend outside of class studying your CLASS NOTES for the Unit 2 TEST?
    a. 0-15 minutes
    b. 15-30 minutes
    c. 30-45 minutes
    d. 45-60 minutes
    e. More than 60 minutes

3) Other than class notes which materials did you use to study for the Unit 2 TEST?
    a. Worksheets/assignments
    b. Labs
    c. Textbook
    d. Online resources
    e. Nothing else

4) How helpful do you think the flip charts were while taking the Unit 2 TEST
    a. Very helpful
    b. Helpful
    c. No opinion
    d. Not very helpful
    e. Not helpful at all

APPENDIX K

STUDENT INTERVIEW QUESTIONS

Disclaimer to be read to each student before beginning:

"Thank you for speaking with me today. I will ask you some questions about your most recent unit in Global Issues. Your responses will be recorded in order to help me remember how you responded. Your participation in this interview is completely voluntary and will not affect your academic standing in this class in any way."

The five interview questions will be:

1) What are your thoughts about the two-column, teacher-guided notes that we have used this unit?

2) How closely did you follow the study schedule provided for you from week to week?

3) How closely does your score on the unit test represent your understanding of the test material?

4) In your opinion was the time in class spent on the CLASS NOTES worth all of the work? (Why or why not?)

5) How would you change or alter the method of taking notes in our class?

APPENDIX L

TEACHER JOURNAL

Date: _____
Block _____

Main topics covered
a.
b.

Time spent writing notes (minutes): _____

Student attitude toward notes (1 = unengaged, 5 = engaged)

1 2 3 4 5

Student statements/body language observed:

Other observations:

APPENDIX M

DESIRE SURVEY

socrative by MasteryConnect

Name: _____ Date: _____

Quiz name: GI Final Survey

1. What is the lowest letter grade you would be okay with earning for the semester in this class?
   - (A) A
   - (B) B
   - (C) C
   - (D) D
   - (E) F

2. Do you need this class for graduation?
   - (A) Yes
   - (B) No
   - (C) Not sure

3. How distracting is your laptop to you in class when there is work to be done?
   - (A) Not distracting at all
   - (B) A little bit distracting
   - (C) Not really sure
   - (D) Very distracting
   - (E) Always a distration

4. Which unit did you find the most interesting?
   - (A) Population Growth
   - (B) Food Production
   - (C) Genetic Engineering
   - (D) Cloning
   - (E) Infectious Diseases
   - (F) Alternate Energy Sources

5. What would you change about this class? What would you keep the same? Any feedback for me and future students should go here.